Alcatel-Lucent 7750

SERVICE ROUTER | RELEASE 13.0.R1

TRIPLE PLAY SERVICE DELIVERY ARCHITECTURE GUIDE

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Preface

About This Guide

This guide describes details pertaining to Triple Play Services Delivery Architecture (TPSDA) support provided by the SR OS and presents examples to configure and implement various protocols and services.

This guide is organized into functional chapters and provides concepts and descriptions of the implementation flow, as well as Command Line Interface (CLI) syntax and command usage.

Audience

This guide is intended for network administrators who are responsible for configuring the 7750 SR routers. It is assumed that the network administrators have an understanding of networking principles and configurations. Concepts described in this guide include the following:

- Triple Play concepts
- Triple Play Security
- Enhanced subscriber management
- Multicast
- Operation, Administration and Maintenance (OAM) operations

List of Technical Publications

The 7750 SR documentation set is composed of the following guides:

- 7750 SR Basic System Configuration Guide

  This guide describes basic system configurations and operations.
- 7750 SR System Management Guide

  This guide describes system security and access configurations as well as event logging and accounting logs.
- 7750 SR Interface Configuration Guide

This guide describes card, Media Dependent Adapter (MDA) and port provisioning.

- 7750 SR Router Configuration Guide

  This guide describes logical IP routing interfaces and associated attributes such as an IP address, as well as IP and MAC-based filtering, and VRRP and Cflowd.

- 7750 SR Routing Protocols Guide

  This guide provides an overview of routing concepts and provides configuration examples for RIP, OSPF, IS-IS, BGP, and route policies.

- 7750 SR MPLS Configuration Guide

  This guide describes how to configure Multiprotocol Label Switching (MPLS) and Label Distribution Protocol (LDP).

- 7750 SRServices Overview Guide
  This guide describes how to configure service parameters such as service distribution points (SDPs), customer information, and user services.

- 7750 SRLayer 2 Services and EVPN Guide
  This guide describes Virtual Leased Lines (VLL), Virtual Private LAN Service (VPLS), Provider Backbone Bridging (PBB), and Ethernet VPN (EVPN).

- 7750 SR Layer 3 Services Guide
  This guide describes Internet Enhanced Services (IES) and Virtual Private Routed Network (VPRN) services.

- 7750 SR Versatile Service Module Guide
  This guide describes how to configure service parameters for the Versatile Service Module (VSM).

- 7750 SR OAM and Diagnostics Guide

  This guide describes how to configure features such as service mirroring and Operations, Administration and Management (OAM) tools.

- 7750 SR Triple Play Guide

  This guide describes Triple Play services and support provided by the 7750 SR and presents examples to configure and implement various protocols and services.

- 7750 SR Quality of Service Guide

  This guide describes how to configure Quality of Service (QoS) policy management.

- 7750 SR RADIUS Attributes Guide
  This guide describes all supported RADIUS Authentication, Authorization and Accounting attributes.

- 7750 SR Gx AVPs Reference Guide
  This guide describes Gx Attribute Value Pairs (AVP).

- OS Multi-Service ISA Guide

This guide describes services provided by integrated service adapters such as Application Assurance, IPSec, ad insertion (ADI) and Network Address Translation (NAT).

- 7750 SR OS Gx AVPs Reference Guide

  This guide describes Gx Attribute Value Pairs (AVP).

Technical Support

If you purchased a service agreement for your 7750 SR router and related products from a distributor or authorized reseller, contact the technical support staff for that distributor or reseller for assistance. If you purchased an Alcatel-Lucent service agreement, follow this link to contact an Alcatel-Lucent support representative and to access product manuals and documentation updates:

http://support.alcatel-lucent.com

Getting Started

In This Chapter

This book provides process flow information to configure provision protocols and services pertaining to Triple Play Services Delivery Architecture (TPSDA).

Alcatel-Lucent 7750 SR-Series Services Configuration Process

Table 1 lists the tasks necessary to configure TPSDA entities. Each section describes a software area and provides CLI syntax and command usage to configure parameters for a functional area.

Table 1: Configuration Process

Area	Task	Chapter
Introduction	Overview	Introduction to Triple Play on page 33
DHCP	Theory, configuration	DHCP Management on page 347
Security	Anti-spoofing, MAC pinning, MAC protection, DoS protection VPLS redirect policies, Web portal redirect, ARP handling	Triple Play Security on page 737
PPPoE	Theory, configuration	Point-to-Point Protocol over Ethernet (PPPoE) Management on page 579
Multicast	Multicast, IGMP, SSM, PIM	Triple Play Multicast on page 781
Enhanced Subscriber management	RADIUS authentication, ESM entities, Routed CO, M-SAP	Triple Play Enhanced Subscriber Management on page 929

Table 1: Configuration Process

Area	Task	Chapter (Continued)
	Python Scripting	Python Script Support for ESM on page 2091
Reference	List of IEEE, IETF, and other proprietary entities.	Standards and Protocol Support on page 1507

Note: In SR OS 12.0.R4 any function that displays an IPv6 address or prefix changes to reflect rules described in RFC 5952, *A Recommendation for IPv6 Address Text Representation*. Specifically, hexadecimal letters in IPv6 addresses are now represented in lowercase, and the correct compression of all leading zeros is displayed. This changes visible display output compared to previous SR OS releases. Previous SR OS behavior can cause issues with operator scripts that use standard IPv6 address expressions and with libraries that have standard IPv6 parsing as per RFC 5952 rules. See the section on IPv6 Addresses in the Router Configuration Guide for more information.

Introduction to Triple Play

In This Section

This section provides an overview of the 7750 SR services, service model and service entities used in conjunction with Triple Play services only to the relevant service types. Details about services, configurations, and CLI syntax can be found in the 7750 SR Services Guide.
Topics in this section include:

Alcatel-Lucent’s Triple Play Service Delivery Architecture

Introduction to Triple Play

For more than a decade, telephony service providers have considered offering video services to residential customers. However, in the past it was not economically nor technically feasible to launch the implementation on a large scale.

Recently, several technical trends and evolutions have propelled video delivery to the foreground, including:

- Technical improvements in areas such as real-time MPEG encoding and compression.
- Widespread deployment of High Speed Internet (HSI) over broadband access (ADSL and cable modems).
- Decreased cost of high-bandwidth infrastructure (typically Ethernet-based) as well as storing, converting, and delivering video content.
- Increased competition between telephony and cable operators. This is partly due to changes in regulations.

Traditional cable operators began offering television services and later added Internet access and telephony to their offerings. Conversely, traditional telephony operators such as RBOCS, PTTs, have also added Internet access, and many are now in the process of also adding video delivery.

This bundling of video, voice, and data services to residential subscribers is now commonly known as Triple Play services. The video component always includes linear programming (broadcast television), but often also has a non-linear Video on Demand (VoD) component.

Blueprint for Optimizing Triple Play Service Infrastructures

Alcatel-Lucent's TPSDA allows network operators to progressively integrate their HSI, voice, and video services within a unified and homogeneous Ethernet-based aggregation network environment. The key benefits of the proposed service infrastructure include cost optimization, reduced risk, and accelerated time to market for new services.

At a high level, TPSDA implements:

- Ethernet-based service architecture — Solves bandwidth bottlenecks and exponential capital expenditure and operating expenses issues in the second mile by leveraging the efficiency of this technology.
- Multiple distributed service edges — Allows service providers to achieve faster times to market for new services while retaining the existing Broadband Remote Access Server (BRAS) / Point-to-Point Protocol over Ethernet (PPPoE) mode of operation for wholesale and retail HSI.
- Distributed multicasting functions in access and aggregation networks — Enables service providers to optimize bandwidth and content delivery mechanisms, based on densities and penetration rates. It is also essential to subscriber and service scaling, and optimizes the bandwidth required in the aggregation network.
- Carrier video and Voice over Internet Protocol (VoIP) services using Dynamic Host Configuration Protocol (DHCP) — Enables service providers to introduce plug-and-play services delivered through set-top boxes and VoIP devices, which are designed for use with the DHCP.
- Flexible deployment models — The architecture allows data, video, and VoIP services to be rapidly rolled out without any lock-in to specific operational models. It allows service providers to maximize flexibility and minimize financial and technological risks by allowing all modes of operation, including:
  - → Copper (DSL/DSLAM) and fiber-based (FTTx) deployments in the first mile.
  - → Single or multiple last mile circuits.
  - → Bridged or routed home gateways.
  - → Single or multiple IP address deployment models.

Architectural Foundations

With SR OS, the architectural foundations of Alcatel-Lucent's TPSDA established in previous releases is reinforced while its applicability is expanded to encompass many new deployment models and support Any Mode of Operation (AMO). Through these enhancements, TPSDA becomes more universally deployable and flexible in addressing the specifics of any provider's network/rollout.

Alcatel-Lucent has defined new terminologies that have been adopted industry-wide, including:

- Broadband Service Access Node (BSAN)
- Broadband Service Aggregator (BSA)
- Broadband Service Router (BSR)

Figure 1 depicts TPSDA's centralized, integrated element, service and subscriber management architecture.

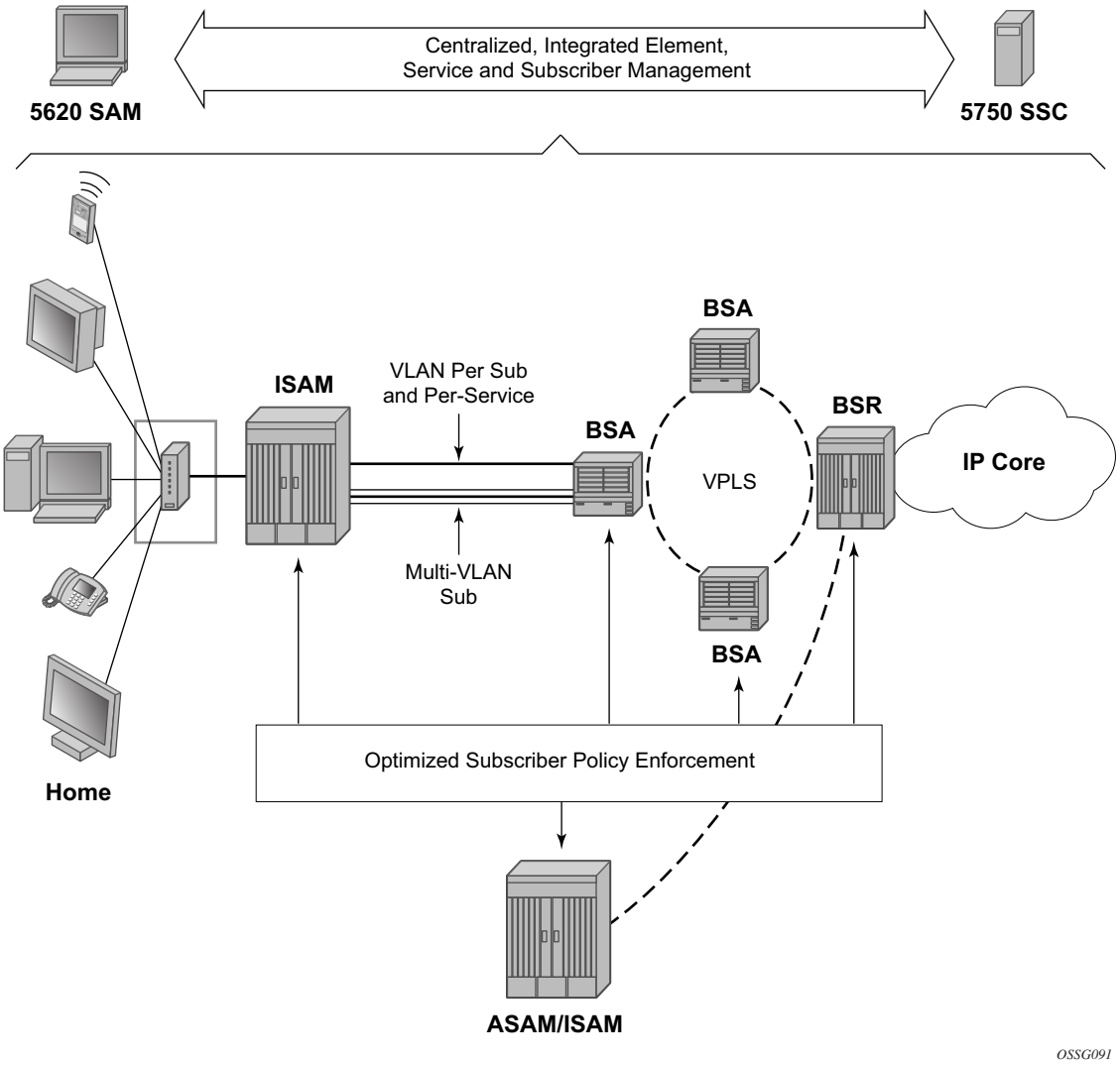


Figure 1: Triple Play Service Delivery Architecture

Optimizing Triple Play Service Infrastructures

More than a branding exercise, new terminologies signal a significant shift from “best effort” and traditional DSLAMs, Ethernet switches and BRASs, in the sense that they capture a shift in required characteristics and capabilities for a new generation of service rollouts, including:

- High-availability for non-stop service delivery (non-stop unicast and multicast routing, non-stop services, etc.).
- Multi-dimensional scale (such as the ability to scale performance, bandwidth, services, and subscribers concurrently).
- Ethernet — Optimization (leading density, capacity, scaling, performance).
- Optimal system characteristics (optimal delay/jitter/loss characteristics, etc.).
- Rich service capabilities with uncompromised performance.

Alcatel-Lucent’s Triple Play Service Delivery Architecture (TPSDA) advocates the optimal distribution of service intelligence over the BSAN, BSA and BSR, rather than concentrating on fully centralized or decentralized BRAS models which artificially define arbitrary policy enforcement points in the network. With SR OS, the optimized enforcement of subscriber policies across nodes or over a single node (as dictated by evolving traffic patterns), allows a more flexible, optimized, and cost-effective deployment of services in a network, guaranteeing high quality and reliable delivery of all services to the user.

Table 2: Alcatel-Lucent’s TPSDA

Entity	Description
Subscriber Management	Centralized and fully integrated with element and services management across the infrastructure end-to-end solution (through the Alcatel-Lucent 5750 SSC).
Policy Enforcement	Optimally distributed, based on actual traffic patterns. Maximized flexibility, minimized risk of architectural lock-in. Optimized cost structure.
Support for “Any Mode of Operation”	With TPSDA, network economics, subscriber density, network topologies and subscriber viewership patterns define the optimal policy enforcement point for each policy type (security, QoS, multicasting, anti-spoofing, filtering etc.). The SR OS capabilities allow service providers to support any mode of operation, including any combination of access methods, home gateway type, and policy enforcement point (BSAN, BSA or BSR or a combination of the three).

All of the SR OS and Alcatel-Lucent’s 5750 SSC’s subscriber policy enforcement and management capabilities described in this section build upon Alcatel-Lucent’s TPSDA extensive capabilities and provide key capabilities in the following areas:

- Operationalization of Triple Play Services (AAA, subscriber policy enforcement, etc.)
- Service Assurance and Control
- Non-stop Video Service Delivery

Distributed Service Edges

The TPSDA architecture (Figure 2), is based on two major network elements optimized for their respective roles, the Broadband Service Aggregator (BSA) and the Broadband Service Router (BSR). An important characteristic of BSAs and BSRs is that they effectively form a distributed virtual node with the BSAs performing subscriber-specific functions where the various functions scale, and the BSRs providing the routing intelligence where it is most cost-effective.

The Alcatel-Lucent 7450 ESS and 7750 SR Series, respectively, provide the BSA and BSR functionalities in TPSDA. Both are managed as a single virtual node using Alcatel-Lucent's 5620 Service Aware manager (SAM), which provides a unified interface for streamlined service and policy activation across the distributed elements of the TPSDA architecture, including VPLS, QoS, multicasting, security, filtering and accounting.

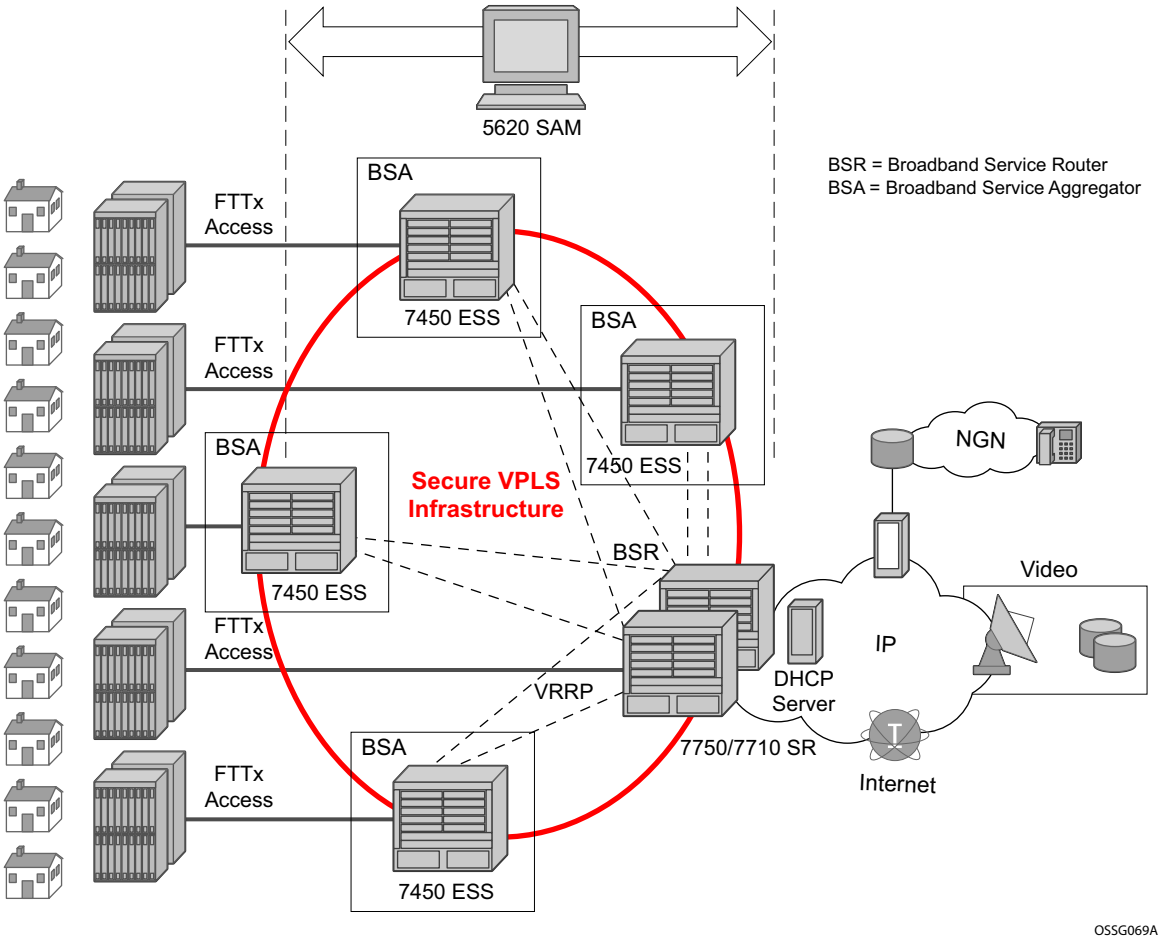


Figure 2: Alcatel-Lucent's Triple Play Service Delivery Architecture

Digital subscriber line access multiplexers (DSLAMs) or other access nodes are connected to Ethernet access ports on the BSA. Typically a single VLAN per subscriber is configured between the access node and the BSA. A VLAN per subscriber provides a persistent context against which per-subscriber policies (QoS, filtering, accounting) can be applied in the BSA.

Scaling of traffic and services is achieved by dividing the Layer 2 and Layer 3 functions between the BSA and BSR and by distributing key service delivery functions. BSAs are more distributed than BSRs, cost-effectively scaling per-subscriber policy enforcement.

The BSA is a high-capacity Ethernet-centric aggregation device that supports hundreds of Gigabit Ethernet ports, tens of thousands of filter policies, and tens of thousands of queues. The BSA incorporates wire speed security, per-subscriber service queuing, scheduling, accounting, and filtering.

BSAs aggregate traffic for all services towards the BSR. The BSR terminates the Layer 2 access and routes over IP/MPLS (Multi Protocol Label Switching) with support for a full set of MPLS and IP routing protocols, including multicast routing. The BSR supports hundreds of ports and sophisticated QoS for per-service and per-content/source differentiation.

The connectivity between BSAs and BSRs is a Layer 2 forwarding model shown in Figure 2 above as a secure VPLS infrastructure. This refers to the fact that the BSA-BSR interconnections form a multipoint Ethernet network with security extensions to prevent unauthorized communication, denial of service, and theft of service. One of the advantages of using VPLS for this application is that VPLS instances can be automatically established over both ‘hub and spoke’ and ring topologies providing sub-50 ms resilience. Regardless of the fiber plant layout, VPLS enables a full mesh to be created between BSA and BSR nodes, ensuring efficient traffic distribution and resilience to node or fiber failure.

Other unique features of the BSA and BSR that contribute to this secure VPLS infrastructure are:

1. Using Residential Split Horizon Groups (RSHG), direct user-user bridging is automatically prohibited, without the need for address-specific ACLs;
2. RSHG combined with the ARP reply agent perform ARP and broadcast suppression to ensure that addressing information is restricted;
3. Protection against theft of service and denial of service is provided by MAC and/or IP filters automatically populated using DHCP snooping, and by MAC pinning;
4. Using the RADIUS interface, is possible to perform RADIUS authentication of users before allowing a DHCP discover to progress into the network.

Service Differentiation, QoS Enablement

Alcatel-Lucent's TPSDA approach provides a model based on call admission for video and VoIP, with the need to guarantee delay/jitter/loss characteristics once the service connection is accepted. The architecture also meets the different QoS needs of HSI, namely per-subscriber bandwidth controls, including shaping and policing functions that have little or no value for video and VoIP services. In conjunction with the architecture's support for content differentiation, this enables differentiated service pricing within HSI.

The distribution of QoS policy and enforcement across BSA and BSR allows the service provider to implement meaningful per-subscriber service level controls. Sophisticated and granular QoS in the BSA allows the service provider to deliver truly differentiated IP services based on the subscriber as well as on the content.

In the BSR to BSA downstream direction (Figure 3), IP services rely on IP layer classification of traffic from the network to queue traffic appropriately towards the BSA. Under extreme loading (only expected to occur under network fault conditions), lower priority data services and/or HSI traffic will be compromised in order to protect video and voice traffic. Classification of HSI traffic based on source network address or IEEE 802.1p marking allows the QoS information to be propagated to upstream or downstream nodes by network elements. Refer to Table 3 for the descriptions.

The BSR performs service distribution routing based on guarantees required to deliver the service and associated content, rather than on individual subscribers. The BSR only needs to classify content based on the required forwarding class for a given BSA to ensure that each service's traffic receives the appropriate treatment towards the BSA.

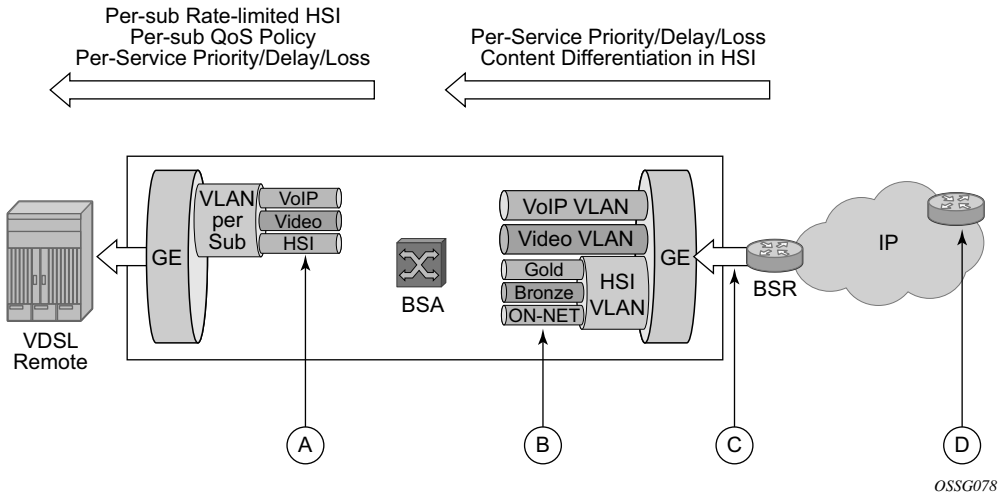


Figure 3: Downstream QoS Enablement

Table 3: Downstream QoS Enablement

Key	Description
A	Per-subscriber queueing and PIR/CIR policing/shaping for HSI. HSI service classified on source IP range. Per-service prioritization for VoIP and video. VoIP is prioritized over video. Destination IP and/or DSCP classification. 802.1 marking for prioritization in the access and home.
B	VoIP and video queued and prioritized on per-VLAN QoS policy basis. HSI content differentiation based on DSCP. Each queue may have individual CIR/PIR and shaping. Optical overall subscriber rate limiting on VLAN (H-QoS).
C	For HSI, content differentiation queueing for gold/silver/bronze based on DSCP classification. Optional overall subscriber rate limiting on VLAN.
D	Preferred content marked (DSCP) of trusted ingress points of IP network.

In the upstream direction (BSA to BSR. Figure 4), traffic levels are substantially lower. Class-based queuing is used on the BSA network interface to ensure that video control traffic is propagated with a minimal and consistent delay, and that preferred data/HSI services receive better treatment for upstream/peering service traffic than the best effort Internet class of service.

Note that the IP edge is no longer burdened with enforcing per-subscriber policies for hundreds of thousands of users. This function is now distributed to the BSAs, and the per-subscriber policies can be implemented on the interfaces directly facing the access nodes.

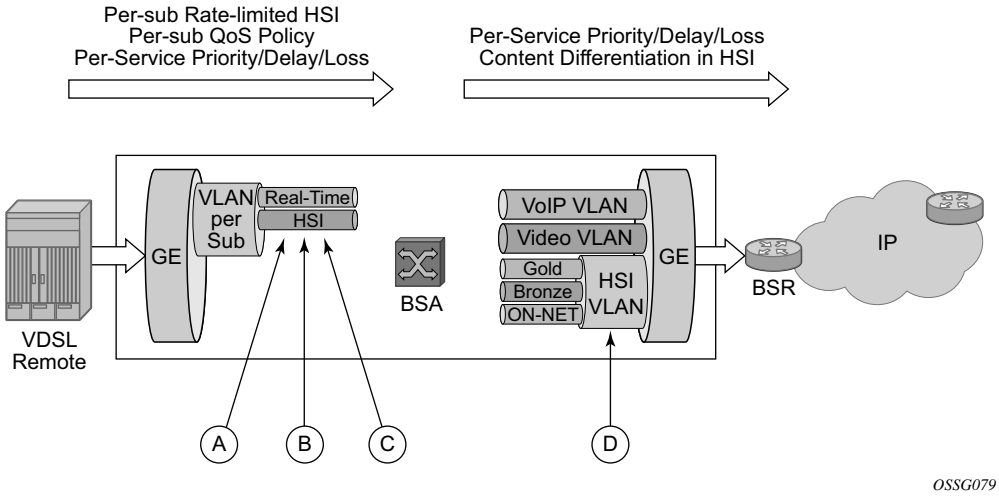


Figure 4: Upstream QoS Enablement

Table 4: Upstream QoS Enablement

Key	Description
A	HSI: Per-subscriber queueing with PIR/CIR policy/shaping.
B	VoIP/Video: Shared queueing for prioritization of real-time traffic over HSI. Upstream video is negligible.
C	Per-subscriber QoS/Content classification for content differentiation.
D	Video/VoIP: Policy defines priority aggregate CIR/PIR. HSI: QoS policy defines priority and aggregate CIR/PIR. Content differentiation based on ingress classification. DSCP is marked.

The BSA is capable of scheduling and queuing functions on a per-service, per-subscriber basis, in addition to performing wire-speed packet classification and filtering based on both Layer 2 and Layer 3 fields.

Each subscriber interface provides at least three dedicated queues. TPSDA makes it possible to configure these queues such that the forwarding classes defined for all services can all be mapped to one service VLAN upstream. In the BSA, assuming hundreds of subscribers per Gigabit Ethernet interface, this translates to a thousand or more queues per port.

In addition to per-service rate limiting for HSI services, each subscriber's service traffic can be rate limited as an aggregate using a bundled service policy. This allows different subscribers to receive different service levels independently and simultaneously.

Distributed multicasting today's predominant video service is broadcast TV, and will likely remain significant for a long time. As video services are introduced, it is sensible to optimize investments by matching resources to the service model relevant at the time. Consequently, the objective of the service infrastructure should be to incorporate sufficient flexibility to optimize for broadcast TV in the short term, yet scale to support a full unicast (VoD) model as video service offerings evolve.

Optimizing for broadcast TV means implementing multicast packet replication throughout the network. Multicast improves the efficiency of the network by reducing the bandwidth and fiber needed to deliver broadcast channels to the subscriber. A multicasting node can receive a single copy of a broadcast channel and replicate it to any downstream nodes that require it, substantially reducing the required network resources. This efficiency becomes increasingly important closer to the subscriber. Multicast should be performed at each or either of the access, aggregation, and video edge nodes.

Multicasting as close as possible to the subscriber has other benefits since it enables a large number of users to view the content concurrently. The challenges of video services are often encountered in the boundary cases, such as live sports events and breaking news, for which virtually all the subscribers may be watching just a few channels. These exceptional cases generally involve live content, which is true broadcast content. Multicasting throughout the

network makes it possible to deliver content under these circumstances while simplifying the engineering of the network.

Efficient multicasting requires the distribution of functions throughout the access and the aggregation network to avoid overloading the network capacity with unnecessary traffic. TPSDA realizes efficient multicasting by implementing IGMP snooping in the access nodes, IGMP snooping in the BSA and multicast routing in the BSR (Figure 5).

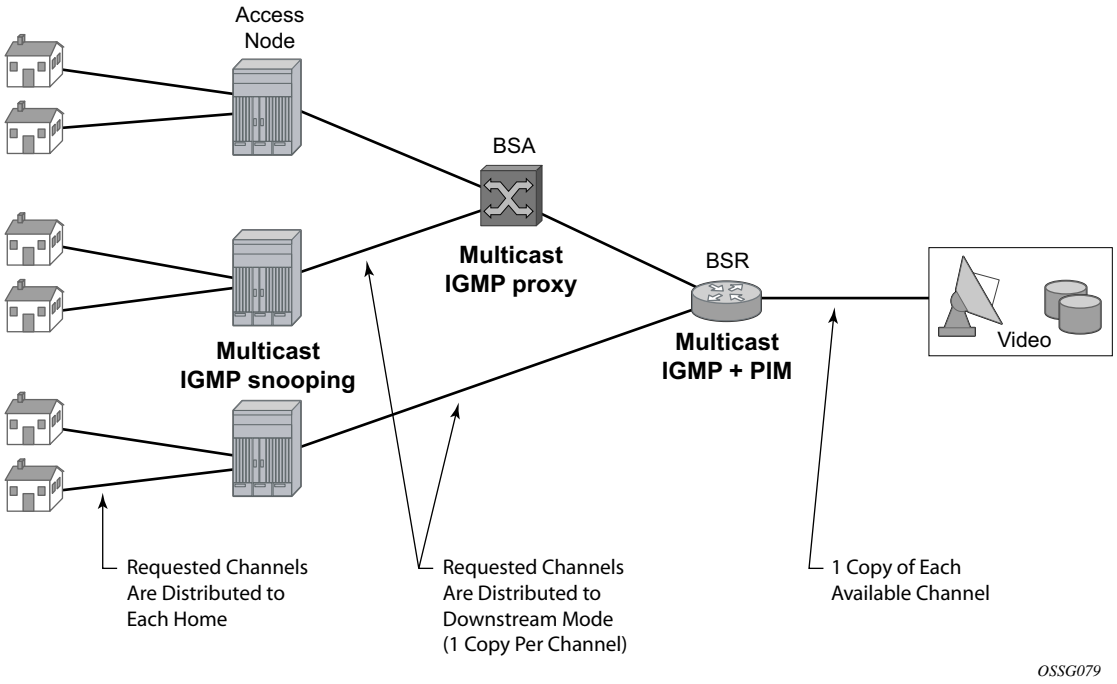


Figure 5: Distributed Multicasting in TPSDA

Virtual MAC Subnetting for VPLS

This feature allows, at the VPLS instance level, MAC subnetting, such as learning and switching based on a configurable number of bits from the source MAC address and from the destination MAC, respectively. This considerably reduces the VPLS FIB size.

MAC scalability involving MAC learning and switching based on the first x bits of a virtual MAC address is suitable in an environment where some MAC addresses can be aggregated based on a common first x bits, for example 28 out of 48. This can be deployed in a TPSDA environment where the VPLS is used for pure aggregation (there is no subscriber management) between the DSLAM and BRAS devices. The DSLAMs must be able to map customer MAC addresses to a pool of internal virtual MAC addresses where the first bits (28, for example) identify the DSLAM with the next 20 bits identifying, the DSLAM slot, port number, and customer MAC station on that port. The VPLS instance(s) in the PE distinguishes only between different DSLAMs connected to it. They need to learn and switch based only on the first 28 bits of the MAC address allowing scaling of the FIB size in the PE.

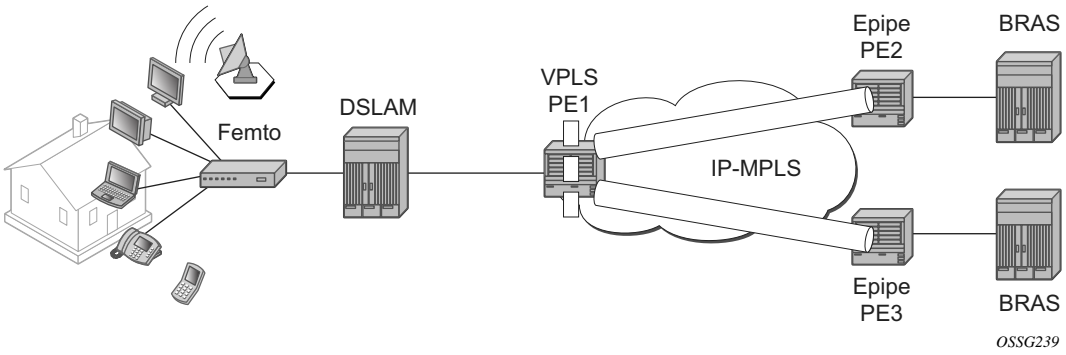


Figure 6: Subnetting Topology

Figure 6 displays a Layer 2 PE network (such as the ESS-Series) aggregating traffic from DSLAMs (Alcatel-Lucent) to BRAS devices. The VPLS service is running in the PEs directly connected to the DSLAMs (VPLS PE1) while the PEs connected to the BRAS devices are running a point-to-point Layer 2 service (Epipe).

Alcatel-Lucent DSLAMs have the capability to map every customer MAC to a service provider MAC using the virtual MAC addressing scheme depicted in Figure 7.

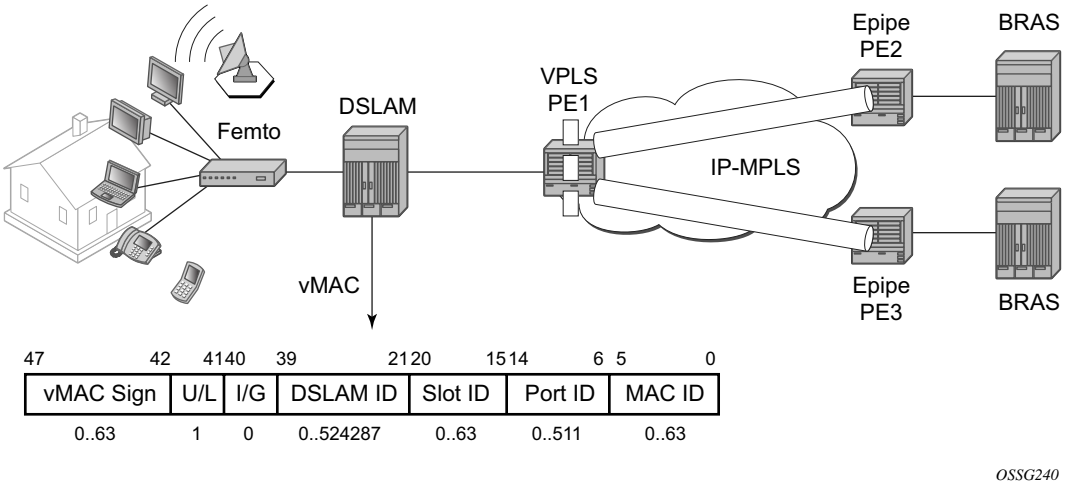


Figure 7: VMAC Subnetting Topology

As the packet ingresses the DSLAM from the residential customer, the source MAC address (a customer MAC for one of its terminals/routers) is replaced by the DSLAM with a virtual MAC using the format depicted in Figure 7.

- The U/L bit is the seventh bit of the first byte and is used to determine whether the address is universally or locally administered. The U/L bit is set to 1 to indicate the address is locally administered.
- The following bits are used to build the VMAC address: DSLAM ID bits 39 — 21, slot ID bits 20 — 15, port ID bits 14-6 and the customer station ID bits 5 — 0.

Based on this scheme, it is apparent that the VMACs from one DSLAM have bits 47-21 in common.

The VPLS instance in PE1 only learns the first part of the MAC (bits 47 — 21) and, as the packets arrive from the BRAS device, switches based only on these bits in the destination MAC address to differentiate between the connected DSLAMs. Once the packet arrives at the DSLAM, the entire destination MAC is checked to determine the slot, port and which specific customer station the packet is destined to. As the packet is sent to the customer, the DSLAM replaces the destination MAC address with the actual customer MAC corresponding to the customer station.

The following are VPLS features not supported when the VMAC subnetting feature is enabled:

- Blocked features — CLI consistency checked provided
- Residential Split Horizon Groups
- BGP AD
- TPSDA (subscriber management) features
- PBB
- VPLS OAM (MAC populate, MAC ping, MAC trace, CPE Ping)

Services

A service is a globally unique entity that refers to a type of connectivity service for either Internet or VPN connectivity. Each service is uniquely identified by a service ID within a service area. The 7750 SR service model uses logical service entities to construct a service. In the service model, logical service entities are provide a uniform, service-centric configuration, management, and billing model for service provisioning.

Services can provide Layer 2/bridged service or Layer3/IP routed connectivity between a service access point (SAP) on one 7750 SR router and another service access point (a SAP is where traffic enters and exits the service) on the same (local) or another 7750 SR router (distributed). A distributed service spans more than one router.

Distributed services use service distribution points (SDPs) to direct traffic to another 7750 SR through a service tunnel. SDPs are created on each participating 7750 SR, specifying the origination address (the 7750 SR router participating in the service communication) and the destination address of another SR-Series. SDPs are then bound to a specific customer service. Without the binding process, far-end 7750 SR devices are not able to participate in the service (there is no service without associating an SDP with a service).

Service Types

The 7750 SR offers the following types of subscriber services which are described in more detail in the referenced chapters:

- Virtual Leased Line (VLL) services:
  - → Ethernet pipe (Epipe) — A Layer 2 point-to-point VLL service for Ethernet frames.
  - → ATM VLL (Apipe) — A point-to-point ATM service between users connected to 7750 nodes on an IP/MPLS network.
  - → Frame-Relay (Fpipe) — A point-to-point Frame Relay service between users connected to 7750 nodes on the IP/MPLS network.
  - → IP Pipe (Ipipe) — Provides IP connectivity between a host attached to a point-to-point access circuit (FR, ATM, PPP) with routed IPv4 encapsulation and a host attached to an Ethernet interface.
- Virtual Private LAN Service (VPLS) — A Layer 2 multipoint-to-multipoint VPN. VPLS includes Hierarchical VPLS (H-VPLS) which is an enhancement of VPLS which extends Martini-style signaled or static virtual circuit labeling outside the fully meshed VPLS core.
- Internet Enhanced Service (IES) — A direct Internet access service where the customer is assigned an IP interface for Internet connectivity.
- Virtual Private Routed Network (VPRN) — Layer 3 IP multipoint-to-multipoint VPN service as defined in RFC 2547bis.

Service Policies

Common to all 7750 SR connectivity services are policies that are assigned to the service. Policies are defined at a global level and then applied to a service on the router. Policies are used to define 7750 SR service enhancements. The types of policies that are common to all 7750 SR connectivity services are:

- SAP Quality of Service (QoS) policies which allow for different classes of traffic within a service at SAP ingress and SAP egress.

  QoS ingress and egress policies determine the QoS characteristics for a SAP. A QoS policy applied to a SAP specifies the number of queues, queue characteristics (such as forwarding class, committed, and peak information rates, etc.) and the mapping of traffic to a forwarding class. A QoS policy must be created before it can be applied to a SAP. A single ingress and a single egress QoS policy can be associated with a SAP.
- Filter policies allow selective blocking of traffic matching criteria from ingressing or egressing a SAP.

  Filter policies, also referred to as access control lists (ACLs), control the traffic allowed in or out of a SAP based on MAC or IP match criteria. Associating a filter policy on a SAP is optional. Filter policies are identified by a unique filter policy ID. A filter policy must be created before it can be applied to a SAP. A single ingress and single egress filter policy can be associated with a SAP.
- Scheduler policies define the hierarchy and operating parameters for virtual schedulers. Schedulers are divided into groups based on the tier each scheduler is created under. A tier is used to give structure to the schedulers within a policy and define rules for parent scheduler associations.
- Accounting policies define how to count the traffic usage for a service for billing purposes.

  The 7750 SR routers provide a comprehensive set of service-related counters. Accounting data can be collected on a per-service, per-forwarding class basis, which enables network operators to accurately measure network usage and bill each customer for each individual service using any of a number of different billing models.

Alcatel-Lucent Service Model

Topics in this section:

Introduction

In the 7750 SR service model, the 7750 SR service edge routers are deployed at the provider edge. Services are provisioned on 7750 SRs and transported across an IP and/or IP/MPLS provider core network in encapsulation tunnels created using Generic Router Encapsulation (GRE) or MPLS Label Switched Paths (LSPs).

The service model uses logical service entities to construct a service. The logical service entities are designed to provide a uniform, service-centric configuration, management, and billing model for service provisioning. Some benefits of this service-centric design include:

- Many services can be bound to a single customer.
- Many services can be bound to a single tunnel.
- Tunnel configurations are independent of the services they carry.
- Changes are made to a single logical entity rather than multiple ports on multiple devices. It is easier to change one tunnel rather than several services.
- The operational integrity of a logical entity (such as a service tunnel and service end points) can be verified rather than dozens of individual services improving management scaling and performance.
- A failure in the network core can be correlated to specific subscribers and services.
- QoS policies, filter policies, and accounting policies are applied to each service instead of correlating parameters and statistics from ports to customers to services.

Service provisioning uses logical entities to provision a service where additional properties can be configured for bandwidth provisioning, QoS, security filtering, accounting/billing to the appropriate entity.

Service Entities

The basic logical entities in the service model used to construct a service are:

- Customers (see page 52)
- Service Access Points (SAPs) (see page 53)
- Service Distribution Points (SDPs) (see page 57) (for distributed services only)

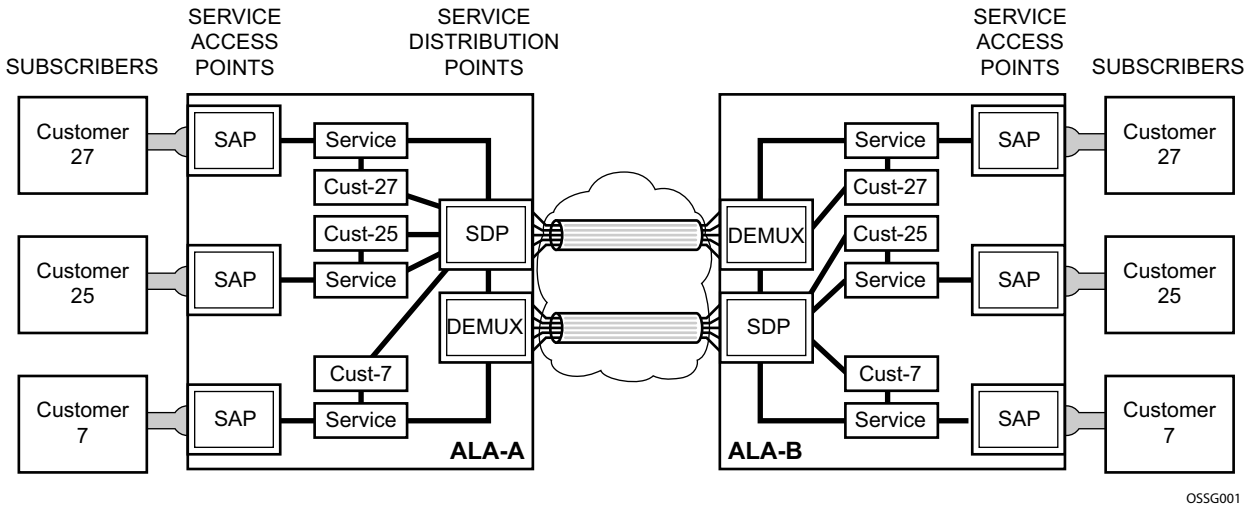


Figure 8: Alcatel-Lucent's Service Entities

Customers

The terms customers and subscribers are used synonymously. The most basic required entity is the customer ID value which is assigned when the customer account is created. To provision a service, a customer ID must be associated with the service at the time of service creation.

Service Access Points (SAPs)

Each subscriber service type is configured with at least one service access point (SAP). A SAP identifies the customer interface point for a service on an Alcatel-Lucent 7750 SR router (Figure 9). The SAP configuration requires that slot, MDA, and port/channel information be specified. The slot, MDA, and port/channel parameters must be configured prior to provisioning a service (see the Cards, MDAs, and Ports section of the 7750 SR Interface Configuration Guide).

A SAP is a local entity to the 7750 SR and is uniquely identified by:

- The physical Ethernet port or SONET/SDH port or TDM channel
- The encapsulation type
- The encapsulation identifier (ID)

Depending on the encapsulation, a physical port or channel can have more than one SAP associated with it. SAPs can only be created on ports or channels designated as “access” in the physical port configuration. SAPs cannot be created on ports designated as core-facing “network” ports as these ports have a different set of features enabled in software.

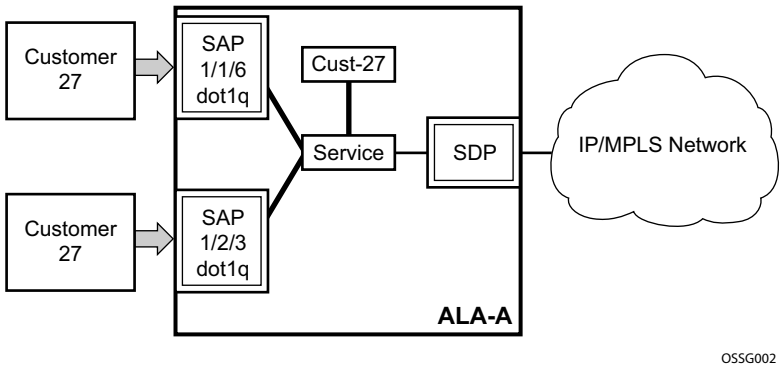


Figure 9: Service Access Point (SAP)

SAP Encapsulation Types and Identifiers

The encapsulation type is an access property of a service Ethernet port or SONET/SDH or TDM channel. The appropriate encapsulation type for the port or channel depends on the requirements to support multiple services on a single port/channel on the associated SAP and the capabilities of the downstream equipment connected to the port/channel. For example, a port can be tagged with IEEE 802.1Q (referred to as dot1q) encapsulation in which each individual tag can be identified with a service. A SAP is created on a given port or channel by identifying the service with a specific encapsulation ID.

Ethernet Encapsulations

The following lists encapsulation service options on Ethernet ports:

1. Null — Supports a single service on the port. For example, where a single customer with a single service customer edge (CE) device is attached to the port. The encapsulation ID is always 0 (zero).
2. Dot1q — Supports multiple services for one customer or services for multiple customers (Figure 10). For example, the port is connected to a multi-tenant unit (MTU) device with multiple downstream customers. The encapsulation ID used to distinguish an individual service is the VLAN ID in the IEEE 802.1Q header.
3. Q-in-Q — The q-in-q encapsulation type adds a IEEE 802.1Q tag to the 802.1Q tagged packets entering the network to expand the VLAN space by tagging tagged packets, producing a double tagged frame.
   Note that the SAP can be defined with a wildcard for the inner label. (e.g. “100:*”). In this situation all packets with an outer label of 100 will be treated as belonging to the SAP. If, on the same physical link there is also a SAP defined with q-in-q encap of 100:1 then traffic with 100:1 will go to that SAP and all other traffic with 100 as the first label will go to the SAP with the 100:* definition.

In the dot1q and q-in-q options, traffic encapsulated with tags for which there is no definition are discarded.

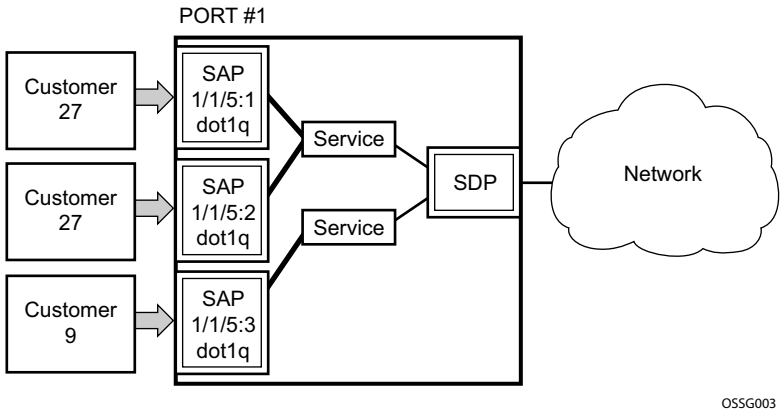


Figure 10: Multiple SAPs on a Single Port/Channel

SAP Considerations

When configuring a SAP, consider the following:

- A SAP is a local entity and only locally unique to a given device. The same SAP ID value can be used on another 7750 SR.
- There are no default SAPs. All SAPs must be created.
- The default administrative state for a SAP at creation time is administratively enabled.
- When a SAP is deleted, all configuration parameters for the SAP will also be deleted. For Internet Ethernet Service (IES), the IP interface must be shutdown before the SAP on that interface may be removed.
- A SAP is owned by and associated with the service in which it is created in each 7750 SR.
- A port/channel with a dot1q or BCP-dot1q encapsulation type means the traffic for the SAP is identified based on a specific IEEE 802.1Q VLAN ID value. The VLAN ID is stripped off at SAP ingress and the appropriate VLAN ID placed on at SAP egress. As a result, VLAN IDs only have local significance, so the VLAN IDs for the SAPs for a service need not be the same at each SAP.
- If a port/channel is administratively shutdown, all SAPs on that port/channel will be operationally out of service.
- A SAP cannot be deleted until it has been administratively disabled (shutdown).

- Each SAP can be configured with only the following:
  - → Ingress or egress filter policy
  - → Ingress or egress QoS policy
  - → Accounting policy
  - → Ingress or egress scheduler policy

Service Distribution Points (SDPs)

A service distribution point (SDP) acts as a logical way to direct traffic from one 7750 SR to another 7750 SR through a uni-directional (one-way) service tunnel. The SDP terminates at the far-end 7750 SR which directs packets to the correct service egress SAPs on that device. A distributed service consists of a configuration with at least one SAP on a local node, one SAP on a remote node, and an SDP binding the service to the service tunnel.

An SDP has the following characteristics:

- An SDP is locally unique to a participating 7750 SR. The same SDP ID can appear on other 7750 SR routers.
- An SDP uses the system IP address to identify the far-end 7750 SR edge router.
- An SDP is not specific to any one service or any type of service. Once an SDP is created, services are bound to the SDP. An SDP can also have more than one service type associated with it.
- All services mapped to an SDP use the same transport encapsulation type defined for the SDP (either GRE or MPLS).
- An SDP is a management entity. Even though the SDP configuration and the services carried within are independent, they are related objects. Operations on the SDP affect all the services associated with the SDP. For example, the operational and administrative state of an SDP controls the state of services bound to the SDP.

An SDP from the local device to a far-end 7750 SR requires a return path SDP from the far-end 7750 SR back to the local 7750 SR. Each device must have an SDP defined for every remote router to which it wants to provide service. SDPs must be created first, before a distributed service can be configured.

SDP Binding

To configure a distributed service from ALA-A to ALA-B, the SDP ID (4) (Figure 11) must be specified in the service creation process in order to “bind” the service to the tunnel (the SDP). Otherwise, service traffic is not directed to a far-end point and the far-end 7750 SR device(s) cannot participate in the service (there is no service).

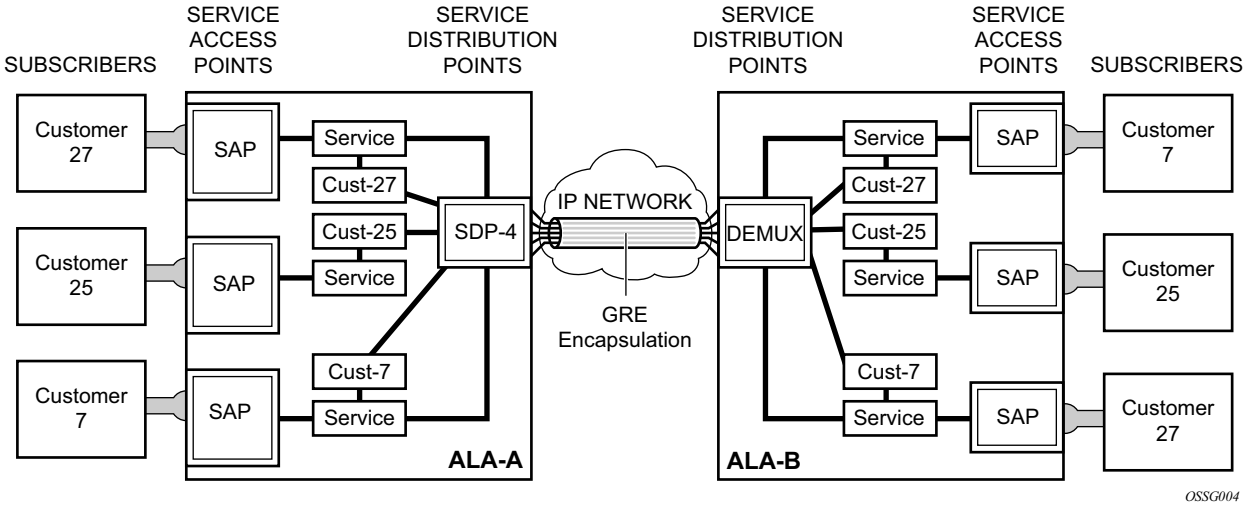


Figure 11: A GRE Service Distribution Point (SDP) pointing from ALA-A to ALA-B

Spoke and Mesh SDPs

When an SDP is bound to a service, it is bound as either a spoke SDP or a mesh SDP. The type of SDP indicates how flooded traffic is transmitted.

A spoke SDP is treated like the equivalent of a traditional bridge “port” where flooded traffic received on the spoke SDP is replicated on all other “ports” (other spoke and mesh SDPs or SAPs) and not transmitted on the port it was received.

All mesh SDPs bound to a service are logically treated like a single bridge “port” for flooded traffic where flooded traffic received on any mesh SDP on the service is replicated to other “ports” (spoke SDPs and SAPs) and not transmitted on any mesh SDPs.

SDP Encapsulation Types

The Alcatel-Lucent service model uses encapsulation tunnels through the core to interconnect 7750 SR service edge routers. An SDP is a logical way of referencing the entrance to an encapsulation tunnel.

The following encapsulation types are supported:

- L2 within Generic Routing Encapsulation (GRE)
- L2 within RSVP signaled, loose hop non-reserved MPLS LSP
- L2 within RSVP signaled, strict hop non-reserved MPLS LSP
- L2 within RSVP-TE signaled, bandwidth reserved MPLS LSP

GRE

GRE encapsulated tunnels have very low overhead and are best used for Best-Effort class of service. Packets within the GRE tunnel follow the Interior Gateway Protocol (IGP) shortest path from edge to edge. If a failure occurs within the service core network, the tunnel will only converge as fast as the IGP itself. If Equal Cost Multi-Path (ECMP) routing is used in the core, many loss-of-service failures can be minimized to sub-second timeframes.

MPLS

Multi-Protocol Label Switching (MPLS) encapsulation has the following characteristics:

- LSPs (label switched paths) are used through the network, for example, primary, secondary, loose hop, etc. These paths define how traffic traverses the network from point A to B. If a path is down, depending on the configuration parameters, another path is substituted.

  Paths can be manually defined or a constraint-based routing protocol (e.g., OSPF-TE or CSPF) can be used to determine the best path with specific constraints.
- A 7750 SR router supports both signaled and non-signaled LSPs through the network.
- Non-signaled paths are defined at each hop through the network.
- Signaled paths are communicated via protocol from end to end using Resource Reservation Protocol (RSVP).

  Because services are carried in encapsulation tunnels and an SDP is an entrance to the tunnel, an SDP has an implicit Maximum Transmission Unit (MTU) value. The MTU for the service tunnel can affect and interact with the MTU supported on the physical port where the SAP is defined.

SDP Keepalives

SDP keepalives are a way of actively monitoring the SDP operational state using periodic Alcatel-Lucent SDP Ping Echo Request and Echo Reply messages. Alcatel-Lucent SDP Ping is a part of Alcatel-Lucent's suite of Service Diagnostics built on an Alcatel-Lucent service-level OA&M protocol. When SDP Ping is used in the SDP keepalive application, the SDP Echo Request and Echo Reply messages are a mechanism for exchanging far-end SDP status.

Configuring SDP keepalives on a given SDP is optional. SDP keepalives for a particular SDP have the following configurable parameters:

- AdminUp/AdminDown State
- Hello Time
- Message Length
- Max Drop Count
- Hold Down Time

SDP keepalive Echo Request messages are only sent when the SDP is completely configured and administratively up and SDP keepalives is administratively up. If the SDP is administratively down, keepalives for the SDP are disabled.

SDP keepalive Echo Request messages are sent out periodically based on the configured Hello Time. An optional Message Length for the Echo Request can be configured. If Max Drop Count Echo Request messages do not receive an Echo Reply, the SDP will immediately be brought operationally down.

If a keepalive response is received that indicates an error condition, the SDP will immediately be brought operationally down.

Once a response is received that indicates the error has cleared and the Hold Down Time interval has expired, the SDP will be eligible to be put into the operationally up state. If no other condition prevents the operational change, the SDP will enter the operational state.

Epipe Service Overview

An Epipe service is Alcatel-Lucent's implementations of an Ethernet VLL based on the IETF "Martini Drafts" (draft-martini-l2circuit-trans-mpls-08.txt and draft-martini-l2circuit-encapmpls-04.txt) and the IETF Ethernet Pseudo-wire Draft (draft-so-pwe3-ethernet-00.txt).

An Epipe service is a Layer 2 point-to-point service where the customer data is encapsulated and transported across a service provider's IP or MPLS network. An Epipe service is completely transparent to the subscriber's data and protocols. The 7750 SR Epipe service does not perform any MAC learning. A local Epipe service consists of two SAPs on the same node, whereas a distributed Epipe service consists of two SAPs on different nodes. SDPs are not used in local Epipe services.

Each SAP configuration includes a specific port/channel on which service traffic enters the 7750 SR from the customer side (also called the access side). Each port is configured with an encapsulation type. If a port is configured with an IEEE 802.1Q (referred to as dot1q) encapsulation, then a unique encapsulation value (ID) must be specified.

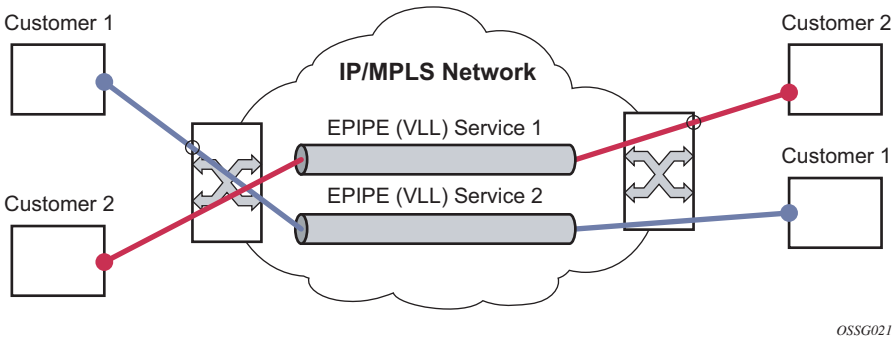


Figure 12: Epipe/VLL Service

VPLS Service Overview

Virtual Private LAN Service (VPLS) as described in Internet Draft *draft-ietf-ppvpn-vpls-ldp-01.txt*, is a class of virtual private network service that allows the connection of multiple sites in a single bridged domain over a provider-managed IP/MPLS network. The customer sites in a VPLS instance appear to be on the same LAN, regardless of their location. VPLS uses an Ethernet interface on the customer-facing (access) side which simplifies the LAN/WAN boundary and allows for rapid and flexible service provisioning.

VPLS offers a balance between point-to-point Frame Relay service and outsourced routed services (VPRN). VPLS enables each customer to maintain control of their own routing strategies. All customer routers in the VPLS service are part of the same subnet (LAN) which simplifies the IP addressing plan, especially when compared to a mesh constructed from many separate point-to-point connections. The VPLS service management is simplified since the service is not aware of nor participates in the IP addressing and routing.

A VPLS service provides connectivity between two or more SAPs on one (which is considered a local service) or more (which is considered a distributed service) 7750 SR routers. The connection appears to be a bridged domain to the customer sites so protocols, including routing protocols, can traverse the VPLS service.

Other VPLS advantages include:

- VPLS is a transparent, protocol-independent service.
- There is no Layer 2 protocol conversion between LAN and WAN technologies.
- There is no need to design, manage, configure, and maintain separate WAN access equipment, thus, eliminating the need to train personnel on WAN technologies such as Frame Relay.

For details on VPLS, including a packet walkthrough, refer to VPLS section in the SR-OS Services Guide.

Split Horizon SAP Groups and Split Horizon Spoke SDP Groups

Within the context of VPLS services, a loop-free topology within a fully meshed VPLS core is achieved by applying split-horizon forwarding concept that packets received from a mesh SDP are never forwarded to other mesh SDPs within the same service. The advantage of this approach is that no protocol is required to detect loops within the VPLS core network.

In applications such as DSL aggregation, it is useful to extend this split-horizon concept also to groups of SAPs and/or spoke SDPs. This extension is referred to as a split horizon SAP group or residential bridging.

Traffic arriving on a SAP or a spoke SDP within a split horizon group will not be copied to other SAPs and spoke SDPs in the same split horizon group (but will be copied to SAPs / spoke SDPs in other split horizon groups if these exist within the same VPLS).

Residential Split Horizon Groups

To improve the scalability of a SAP-per-subscriber model in the broadband services aggregator (BSA), the 7750 SR supports a variant of split horizon groups called residential split horizon groups (RSHG).

A RSHG is a group of split horizon group SAPs with following limitations:

- Downstream broadcast traffic is not allowed.
- Downstream multicast traffic is allowed when IGMP snooping is configured in the VPLS.
- STP is not supported.

Spoke SDPs can also be members of a RSHG VPLS. The downstream multicast traffic restriction does not apply to spoke SDPs.

IES Service Overview

Internet Enhanced Service (IES) is a routed connectivity service where the subscriber communicates with an IP router interface to send and receive Internet traffic. An IES has one or more logical IP routing interfaces each with a SAP which acts as the access point to the subscriber's network. IES allow customer-facing IP interfaces to participate in the same routing instance used for service network core routing connectivity. IES services require that the IP addressing scheme used by the subscriber be unique between other provider addressing schemes and potentially the entire Internet.

While IES is part of the routing domain, the usable IP address space may be limited. This allows a portion of the service provider address space to be reserved for service IP provisioning, and be administered by a separate but subordinate address authority.

IP interfaces defined within the context of an IES service must have a SAP associated as the access point to the subscriber network. Multiple IES services are created to segregate subscriber-owned IP interfaces.

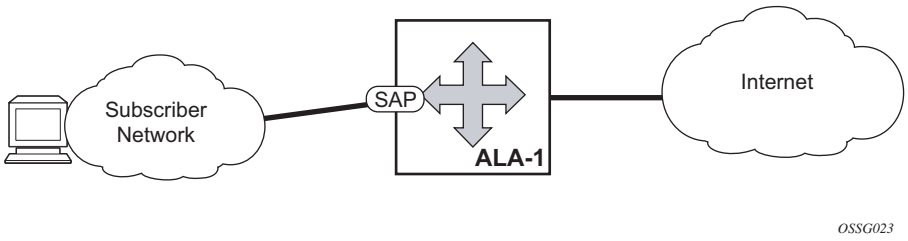


Figure 13: Internet Enhanced Service

The IES service provides Internet connectivity. Other features include:

- Multiple IES services are created to separate customer-owned IP interfaces.
- More than one IES service can be created for a single customer ID.
- More than one IP interface can be created within a single IES service ID. All IP interfaces created within an IES service ID belong to the same customer.

IP Interface

IES customer IP interfaces can be configured with most of the same options found on the core IP interfaces. The advanced configuration options supported are:

- VRRP (for IES services with more than one IP interface)
- Cflowd
- Secondary IP addresses
- ICMP options

Configuration options found on core IP interfaces not supported on IES IP interfaces are:

- Unnumbered interfaces
- NTP broadcast receipt

VPRN Service Overview

RFC2547bis is an extension to the original RFC 2547, which details a method of distributing routing information and forwarding data to provide a Layer 3 Virtual Private Network (VPN) service to end customers.

Each Virtual Private Routed Network (VPRN) consists of a set of customer sites connected to one or more PE routers. Each associated PE router maintains a separate IP forwarding table for each VPRN. Additionally, the PE routers exchange the routing information configured or learned from all customer sites via MP-BGP peering. Each route exchanged via the MP-BGP protocol includes a Route Distinguisher (RD), which identifies the VPRN association.

The service provider uses BGP to exchange the routes of a particular VPN among the PE routers that are attached to that VPN. This is done in a way which ensures that routes from different VPNs remain distinct and separate, even if two VPNs have an overlapping address space. The PE routers distribute routes from other CE routers in that VPN to the CE routers in a particular VPN. Since the CE routers do not peer with each other there is no overlay visible to the VPN's routing algorithm.

When BGP distributes a VPN route, it also distributes an MPLS label for that route. On a SR-Series, a single label is assigned to all routes in a VPN.

Before a customer data packet travels across the service provider's backbone, it is encapsulated with the MPLS label that corresponds, in the customer's VPN, to the route which best matches the packet's destination address. The MPLS packet is further encapsulated with either another MPLS label or GRE tunnel header, so that it gets tunneled across the backbone to the proper PE router. Each route exchanged by the MP-BGP protocol includes a route distinguisher (RD), which identifies the VPRN association. Thus the backbone core routers do not need to know the VPN routes.

Deploying and Provisioning Services

The service model provides a logical and uniform way of constructing connectivity services. The basic steps for deploying and provisioning services can be broken down into three phases.

Phase 1: Core Network Construction

Before the services are provisioned, the following tasks should be completed:

- Build the IP or IP/MPLS core network.
- Configure routing protocols.
- Configure MPLS LSPs (if MPLS is used).
- Construct the core SDP service tunnel mesh for the services.

Phase 2: Service Administration

Perform preliminary policy and SDP configurations to control traffic flow, operator access, and to manage fault conditions and alarm messages, the following tasks should be completed:

- Configure group and user access privileges.
- Build templates for QoS, filter and/or accounting policies needed to support the core services.

Phase 3: Service Provisioning

- Provision customer account information.
- If necessary, build any customer-specific QoS, filter or accounting policies.
- Provision the customer services on the 7750 SR service edge routers by defining SAPs, binding policies to the SAPs, and then binding the service to appropriate SDPs as necessary.

Configuration Notes

This section describes service configuration caveats.

General

Service provisioning tasks can be logically separated into two main functional areas, core tasks and subscriber tasks and are typically performed prior to provisioning a subscriber service.

Core tasks include the following:

- Create customer accounts
- Create template QoS, filter, scheduler, and accounting policies
- Create LSPs
- Create SDPs

Subscriber services tasks include the following:

- Create VLL, VPLS, IES, or VPRN services
- Configure interfaces (where required) and SAPs
- Bind SDPs
- Create exclusive QoS and filter policies

Configuring Triple Play Services with CLI

This section provides information to configure Residential Broadband Aggregation services using the command line interface. It is assumed that the reader is familiar with basic configuration of VPLS, IES and VPRN services.

Topics in this section include:

Configuring VPLS Residential Split Horizon Groups

To configure a group of SAPs in a VPLS service as a Residential Split Horizon Group (RSHG), add the residential-group parameter when creating the split horizon group. Traffic arriving on a SAP within an RSHG will not be copied to other SAPs in the same split horizon group. Note that the split horizon group must be created before it can be applied.

The following example displays a VPLS configuration with split horizon enabled:

```
*A:ALA-48>config>service>vpls# info
----------------------------------------------
            split-horizon-group "DSL-group2" residential-group create
                description "split horizon group for DSL - no broadcast supported"
            exit
            stp
                shutdown
            exit
            sap 2/1/4:100 split-horizon-group "DSL-group2" create
                description "SAP in RSHG"
            exit
            sap 2/1/4:200 split-horizon-group "DSL-group2" create
                description "another SAP in the RSHG"
            exit
            no shutdown
----------------------------------------------
*A:ALA-48>config>service>vpls#
```

Configuring Static Hosts

In order for the static host to be operational, forwarding traffic bi-directional, the mac address of the host must be learned or configured. Learning the MAC of the static host is different for IPv4 or IPv6.

If an IPv4 static host MAC is not specified

- The system will learn respective MAC address dynamically from ARP packets (arp-request or gratuitous-arp) generated by the host with the specified IP address.
- On a VPLS service, this can occur if arp-reply-agent function is enabled on a given SAP. On Layer 3 services, such as IES or VPRN, the ARP packets are always examined so no further conditions are applicable.

If an IPv6 static host MAC is not specified

- The system learns the MAC address depending on the type of host configured such as: IPv6 prefix host or IPv6 address host.
  - → A SAP can be specified as a single-MAC and it implies that there is only a single device attached to the SAP. It changes the MAC learning behavior on the SAP for IPv6 host only. Firstly, all IPv6 hosts will share the same learned MAC. Secondly, the MAC address is learned from the host's router solicits and neighbor discoveries.
  - → For static host with an address, upon shutdown, a RS for the clients IPv6 address is sent towards the host and the MAC is learned upon the RA reply
  - → For static host with an address, SHCV will send the RS, and the MAC is learned from the RA
  - → For static host with an address, the OAM command can trigger a RS and the MAC is learned from the RA
  - → For static host with either a prefix or an address, linking the IPv6 host to an IPv4 host will copy the IPv4 host MAC address to the IPv6 host and vice versa.

The learned MAC address will be handled as a MAC address of static host with explicitly defined mac-address. Meaning:

- The MAC address will not be aged by the mac-aging or any other aging timers.
- The MAC address will not be moved to another SAP as a consequence of re-learning event (= event when learning request for the same MAC address comes from another SAP).
- The MAC address will not be flushed from FDB due to SAP failure or STP flush messages.

Every time the given static-host uses different MAC address in its ARP request, the dynamic MAC learning process will be performed. The old MAC address will be overwritten by a new MAC address.

The learned MAC address will not be made persistent (a static host is not a part of the persistency file). A service discontinuity of such a host could be proportional to its arp-cache timeout.

The following interactions are described:

- Antispoof (all services) — In case a static IP-only host is configured on a given SAP, anti-spoof types, IP, NH MAC, and IP MAC are supported. Static hosts for which MAC address is not known will not have any antispoof entry. This will be added only after the corresponding MAC has been learned. As a consequence, all traffic generated by the host before the MAC is learned are dropped.
- MAC-linking (IES and VPRN service only) — the MAC address can be learned from either the IPv4 or IPv6 host. Once learned it is copied over to the host of the other address family
- Single-MAC (IES and VPRN service only) — This specifies that there is only one single subscriber (MAC) on the SAP and any ICMP6 message from the SAP can be assumed to be the subscriber MAC address. This does not apply to IPv4 host.
- Enhanced subscriber management (all services) — ESM is supported in a combination with a static ip-only host. It is assumed that ip-mac antispoofing is enabled. The resources (queues, etc.) are allocated at the time such a host is configured, although they will be effectively used only after antispoof entry has been installed.
- Dual-homing (for IPv4 host only) — It is assumed that static host is configured on both chassis. The dynamic mac-address learning event will be then synchronized (also, if the members are on two different nodes) and corresponding anti-spoof entries will be installed on both chassis.
- MAC-pinning (for VPLS services only) — The dynamically learned MAC address of the static-host will be considered as a static-mac and is not affected by the no mac-pinning command.
- ARP-reply-agent (VPLS services only) — It is possible to the enable arp-reply-agent on a SAP where static host with ip-only configured. Besides the regular arp-reply-agent functionality (reply to all arp-requests targeting the given host's IP address) learning of the host's MAC address will be performed. As long as no MAC address have been learned no ARP replies on behalf of such host should be expected. Enabling of arp-reply-agent is optional for SAP with ip-only static hosts.

Configuring Static Hosts on an VPLS SAP

The following example displays a static host on a VPLS SAP configuration:

```
*A:ALA-48>config>service# info
----------------------------------------------
vpls 800 customer 6001 create
     description "VPLS with residential split horizon for DSL"
     stp
          shutdown
     exit
     sap 1/2/7:100 split-horizon-group "DSL-group2" create
          description "SAP for RSHG"
          static-host ip 10.1.1.1
     exit
     no shutdown
----------------------------------------------
*A:ALA-48>config>service#
```

Configuring Static Hosts on an IES SAP

The following displays a static host on an IES SAP:

```
*A:ALA-49>config>service>ies>sub-if>grp-if# info
----------------------------------------------
     sap 7/1/5 create
     description "IES with static host"
          static-host ip 10.1.1.1 create
          static-host ip 2001::1/128 create
          static-host ip 2001:1::/64 create
     exit
----------------------------------------------
*A:ALA-49>config>service>ies#
```

Configuring Static Hosts on an VPRN SAP

The following displays a static host on a VPRN SAP:

```
*A:ALA-49>config>service>vprn>sub-if>grp-if# info
----------------------------------------------
     description "VPRN service with static host"
     sap 7/1/5 create
          description "IES with static host"
          static-host ip 10.1.1.1 create
          static-host ip 2001::1/128 create
          static-host ip 2001:1::/64 create
     exit
----------------------------------------------
*A:ALA-49>config>service>vprn#
```

Triple Play Services Command Reference

Configuration Commands

Note: The command trees in this section are limited to those commands specific to Triple Play services. For the full command trees for a specific service type refer to the appropriate section in the 7750 SR Services Guide.

Generic VPLS Triple Play Commands

```
config
    — service
        — [no] vpls service-id [customer customer-id] [vpn vpn-id] [m-vpls]
            — description description-string
            — no description
            — [no] shutdown
            — [no] disable-aging
            — [no] disable-learning
            — [no] discard-unknown
            — [no] fdb-table-high-wmark
            — [no] fdb-table-low-wmark
            — fdb-table-size table-size
            — no fdb-table-size [table-size]
            — igmp-snooping
                — mvr
                    — description description-string
                    — no description
                    — group-policy policy-name
                    — no group-policy
                    — [no] shutdown
                — query-interval seconds
                — no query-interval
                — query-src-ip ip-address
                — no query-src-ip
                — report-src-ip ip-address
                — no report-src-ip
                — robust-count robust-count
```

```
                — no robust-count
                — [no] shutdown
        — local-age aging-timer
        — no local-age
        — mac-protect
                — [no] mac ieee-address
        — mac-subnet-length subnet-length
        — no mac-subnet-length
        — mcr-default-gtw
                — ip address
                — no ip
                — mac ieee-address
                — no mac
        — remote-age seconds
        — no remote-age
        — service-mtu octets
        — no service-mtu
        — service-name service-name
        — no service-name
        — [no] split-horizon-group [group-name] [residential-group]
                — description description-string
                — no description
        — sap sap-id [split-horizon-group group-name]
        — no sap sap-id
                — accounting-policy acct-policy-id
                — no accounting-policy [acct-policy-id]
                — arp-host
                        — host-limit max-num-hosts
                        — no host-limit
                        — min-auth-interval min-auth-interval
                        — no min-auth-interval
                        — [no] shutdown
                — calling-station-id calling-station-id
                — no calling-station-id
                — description description-string
                — no description
                — [no] collect-stats
                — [no] disable-aging
                — [no] disable-learning
                — egress
                        — filter ip ip-filter-id
                        — filter ipv6 ipv6-filter-id
                        — filter mac mac-filter-id
                        — no filter
                        — no filter [ip ip-filter-id] [mac mac-filter-id] [ipv6 ipv6-filter-id]
                        — qos policy-id
                        — no qos
                        — queue-override
                                — [no] queue queue-id
                                — adaptation-rule [pir {max|min|closest}] [cir
                                  {max | min | closest}]
                                — no adaptation-rule
                                — avg-frame-overhead percentage
                                — no avg-frame-overhead
                                — cbs size-in-kbytes
                                — no cbs
                                — high-prio-only percent
```

- — **no high-prio-only**
- — **mbs** *size-in-kbytes*
- — **no mbs**
- — **rate** *pir-rate* [**cir** *cir-rate*]
- — **no rate**
- — [**no**] **scheduler-override**
- — [**no**] **scheduler** *scheduler-name*
- — **rate** *pir-rate* [**cir** *cir-rate*]
- — **no rate**
- — **scheduler-policy** *scheduler-policy-name*
- — **no scheduler-policy**

— **host** {[**ip** *ip-address*] [**mac** *mac-address*]} [**subscriber-sap-id** | **subscriber** *sub-ident-string*] [**sub-profile** *sub-profile-name*] [**sla-profile** *sla-profile-name*] [**ancp-string** *ancp-string*] [**inter-dest-id** *intermediate-destination-id*]

— **no host** {[**ip** *ip-address*] [**mac** *mac-address*]}

— **no host all**

— **ingress**

- — **filter ip** *ip-filter-id*
- — **filter ipv6** *ipv6-filter-id*
- — **filter mac** *mac-filter-id*
- — **no filter**
- — **no filter** [**ip** *ip-filter-id*] [**mac** *mac-filter-id*] [**ipv6** *ipv6-filter-id*]
- — **qos** *policy-id*
- — **no qos**
- — **queue-override**
- — [**no**] **queue** *queue-id*
- — **adaptation-rule** [**pir** {**max**|**min**|**closest**}] [**cir** {**max** | **min** | **closest**}]
- — **no adaptation-rule**
- — **cbs** *size-in-kbytes*
- — **no cbs**
- — **high-prio-only** *percent*
- — **no high-prio-only**
- — **mbs** *size-in-kbytes*
- — **no mbs**
- — **rate** *pir-rate* [**cir** *cir-rate*]
- — **no rate**
- — [**no**] **scheduler-override**
- — [**no**] **scheduler** *scheduler-name*
- — **rate** *pir-rate* [**cir** *cir-rate*]
- — **no rate**
- — **scheduler-policy** *scheduler-policy-name*
- — **no scheduler-policy**
- — **scheduler-policy** *scheduler-policy-name*
- — **no scheduler-policy**

— **max-nbr-mac-addr** *table-size*

— **no max-nbr-mac-addr**

— **multi-service-site** *customer-site-name*

— **no multi-service-site**

— **static-host ip** *ip/did-address* [**mac** *ieee-address*] [**create**]

— **static-host mac** *ieee-address* [**create**]

— **no static-host** [**ip** *ip-address*] **mac** *ieee-address*

— **no static-host all** [**force**]

— **no static-host ip** *ip-address*

```
                        — ancp-string ancp-string
                        — no ancp-string
                        — app-profile app-profile-name
                        — no app-profile
                        — inter-dest-id intermediate-destination-id
                        — no inter-dest-id
                        — [no] shutdown
                        — sla-profile sla-profile-name
                        — no sla-profile
                        — sub-profile sub-profile-name
                        — no sub-profile
                        — subscriber sub-ident
                        — no subscriber
                        — [no] subscriber-sap-id
                [no] shutdown
                [no] static-mac
        mesh-sdp sdp-id[:vc-id] [vc-type {ether | vlan}]
        no mesh-sdp sdp-id[:vc-id]
                accounting-policy acct-policy-id
                no accounting-policy [acct-policy-id]
                [no] collect-stats
                egress
                        filter {ip ip-filter-name | mac mac-filter-id}
                        no filter
                        vc-label egress-vc-label
                        no vc-label [egress-vc-label]
                ingress
                        filter {ip ip-filter-name | mac mac-filter-id}
                        no filter
                        vc-label ingress-vc-label
                        no vc-label [ingress-vc-label]
                [no] shutdown
                [no] static-mac
                vlan-vc-tag 0..4094
                no vlan-vc-tag [0..4094]
        spoke-sdp sdp-id[:vc-id] [vc-type {ether | vlan}] [split-horizon-group group-
        name]
        no spoke-sdp sdp-id[:vc-id]
                accounting-policy acct-policy-id
                no accounting-policy [acct-policy-id]
                [no] block-on-mesh-failure
                [no] collect-stats
                egress
                        filter {ip ip-filter-name | mac mac-filter-id}
                        no filter
                        vc-label egress-vc-label
                        no vc-label [egress-vc-label]
                ingress
                        filter {ip ip-filter-name | mac mac-filter-id}
                        no filter
                        vc-label ingress-vc-label
                        no vc-label [ingress-vc-label]
                max-nbr-mac-addr table-size
                no max-nbr-mac-addr
                [no] shutdown
                [no] static-mac
                vlan-vc-tag 0..4094
```

— **no vlan-vc-tag** [*0..4094*]

Generic IES Triple Play Commands

```
config
    — service
        — ies service-id [customer customer-id] [vpn vpn-id]
            — description description-string
            — no description
            — service-name service-name
            — no service-name
            — [no] shutdown
            — [no] interface ip-int-name
                — address ip-address/mask [netmask] [broadcast {all-ones | host-ones}]
                — no address
                — [no] allow-directed-broadcast
                — description description-string
                — no description
                — [no] loopback
                — mac ieee-address
                — no mac
                — [no] sap sap-id
                    — accounting-policy acct-policy-id
                    — no accounting-policy [acct-policy-id]
                    — anti-spoof [ip | mac | ip-mac]
                    — no anti-spoof
                    — [no] collect-stats
                    — description description-string
                    — no description
                    — egress
                        — filter {ip ip-filter-name | mac mac-filter-id}
                        — no filter
                        — qos policy-id
                        — no qos
                        — [no] queue-override
                            — [no] queue queue-id
                                — adaptation-rule [pir {max|min|closest}] [cir {max | min | closest}]
                                — no adaptation-rule
                                — avg-frame-overhead percentage
                                — no avg-frame-overhead
                                — cbs size-in-kbytes
                                — no cbs
                                — high-prio-only percent
                                — no high-prio-only
                                — mbs size-in-kbytes
                                — no mbs
                                — rate pir-rate [cir cir-rate]
                                — no rate
                        — scheduler-policy scheduler-policy-name
                        — no scheduler-policy
                    — host {[ip ip-address] [mac mac-address]} [subscriber sub-ident-string] [sub-profile sub-profile-name] [sla-profile sla-profile-name]
                    — no host {[ip ip-address] [mac mac-address]}
                    — no host all
                    — ingress
                        — filter {ip ip-filter-name | mac mac-filter-id}
                        — no filter
```

```
                        — match-qinq-dot1p {top | bottom}
                        — no match-qinq-dot1p
                        — qos policy-id
                        — no qos
                        — scheduler-policy scheduler-policy-name
                        — no scheduler-policy
                    — multi-service-site customer-site-name
                    — no multi-service-site
                    — static-host ip ip/did-address [mac ieee-address] [create]
                    — static-host mac ieee-address [create]
                    — no static-host [ip ip-address] mac ieee-address
                    — no static-host all [force]
                    — no static-host ip ip-address
                        — ancp-string ancp-string
                        — no ancp-string
                        — app-profile app-profile-name
                        — no app-profile
                        — inter-dest-id intermediate-destination-id
                        — no inter-dest-id
                        — managed-routes
                            — route {ip-prefix/length | ip-prefix netmask} [cre-
                            ate]
                            — no route {ip-prefix/length | ip-prefix netmask}
                        — [no] shutdown
                        — sla-profile sla-profile-name
                        — no sla-profile
                        — sub-profile sub-profile-name
                        — no sub-profile
                        — subscriber sub-ident
                        — no subscriber
                        — [no] subscriber-sap-id
                    — [no] shutdown
            — spoke-sdp sdp-id:vc-id
                    — egress
                        — filter {ip ip-filter-id}
                        — no filter
                        — vc-label egress-vc-label
                        — no vc-label [egress-vc-label]
                    — ingress
                        — filter {ip ip-filter-id}
                        — no filter
                        — vc-label ingress-vc-label
                        — no vc-label [ingress-vc-label]
```

Service DHCP and Anti-Spoof Filtering Commands

```
config
    — service
        — [no] vpls service-id [customer customer-id] [vpn vpn-id] [m-vpls]
            — sap sap-id [split-horizon-group group-name] [capture-sap]
            — no sap sap-id
                — anti-spoof {ip | mac | ip-mac}
                — no anti-spoof
                — authentication-policy auth-plcy-name
                — no authentication-policy
                — diameter-auth-policy name
                — no diameter-auth-policy
                — dhcp
                    — description description-string
                    — no description
                    — lease-populate [nbr-of-leases]
                    — no lease-populate
                    — [no] option
                        — action [dhcp-action]
                        — no action
                        — [no] circuit-id
                        — [no] remote-id
                    — [no] shutdown
                    — [no] snoop
            — mesh-sdp sdp-id[:vc-id] [vc-type {ether | vlan}]
            — no mesh-sdp sdp-id[:vc-id]
                — dhcp
                    — description description-string
                    — no description
                    — [no] snoop
            — spoke-sdp sdp-id[:vc-id] [vc-type {ether | vlan}] [split-horizon-group group-
              name]
            — no spoke-sdp sdp-id[:vc-id]
                — dhcp
                    — description description-string
                    — no description
                    — [no] snoop


config
    — service
        — ies service-id [customer customer-id] [vpn vpn-id]
            — [no] interface ip-int-name
                — anti-spoof {ip | mac | ip-mac}
                — no anti-spoof
                — dhcp
                    — description description-string
                    — no description
                    — gi-address ip-address [src-ip-addr]
                    — no gi-address
                    — lease-populate nbr-of-leases
                    — no lease-populate
                    — option
                        — action {replace | drop | keep}
                        — no action
                        — circuit-id [ascii-tuple | ifindex]
```

```
                                        — no circuit-id
                                        — [no] remote-id
                                    — [no] relay-plain-bootp
                                    — relay-unicast-msg [release-update-src-ip]
                                    — no relay-unicast-msg
                                    — server server1 [server2...(up to 8 max)]
                                    — no server
                                    — [no] shutdown
                                    — [no] trusted

config
      — service
            — vprn
                  — [no] interface ip-int-name
                        — dhcp
                              — description description-string
                              — no description
                              — gi-address ip-address [src-ip-addr]
                              — no gi-address
                              — lease-populate [nbr-of-leases]
                              — no lease-populate
                              — [no] option
                                    — action {replace | drop | keep}
                                    — no action
                                    — circuit-id [ascii-tuple | ifindex]
                                    — no circuit-id
                                    — [no] remote-id
                              — [no] relay-plain-bootp
                              — relay-unicast-msg [release-update-src-ip]
                              — no relay-unicast-msg
                              — server server1 [server2...(up to 8 max)]
                              — no server
                              — [no] shutdown
                              — [no] trusted
```

Triple Play ARP Commands

```
config
    — service
        — [no] vpls service-id [customer customer-id] [vpn vpn-id] [m-vpls]
            — sap sap-id [split-horizon-group group-name]
            — no sap sap-id
                — arp-reply-agent [sub-ident]
                — no arp-reply-agent
```

```
config
    — service
        — ies service-id [customer customer-id] [vpn vpn-id]
            — [no] interface ip-int-name
                — [no] arp-populate
                — arp-timeout seconds
                — no arp-timeout
                — [no] local-proxy-arp
                — [no] proxy-arp-policy
                — [no] remote-proxy-arp
                — [no] sap sap-id
```

```
config
    — service
        — vprn
            — [no] interface ip-int-name
                — [no] arp-populate
                — arp-timeout [seconds]
                — no arp-timeout
                — [no] local-proxy-arp
                — [no] proxy-arp-policy
                — [no] remote-proxy-arp
                — static-arp ip-address ieee-address
                — no static-arp ip-address [ieee-address]
```

Triple Play Multicast Commands

```
config
    — service
        — [no] vpls service-id [customer customer-id] [vpn vpn-id] [m-vpls]
            — igmp-snooping
                — mvr
                    — group-policy policy-name
                    — [no] shutdown
                — query-interval seconds
                — no query-interval
                — robust-count robust-count
                — no robust-count
                — [no] shutdown
            — mfib-table-high-wmark high-water-mark
            — no mfib-table-high-wmark
            — mfib-table-low-wmark low-water-mark
            — no mfib-table-low-wmark
            — mfib-table-size table-size
            — no mfib-table-size
            — sap sap-id [split-horizon-group group-name]
            — no sap ap-id
                — igmp-snooping
                    — [no] fast-leave
                    — import policy-name
                    — no import
                    — last-member-query-interval interval
                    — no last-member-query-interval
                    — max-num-groups max-num-groups
                    — no max-num-groups
                    — [no] mrouter-port
                    — mvr
                        — from-vpls vpls-id
                        — no from-vpls
                        — to-sap sap-id
                        — no to-sap
                    — query-interval interval
                    — no query-interval
                    — query-response-interval interval
                    — no query-response-interval
                    — robust-count count
                    — no robust-count
                    — [no] send-queries
                    — static
                        — [no] group group-address
                            — [no] source ip-address
                            — [no] starg
            — mesh-sdp sdp-id[:vc-id] [vc-type {ether | vlan | vpls}]
            — no mesh-sdp sdp-id[:vc-id]
                — igmp-snooping
                    — [no] fast-leave
                    — import policy-name
                    — no import
                    — last-member-query-interval interval
```

```
                    — no last-member-query-interval
                    — max-num-groups max-num-groups
                    — no max-num-groups
                    — query-interval interval
                    — no query-interval
                    — query-response-interval interval
                    — no query-response-interval
                    — robust-count count
                    — no robust-count
                    — [no] send-queries
                    — static
                        — [no] group group-address
                            — [no] source ip-address
                            — [no] starg
— spoke-sdp sdp-id[:vc-id] [vc-type {ether | vlan | vpls}] [split-horizon-group
  group-name]
— no spoke-sdp sdp-id[:vc-id]
        — igmp-snooping
                    — [no] fast-leave
                    — import policy-name
                    — no import
                    — last-member-query-interval interval
                    — no last-member-query-interval
                    — max-num-groups max-num-groups
                    — no max-num-groups
                    — [no] mrouter-port
                    — query-interval interval
                    — no query-interval
                    — query-response-interval interval
                    — no query-response-interval
                    — robust-count count
                    — no robust-count
                    — [no] send-queries
                    — static
                        — [no] group group-address
                            — [no] source ip-address
                            — [no] starg
```

Show Commands

```
show
    — service
        — active-subscribers detail
        — active-subscribers mirror
        — active-subscribers [summary]
            — credit-control credit-control [subscriber sub-ident-string]
            — credit-control out-of-credit [action action] [summary]
            — filter [subscriber sub-ident-string] [origin origin]
            — hierarchy [subscriber sub-ident-string]
            — host-tracking [subscriber sub-ident-string]
            — host-tracking [subscriber sub-ident-string] detail
            — host-tracking [subscriber sub-ident-string] summary
            — host-tracking [subscriber sub-ident-string] statistics
                — groups [group group-ip-address]
                — groups group group-ip-address] detail
                — groups group group-ip-address] summary
            — igmp [subscriber sub-ident-string][detail]
            — subscriber sub-ident-string
            — subscriber sub-ident-string detail
            — subscriber sub-ident-string mirror
            — subscriber sub-ident-string sap sap-id sla-profile sla-profile-name
            — subscriber sub-ident-string sap sap-id sla-profile sla-profile-name detail
            — subscriber sub-ident-string sap sap-id sla-profile sla-profile-name mirror
        — id service-id
            — arp [ip-address] | [mac ieee-address] | [sap port-id:encap] | [interface ip-int-name]
            — base
            — authentication
                — statistics
            — dhcp
                — lease-state [wholesaler service-id] [sap sap-id | sdp sdp-id:vc-id | interface interface-name | ip-address ip-address[/mask] | chaddr ieee-address | mac ieee-address | {[port port-id] [no-inter-dest-id | inter-dest-id inter-dest-id]}] [detail]
                — statistics [sap sap-id] | [sdp [sdp-id[:vc-id] ]]
                — summary
            — gsmp
                — neighbors group [name] [ip-address]
                — sessions [group name] neighbor ip-address] [port port-number] [association] [statistics]
            — host [sap sap-id] [wholesaler service-id] [port port-id] [inter-dest-id intermediate-destination-id] [detail]
            — host [sap sap-id] [wholesaler service-id] [port port-id] no-inter-dest-id [detail]
            — host summary
            — retailers
            — split-horizon-group [group-name]
            — static-host [sap sap-id] [wholesaler service-id] [port port-id] [inter-dest-id intermediate-destination-id] [detail]
            — static-host [sap sap-id] [wholesaler service-id] [port port-id] no-inter-dest-id [detail]
            — static-host summary
            — wholesalers
        — subscriber-using [service-id service-id] [sap-id sap-id] [interface ip-int-name] [ip ip-address[/mask]] [mac ieee-address] [sub-profile sub-profile-name] [sla-profile sla-profile-
```

name] [**app-profile** *app-profile-name*] [**port** *port-id*] [**no-inter-dest-id** | **inter-dest-id** *interme-diate-destination-id*]

— **router**
— **dhcp**
— **lease-state** [**interface** *ip-int-name* | *ip-address*]
— **statistics** [*ip-int-name* | *ip-address*]
— **summary**

show
— **service**
— **id** *service-id*
— **igmp-snooping**
— **all**
— **base**
— **mrouters** [**detail**]
— **mvr**
— **port-db** {**sap** *sap-id* | **sdp** *sdp-id*:*vc-id*} [**group** *grp-address*] | **detail**]
— **proxy-db** [**group** *grp-address* | **detail**]
— **querier**
— **static** [**sap** *sap-id* | **sdp** *sdp-id*:*vc-id*]
— **statistics** [**sap** *sap-id* | **sdp** *sdp-id*:*vc-id*]
— **mfib** [**brief** | **group** *grp-address* | **statistics** [**group** *grp-address*]]

Clear Commands

```
clear
    — router
        — dhcp
            — lease-state [interface ip-int-name | ip-addr | ip-address ip-address | mac ieee-address]
            — statistics [ip-int-name | ip-address]
    — service
        — id service-id
            — authentication
                — statistics
            — dhcp
                — lease-state [no-dhcp-release]
                — lease-state [port port-id] [inter-dest-id intermediate-destination-id] [no-dhcp-release]
                — lease-state [port port-id] no-inter-dest-id [no-dhcp-release]
                — lease-state ip-address ip-address[/mask] [no-dhcp-release]
                — lease-state mac ieee-address [no-dhcp-release]
                — lease-state sap sap-id [no-dhcp-release]
                — lease-state sdp sdp-id[:vc-id] [no-dhcp-release]
            — igmp-snooping
                — port-db sap sap-id [group grp-address [source ip-address]]
                — port-db sdp sdp-id:vc-id [group grp-address [source ip-address]]
                — querier
                — statistics [all | sap sap-id | sdp sdp-id:vc-id]
            — mfib
                — statistics [all | group grp-address]
            — mld-snooping
                — port-db sap sap-id [group grp-ipv6-address]
                — port-db sap sap-id group grp-ipv6-address source src-ipv6-address
                — port-db sdp sdp-id:vc-id [group grp-ipv6-address]
                — port-db sdp sdp-id:vc-id group grp-ipv6-address source src-ipv6-address
                — querier
                — statistics all
                — statistics sap sap-id
                — statistics sdp sdp-id:vc-id
```

Triple Play Service Configuration Commands

Global Commands

shutdown

Syntax [**no**] **shutdown**

Context
config>service>vpls>sap>dhcp
config>service>vpls>igmp-snooping>mvr
config>service>vpls
config>service>vpls>sap
config>service>vpls>sap>arp-host
config>service>vpls>mesh-sdp
config>service>vpls>spoke-sdp
config>service>ies>if>sap
config>service>ies>if>dhcp
config>service>ies>sub-if>grp-if>lcl-addr-assign
config>service>vprn>sub-if>grp-if>lcl-addr-assign
config>service>ies>sub-if>grp-if>srrp
config>service>vprn
config>service>vprn>sub-if
config>service>vprn>sub-if>dhcp
config>service>vprn>sub-if>dhcp>proxy-server

Description This command administratively disables an entity. When disabled, an entity does not change, reset, or remove any configuration settings or statistics.

The operational state of the entity is disabled as well as the operational state of any entities contained within. Many objects must be shut down before they may be deleted.

Services are created in the administratively down (**shutdown**) state. When a **no shutdown** command is entered, the service becomes administratively up and then tries to enter the operationally up state. Default administrative states for services and service entities is described below in Special Cases.

The **no** form of this command places the entity into an administratively enabled state.

Special Cases **Service Admin State —** Bindings to an SDP within the service will be put into the out-of-service state when the service is shutdown. While the service is shutdown, all customer packets are dropped and counted as discards for billing and debugging purposes.

Service Operational State — A service is regarded as operational providing that two SAPs or if one SDP are operational.

SDP (global) — When an SDP is shutdown at the global service level, all bindings to that SDP are put into the out-of-service state and the SDP itself is put into the administratively and operationally down states. Packets that would normally be transmitted using this SDP binding will be discarded and counted as dropped packets.

SDP (service level) — Shutting down an SDP within a service only affects traffic on that service from entering or being received from the SDP. The SDP itself may still be operationally up for other services.

SDP Keepalives — Enables SDP connectivity monitoring keepalive messages for the SDP ID. Default state is disabled (shutdown) in which case the operational state of the SDP-ID is not affected by the keepalive message state.

VPLS SAPs and SDPs — SAPs are created in a VPLS and SDPs are bound to a VPLS in the administratively up default state. The created SAP will attempt to enter the operationally up state. An SDP will attempt to go into the in-service state once bound to the VPLS.

description

Syntax **description** *description-string*
no description

Context config>service>vpls
config>service>vpls>igmp-snooping>mvr
config>service>vpls>split-horizon-group
config>service>vpls>sap
config>service>ies>if>sap
config>service>vprn
config>service>vprn>subscriber-interface
config>service>vprn>subscriber-interface>group-interface
config>service>vprn>subscriber-interface>grp-if>dhcp
config>service>vprn>sub-if>grp-if>srrp
config>service>vpls>sap>dhcp
config>service>vpls>mld-snooping>mvr

Description This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the content in the configuration file.

The **no** form of this command removes the string from the configuration.

Default No description associated with the configuration context.

Parameters *description-string* — The description character string. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

Service Commands

vpls

Syntax **vpls** *service-id* **customer** *customer-id* **vpn** *vpn-id* [**m-vpls**]
vpls *service-id*
no vpls *service-id*

Context config>service

Description This command creates or edits a Virtual Private LAN Services (VPLS) instance.

The **vpls** command is used to create or maintain a VPLS service. If the *service-id* does not exist, a context for the service is created. If the *service-id* exists, the context for editing the service is entered.

A VPLS service connects multiple customer sites together acting like a zero-hop, layer 2 switched domain. A VPLS is always a logical full mesh.

When a service is created, the **create** keyword must be specified if the **create** command is enabled in the **environment** context.

When a service is created, the **customer** keyword and *customer-id* must be specified and associates the service with a customer. The *customer-id* must already exist having been created using the **customer** command in the service context. Once a service has been created with a customer association, it is not possible to edit the customer association. The service must be deleted and recreated with a new customer association.

To create a management VPLS, the m-vpls keyword must be specified. See section **Hierarchical VPLS Redundancy** for an introduction to the concept of management VPLS.

Once a service is created, the use of the **customer** *customer-id* is optional for navigating into the service configuration context. Attempting to edit a service with the incorrect *customer-id* specified will result in an error.

More than one VPLS service may be created for a single customer ID.

By default, no VPLS instances exist until they are explicitly created.

The **no** form of this command deletes the VPLS service instance with the specified *service-id*. The service cannot be deleted until all SAPs and SDPs defined within the service ID have been shutdown and deleted, and the service has been shutdown.

service-id — The unique service identification number identifying the service in the service domain. This ID must be unique to this service and may not be used for any other service of any type. The *service-id* must be the same number used for every router on which this service is defined.

Values service-id: 1 — 214748364
svc-name: A string up to 64 characters in length.

customer *customer-id* **—** Specifies the customer ID number to be associated with the service. This parameter is required on service creation and optional for service editing or deleting.

Values 1 — 2147483647

vpn *vpn-id* — Specifies the VPN ID number which allows you to identify virtual private networks (VPNs) by a VPN identification number.

Values 1 — 2147483647

Default **null** (0)

m-vpls — Specifies a managed VPLS.

service-name

Syntax **service-name** *service-name*
no service-name

Context config>service>epipe
config>service>ies
config>service>vpls
config>service>vprn

Description This command configures an optional service name, up to 64 characters in length, which adds a name identifier to a given service to then use that service name in configuration references as well as display and use service names in show commands throughout the system. This helps the service provider/administrator to identify and manage services within the 7750 SR and 7450 ESS platforms.

All services are required to assign a service ID to initially create a service. However, either the service ID or the service name can be used o identify and reference a given service once it is initially created.

Parameters *service-name* — Specifies a unique service name to identify the service. Service names may not begin with an integer (0-9).

ies

Syntax **ies** *service-id* **customer** *customer-id* **vpn** *vpn-id*
ies *service-id*
no ies *service-id*

Context config>service

Description This command creates or edits an IES service instance.

The **ies** command is used to create or maintain an Internet Ethernet Service (IES). If the *service-id* does not exist, a context for the service is created. If the *service-id* exists, the context for editing the service is entered.

IES services allow the creation of customer facing IP interfaces in the same routing instance used for service network core routing connectivity. IES services require that the IP addressing scheme used by the subscriber must be unique between it and other addressing schemes used by the provider and potentially the entire Internet.

While IES is part of the routing domain, the usable IP address space may be limited. This allows a portion of the service provider address space to be set aside for service IP provisioning, becoming administered by a separate but subordinate address authority. This feature is defined using the **config router service-prefix** command.

IP interfaces defined within the context of an IES service ID must have a SAP created as the access point to the subscriber network. This allows a combination of bridging and IP routing for redundancy purposes.

When a service is created, the **customer** keyword and *customer-id* must be specified and associates the service with a customer. The *customer-id* must already exist having been created using the **customer** command in the service context. Once a service has been created with a customer association, it is not possible to edit the customer association. The service must be deleted and recreated with a new customer association.

Once a service is created, the use of the **customer** *customer-id* is optional for navigating into the service configuration context. Attempting to edit a service with the incorrect *customer-id* specified will result in an error.

Multiple IES services are created to separate customer owned IP interfaces. More than one IES service may be created for a single customer ID. More than one IP interface may be created within a single IES service ID. All IP interfaces created within an IES service ID belongs to the same customer.

By default, no IES service instances exist until they are explicitly created.

The **no** form of this command deletes the IES service instance with the specified *service-id*. The service cannot be deleted until all the IP interfaces defined within the service ID have been shutdown and deleted.

Parameters *service-id* — The unique service identification number identifying the service in the service domain. This ID must be unique to this service and may not be used for any other service of any type. The *service-id* must be the same number used for every router on which this service is defined.

Values service-id: 1 — 214748364
svc-name: A string up to 64 characters in length.

customer *customer-id* **—** Specifies the customer ID number to be associated with the service. This parameter is required on service creation and optional for service editing or deleting.

Values 1 — 2147483647

vpn *vpn-id* — Specifies the VPN ID number which allows you to identify virtual private networks (VPNs) by a VPN identification number.

Values 1 — 2147483647

Default **null** (0)

vprn

Syntax **vprn** *service-id* [**customer** *customer-id*]
no vprn *service-id*

Context config>service

Description This command creates or edits a Virtu9al Private Routed Network (VPRN) service instance.

If the *service-id* does not exist, a context for the service is created. If the *service-id* exists, the context for editing the service is entered.

VPRN services allow the creation of customer-facing IP interfaces in the same routing instance used for service network core routing connectivity. VPRN services require that the IP addressing scheme used by the subscriber must be unique between it and other addressing schemes used by the provider and potentially the entire Internet.

IP interfaces defined within the context of an VPRN service ID must have a SAP created as the access point to the subscriber network.

When a service is created, the **customer** keyword and *customer-id* must be specified and associates the service with a customer. The *customer-id* must already exist having been created using the customer command in the service context. When a service is created with a customer association, it is not possible to edit the customer association. The service must be deleted and re-created with a new customer association.

When a service is created, the use of the **customer** *customer-id* is optional to navigate into the service configuration context. If attempting to edit a service with the incorrect *customer-id* results in an error.

Multiple VPRN services are created to separate customer-owned IP interfaces. More than one VPRN service can be created for a single customer ID. More than one IP interface can be created within a single VPRN service ID. All IP interfaces created within an VPRN service ID belongs to the same customer.

The **no** form of the command deletes the VPRN service instance with the specified *service-id*. The service cannot be deleted until all the IP interfaces and all routing protocol configurations defined within the service ID have been shutdown and deleted.

Default None — No VPRN service instances exist until they are explicitly created.

Parameters *service-id* — The unique service identification number identifying the service in the service domain. This ID must be unique to this service and may not be used for any other service of any type. The *service-id* must be the same number used for every 7750 SR on which this service is defined.

Values *service-id*: 1 — 2147483648
svc-name: 64 characters maximum

customer *customer-id* — Specifies an existing customer identification number to be associated with the service. This parameter is required on service creation and optional for service editing or deleting.

Values 1 — 2147483647

sap

Syntax **sap** *sap-id*
no sap *sap-id*

Context config>service>vprn>if
config>service>vprn>subscriber-interface>sap

Description This command creates a Service Access Point (SAP) within a service. A SAP is a combination of port and encapsulation parameters which identifies the service access point on the interface and within the router. Each SAP must be unique.

All SAPs must be explicitly created. If no SAPs are created within a service or on an IP interface, a SAP will not exist on that object.
Enter an existing SAP without the **create** keyword to edit SAP parameters. The SAP is owned by the service in which it was created.
A SAP can only be associated with a single service. A SAP can only be defined on a port that has been configured as an access port using the **config interface** *port-type port-id* **mode access** command. Channelized TDM ports are always access ports.
If a port is shutdown, all SAPs on that port become operationally down. When a service is shutdown, SAPs for the service are not displayed as operationally down although all traffic traversing the service will be discarded. The operational state of a SAP is relative to the operational state of the port on which the SAP is defined.

The **no** form of this command deletes the SAP with the specified port. When a SAP is deleted, all configuration parameters for the SAP will also be deleted.

Default No SAPs are defined.

Parameters *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common CLI Command Descriptions on page 2167 for command syntax.

port-id — Specifies the physical port ID in the *slot/mda/port* format.

If the card in the slot has Media Dependent Adapters (MDAs) installed, the *port-id* must be in the slot_number/MDA_number/port_number format. For example 6/2/3 specifies port 3 on MDA 2 in slot 6.

The *port-id* must reference a valid port type. When the *port-id* parameter represents SONET/SDH and TDM channels the port ID must include the channel ID. A period "." separates the physical port from the *channel-id*. The port must be configured as an access port.

If the SONET/SDH port is configured as clear-channel then only the port is specified.

create — Keyword used to create a SAP instance.

disable-aging

Syntax [**no**] **disable-aging**

Context config>service>vpls
config>service>vpls>spoke-sdp
config>service>vpls>sap

Description This command disables MAC address aging across a VPLS service or on a VPLS service SAP or spoke SDP.

Like in a Layer 2 switch, learned MACs can be aged out if no packets are sourced from the MAC address for a period of time (the aging time). In each VPLS service instance, there are independent aging timers for local learned MAC and remote learned MAC entries in the VPLS forwarding database (FDB). The **disable-aging** command turns off aging for local and remote learned MAC addresses.

When **no disable-aging** is specified for a VPLS, it is possible to disable aging for specifc SAPs and/or spoke SDPs by entering the **disable-aging** command at the appropriate level.

When the **disable-aging** command is entered at the VPLS level, the **disable-aging** state of individual SAPs or SDPs will be ignored.

The **no** form of this command enables aging on the VPLS service.

Default no disable-aging

disable-learning

Syntax **disable-learning**
no disable-learning

Context config>service>vpls
config>service>vpls>sap
config>service>vpls>spoke-sdp

Description This command enables learning of new MAC addresses in the VPLS forwarding database (FDB) for the service instance, SAP instance or spoke SDP instance.

When **disable-learning** is enabled, new source MAC addresses will not be entered in the VPLS service forwarding database. This is true for both local and remote MAC addresses.

When disabled, new source MAC addresses will be learned and entered into the VPLS forwarding database. This parameter is mainly used in conjunction with the **discard-unknown** command.

The **no** form of this command enables learning of MAC addresses meaning that normal MAC learning is enabled.

Default no disable-learning

discard-unknown

Syntax [**no**] **discard-unknown**

Context config>service>vpls

Description By default, packets with unknown destination MAC addresses are flooded. If discard-unknown is enabled at the VPLS level, packets with unknown destination MAC address will be dropped instead (even when configured FIB size limits for VPLS or SAP are not yet reached).

The **no** form of this command allows flooding of packets with unknown destination MAC addresses in the VPLS.

Default **no discard-unknown**

fdb-table-high-wmark

Syntax [**no**] **fdb-table-high-wmark** *high-water-mark*

Context config>service>vpls

Description This command specifies the value to send logs and traps when the threshold is reached.

Default 95

Parameters *high-water-mark* — When to send logs and traps.

Values 0 — 100

fdb-table-low-wmark

Syntax [**no**] **fdb-table-low-wmark** *low-water-mark*

Context config>service>vpls

Description This command specifies the value to send logs and traps when the threshold is reached.

Default 90

Parameters *low-water-mark* — When to send logs and traps.

Values 0 — 100

fdb-table-size

Syntax **fdb-table-size** *table-size*
no fdb-table-size [*table-size*]

Context config>service>vpls

Description This command specifies the maximum number of MAC entries in the forwarding database (FDB) for the VPLS instance on this node.

The **fdb-table-size** specifies the maximum number of forwarding database entries for both learned and static MAC addresses for the VPLS instance.

The **no** form of this command returns the maxium FDB table size to default.

Default **250** — Forwarding table of 250 MAC entries.

Parameters *table-size* — The number of entries permitted in the forwarding database for this VPLS instance.

Values Chassis-mode A or B limit: 131071
Chassis-mode D limit: 511999

local-age

Syntax **local-age** *seconds*
no local-age

Context config>service>vpls

Description Specifies the aging time for locally learned MAC addresses in the forwarding database (FDB) for the Virtual Private LAN Service (VPLS) instance.

In a VPLS service, MAC addresses are associated with a Service Access Point (SAP) or with a Service Distribution Point (SDP). MACs associated with a SAP are classified as local MACs, and MACs associated with an SDP are remote MACs.

Like in a Layer 2 switch, learned MACs can be aged out if no packets are sourced from the MAC address for a period of time (the aging time). In each VPLS service instance, there are independent aging timers for local learned MAC and remote learned MAC entries in the FDB. The **local-age** timer specifies the aging time for local learned MAC addresses.

The **no** form of this command returns the local aging timer to the default value.

Default **local age 300** — Local MACs aged after 300 seconds.

Parameters *seconds* — The aging time for local MACs expressed in seconds.

Values 60 — 86400

remote-age

Syntax **remote-age** *seconds*
no remote-age

Context config>service>vpls

Description Specifies the aging time for remotely learned MAC addresses in the forwarding database (FDB) for the Virtual Private LAN Service (VPLS) instance.

In a VPLS service, MAC addresses are associated with a Service Access Point (SAP) or with a Service Distribution Point (SDP). MACs associated with a SAP are classified as local MACs, and MACs associated with an SDP are remote MACs.

Like in a layer 2 switch, learned MACs can be aged out if no packets are sourced from the MAC address for a period of time (the aging time). In each VPLS service instance, there are independent aging timers for local learned MAC and remote learned MAC entries in the FDB. The **remote-age** timer specifies the aging time for remote learned MAC addresses. To reduce the amount of signaling required between switches configure this timer larger than the **local-age** timer.

The **no** form of this command returns the remote aging timer to the default value.

Default **remote age 900** — Remote MACs aged after 900 seconds.

Parameters *seconds* — The aging time for remote MACs expressed in seconds.

Values 60 — 86400

service-mtu

Syntax **service-mtu** *octets*
no service-mtu

Context config>service>vpls

Description This command configures the service payload (Maximum Transmission Unit – MTU), in bytes, for the service. This MTU value overrides the service-type default MTU.

The **service-mtu** defines the payload capabilities of the service. It is used by the system to validate the SAP and SDP binding's operational state within the service.

The service MTU and a SAP's service delineation encapsulation overhead (i.e., 4 bytes for a Dot1q tag) is used to derive the required MTU of the physical port or channel on which the SAP was created. If the required payload is larger than the port or channel MTU, then the SAP will be placed in an inoperative state. If the required MTU is equal to or less than the port or channel MTU, the SAP will be able to transition to the operative state.

When binding an SDP to a service, the service MTU is compared to the path MTU associated with the SDP. The path MTU can be administratively defined in the context of the SDP. The default or administrative path MTU can be dynamically reduced due to the MTU capabilities discovered by the tunneling mechanism of the SDP or the egress interface MTU capabilities based on the next hop in the tunnel path. If the service MTU is larger than the path MTU, the SDP binding for the service will be placed in an inoperative state. If the service MTU is equal to or less than the path MTU, then the SDP binding will be placed in an operational state.

In the event that a service MTU, port or channel MTU, or path MTU is dynamically or administratively modified, then all associated SAP and SDP binding operational states are automatically re-evaluated.

The **no** form of this command returns the default **service-mtu** for the indicated service type to the default value.

Default VPLS: 1514

The following table displays MTU values for specific VC types.

VC-Type	Example Service MTU	Advertised MTU
Ethernet	1514	1500
Ethernet (with preserved dot1q)	1518	1504
VPLS	1514	1500
VPLS (with preserved dot1q)	1518	1504
VLAN (dot1p transparent to MTU value)	1514	1500
VLAN (QinQ with preserved bottom Qtag)	1518	1504

octets — The size of the MTU in octets, expressed as a decimal integer.

Values 1 — 9194

split-horizon-group

Syntax [**no**] **split-horizon-group** [*group-name*] [*residential-group*]

Context config>service>vpls

Description This command creates a new split horizon group for the VPLS instance. Traffic arriving on a SAP or spoke SDP within this split horizon group will not be copied to other SAPs or spoke SDPs in the same split horizon group.

A split horizon group must be created before SAPs and spoke SDPs can be assigned to the group.

The split horizon group is defined within the context of a single VPLS. The same group-name can be re-used in different VPLS instances.

Up to 30 split horizon groups can be defined per VPLS instance.

The **no** form of the command removes the group name from the configuration.

Parameters *group-name* — Specifies the name of the split horizon group to which the SDP belongs.

residential-group — Defines a split horizon group as a residential split horizon group (RSHG). Doing so entails that:

a) SAPs which are members of this Residential Split Horizon Group will have:

- Double-pass queuing at ingress as default setting (can be disabled)
- STP disabled (can not be enabled)
- ARP reply agent enabled by default (can be disabled)
- MAC pinning enabled by default (can be disabled)
- broadcast packets are discarded, blocking unknown, flooded traffic

b) Spoke SDPs which are members of this Residential Split Horizon Group will have:

- Downstream multicast traffic supported
- Double-pass queuing is not applicable
- STP is disabled (can be enabled)
- ARP reply agent is not applicable (dhcp-lease-states are not supported on spoke SDPs)
- MAC pinning enabled per default (can be disabled)

Default A split horizon group is by default not created as a residential-group.

sap

Syntax **sap** *sap-id* [**split-horizon-group** *group-name*] [**create**] [**capture-sap**]
no sap *sap-id*

Context config>service>vpls

Description This command creates a Service Access Point (SAP) within a service. A SAP is a combination of port and encapsulation parameters which identifies the service access point on the interface and within the 7750. Each SAP must be unique. All SAPs must be explicitly created. If no SAPs are created within a

service or on an IP interface, a SAP will not exist on that object.

Enter an existing SAP without the **create** keyword to edit SAP parameters. The SAP is owned by the service in which it was created.

A SAP can only be associated with a single service. A SAP can only be defined on a port that has been configured as an access port using the **config interface** *port-type port-id* **mode access** command. Channelized TDM ports are always access ports.

If a port is shutdown, all SAPs on that port become operationally down. When a service is shutdown, SAPs for the service are not displayed as operationally down although all traffic traversing the service will be discarded. The operational state of a SAP is relative to the operational state of the port on which the SAP is defined.

The **no** form of this command deletes the SAP with the specified port. When a SAP is deleted, all configuration parameters for the SAP will also be deleted. For Internet Ethernet Service (IES), the IP interface must be shutdown before the SAP on that interface may be removed.

Default No SAPs are defined.

Special Cases A VPLS SAP can be defined with Ethernet ports, SONET/SDH or TDM channels.

A default SAP has the following format: port-id:*. This type of SAP is supported only on Ethernet MDAs and its creation is allowed only in the scope of Layer 2 services (Epipe and VPLS). This type of SAP is mutually exclusive with a SAP defined by explicit null encapsulation (for example, 1/1/1:0).

Parameters *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

port-id — Specifies the physical port ID in the *slot/mda/port* format.

If the card in the slot has Media Dependent Adapters (MDAs) installed, the *port-id* must be in the slot_number/MDA_number/port_number format. For example 6/2/3 specifies port 3 on MDA 2 in slot 6.

The *port-id* must reference a valid port type. When the *port-id* parameter represents SONET/SDH and TDM channels, the port ID must include the channel ID. A period "." separates the physical port from the *channel-id*. The port must be configured as an access port.

If the SONET/SDH port is configured as clear-channel then only the port is specified.

split-horizon-group *group-name* **—** Specifies an existing split horizon group name.

capture-sap — Keyword to create a capture SAP.

create — Keyword used to create a SAP instance. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

accounting-policy

Syntax **accounting-policy** *acct-policy-id*
no accounting-policy

Context config>service>vpls>sap
config>service>vpls>spoke-sdp
config>service>vpls>mesh-sdp

config>service>ies>if>sap
config>service>ies>sub-if>grp-if>sap

Description This command creates the accounting policy context that can be applied to a SAP or SDP.

An accounting policy must be defined before it can be associated with a SAP or SDP. If the *policy-id* does not exist, an error message is generated.

A maximum of one accounting policy can be associated with a SAP or SDP at one time. Accounting policies are configured in the **config>log** context.

The **no** form of this command removes the accounting policy association from the SAP or SDP, and the acccounting policy reverts to the default.

Default Default accounting policy.

Parameters *acct-policy-id* — Enter the accounting *policy-id* as configured in the **config>log>accounting-policy** context.

Values 1 — 99

collect-stats

Syntax [**no**] **collect-stats**

Context config>service>vpls>sap
config>service>vpls>spoke-sdp
config>service>vpls>mesh-sdp
config>service>ies>if>sap

Description This command enables accounting and statistical data collection for either the SAP or SDP, network port, or IP interface. When applying accounting policies the data, by default, is collected in the appropriate records and written to the designated billing file.

When the **no collect-stats** command is issued the statistics are still accumulated by the IOM cards. However, the CPU will not obtain the results and write them to the billing file. If a subsequent **collect-stats** command is issued then the counters written to the billing file include all the traffic while the **no collect-stats** command was in effect.

Default collect-stats

cflowd

Syntax **cflowd** {**acl** | **interface**}
no cflowd

Context config>service>ies>interface

Description This command enables **cflowd** to collect traffic flow samples through a router for analysis.

cflowd is used for network planning and traffic engineering, capacity planning, security, application and user profiling, performance monitoring, usage-based billing, and SLA measurement. When

cflowd is enabled at the interface level, all packets forwarded by the interface are subjected to analysis according to the **cflowd** configuration.

Default no cflowd

Parameters *acl — cflowd* configuration associated with a filter.

interface — cflowd configuration associated with an IP interface.

limit-mac-move

Syntax **limit-mac-move** [**blockable** | **non-blockable**]
no limit-mac-move

Context config>service>vpls>sap
config>service>vpls>spoke-sdp

Description This command indicates whether or not the mac-move agent, when enabled using **config>service>vpls>mac-move** or **config>service>epipe>mac-move**, will limit the MAC re-learn (move) rate on this SAP.

Default **SAPs and spoke SDPs are blockable**

Parameters **blockable —** the agent will monitor the MAC re-learn rate on the SAP, and it will block it when the re-learn rate is exceeded.

non-blockable — When specified, this SAP will not be blocked, and another blockable SAP will be blocked instead.

mac-pinning

Syntax [**no**] **mac-pinning**

Context config>service>vpls>sap
config>service>vpls>spoke-sdp
config>service>vpls>mesh-sdp

Description Enabling this command will disable re-learning of MAC addresses on other SAPs within the VPLS. The MAC address will remain attached to a given SAP for the duration of its age-timer.

The age of the MAC address entry in the FIB is set by the age timer. If **mac-aging** is disabled on a given VPLS service, any MAC address learned on a SAP/SDP with **mac-pinning** enabled will remain in the FIB on this SAP/SDP forever.

Every event that would otherwise result in re-learning will be logged (MAC address, original-SAP, new-SAP).

Note that MAC addresses learned during DHCP address assignment (DHCP snooping enabled) are not impacted by this command. MAC-pinning for such addresses is implicit.

Default When a SAP or spoke SDP is part of a Residential Split Horizon Group (RSHG), MAC pinning is activated at creation of the SAP. Otherwise MAC pinning is not enabled by default.

managed-vlan-list

Syntax **managed-vlan-list**

Context config>service>vpls>sap

Description This command enters the context for configuring VLAN ranges to be managed by a management VPLS. The list indicates, for each SAP, the ranges of associated VLANs that will be affected when the SAP changes state.

This command is only valid when the VPLS in which it is entered was created as a management VPLS.

range

Syntax [**no**] **range** *vlan-range*

Context config>service>vpls>sap>managed-vlan-list

Description This command configures a range of VLANs on an access port that are to be managed by an existing management VPLS.

This command is only valid when the VPLS in which it is entered was created as a management VPLS, and when the SAP in which it was entered was created on an Ethernet port with encapsulation type of dot1q or qinq, or on a Sonet/SDH port with encapsulation type of bcp-dot1q.

To modify the range of VLANs, first the new range should be entered and afterwards the old range removed.

Default None

Parameters *vlan-range* — Specify the VLAN start value and VLAN end value. The end-vlan must be greater than start-vlan. The format is <start-vlan>-<end-vlan>

Values start-vlan: 1 — 4094
end-vlan: 1 — 4094

track-srrp

Syntax **track-srrp** *srrp-id*
no track-srrp

Context configure>service>vpls>sap>

Description This is a capture SAP level command. This command is important in PPPoE deployments with MSAPs. PPPoE operation requires that the MAC address learned by the client at the very beginning of the session negotiation phase remains unchanged for the lifetime of the session (RFC 2516). This command will ensure that that the virtual MAC address used during the PPPoE session negotiation phase on the capture SAP is the same virtual MAC address that is used by the SRRP on the group-interface on which the session is established. Therefore, it is mandated that the SRRP instance (and implicitly the group-interface) where the session belongs to is known in advance. If the group-interface name for the session is returned by the RADIUS, it must be ensured that this group-interface

is the one on which the tracked SRRP instance is configured. PPPoE sessions on the same capture SAP cannot be shared across multiple group-interfaces, but instead they all must belong to a single group-interface that is known in advance.

The same restrictions will apply to IPoE clients in MC Redundancy scenario if they are to be supported concurrently on the same capture SAP as PPPoE.

The supported capture SAP syntax is this:

sap <port-id>:X.* capture-sap

The capture SAP syntax that is NOT supported is this:

sap <port-id>:*.* capture-sap

Default None

Parameters *srrp-id* — Specify the SRRP instance number.

Values 1..4294967295

VPLS SAP ATM Commands

atm

Syntax **atm**

Context config>service>vpls>sap

Description This command enables access to the context to configure ATM-related attributes. This command can only be used when a given context (for example, a channel or SAP) supports ATM functionality such as:

- Configuring ATM port or ATM port-related functionality on MDAs supporting ATM functionality
- Configuring ATM-related configuration for ATM-based SAPs that exist on MDAs supporting ATM functionality.

If ATM functionality is not supported for a given context, the command returns an error.

egress

Syntax **egress**

Context config>service>vpls>sap>atm

Description This command enables the context to configure egress ATM attributes for the SAP.

encapsulation

Syntax **encapsulation** *atm-encap-type*

Context config>service>vpls>sap>atm

Description This command specifies the data encapsulation for an ATM PVCC delimited SAP. The definition references RFC 2684, *Multiprotocol Encapsulation over ATM AAL5,* and to the ATM Forum LAN Emulation specification.

Ingress traffic that does not match the configured encapsulation will be dropped.

Default The encapsulation is driven by the services for which the SAP is configured.
For IES and VPRN service SAPs, the default is **aal5snap-routed**.

Parameters *atm-encap-type* — Specify the encapsulation type.

Values **aal5snap-routed** — Routed encapsulation for LLC encapsulated circuit (LLC/SNAP precedes protocol datagram) as defined in RFC 2684.
aal5mux-ip — Routed IP encapsulation for VC multiplexed circuit as defined in RFC 2684

ingress

Syntax **ingress**

Context config>service>vpls>sap>atm

Description This command enables the context to configure ingress ATM attributes for the SAP.

traffic-desc

Syntax **traffic-desc** *traffic-desc-profile-id*
no traffic-desc

Context config>service>vpls>sap>atm>ingress
config>service>vpls>sap>atm>egress

Description This command assigns an ATM traffic descriptor profile to a given context (for example, a SAP).

When configured under the ingress context, the specified traffic descriptor profile defines the traffic contract in the forward direction.

When configured under the egress context, the specified traffic descriptor profile defines the traffic contract in the backward direction.

The **no** form of the command reverts the traffic descriptor to the default traffic descriptor profile.

Default The default traffic descriptor (trafficDescProfileId. = 1) is associated with newly created PVCC-delimited SAPs.

Parameters *traffic-desc-profile-id* — Specify a defined traffic descriptor profile (see the QoS atm-td-profile command).

oam

Syntax **oam**

Context config>service>vpls>sap>atm

Description This command enables the context to configure OAM functionality for a PVCC delimiting a SAP.

The ATM-capable MDAs support F5 end-to-end OAM functionality (AIS, RDI, loopback):

- ITU-T Recommendation I.610 - B-ISDN Operation and Maintenance Principles and Functions version 11/95
- GR-1248-CORE - Generic Requirements for Operations of ATM Network Elements (NEs). Issue 3 June 1996
- GR-1113-CORE - Bellcore, Asynchronous Transfer Mode (ATM) and ATM Adaptation Layer (AAL) Protocols Generic Requirements, Issue 1, July 1994

alarm-cells

Syntax [**no**] **alarm-cells**

Context config>service>vpls>sap>atm

Description This command configures AIS/RDI fault management on a PVCC. Fault management allows PVCC termination to monitor and report the status of their connection by propagating fault information through the network and by driving PVCC's operational status.

When alarm-cells functionality is enabled, PVCC's operational status is affected when a PVCC goes into AIS or RDI state because of an AIS/RDI processing (i.e. assuming nothing else affects PVCC's operational status, PVCC goes DOWN, when it enters a fault state and comes back UP, when it exits that fault state) and RDI cells are generated when PVCC is operationally DOWN. No OAM-specific SNMP trap is raised whenever an endpoint enters/exits an AIS or RDI state; however, if as result of an OAM state change, the PVCC changes operational status; then a trap is expected from an entity the PVCC is associated with (for example a SAP).

The no command disables alarm-cells functionality for a PVCC. When alarm-cells functionality is disabled, PVCC's operational status is no longer affected by PVCC's OAM state changes due to AIS/RDI processing (Note that when alarm-cells is disabled, a PVCC will change operational status to UP, if it was DOWN because of the alarm-cell processing) and RDI cells are not generated as result of PVCC going into an AIS or RDI state; however, PVCC's OAM status will record OAM faults as described above.

Default Enabled for PVCCs delimiting VPLS SAPs

Service Billing Commands

authentication-policy

Syntax **authentication-policy** *name*
no authentication-policy

Context config>service>vpls>sap
config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command defines which subscriber authentication policy must be applied when a DHCP message is received on the interface. The authentication policies must already be defined. The policy will only be applied when DHCP snooping is enabled on the SAP on Layer 2 interfaces.

Parameters *name* — Specifies a unique authentication policy name.

root-guard

Syntax [**no**] **root-guard**

Context config>service>vpls>sap>stp

Description This command specifies whether this port is allowed to become an STP root port. It corresponds to the restrictedRole parameter in 802.1Q. If set, it can cause lack of spanning tree connectivity.

Default no root-guard

SAP Subscriber Management Commands

Subscriber management commands are also described in the Triple Play Services Command Reference on page 73 section.

sub-sla-mgmt

Syntax [**no**] **sub-sla-mgmt**

Context config>service>vpls>sap
config>service>ies>sub-if>grp-if>sap
config>service>ies>if>sap

Description This command entables the context to configure subscriber management parameters for this SAP.

Default no sub-sla-mgmt

def-sla-profile

Syntax **def-sla-profile** *default-sla-profile-name*
no def-sla-profile

Context config>service>vpls>sap>sub-sla-mgmt
config>service>ies>if>sap>sub-sla-mgmt
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt

Description This command specifies a default SLA profile for this SAP. The SLA profile must be defined prior to associating the profile with a SAP in the **config>subscriber-mgmt>sla-profile** context.

An SLA profile is a named group of QoS parameters used to define per service QoS for all subscriber hosts common to the same subscriber within a provider service offering. A single SLA profile may define the QoS parameters for multiple subscriber hosts. SLA profiles are maintained in two locations, the subscriber identification policy and the subscriber profile templates. After a subscriber host is associated with an SLA profile name, either the subscriber identification policy used to identify the subscriber or the subscriber profile associated with the subscriber host must contain an SLA profile with that name. If both the subscriber identification policy and the subscriber profile contain the SLA profile name, the SLA profile in the subscriber profile is used.

The **no** form of the command removes the default SLA profile from the SAP configuration.

Default no def-sla-profile

Parameters *default-sla-profile-name* — Specifies a default SLA profile for this SAP. The SLA profile must be defined prior to associating the profile with a SAP in the **config>subscriber-mgmt>sla-profile** context.

def-sub-profile

Syntax **def-sub-profile** *default-subscriber-profile-name*

Context config>service>vpls>sap>sub-sla-mgmt
config>service>ies>if>sap>sub-sla-mgmt
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt

Description This command specifies a default subscriber profile for this SAP. The subscriber profile must be defined prior to associating the profile with a SAP in the **config>subscriber-mgmt>sub-profile** context.

A subscriber profile defines the aggregate QoS for all hosts within a subscriber context. This is done through the definition of the egress and ingress scheduler policies that govern the aggregate SLA for subscriber using the subscriber profile. Subscriber profiles also allow for specific SLA profile definitions when the default definitions from the subscriber identification policy must be overridden.

The **no** form of the command removes the default SLA profile from the SAP configuration.

Parameters *default-sub-profile* — Specifies a default subscriber profile for this SAP. The subscriber profile must be defined prior to associating the profile with a SAP in the **config>subscriber-mgmt>sub-profile** context.

sub-ident-policy

Syntax **sub-ident-policy** *sub-ident-policy-name*

Context config>service>vpls>sap>sub-sla-mgmt
config>service>ies>if>sap>sub-sla-mgmt
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt

Description This command associates a subscriber identification policy to this SAP. The subscriber identification policy must be defined prior to associating the profile with a SAP in the **config>subscriber-mgmt>sub-ident-policy** context.

Subscribers are managed by the system through the use of subscriber identification strings. A subscriber identification string uniquely identifies a subscriber. For static hosts, the subscriber identification string is explicitly defined with each static subscriber host.

For dynamic hosts, the subscriber identification string must be derived from the DHCP ACK message sent to the subscriber host. The default value for the string is the content of Option 82 CIRCUIT-ID and REMOTE-ID fields interpreted as an octet string. As an option, the DHCP ACK message may be processed by a subscriber identification policy which has the capability to parse the message into an alternative ASCII or octet string value.

When multiple hosts on the same port are associated with the same subscriber identification string they are considered to be host members of the same subscriber.

The **no** form of the command removes the default subscriber identifcation policy from the SAP configuration.

Default no sub-ident-policy

Parameters *sub-ident-policy-name* — Specifies a subscriber identification policy for this SAP. The subscriber profile must be defined prior to associating the profile with a SAP in the **config>subscriber-mgmt>sub-ident-policy** context.

subscriber *sub-ident-string* — Specifies a subscriber identification profile to be associated with the static subscriber host. The subscriber information is used by the SAP arp-reply-agent to determine the proper handling of received ARP requests from subscribers.

- For VPLS SAPs with **arp-reply-agent** enabled with the optional *sub-ident* parameter, the static subscriber host's sub-ident-string is used to determine whether an ARP request received on the SAP is sourced from a host belonging to the same subscriber as the destination host. When both the destination and source hosts from the ARP request are known on the SAP and the subscriber identifications do not match, the ARP request may be forwarded to the rest of the destinations.

  If the static subscriber host's *sub-ident* string is not defined, the host is not considered to belong to the same subscriber as another host on the SAP.

  If source or destination host is unknown, the hosts are not considered to belong to the same subscriber. (ARP messages from unknown hosts are subject to anti-spoof filtering rules applied at the SAP.)

  If *sub-ident* is not enabled on the SAP arp-reply-agent, subscriber identification matching is not performed on ARP requests received on the SAP.
  ARP requests are never forwarded back to the same SAP or within the receiving SAP's Split Horizon Group.

profiled-traffic-only

Syntax [**no**] **profiled-traffic-only**

Context config>service>vpls>sap>sub-sla-mgmt
config>service>ies>if>sap>sub-sla-mgmt>single-sub
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt

Description This command enables profiled traffic only for this SAP. The profiled traffic refers to single subscriber traffic on a dedicated SAP (in the VLAN-per-subscriber model). When enabled, subscriber queues are instantiated through the QOS policy defined in the sla-profile and the associated SAP queues are deleted. This can increase subscriber scaling by reducing the number of queues instantiated per subscriber (in the VLAN-per-subscriber model). In order for this to be achieved, any configured multi-sub-sap limit must be removed (leaving the default of 1).

The **no** form of the command disables the command.

non-sub-traffic

Syntax **non-sub-traffic sub-profile** *sub-profile-name* **sla-profile** *sla-profile-name* [**subscriber** *sub-ident-string*]
no non-sub-traffic

Context config>service>ies>if>sap>sub-sla-mgmt>single-sub
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt>single-sub

Description This command configures non-subscriber traffic profiles. It is used in conjunction with the profiled-traffic-only on single subscriber SAPs and creates a subscriber host which is used to forward non-IP traffic through the single subscriber SAP without the need for SAP queues.

The **no** form of the command removes removes the profiles and disables the feature.

Parameters **sub-profile** *sub-profile-name* **—** Specifies an existing subscriber profile name to be associated with the static subscriber host. The subscriber profile is configured in the **config>subscr-mgmt>sub-profile** context.

sla-profile *sla-profile-name* **—** Specifies an existing SLA profile name to be associated with the static subscriber host. The SLA profile is configured in the **config>subscr-mgmt>sla-profile** context.

subscriber *sub-ident-string* — Specifies an existing subscriber identification profile to be associated with the static subscriber host. The subscriber identification profile is configured in the **config>subscr-mgmt>sub-ident-policy** context. The subscriber information is used by the VPRN SAP arp-reply-agent to determine the proper handling of received ARP requests from subscribers.

- For SAPs with **arp-reply-agent** enabled with the optional *sub-ident* parameter, the static subscriber host's sub-ident-string is used to determine whether an ARP request received on the SAP is sourced from a host belonging to the same subscriber as the destination host. When both the destination and source hosts from the ARP request are known on the SAP and the subscriber identifications do not match, the ARP request may be forwarded to the rest of the destinations.

  If the static subscriber host's *sub-ident* string is not defined, the host is not considered to belong to the same subscriber as another host on the SAP.

  If source or destination host is unknown, the hosts are not considered to belong to the same subscriber. (ARP messages from unknown hosts are subject to anti-spoof filtering rules applied at the SAP.)

  If *sub-ident* is not enabled on the SAP arp-reply-agent, subscriber identification matching is not performed on ARP requests received on the SAP.

  ARP requests are never forwarded back to the same SAP or within the receiving SAP's Split Horizon Group.

profiled-traffic-only

Syntax [no] **profiled-traffic-only**

Context config>service>ies>if>sap>sub-sla-mgmt>single-sub
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt>single-sub

Description This command enables profiled traffic only for this SAP. The profiled traffic refers to single subscriber traffic on a dedicated SAP (in the VLAN-per-subscriber model). When enabled, subscriber queues are instantiated through the QOS policy defined in the sla-profile and the associated SAP queues are deleted. This can increase subscriber scaling by reducing the number of queues instantiated per subscriber (in the VLAN-per-subscriber model). In order for this to be achieved, any configured multi-sub-sap limit must be removed (leaving the default of 1).

The **no** form of the command disables the command.

Multicast Commands

fast-leave

Syntax [**no**] **fast-leave**

Context config>service>vpls>sap>snooping
config>service>vpls>spoke-sdp>snooping
config>service>vpls>mesh-sdp>snooping
config>service>vpls>sap>mld-snooping
config>service>vpls>spoke-sdp>mld-snooping
config>service>vpls>mesh-sdp>mld-snooping

Description This command enables fast leave.

When IGMP fast leave processing is enabled, the SR-Series will immediately remove a SAP or SDP from the IP multicast group when it detects an IGMP 'leave' on that SAP or SDP. Fast leave processing allows the switch to remove a SAP or SDP that sends a 'leave' from the forwarding table without first sending out group-specific queries to the SAP or SDP, and thus speeds up the process of changing channels ('zapping').

Fast leave should only be enabled when there is a single receiver present on the SAP or SDP.

When fast leave is enabled, the configured last-member-query-interval value is ignored.

Default no fast-leave

from-vpls

Syntax **from-vpls** *vpls-id*
no from-vpls

Context config>service>vpls>sap>snooping>mvr
config>service>vpls>sap>mld-snooping>mvr

Description This command configures the VPLS from which multicast traffic is copied upon receipt of an IGMP join request.

IGMP snooping must be enabled on the MVR VPLS.

Default no from-vpls

Parameters *vpls-id* — Specifies the MVR VPLS from which multicast channels should be copied into this SAP.

group

Syntax [**no**] **group** *grp-address*

Context config>service>vpls>sap>snooping>static
config>service>vpls>spoke-sdp>snooping>static
config>service>vpls>mesh-sdp>snooping>static

Description This command adds a static multicast group either as a (*, g) or as one or more (s,g) records. When a static IGMP group is added, multicast data for that (*,g) or (s,g) is forwarded to the specific SAP or SDP without receiving any membership report from a host.

Default none

Parameters *grp-address* — Specifies an IGMP multicast group address that receives data on an interface. The IP address must be unique for each static group.

group-policy

Syntax **group-policy** *policy-name*
no group-policy

Context config>service>vpls>snooping>mvr
config>service>vpls>mld-snooping>mvr

Description Identifies filter policy of multicast groups to be applied to this MVR VPLS. The sources of the multicast traffic must be a member of the MVR VPLS

The **no** form of the command removes the MVR policy association from the VPLS.

Default no import policy is specified.

Parameters *policy-name* — The routing policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes. Routing policies are configured in the config>router>policy-options context The router policy must be defined before it can be imported. For details on IGMP policies, see Enabling IGMP Group Membership Report Filtering on page 858.

igmp-snooping

Syntax **igmp-snooping**

Context config>service>vpls
config>service>vpls>sap
config>service>vpls>spoke-sdp
config>service>vpls>mesh-sdp

Description This command enables the Internet Group Management Protocol (IGMP) snooping context.

Default none

mld-snooping

Syntax **mld-snooping**

Context config>service>vpls
config>service>vpls>sap

Description This command configures MLD snooping parameters.

import

Syntax **import** *policy-name*
no import

Context config>service>vpls>sap>snooping
config>service>vpls>spoke-sdp>snooping
config>service>vpls>mesh-sdp>snooping
config>service>vpls>sap>mld-snooping
config>service>vpls>spoke-sdp>mld-snooping
config>service>vpls>mesh-sdp>mld-snooping

Description This command specifies the import routing policy to be used for IGMP packets to be used on this SAP or SDP. Only a single policy can be imported on a single SAP at any time.

The **no** form of the command removes the policy association from the SAP or SDP.

Default no import (No import policy is specified)

Parameters *policy-name* — The routing policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes. Routing policies are configured in the config>router>policy-options context The router policy must be defined before it can be imported.

last-member-query-interval

Syntax **last-member-query-interval** *tenths-of-seconds*
no last-member-query-interval

Context config>service>vpls>sap>snooping
config>service>vpls>spoke-sdp>snooping
config>service>vpls>mesh-sdp>snooping
config>service>vpls>sap>mld-snooping
config>service>vpls>spoke-sdp>mld-snooping
config>service>vpls>mesh-sdp>mld-snooping

Description This command configures the maximum response time used in group-specific queries sent in response to 'leave' messages, and is also the amount of time between 2 consecutive group-specific queries. This value may be tuned to modify the leave latency of the network. A reduced value results in reduced time to detect the loss of the last member of a group.

The configured last-member-query-interval is ignored when fast-leave is enabled on the SAP or SDP.

Default 10

Parameters *seconds* — Specifies the frequency, in tenths of seconds, at which query messages are sent.

Values 1 — 50

max-num-groups

Syntax **max-num-groups** *count*
no max-num-groups

Context config>service>vpls>sap>snooping
config>service>vpls>spoke-sdp>snooping
config>service>vpls>mesh-sdp>snooping
config>service>vpls>sap>mld-snooping
config>service>vpls>spoke-sdp>mld-snooping
config>service>vpls>mesh-sdp>mld-snooping

Description This command defines the maximum number of multicast groups that can be joined on this SAP or SDP. If the SR-Series receives an IGMP join message that would exceed the configured number of groups, the request is ignored.

Default no max-num-groups

Parameters *count* — Specifies the maximum number of groups that can be joined on this SAP or SDP.

Values 1 — 1000

mcac

Syntax **mcac**

Context config>service>pw-template>igmp-snooping
config>service>vpls>mesh-sdp>snooping

Description This command configures multicast CAC policy and constraints for this interface.

Default none

policy

Syntax **policy** *policy-name*
no policy

Context config>service>pw-template>igmp-snooping>mcac
config>service>vpls>mesh-sdp>snooping>mcac

Description This command configures the multicast CAC policy name.

Parameters *policy-name* — The multicast CAC policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

unconstrained-bw

Syntax **unconstrained-bw** *bandwidth* **mandatory-bw** *mandatory-bw*
no unconstrained-bw

Context config>service>vpls>mesh-sdp>snooping>mcac
config>service>vpls>spoke-sdp>snooping>mcac
config>service>vpls>sap>igmp-snooping>mcac

Description This command configures the bandwidth for the interface's multicast CAC policy traffic. When disabled (**no unconstrained-bw**) there will be no checking of bandwidth constraints on the interface level. When enabled and a policy is defined, enforcement is performed. The allocated bandwidth for optional channels should not exceed the **unconstrained-bw** minus the **mandatory-bw** and the mandatory channels have to stay below the specified value for the **mandatory-bw**. After this interface check, the bundle checks are performed.

Parameters *bandwidth* — The bandwidth assigned for interface's MCAC policy traffic, in kilo-bits per second (kbps).

Values 0 — 2147483647

mandatory-bw *mandatory-bw* **—** Specifies the bandwidth pre-reserved for all the mandatory channels on a given interface in kilo-bits per second (kbps).

If the *bandwidth* value is 0, no mandatory channels are allowed. If *bandwith* is not configured, then all mandatory and optional channels are allowed.

If the value of *mandatory-bw* is equal to the value of *bandwidth*, then all the unconstrained bandwidth on a given interface is allocated to mandatory channels configured through multicast CAC policy on that interface and no optional groups (channels) are allowed.

The value of *mandatory-bw* should always be less than or equal to that of *bandwidth*, An attempt to set the value of *mandatory-bw* greater than that of *bandwidth*, will result in inconsistent value error.

Values 0 — 2147483647

mrouter-port

Syntax [**no**] **mrouter-port**

Context config>service>vpls>sap>snooping
config>service>vpls>spoke-sdp>snooping
config>service>vpls>mesh-sdp>snooping

Description This command specifies whether a multicast router is attached behind this SAP or SDP.

Configuring a SAP as an mrouter-port will have a double effect. Firstly, all multicast traffic received on another SAP or SDP will be copied to this SAP or SDP. Secondly, IGMP reports generated by the system as a result of someone joining or leaving a multicast group, will be sent to this SAP or SDP.

If two multicast routers exist in the network, one of them will become the active querier. While the other multicast router (non-querier) stops sending IGMP queries, it should still receive reports to keep its multicast trees up to date. To support this, the mrouter-port should be enabled on all SAPs or SDPs connecting to a multicast router.

Note that the IGMP version to be used for the reports (v1, v2 or v3) can only be determined after an initial query has been received. Until such time no reports are sent on the SAP or spoke SDP, even if mrouter-port is enabled.

If the **send-queries** command is enabled on this SAP or spoke SDP, the **mrouter-port** parameter can not be set.

Default no mrouter-port

mvr

Syntax **mvr**

Context config>service>vpls>snooping
config>service>vpls>mld-snooping
config>service>vpls>sap>snooping

Description This command enables the context to configure Multicast VPLS Registration (MVR) parameters.

query-interval

Syntax **query-interval** *seconds*
no query-interval

Context config>service>vpls>snooping
config>service>vpls>sap>snooping
config>service>vpls>spoke-sdp>snooping
config>service>vpls>mesh-sdp>snooping
config>service>vpls>mld-snooping
config>service>vpls>sap>mld-snooping
config>service>vpls>spoke-sdp>mld-snooping
config>service>vpls>mesh-sdp>mld-snooping

Description If the **send-queries** command is enabled, this parameter specifies the interval between two consecutive general queries sent by the system on this SAP or SDP.

The configured query-interval must be greater than the configured query-response-interval.

If send-queries is not enabled on this SAP or SDP, the configured query-interval value is ignored.

Default 125

Parameters *seconds* — The time interval, in seconds, that the router transmits general host-query messages.

Values 2 — 1024

query-src-ip

Syntax **query-src-ip** *ipv6-address*
no query-src-ip

Context config>service>vpls>mld-snooping
config>service>vpls>igmp-snooping

Description This command configures the IP source address used in IGMP or MLD queries.

query-response-interval

Syntax **query-response-interval** *seconds*

Context config>service>vpls>sap>snooping
config>service>vpls>spoke-sdp>snooping
config>service>vpls>mesh-sdp>snooping
config>service>vpls>sap>mld-snooping
config>service>vpls>spoke-sdp>mld-snooping
config>service>vpls>mesh-sdp>mld-snooping

Description If the **send-queries** command is enabled, this parameter specifies the maximum response time advertised in IGMPv2/v3 queries.

The configured query-response-interval must be smaller than the configured query-interval.

If send-queries is not enabled on this SAP or SDP, the configured query-response-interval value is ignored.

Default 10

Parameters *seconds* — Specifies the length of time to wait to receive a response to the host-query message from the host.

Values 1 — 1023

report-src-ip

Syntax **report-src-ip** *ip-address*
no report-src-ip

Context config>service>vpls>igmp-snooping

Description This parameters specifies the source IP address used when generating IGMP reports. According the IGMPv3 standard, a zero source address is allowed in sending IGMP reports. However, for interoperability with some multicast routers, the source IP address of IGMP group reports can be configured using this command.

Default 0.0.0.0

Parameters *ip-address* — The source IP source address in transmitted IGMP reports.

robust-count

Syntax **robust-count** *robust-count*
no robust-count

Context config>service>vpls>snooping
config>service>vpls>sap>snooping
config>service>vpls>spoke-sdp>snooping
config>service>vpls>mesh-sdp>snooping
config>service>vpls>sap>mld-snooping
config>service>vpls>spoke-sdp>mld-snooping
config>service>vpls>mesh-sdp>mld-snooping

Description If the **send-queries** command is enabled, this parameter allows tuning for the expected packet loss on a SAP or SDP. The robust-count variable allows tuning for the expected packet loss on a subnet and is comparable to a retry count. If this SAP or SDP is expected to be 'lossy', this parameter may be increased. IGMP snooping on this SAP or SDP is robust to (robust-count-1) packet losses.

If send-queries is not enabled, this parameter will be ignored.

Default 2

Parameters *robust-count* — Specifies the robust count for the SAP or SDP.

Values 2 — 7

send-queries

Syntax [**no**] **send-queries**

Context config>service>vpls>sap>snooping
config>service>vpls>spoke-sdp>snooping
config>service>vpls>mesh-sdp>snooping
config>service>vpls>sap>mld-snooping
config>service>vpls>spoke-sdp>mld-snooping
config>service>vpls>mesh-sdp>mld-snooping

Description This command specifies whether to send IGMP general query messages on the SAP or SDP.

If mrouter-port is enabled on this SAP or spoke SDP, the **send-queries** command parameter can not be set.

Default no send-queries

source

[no] source *ip-address*

Context config>service>vpls>sap>snooping>static>group
config>service>vpls>spoke-sdp>snooping>static>group
config>service>vpls>mesh-sdp>snooping>static>group

Description This command adds a static (s,g) entry to allow multicast traffic for the corresponding multicast group from that specific source. For the same multicast group, more than one source can be specified.

Static (s,g) entries can not be entered when a starg is already created.

Use the no form of the command to remove the source from the configuration.

Default none

Parameters *ip-address* — Specifies the IPv4 unicast address.

starg

Syntax **[no] starg**

Context config>service>vpls>sap>snooping>static>group
config>service>vpls>spoke-sdp>snooping>static>group
config>service>vpls>mesh-sdp>snooping>static>group

Description This command adds a static (*,g) entry to allow multicast traffic for the corresponding multicast group from any source. This command can only be enabled if no existing source addresses for this group are specified.

Use the **no** form of the command to remove the starg entry from the configuration.

Default no starg

static

Syntax **static**

Context config>service>vpls>sap>snooping
config>service>vpls>spoke-sdp>snooping
config>service>vpls>mesh-sdp>snooping
config>service>vpls>sap>mld-snooping
config>service>vpls>spoke-sdp>mld-snooping
config>service>vpls>mesh-sdp>mld-snooping

Description This command enables access to the context to configure static group addresses. Static group addresses can be configured on a SAP or SDP. When present either as a (*, g) or a (s,g) entry, multicast packets matching the configuration will be forwarded even if no join message was registered for the specific group.

Default none

to-sap

Syntax **to-sap** *sap-id*
no to-sap

Context config>service>vpls>sap>snooping>mvr

Description In some situations, the multicast traffic should not be copied from the MVR VPLS to the SAP on which the IGMP message was received (standard MVR behaviour) but to another SAP.

This command configures the SAP to which the multicast data needs to be copied.

Default no to-sap

Parameters *sap-id* — Specifies the SAP to which multicast channels should be copied. See Common Service Commands on page 2168 for *sap-id* command syntax.

DHCP and Anti-Spoofing Commands

anti-spoof

Syntax **anti-spoof** {**ip** | **mac** | **ip-mac**}
no anti-spoof

Context config>service>vpls>sap
config>service>ies>sap

Description This command enables anti-spoof filtering and optionally changes the anti-spoof matching type for the SAP.

The type of anti-spoof filtering defines what information in the incoming packet is used to generate the criteria to lookup an entry in the anti-spoof filter table. The type parameter (**ip**, **mac**, **ip-mac**) defines the anti-spoof filter type enforced by the SAP when anti-spoof filtering is enabled.

The **no** form of the command disables anti-spoof filtering on the SAP.

Default **no anti-spoof**

Parameters **ip —** Configures SAP anti-spoof filtering to use only the source IP address in its lookup. If a static host exists on the SAP without an IP address specified, the **anti-spoof ip** command will fail.

mac — Configures SAP anti-spoof filtering to use only the source MAC address in its lookup. If a static host exists on the SAP without a specified MAC address, the **anti-spoof mac** command will fail.

ip-mac — Configures SAP anti-spoof filtering to use both the source IP address and the source MAC address in its lookup. If a static host exists on the SAP without both the IP address and MAC address specified, the **anti-spoof ip-mac** command will fail.

arp-host

Syntax **arp-host**

Context config>service>vpls>sap

Description This command enables the context to configure ARP host parameters.

diameter-auth-policy

Syntax **diameter-auth-policy** *name*
no diameter-auth-policy

Context config>service>vpls>sap

Description This command is used to configure the Diameter NASREQ application policy to use for authentication.

Parameters *name* — Specifies the name of the Diameter NASREQ application policy to use for authentication.

host-limit

Syntax **host-limit** *max-num-hosts*
no host-limit

Context config>service>vpls>sap>arp-host

Description This command configures the maximum number of ARP hosts.

The **no** form of the command returns the value to the default.

Default 1

Parameters *max-num-hosts* — specifies the maximum number of ARP hosts allowed on this SAP.

Values 1 — 32767

min-auth-interval

Syntax **min-auth-interval** *min-auth-interval*
no min-auth-interval

Context config>service>vpls>sap>arp-host

Description This command configures the minimum authentication interval.

The **no** form of the command returns the value to the default.

Default 15

Parameters *min-auth-interval* — Specifies the minimum authentical interval, in minutes.

Values 1 — 6000

arp-reply-agent

Syntax **arp-reply-agent** [**sub-ident**]
no arp-reply-agent

Context config>service>vpls>sap

Description This command enables a special ARP response mechanism in the system for ARP requests destined to static or dynamic hosts associated with the SAP. The system responds to each ARP request using the hosts MAC address as the both the source MAC address in the Ethernet header and the target hardware address in the ARP header.

ARP replies and requests received on a SAP with **arp-reply-agent** enabled will be evaluated by the system against the anti-spoof filter entries associated with the ingress SAP (if the SAP has anti-spoof filtering enabled). ARPs from unknown hosts on the SAP will be discarded when anti-spoof filtering is enabled.

The ARP reply agent only responds if the ARP request enters an interface (SAP, spoke-SDP or mesh-SDP) associated with the VPLS instance of the SAP.

A received ARP request that is not in the ARP reply agent table is flooded to all forwarding interfaces of the VPLS capable of broadcast except the ingress interface while honoring split-horizon constraints.

Static hosts can be defined on the SAP using the **host** command. Dynamic hosts are enabled on the system by enabling the **lease-populate** command in the SAP's **dhcp** context. In the event that both a static host and a dynamic host share the same IP and MAC address, the VPLS ARP reply agent will retain the host information until both the static and dynamic information are removed. In the event that both a static and dynamic host share the same IP address, but different MAC addresses, the VPLS ARP reply agent is populated with the static host information.

The **arp-reply-agent** command will fail if an existing static host on the SAP does not have both MAC and IP addresses specified. Once the ARP reply agent is enabled, creating a static host on the SAP without both an IP address and MAC address will fail.

The ARP-reply-agent may only be enabled on SAPs supporting Ethernet encapsulation.

The **no** form of the command disables ARP-reply-agent functions for static and dynamic hosts on the SAP.

Default not enabled

Parameters **sub-ident** — configures the arp-reply-agent to discard ARP requests received on the SAP that are targeted for a known host on the same SAP with the same subscriber identification.

Hosts are identified by their subscriber information. For DHCP subscriber hosts, the subscriber hosts, the subscriber information is configured using the optional subscriber parameter string.

When arp-reply-agent is enabled with **sub-ident**:

- If the subscriber information for the destination host exactly matches the subscriber information for the originating host and the destination host is known on the same SAP as the source, the ARP request is silently discarded.
- If the subscriber information for the destination host or originating host is unknown or undefined, the source and destination hosts are not considered to be the same subscriber. The ARP request is forwarded outside the SAP's Split Horizon Group.
- When **sub-ident** is not configured, the arp-reply-agent does not attempt to identify the subscriber information for the destination or originating host and will not discard an ARP request based on subscriber information.

calling-station-id

Syntax **[no] calling-station-id** {**mac** | **remote-id** | **sap-id** | **sap-string**}

Context config>service>ies>if>sap
config>service>ies>sub-if>grp-if
config>service>vpls>sap
config>service>vprn>interface
config>service>vprn>sub-if>grp-if
config>subscr-mgmt>auth-plcy>include-radius-attribute

Description This command enables the inclusion of the calling-station-id attribute in RADIUS authentication requests and RADIUS accounting messages.

Default no calling-station-id

Parameters **mac —** Specifies that the mac-address will be sent.

remote-id — Specifies that the remote-id will be sent.

sap-id — Specifies that the sap-id will be sent.

sap-string — Specifies that the value is the inserted value set at the SAP level. If no **calling-station-id** value is set at the SAP level, the **calling-station-id** attribute will not be sent.

host

Syntax **host** {[**ip** *ip-address*] [**mac** *mac-address*]} [**subscriber-sap-id** | **subscriber** *sub-ident-string*] [**sub-profile** *sub-profile-name*] [**sla-profile** *sla-profile-name*] [**ancp-string** *ancp-string*] [**inter-dest-id** *intermediate-destination-id*] [**mac-linking** *ip-address*][**rip-policy** *rip-policy-name*]
no host {[**ip** *ip-address*] [**mac** *ieee-address*]}
no host all [**force**]

Context config>service>vpls>sap
config>service>ies>if>sap
config>service>vprn>if>sap

Description This command creates a static subscriber host for the SAP. Static subscriber hosts may be used by the system for various purposes. Applications within the system that make use of static host entries include anti-spoof, ARP reply agent and source MAC population into the VPLS forwarding database.

Multiple static hosts may be defined on the SAP. Each host is identified by either a source IP address, a source MAC address or both a source IP and source MAC address. Every static host definition must have at least one address defined, IP or MAC.

Static hosts can exist on the SAP even with anti-spoof and ARP reply agent features disabled. When enabled, each feature has different requirements for static hosts.

Use the **no** form of the command to remove a static entry from the system. The specified *ip-address* and *mac-address* must match the host's exact IP and MAC addresses as defined when it was created. When a static host is removed from the SAP, the corresponding anti-spoof filter entry and/or FDB entry is also removed.

Default none

Parameters **ip** *ip-address* — Specify this optional parameter when defining a static host. The IP address must be specified for **anti-spoof ip** and **anti-spoof ip-mac**. Only one static host may be configured on the SAP with a given IP address.

mac *mac-address* — Specify this optional parameter when defining a static host. The MAC address must be specified for **anti-spoof mac** and **anti-spoof ip-mac**. Multiple static hosts may be configured with the same MAC address given that each definition is distinguished by a unique IP address.

If the MAC address is not specified for a static host, the system will learn respective MAC address dynamically from ARP packets (arp-request or gratuitous-arp) generated by the host with the specified IP address. On a VPLS service, this can occur if arp-reply-agent function is enabled on a given SAP. On Layer 3 services, such as IES or VPRN) the ARP packets are always examined so no further conditions are applicable.

The learned MAC address will be handled as a MAC address of static host with explicitly defined *mac-address*. Meaning:

- The MAC address will not be aged by the mac-aging or arp-aging timers.
- The MAC address will not be moved to another SAP as a consequence of re-learning event (= event when learning request for the same MAC address comes from another SAP)
- The MAC address will not be flushed from FDB due to SAP failure or STP flush messages.

Every time the given static-host uses different MAC address in its ARP request, the dynamic mac-learning process will be performed. The old MAC address will be overwritten by a new MAC address.

The learned MAC address will not be made persistent (a static host is not a part of the persistency file). A service discontinuity of such a host could be proportional to its arp-cache timeout.

The following interactions are described:

- Antispoof (all services) — In case a static IP-only host is configured on a given SAP, both anti-spoof types, IP and IP MAC are supported. Static hosts for which MAC address is not known will not have any antispoof entry. This will be added only after the corresponding MAC has been learned. As a consequence, all traffic generated by the host before sending any arp packets will be most likely dropped.
- Enhanced subscriber management (all services) — ESM is supported in a combination with a static ip-only host. It is assumed that ip-mac antispoofing is enabled. The resources (queues, etc.) are allocated at the time such a host is configured, although they will be effectively used only after antispoof entry has been installed.
- Dual-homing (all services) — It is assumed that static host is configured on both chassis. The dynamic mac-address learning event will be then synchronized (also, if the members are on two different nodes) and corresponding anti-spoof entries will be installed on both chassis.
- MAC-pinning (for VPLS services only) — The dynamically learned MAC address of the static-host will be considered as a static-mac and is not affected by the **no mac-pinning** command.
- ARP-reply-agent (VPLS services only) — It is possible to the enable arp-reply-agent on a SAP where static host with ip-only configured. Besides the regular arp-reply-agent functionality (reply to all arp-requests targeting the given host's IP address) learning of the host's MAC address will be performed. As long as no MAC address have been learned no ARP replies on behalf of such host should be expected. Enabling of arp-reply-agent is optional for SAP with ip-only static hosts.

Every static host definition must have at least one address defined, IP or MAC.

subscriber-sap-id — Specifies to use the sap-id as the subscriber-id.

subscriber *sub-ident-string* — This optional parameter is used to specify an existing subscriber identification profile to be associated with the static subscriber host. The subscriber identification profile is configured in the **config>subscr-mgmt>sub-ident-policy** context.

sub-profile *sub-profile-name* — This optional parameter is used to specify an existing subscriber profile name to be associated with the static subscriber host. The subscriber profile is configured in the **config>subscr-mgmt>sub-profile** context.

sla-profile *sla-profile-name* — This optional parameter is used to specify an existing SLA profile name to be associated with the static subscriber host. The SLA profile is configured in the **config>subscr-mgmt>sla-profile** context.

ancp-string *ancp-string* — Specifies the ANCP string associated to this SAP host.

inter-dest-id *intermediate-destination-id* — Specifies to which intermediate destination (for example a DSLAM) this host belongs.

mac-linking

Syntax **mac-linking** *ip-address*
no mac-linking

Context config>service>ies>sub-if>grp-if>sap>static-host

Description This command associates this IPv6 host to the specified IPv4 host through the learned MAC address. A learned MAC from the IPv6 host will be associated with the IPv4 host and vice versa.

Default none

rip-policy

Syntax **rip-policy** *rip-policy-name*
no rip-policy

Context config>service>ies>sub-if>grp-if>sap>static-host

Description This command specifies the name of the RIP policy up to 32 characters inlength.

The no form of the command removes the policy name from the static-host configuration.

Default none

igmp-host-tracking

Syntax **igmp-host-tracking**

Context config>service>vprn>sub-if>grp-if>sap

Description This command enables the context to configure IGMP host tracking parameters.

disable-router-alert-check

Syntax [**no**] **disable-router-alert-check**

Context config>service>vprn>sub-if>grp-if>sap>igmp-host-tracking

Description This command enables the IGMP router alert check option.

The **no** form of the command disables the router alert check.

expiry-time

Syntax **expiry-time** *expiry-time*
no expiry-time

Context config>service>vprn>sub-if>grp-if>sap>igmp-snooping

Description This command configures the time that the system continues to track inactive hosts.

The **no** form of the command removes the values from the configuration.

Default no expiry-time

Parameters *expiry-time* — Specifies the time, in seconds, that this system continues to track an inactive host.

Values 1 — 65535

import

Syntax **import** *policy-name*
no import

Context config>service>vprn>sub-if>grp-if>sap>igmp-snooping

Description This command specifies the import routing policy to be used for IGMP packets to be used on this SAP or SDP. Only a single policy can be imported on a single SAP at any time.

The **no** form of the command removes the policy association from the SAP or SDP.

Default no import (No import policy is specified)

Parameters *policy-name* — The routing policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes. Routing policies are configured in the config>router>policy-options context The router policy must be defined before it can be imported.

max-num-group

Syntax **max-num-groups** *max-num-groups*
no max-num-groups

Context config>service>vprn>sub-if>grp-if>sap>igmp-snooping

Description This command configures the maximum number of multicast groups allowed to be tracked.

The **no** form of the command removes the values from the configuration.

Default no max-num-groups

Parameters *max-num-groups* — Specifies the maximum number of multicast groups allowed to be tracked.

Values 1 — 196607

max-num-sources

Syntax **max-num-sources** *max-num-sources*
no max-num-sources

Context config>service>vprn>sub-if>grp-if>sap>igmp-snooping

Description This command configures the maximum number of multicast sources allowedto be tracked per group.

The no form of the command removes the value from the configuration.

Parameters *max-num-sources* — Specifies the maximum number of multicast sources allowedto be tracked per group.

Values 1 — 1000

max-num-grp-sources

Syntax **max-num-grp-sources** [1..32000]
no max-num-grp-sources

Context config>service>vprn>sub-if>grp-if>sap>igmp-snooping

Description This command configures the maximum number of group sources for which IGMP can have local receiver information based on received IGMP reports on this interface. When this configuration is changed dynamically to a value lower than currently accepted number of group sources, the group sources that are already accepted are not deleted. Only new group sources will not be allowed. When this object has a value of 0, there is no limit to the number of group sources.

The **no** form of the command removes the value from the configuration.

Default no max-num-grp-sources

Parameters **1..32000 —** Specifies the maximum number of multicast sources allowed to be tracked per group

Filter and QoS Policy Commands

egress

Syntax **egress**

Context config>service>vpls>sap
config>service>vpls>mesh-sdp
config>service>ies>if>sap

Description This command enables the context to configure egress Quality of Service (QoS) policies and filter policies.

If no QoS policy is defined, the system default QoS policy is used for egress processing. If no egress filter is defined, no filtering is performed.

ingress

Syntax **ingress**

Context config>service>vpls>sap>egress
config>service>vpls>mesh-sdp
config>service>vpls>spoke-sdp
config>service>ies>if>sap

Description This command enables the context to configure ingress Quality of Service (QoS) policies and filter policies.

If no QoS policy is defined, the system default sap-ingress QoS policy is used for ingress processing. If no ingress filter is defined, no filtering is performed.

filter

Syntax **filter ip** *ip-filter-id*
filter ipv6 *ipv6-filter-id*
filter mac *mac-filter-id*
no filter [**ip** *ip-filter-id*] [**mac** *mac-filter-id*] [**ipv6** *ipv6-filter-id*]

Context config>service>vpls>sap>egress
config>service>vpls>sap>ingress
config>service>vpls>mesh-sdp
config>service>vpls>spoke-sdp
config>service>ies>if>spoke-sdp>egress
config>service>ies>if>spoke-sdp>ingress

Description This command associates an IP filter policy or MAC filter policy with an ingress or egress Service Access Point (SAP) or IP interface.

Filter policies control the forwarding and dropping of packets based on IP or MAC matching criteria. There are two types of filter policies: IP and MAC. Only one type may be applied to a SAP at a time.

The **filter** command is used to associate a filter policy with a specified filter ID with an ingress or egress SAP. The filter ID must already be defined before the **filter** command is executed. If the filter policy does not exist, the operation will fail and an error message returned.

In general, filters applied to SAPs (ingress or egress) apply to all packets on the SAP. One exception is non-IP packets are not applied to IP match criteria, so the default action in the filter policy applies to these packets.

The **no** form of this command removes any configured filter ID association with the SAP or IP interface. The filter ID itself is not removed from the system unless the scope of the created filter is set to local. To avoid deletion of the filter ID and only break the association with the service object, use **scope** command within the filter definition to change the scope to **local** or **global**. The default scope of a filter is **local**.

Special Cases **VPLS —** Both MAC and IP filters are supported on a VPLS service SAP.

Parameters **ip** *ip-filter-id* — Specifies IP filter policy. The filter ID must already exist within the created IP filters.

Values 1 — 65535

ipv6 *ipv6-filter-id* — Specifies the IPv6 filter policy. The filter ID must already exist within the created IPv6 filters.

Values 1 — 65535

mac *mac-filter-id* — Specifies the MAC filter policy. The specified filter ID must already exist within the created MAC filters. The filter policy must already exist within the created MAC filters.

Values 1 — 65535

agg-rate

Syntax [**no**] **agg-rate**

Context config>service>vprn>subscriber-interface>group-if>sap>egress
config>service>ies>subscriber-interface>group-if>sap>egress

Description This command is used to control an HQoS aggregate rate limit. It is used in conjunction with the following parameter commands: **rate**, **limit-unused-bandwidth**, **and queue-frame-based-accounting**.

rate

Syntax **rate** {**max** | **rate**}
no rate

Context config>service>vprn>subscriber-interface>group-if>sap>egress>agg-rate

config>service>ies>subscriber-interface>group-if>sap>egress>agg-rate

Description This command defines the enforced aggregate rate for all queues associated with the agg-rate context. A rate must be specified for the agg-rate context to be considered to be active on the context's object (SAP, subscriber, VPORT etc.).

limit-unused-bandwidth

Syntax [**no**] **limit-unused-bandwidth**

Context config>service>vprn>subscriber-interface>group-if>sap>egress>agg-rate
config>service>ies>subscriber-interface>group-if>sap>egress>agg-rate

Description This command is used to enable (or disable) aggregate rate overrun protection on the agg-rate context.

queue-frame-based-accounting

Syntax [**no**] **queue-frame-based-accounting**

Context config>service>vprn>subscriber-interface>group-if>sap>egress>agg-rate

Description This command is used to enabled (or disable) frame based accounting on all queues associated with the agg-rate context. Only supported on Ethernet ports. Not supported on HSMDA Ethernet ports.

filter

Syntax **filter ip** *ip-filter-id*
filter ipv6 *ipv6-filter-id*
no filter [**ip** *ip-filter-id*] [**ipv6** *ipv6-filter-id*]

Context config>service>ies>if>sap>egress
config>service>ies>if>sap>ingress
config>service>ies>sub-if>grp-if>sap>egress
config>service>ies>sub-if>grp-if>sap>ingress
config>service>vprn>sub-if>grp-if>sap>egress
config>service>vprn>sub-if>grp-if>sap>ingress

Description This command associates an IP filter policy with an ingress or egress Service Access Point (SAP). Filter policies control the forwarding and dropping of packets based on the matching criteria. MAC filters are only allowed on Epipe and Virtual Private LAN Service (VPLS) SAPs.

The **filter** command is used to associate a filter policy with a specified filter ID with an ingress or egress SAP. The filter policy must already be defined before the **filter** command is executed. If the filter policy does not exist, the operation will fail and an error message returned.

In general, filters applied to SAPs (ingress or egress) apply to all packets on the SAP. One exception is non-IP packets are not applied to the match criteria, so the default action in the filter policy applies to these packets.

The **no** form of this command removes any configured filter ID association with the SAP. The filter ID itself is not removed from the system unless the scope of the created filter is set to local. To avoid deletion of the filter ID and only break the association with the service object, use **scope** command within the filter definition to change the scope to **local** or **global**. The default scope of a filter is **local**.

Special Cases **IES —** Only IP filters are supported on an IES IP interface, and the filters only apply to routed traffic.

Parameters **ip** *ip-filter-id* **—** Specifies IP filter policy. The filter ID must already exist within the created IP filters.

Values 1 — 65535

ipv6 *ipv6-filter-id* **—** Specifies the IPv6 filter policy. The filter ID must already exist within the created IPv6 filters.

Values 1 — 65535

qinq-mark-top-only

Syntax [**no**] **qinq-mark-top-only**

Context config>service>vprn>if>sap>egress
config>service>vprn>sub-if>grp-if>sap>egress

Description When enabled (the encapsulation type of the access port where this SAP is defined as qinq), the **qinq-mark-top-only** command specifies which P-bits to mark during packet egress. When disabled, both set of P-bits are marked. When the enabled, only the P-bits in the top Q-tag are marked.

Default no qinq-mark-top-only

multicast-group

Syntax **multicast-group** *group-name*
no multicast-group

Context config>service>vpls>sap>egress

Description This command places a VPLS Ethernet SAP into an egress multicast group. The SAP must comply with the egress multicast group's common requirements for member SAPs. If the SAP does not comply, the command will fail and the SAP will not be a member of the group. Common requirements for an egress multicast group are listed below:

- If an egress-filter is specified on the egress multicast group, the SAP must have the same egress filter applied.
- If an egress-filter is not defined on the egress multicast group, the SAP cannot have an egress filter applied.
- If the egress multicast group has an encap-type set to null, the SAP must be defined on a port with the port encapsulation type set to null.

- If the egress multicast group has an encap-type set to dot1q, the SAP must be defined on a port with the port encapsulation type set to dot1q and the port's dot1q-etype must match the dot1q-etype defined on the egress multicast group.
- The access port the SAP is created on cannot currently be an egress mirror source.

Once a SAP is a member of an egress multicast group, the following rules apply:

- The egress filter defined on the SAP cannot be removed or modified. Egress filtering is managed at the egress multicast group for member SAPs.
- If the encapsulation type for the access port the SAP is created on is set to dot1q, the port's dot1q-etype value cannot be changed.
- Attempting to define an access port with a SAP that is currently defined in an egress multicast group as an egress mirror source will fail.

Once a SAP is included in an egress multicast group, it is then eligible for efficient multicast replication if the egress forwarding plane performing replication for the SAP is capable. If the SAP is defined as a Link Aggregation Group (LAG) SAP, it is possible that some links in the LAG are on forwarding planes that support efficient multicast replication while others are not. The fact that some or all the forwarding planes associated with the SAP cannot perform efficient multicast replication does not affect the ability to place the SAP into an egress multicast group.

A SAP may be a member of one and only one egress multicast group. If the multicast-group command is executed with another egress multicast group name, the system will attempt to move the SAP to the specified group. If the SAP is not placed into the new group, the SAP will remain a member of the previous egress multicast group. Moving a SAP into an egress multicast group may cause a momentary gap in replications to the SAP destination while the move is being processed.

The **no** form of the command removes the SAP from any egress multicast group in which it may currently have membership. The SAP will be removed from all efficient multicast replication chains and normal replication will apply to the SAP. A momentary gap in replications to the SAP destination while it is being moved is possible. If the SAP is not currently a member in an egress multicast group, the command has no effect.

Default no multicast-group

Parameters *group-name* — The *group-name* is required when specifying egress multicast group membership on a SAP. An egress multicast group with the specified egress-multicast-group-name must exist and the SAP must pass all common requirements or the command will fail.

Values Any valid egress multicast group name.

Default None, an egress multicast group name must be explicitly specified.

qos

Syntax **qos** *policy-id*
no qos

Context config>service>vpls>sap>egress
config>service>vpls>sap>ingress
config>service>ies>if>sap>egress
config>service>ies>if>sap>ingress
config>service>vprn>if>sap>egress

config>service>vprn>sub-if>grp-if>sap>egress

Description This command associates a Quality of Service (QoS) policy with an ingress or egress Service Access Point (SAP) or IP interface.

QoS ingress and egress policies are important for the enforcement of SLA agreements. The policy ID must be defined prior to associating the policy with a SAP or IP interface. If the *policy-id* does not exist, an error will be returned.

The **qos** command is used to associate both ingress and egress QoS policies. The **qos** command only allows ingress policies to be associated on SAP or IP interface ingress and egress policies on SAP or IP interface egress. Attempts to associate a QoS policy of the wrong type returns an error.

Only one ingress and one egress QoS policy can be associated with a SAP or IP interface at one time. Attempts to associate a second QoS policy of a given type will return an error.

By default, no specific QoS policy is associated with the SAP or IP interface for ingress or egress, so the default QoS policy is used.

The **no** form of this command removes the QoS policy association from the SAP or IP interface, and the QoS policy reverts to the default.

policy-id — The ingress/egress policy ID to associate with SAP or IP interface on ingress/egress. The policy ID must already exist.

Values 1 — 65535

shared-queuing — Specify the ingress shared queue policy used by this SAP. When the value of this object is null, the SAP will use individual ingress QoS queues, instead of the shared ones.

queue-override

Syntax [**no**] **queue-override**

Context config>service>ies>if>sap>egress
config>service>ies>sub-if>grp-if>sap>egress

Description This command enables the context to configure override values for the specified SAP egress QoS queue. These values override the corresponding ones specified in the associated SAP egress QoS policy.

queue

Syntax [**no**] **queue** *queue-id*

Context config>service>ies>if>sap>egress>queue-override
config>service>ies>sub-if>grp-if>sap>egress>queue-override

Description This command specifies the ID of the queue whose parameters are to be overridden.

Parameters *queue-id* — The queue ID whose parameters are to be overridden.

Values 1 — 32

adaptation-rule

Syntax **adaptation-rule** [**pir** {**max** | **min** | **closest**}] [**cir** {**max** | **min** | **closest**}]
no adaptation-rule

Context config>service>ies>if>sap>egress>queue-override>queue
config>service>ies>sub-if>grp-if>sap>egress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's adaptation rule parameters. The adaptation rule controls the method used by the system to derive the operational CIR and PIR settings when the queue is provisioned in hardware. For the CIR and PIR parameters individually, the system attempts to find the best operational rate depending on the defined constraint.

The **no** form of the command removes any explicitly defined constraints used to derive the operational CIR and PIR created by the application of the policy. When a specific **adaptation-rule** is removed, the default constraints for **rate** and **cir** apply.

Default no adaptation-rule

Parameters **pir —** The **pir** parameter defines the constraints enforced when adapting the PIR rate defined within the **queue** *queue-id* **rate** command. The **pir** parameter requires a qualifier that defines the constraint used when deriving the operational PIR for the queue. When the **rate** command is not specified, the default applies.

max — The **max** (maximum) option is mutually exclusive with the **min** and **closest** options. When **max** is defined, the operational PIR for the queue will be equal to or less than the administrative rate specified using the **rate** command.

min — The **min** (minimum) option is mutually exclusive with the **max** and **closest** options. When **min** is defined, the operational PIR for the queue will be equal to or greater than the administrative rate specified using the **rate** command.

closest — The **closest** parameter is mutually exclusive with the **min** and **max** parameter. When **closest** is defined, the operational PIR for the queue will be the rate closest to the rate specified using the **rate** command.

cir — The **cir** parameter defines the constraints enforced when adapting the CIR rate defined within the **queue** *queue-id* **rate** command. The **cir** parameter requires a qualifier that defines the constraint used when deriving the operational CIR for the queue. When the **cir** parameter is not specified, the default constraint applies.

avg-frame-overhead

Syntax **avg-frame-overhead** *percent*
no avg-frame-overhead

Context config>service>ies>if>sap>egress>queue-override
config>service>ies>sub-if>grp-if>sap>egress>queue-override>queue

Description This command configures the average frame overhead to define the average percentage that the offered load to a queue will expand during the frame encapsulation process before sending traffic on-the-wire. While the avg-frame-overhead value may be defined on any queue, it is only used by the system for queues that egress a SONET or SDH port or channel. Queues operating on egress Ethernet ports automatically calculate the frame encapsulation overhead based on a 20 byte per packet rule (8 bytes for preamble and 12 bytes for Inter-Frame Gap).

When calculating the frame encapsulation overhead for port scheduling purposes, the system determines the following values:

- Offered-load — The offered-load of a queue is calculated by starting with the queue depth in octets, adding the received octets at the queue and subtracting queue discard octets. The result is the number of octets the queue has available to transmit. This is the packet based offered-load.
- Frame encapsulation overhead — Using the avg-frame-overhead parameter, the frame encapsulation overhead is simply the queue's current offered-load (how much has been received by the queue) multiplied by the avg-frame-overhead. If a queue had an offered load of 10000 octets and the avg-frame-overhead equals 10%, the frame encapsulation overhead would be 10000 x 0.1 or 1000 octets.

  For egress Ethernet queues, the frame encapsulation overhead is calculated by multiplying the number of offered-packets for the queue by 20 bytes. If a queue was offered 50 packets then the frame encapsulation overhead would be 50 x 20 or 1000 octets.
- Frame based offered-load — The frame based offered-load is calculated by adding the offered-load to the frame encapsulation overhead. If the offered-load is 10000 octets and the encapsulation overhead was 1000 octets, the frame based offered-load would equal 11000 octets.
- Packet to frame factor — The packet to frame factor is calculated by dividing the frame encapsulation overhead by the queue's offered-load (packet based). If the frame encapsulation overhead is 1000 octets and the offered-load is 10000 octets then the packet to frame factor would be 1000 / 10000 or 0.1. When in use, the avg-frame-overhead will be the same as the packet to frame factor making this calculation unnecessary.
- Frame based CIR — The frame based CIR is calculated by multiplying the packet to frame factor with the queue's configured CIR and then adding that result to that CIR. If the queue CIR is set at 500 octets and the packet to frame factor equals 0.1, the frame based CIR would be 500 x 1.1 or 550 octets.
- Frame based within-cir offered-load — The frame based within-cir offered-load is the portion of the frame based offered-load considered to be within the frame-based CIR. The frame based within-cir offered-load is the lesser of the frame based offered-load and the frame based CIR. If the frame based offered-load equaled 11000 octets and the frame based CIR equaled 550 octets, the frame based within-cir offered-load would be limited to 550 octets. If the frame based offered-load equaled 450 octets and the frame based CIR equaled 550 octets, the frame based within-cir offered-load would equal 450 octets (or the entire frame based offered-load).

  As a special case, when a queue or associated intermediate scheduler is configured with a CIR-weight equal to 0, the system automatically sets the queue's frame based within-cir offered-load to 0, preventing it from receiving bandwidth during the port scheduler's within-cir pass.
- Frame based PIR — The frame based PIR is calculated by multiplying the packet to frame factor with the queue's configured PIR and then adding the result to that PIR. If the queue PIR is set to 7500 octets and the packet to frame factor equals 0.1, the frame based PIR would be 7500 x 1.1 or 8250 octets.

- Frame based within-pir offered-load — The frame based within-pir offered-load is the portion of the frame based offered-load considered to be within the frame based PIR. The frame based within-pir offered-load is the lesser of the frame based offered-load and the frame based PIR. If the frame based offered-load equaled 11000 octets and the frame based PIR equaled 8250 octets, the frame based within-pir offered-load would be limited to 8250 octets. If the frame based offered-load equaled 7000 octets and the frame based PIR equaled 8250 octets, the frame based within-pir offered load would equal 7000 octets.

Port scheduler operation using frame transformed rates — The port scheduler uses the frame based rates to figure the maximum rates that each queue may receive during the within-cir and above-cir bandwidth allocation passes. During the within-cir pass, a queue may receive up to its frame based within-cir offered-load. The maximum it may receive during the above-cir pass is the difference between the frame based within-pir offered load and the amount of actual bandwidth allocated during the within-cir pass.

SAP and subscriber SLA-profile average frame overhead override — The average frame overhead parameter on a sap-egress may be overridden at an individual egress queue basis. On each SAP and within the sla-profile policy used by subscribers an avg-frame-overhead command may be defined under the queue-override context for each queue. When overridden, the queue instance will use its local value for the average frame overhead instead of the sap-egress defined overhead.

The **no** form of this command restores the average frame overhead parameter for the queue to the default value of 0 percent. When set to 0, the system uses the packet based queue statistics for calculating port scheduler priority bandwidth allocation. If the no avg-frame-overhead command is executed in a queue-override queue id context, the avg-frame-overhead setting for the queue within the sap-egress QoS policy takes effect.

Default 0

Parameters *percent* — This parameter sets the average amount of packet-to-frame encapsulation overhead expected for the queue. This value is not used by the system for egress Ethernet queues.

Values 0 — 100

cbs

Syntax **cbs** *size-in-kbytes*
no cbs

Context config>service>ies>if>sap>egress>queue-override>queue
config>service>ies>sub-if>grp-if>sap>egress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's CBS parameters.

It is permissible, and possibly desirable, to oversubscribe the total CBS reserved buffers for a given access port egress buffer pool. Oversubscription may be desirable due to the potential large number of service queues and the economy of statistical multiplexing the individual queue's CBS settings into the defined reserved total.

When oversubscribing the reserved total, it is possible for a queue depth to be lower than its CBS setting and still not receive a buffer from the buffer pool for an ingress frame. As more queues are using their CBS buffers and the total in use exceeds the defined reserved total, essentially the buffers are being removed from the shared portion of the pool without the shared in use average and total counts

being decremented. This can affect the operation of the high and low priority RED slopes on the pool, causing them to miscalculate when to start randomly drop packets.

If the CBS value is larger than the MBS value, an error will occur, preventing the CBS change.

The **no** form of this command returns the CBS size to the default value.

Default no cbs

Parameters *size-in-kbytes* — The size parameter is an integer expression of the number of kilobytes reserved for the queue. If a value of 10KBytes is desired, enter the value 10. A value of 0 specifies that no reserved buffers are required by the queue (a minimal reserved size can still be applied for scheduling purposes).

Values 0 — 131072 or default

high-prio-only

Syntax **high-prio-only** *percent*
no high-prio-only

Context config>service>ies>if>sap>egress>queue-override>queue
config>service>ies>sub-if>grp-if>sap>egress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's high-prio-only parameters. The **high-prio-only** command configures the percentage of buffer space for the queue, used exclusively by high priority packets.

The priority of a packet can only be set in the SAP ingress QoS policy and is only applicable on the ingress queues for a SAP. The **high-prio-only** parameter is used to override the default value derived from the **network-queue** command.

The defined **high-prio-only** value cannot be greater than the MBS size of the queue. Attempting to change the MBS to a value smaller than the high priority reserve will generate an error and fail execution. Attempting to set the **high-prio-only** value larger than the current MBS size will also result in an error and fail execution.

The **no** form of this command restores the default high priority reserved size.

Parameters *percent* — The *percent* parameter is the percentage reserved for high priority traffic on the queue. If a value of 10KBytes is desired, enter the value 10. A value of 0 specifies that none of the MBS of the queue will be reserved for high priority traffic. This does not affect RED slope operation for packets attempting to be queued.

Values 0 — 100 | default

mbs

Syntax **mbs** {*size-in-kbytes* | **default**}
no mbs

Context config>service>ies>if>sap>egress>queue-override>queue
config>service>ies>sub-if>grp-if>sap>egress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's MBS parameters. The MBS is a mechanism to override the default maximum size for the queue.

The sum of the MBS for all queues on an egress access port can oversubscribe the total amount of buffering available. When congestion occurs and buffers become scarce, access to buffers is controlled by the RED slope a packet is associated with. A queue that has not exceeded its MBS size is not guaranteed that a buffer will be available when needed or that the packets RED slope will not force the discard of the packet. Setting proper CBS parameters and controlling CBS oversubscription is one major safeguard to queue starvation (when a queue does not receive its fair share of buffers). Another is properly setting the RED slope parameters for the needs of services on this port or channel.

If the CBS value is larger than the MBS value, an error will occur, preventing the MBS change.

The **no** form of this command returns the MBS size assigned to the queue.

Default default

Parameters *size-in-kbytes* — The size parameter is an integer expression of the maximum number of kilobytes of buffering allowed for the queue.For a value of 100 kbps, enter the value 100. A value of 0 causes the queue to discard all packets.

Values 0 — 131072 or default

rate

Syntax **rate** *pir-rate* [**cir** *cir-rate*]
no rate

Context config>service>ies>if>sap>egress>queue-override>queue
config>service>ies>sub-if>grp-if>sap>egress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's Peak Information Rate (PIR) and the Committed Information Rate (CIR) parameters.

The PIR defines the maximum rate that the queue can transmit packets out an egress interface (for SAP egress queues). Defining a PIR does not necessarily guarantee that the queue can transmit at the intended rate. The actual rate sustained by the queue can be limited by oversubscription factors or available egress bandwidth.

The CIR defines the rate at which the system prioritizes the queue over other queues competing for the same bandwidth. In-profile packets are preferentially queued by the system at egress and at subsequent next hop nodes where the packet can traverse. To be properly handled as in- or out-of-profile throughout the network, the packets must be marked accordingly for profiling at each hop.

The CIR can be used by the queue's parent commands *cir-level* and *cir-weight* parameters to define the amount of bandwidth considered to be committed for the child queue during bandwidth allocation by the parent scheduler.

The **rate** command can be executed at any time, altering the PIR and CIR rates for all queues created through the association of the SAP egress QoS policy with the *queue-id*.

The **no** form of the command returns all queues created with the *queue-id* by association with the QoS policy to the default PIR and CIR parameters (**max**, 0).

Default **rate max cir 0 —** The **max** default specifies the amount of bandwidth in kilobits per second (thousand bits per second). The **max** value is mutually exclusive to the **pir-rate** value.

Parameters *pir-rate* — Defines the administrative PIR rate, in kilobits, for the queue. When the **rate** command is executed, a valid PIR setting must be explicitly defined. When the **rate** command has not been executed, the default PIR of **max** is assumed.
Fractional values are not allowed and must be given as a positive integer.

The actual PIR rate is dependent on the queue's **adaptation-rule** parameters and the actual hardware where the queue is provisioned.

Values 1 — 100000000

Default **max**

cir *cir-rate* — The **cir** parameter overrides the default administrative CIR used by the queue. When the **rate** command is executed, a CIR setting is optional. When the **rate** command has not been executed or the **cir** parameter is not explicitly specified, the default CIR (0) is assumed.
Fractional values are not allowed and must be given as a positive integer. The **sum** keyword specifies that the CIR be used as the summed CIR values of the children schedulers or queues.

Values 0 — 100000000, **max**, **sum**

Default 0

scheduler-policy

Syntax **scheduler-policy** *scheduler-policy-name*
no scheduler-policy

Context config>service>vpls>sap>ingress
config>service>vpls>sap>egress
config>service>ies>if>sap>egress
config>service>ies>if>sap>ingress
config>service>vprn>if>sap>egress
config>service>vprn>sub-if>grp-if>sap>egress
config>service>vprn>if>sap>ingress
config>service>vprn>sub-if>grp-if>sap>ingress

Description This command applies an existing scheduler policy to an ingress or egress scheduler used by SAP queues associated with this multi-service customer site. The schedulers defined in the scheduler policy can only be created once the customer site has been appropriately assigned to a chassis port, channel or slot. Scheduler policies are defined in the **config>qos>scheduler-policy** *scheduler-policy-name* context.

The **no** form of this command removes the configured ingress or egress scheduler policy from the multi-service customer site. When the policy is removed, the schedulers created due to the policy are removed also making them unavailable for the ingress SAP queues associated with the customer site. Queues that lose their parent scheduler association are deemed to be orphaned and are no longer subject to a virtual scheduler. The SAPs that have ingress queues reliant on the removed schedulers enter into an operational state depicting the orphaned status of one or more queues. When the **no scheduler-policy** command is executed, the customer site ingress or egress node will not contain an applied scheduler policy.

scheduler-policy-name — The *scheduler-policy-name* parameter applies an existing scheduler policy that was created in the **config>qos>scheduler-policy** *scheduler-policy-name* context to create the hierarchy of ingress or egress virtual schedulers. The scheduler names defined within the

policy are created and made available to any ingress or egress queues created on associated SAPs.

Values Any existing valid scheduler policy name.

block-on-mesh-failure

Syntax [**no**] **block-on-mesh-failure**

Context config>service>vpls>spoke-sdp

Description This command enables blocking (bring the spoke SDP to an opererationally down state) after all configured mesh SDPs are in opererationally down state. This event is signalled to corresponding T-LDP peer by withdrawing service label (status-bit-signaling non-capable peer) or by setting "PW not forwarding" status bit in T-LDP message (status-bit-signaling capable peer).

Default disabled

max-nbr-mac-addr

Syntax **max-nbr-mac-addr** *table-size*
no max-nbr-mac-addr

Context config>service>vpls>sap
config>service>vpls>spoke-sdp

Description This command specifies the maximum number of FDB entries for both learned and static MAC addresses for this SAP or spoke SDP.

When the configured limit has been reached, and discard-unknown-source has been enabled for this SAP or spoke SDP (see the **discard-unknown-source** command), packets with unknown source MAC addresses will be discarded.

The **no** form of the command restores the global MAC learning limitations for the SAP or spoke SDP.

Default no max-nbr-mac-addr

Parameters *table-size* — The maximum number of MAC entries in the FDB from this SAP.

Values 1 — 511999

multi-service-site

Syntax **multi-service-site** *customer-site-name*
no multi-service-site

Context config>service>vpls>sap
config>service>ies>sap
config>service>ies>subscriber-interface>grp-if>sap
config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command associates the SAP with a *customer-site-name*. If the specified *customer-site-name* does not exist in the context of the service customer ID an error occurs and the command will not execute. If *customer-site-name* exists, the current and future defined queues on the SAP (ingress and egress) will attempt to use the scheduler hierarchies created within *customer-site-name* as parent schedulers.

This command is mutually exclusive with the SAP ingress and egress **scheduler-policy** commands. If a **scheduler-policy** has been applied to either the ingress or egress nodes on the SAP, the **multi-service-site** command will fail without executing. The locally applied scheduler policies must be removed prior to executing the **multi-service-site** command.

The **no** form of the command removes the SAP from any multi-service customer site the SAP belongs to. Removing the site can cause existing or future queues to enter an orphaned state.

Default None

customer-site-name — The customer-site-name must exist in the context of the customer-id defined as the service owner. If customer-site-name exists and local scheduler policies have not been applied to the SAP, the current and future queues defined on the SAP will look for their parent schedulers within the scheduler hierarchies defined on customer-site-name.

Values Any valid customer-site-name created within the context of the customer-id.

retail-service-id

Syntax **retail-svc-id** *service-id*
no retail-svc-id

Context config>service>vprn>sub-if>grp-if>sap>static-host

Description This command specifies the service id of the retailer IES/VPRN service to which the static IPv6 host belongs. A corresponding retailer subscriber interface must exist in the specified service.

Default no retai-svc-id

Parameters *service-id* — Specifies the retailer service id.

Values 1— 2148007978 or service name up to 64 characters in length

static-host

Syntax **static-host ip** *ip-prefix*[/*prefix-length*] [**mac** *ieee-address*] [**create**]
no static-host ip *ip-prefix*[/*prefix-length*] **mac** *ieee-address*
no static-host all [**force**]
no static-host ip *ip-prefix*[/*prefix-length*]

Context config>service>ies>if>sap
config>service>vpls>sap
config>service>ies>sub-if>grp-if>sap
config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command configures a static host on this SAP.

Syntax **ip** *ip-prefix[/prefix-length* **—** Specifies the IPv4 address, IPv6 address or the IPv6 prefix.

Values

ip-prefix[/prefix* : ipv4-prefix	a.b.c.d (host bits must be 0)
ipv4-prefix-le	[0..32]
ipv6-prefix	x:x:x:x:x:x:x:x (eight 16-bit pieces) x:x:x:x:x:x:d.d.d.d x - [0..FFFF]H d - [0..255]D
ipv6-prefix-le - [0..128]	

mac *ieee-address* — Specify this optional parameter when defining a static host. Every static host definition must have at least one address defined, IP or MAC.

force — Specifies the forced removal of the static host addresses.

sla-profile *sla-profile-name* **—** This optional parameter is used to specify an existing SLA profile name to be associated with the static subscriber host. The SLA profile is configured in the **config>subscr-mgmt>sla-profile** context.

ancp-string

Syntax **ancp-string** *ancp-string*
no ancp-string

Context config>service>ies>if>sap>static-host
config>service>vpls>sap>static-host
config>service>ies>sub-if>grp-if>sap>static-host
config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command specifies the ANCP string associated to this SAP host.

Parameters *ancp-string* — Specifies the ANCP string up to 63 characters in length.

app-profile

Syntax **app-profile** *app-profile-name*
no app-profile

Context config>service>ies>if>sap>static-host
config>service>vpls>sap>static-host
config>service>ies>sub-if>grp-if>sap>static-host
config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command specifies an application profile name.

Parameters *app-profile-name* — Specifies the application profile name up to 32 characters in length.

inter-dest-id

Syntax **inter-dest-id** *intermediate-destination-id*
no inter-dest-id

Context config>service>ies>if>sap>static-host
config>service>vpls>sap>static-host
config>service>vprn>if>sap>static-host
config>service>vprn>sub-if>grp-if>sap>static-host

Description This command specifies to which intermediate destination (for example a DSLAM) this host belongs.

Parameters *intermediate-destination-id* — Specifies the intermediate destination ID.

managed-routes

Syntax **managed-routes**

Context config>service>vprn>sub-if>grp-if>sap>static-host>managed-routes

Description This command configures managed routes.

route

Syntax **route** {*ip-prefix/length* | *ip-prefix netmask*} [**create**]
no route {*ip-prefix/length* | *ip-prefix netmask*} [**metric** *metric-value*]

Context config>service>vprn>sub-if>grp-if>sap>static-host>managed-routes

Description This command assigns managed-route to a given subscriber-host. As a consequence, a static-route pointing subscriber-host ip address as a next hop will be installed in FIB. Up to 16 managed routes per subscriber-host can be configured.

The **no** form of the command removes the respective route. Per default, there are no managed-routes configured.

Parameters *ipv6-prefix/length* | *ipv6-prefix netmask* — This parameter associates an IPv6 managed route to the IPv6 static host. The IPv6 managed routes can overlap with the static host IPv6 address.

ipv4-prefix/length | *ipv6-prefix netmask* — This parameter associates an IPv4 managed route to the IPv4 static host.

Note: A maximum of 16 managed routes can be associated to a static host. IPv4 hosts can only have IPv4 managed routes and IPv6 hosts can only have IPv6 managed routes.

metric *metric-value* — A metric can be associated with the provisioned managed route.

sla-profile

Syntax **sla-profile** *sla-profile-name*

no sla-profile

Context config>service>ies>if>sap>static-host
config>service>vpls>sap>static-host
config>service>ies>sub-if>grp-if>sap>static-host
config>service>vprn>if>sap>static-host
config>service>vprn>sub-if>grp-if>sap>static-host

Description This command specifies an existing SLA profile name to be associated with the static subscriber host. The SLA profile is configured in the **config>subscr-mgmt>sla-profile** context.

Parameters *sla-profile-name* — Specifies the SLA profile name.

sub-profile

Syntax **sub-profile** *sub-profile-name*
no sub-profile

Context config>service>ies>if>sap>static-host
config>service>vpls>sap>static-host
config>service>ies>sub-if>grp-if>sap>static-host
config>service>vprn>if>sap>static-host
config>service>vprn>sub-if>grp-if>sap>static-host

Description This command specifies an existing subscriber profile name to be associated with the static subscriber host.

Parameters *sub-profile-name* — Specifies the sub-profile name.

subscriber

Syntax **subscriber** *sub-ident*
no subscriber

Context config>service>ies>if>sap>static-host
config>service>vpls>sap>static-host
config>service>ies>sub-if>grp-if>sap>static-host
config>service>vprn>if>sap>static-host
config>service>vprn>sub-if>grp-if>sap>static-host

Description This command specifies an existing subscriber identification profile to be associated with the static subscriber host.

Parameters *sub-ident* — Specifies the subscriber identification.

subscriber-sap-id

Syntax [**no**] **subscriber-sap-id**

Context config>service>ies>if>sap>static-host
config>service>vpls>sap>static-host
config>service>ies>sub-if>grp-if>sap>static-host
config>service>vprn>if>sap>static-host
config>service>vprn>sub-if>grp-if>sap>static-host

Description This command enables using the SAP ID as subscriber id.

Parameters **subscriber-sap-id —** Specifies to use the sap-id as the subscriber-id.

static-host-mgmt

Syntax static-host-mgmt

Context config>service>ies>if>sap
config>service>vpls>sap

Description This command enables the context to configure common parameters for static hosts.

mac-learning-options

Syntax [**no**] **mac-learning-options**

Context config>service>ies>if>sap>static-host-mgmt
config>service>vpls>sap>static-host-mgmt

Description This command enables the context to configure behavior options related to learning of subscriber host MAC addresses.

data-triggered

Syntax [**no**] **data-triggered**

Context config>service>ies>if>sap>static-host-mgmt>mac-learning
config>service>vpls>sap>static-host-mgmt>mac-learning

Description This command enables learning of MAC addresses from data packets.

The **no** form of the command disables learning of MAC addresses from data packets.

Default no data-triggered

single-mac

Syntax [**no**] **single-mac**

Context config>service>ies>if>sap>static-host
config>service>vpls>sap>static-host

Description This command control how the SAP will learn the static host MAC address. Enabling this command indicates that this particular SAP will only have one subscriber and will only have one MAC address for all hosts. With this parameter enabled, the subscriber's NS and RS source MAC address are used to automatically to populate the subscriber MAC address. To allow this auto-populate behavior, the subscriber's NS and RS source IP must be of type link local address.

Default no mac-learning-options

static-mac

Syntax [**no**] **static-mac** *ieee-mac-address*

Context config>service>vpls>sap
config>service>vpls>mesh-sdp
config>service>vpls>spoke-sdp

Description This command creates a remote static MAC entry in the Virtual Private LAN Service (VPLS) forwarding database (FDB) associated with the Service Distribution Point (SDP).

In a VPLS service, MAC addresses are associated with a Service Access Point (SAP) or with a Service Distribution Point (SDP). MACs associated with a SAP are classified as local MACs, and MACs associated with an SDP are remote MACs.

Remote static MAC entries create a permanent MAC address to SDP association in the forwarding database for the VPLS instance so that MAC address will not be learned on the edge device.

Note that static MAC defnitions on one edge device are not propagated to other edge devices participating in the VPLS instance, that is, each edge device has an independent forwarding database for the VPLS.

Only one static MAC entry (local or remote) can be defined per MAC address per VPLS instance.

By default, no static MAC address entries are defined for the SDP.

The **no** form of this command deletes the static MAC entry with the specified MAC address associated with the SDP from the VPLS forwarding database.

ieee-mac-address — Specifies the 48-bit MAC address for the static ARP in the form *aa***:***bb***:***cc***:***dd***:***ee***:***ff* or *aa***-***bb***-***cc***-***dd***-***ee***-***ff* where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

VPLS and IES SDP and SAP Commands

mesh-sdp

mesh-sdp *sdp-id*[:*vc-id*] [**vc-type** {**ether** | **vlan**}]
no mesh-sdp *sdp-id*[:*vc-id*]

Context config>service>vpls
config>service>vpls>mesh-sdp

Description This command binds a VPLS service to an existing Service Distribution Point (SDP).

Mesh SDPs bound to a service are logically treated like a single bridge "port" for flooded traffic where flooded traffic received on any mesh SDP on the service is replicated to other "ports" (spoke SDPs and SAPs) and not transmitted on any mesh SDPs.

Note that this command creates a binding between a service and an SDP. The SDP has an operational state which determines the operational state of the SDP within the service. For example, if the SDP is administratively or operationally down, the SDP for the service will be down.

The SDP must already be defined in the **config>service>sdp** context in order to associate the SDP with an Epipe or VPLS service. If the **sdp** *sdp-id* is not already configured, an error message is generated. If the *sdp-id* does exist, a binding between that *sdp-id* and the service is created.

SDPs must be explicitly associated and bound to a service. If an SDP is not bound to a service, no far-end router devices can participate in the service.

The **no** form of this command removes the SDP binding from the service. The SDP configuration is not affected; only the binding of the SDP to a service. Once removed, no packets are forwarded to the far-end router.

Default No *sdp-id* is bound to a service.

Special Cases **VPLS —** Several SDPs can be bound to a VPLS. Each SDP must be destined to a different router. If two *sdp-id* bindings terminate on the same router, an error occurs and the second SDP binding is rejected.

Parameters *sdp-id* — The SDP identifier.

Values 1 — 17407

vc-id — The virtual circuit identifier. This value is used to validate the VC ID portion of each mesh SDP binding defined in the service. The default value of this object is equal to the service ID.

Values 1 — 4294967295

vc-type — This command overrides the default VC type signaled for the spoke or mesh binding to the far end of the SDP. The VC type is a 15 bit-quantity containing a value which represents the type of VC. The actual signaling of the VC type depends on the signaling parameter defined for the SDP. If signaling is disabled, the **vc-type** command can still be used to define the dot1q value expected by the far-end provider equipment. A change of the binding's VC type causes the binding to signal the new VC type to the far end when signaling is enabled.

VC types are derived according to IETF *draft-martini-l2circuit-trans-mpls*.

- The VC type value for Ethernet is 0x0005.
- The VC type value for an Ethernet VLAN is 0x0004.

ether — Defines the VC type as Ethernet. The **vlan** keyword is mutually exclusive. When the VC type is not defined then the default is Ethernet for spoke SDP bindings. Defining Ethernet is the same as executing **no vc-type** and restores the default VC type for the spoke SDP binding. (hex 5)

vlan — Defines the VC type as VLAN. The **ethernet** keyword is mutually exclusive. When the VC type is not defined then the default is Ethernet for spoke SDP bindings.

spoke-sdp

Syntax **spoke-sdp** *sdp-id*[**:***vc-id*] [**vc-type** {**ether** | **vlan**}] [**split-horizon-group** *group-name*]
no spoke-sdp *sdp-id*[**:***vc-id*]

Context config>service>vpls

Description This command binds a service to an existing Service Distribution Point (SDP).

A spoke SDP is treated like the equivalent of a traditional bridge "port" where flooded traffic received on the spoke SDP is replicated on all other "ports" (other spoke and mesh SDPs or SAPs) and not transmitted on the port it was received.

The SDP has an operational state which determines the operational state of the SDP within the service. For example, if the SDP is administratively or operationally down, the SDP for the service will be down.

The SDP must already be defined in the **config>service>sdp** context in order to associate an SDP with a VPLS service. If the **sdp** *sdp-id* is not already configured, an error message is generated. If the *sdp-id* does exist, a binding between that *sdp-id* and the service is created.

SDPs must be explicitly associated and bound to a service. If an SDP is not bound to a service, no far-end 7750 SR devices can participate in the service.

The **no** form of this command removes the SDP binding from the service. The SDP configuration is not affected; only the binding of the SDP to a service. Once removed, no packets are forwarded to the far-end router.

Default No *sdp-id* is bound to a service.

Special Cases **VPLS —** Several SDPs can be bound to a VPLS service. Each SDP must use unique *vc-ids*. An error message is generated if two SDP bindings with identical *vc-ids* terminate on the same router. Split horizon groups can only be created in the scope of a VPLS service.

Parameters *sdp-id* — The SDP identifier.

Values 1 — 17407

vc-id — The virtual circuit identifier.

Values 1 — 4294967295

vc-type — This command overrides the default VC type signaled for the spoke or mesh binding to the far end of the SDP. The VC type is a 15 bit-quantity containing a value which represents the type of VC. The actual signaling of the VC type depends on the signaling parameter defined for

the SDP. If signaling is disabled, the **vc-type** command can still be used to define the dot1q value expected by the far-end provider equipment. A change of the binding's VC type causes the binding to signal the new VC type to the far end when signaling is enabled.

VC types are derived according to IETF *draft-martini-l2circuit-trans-mpls*.

- The VC type value for Ethernet is 0x0005.
- The VC type value for an Ethernet VLAN is 0x0004.

Values ether, vlan

ether — Defines the VC type as Ethernet. The **ethernet**, **vlan,** and **vpls** keywords are mutually exclusive. When the VC type is not defined then the default is Ethernet for spoke SDP bindings. Defining Ethernet is the same as executing **no vc-type** and restores the default VC type for the spoke SDP binding. (hex 5)

vlan — Defines the VC type as VLAN. The **ethernet**, **vlan,** and **vpls** keywords are mutually exclusive. When the VC type is not defined then the default is Ethernet for spoke SDP bindings. The VLAN VC-type requires at least one dot1Q tag within each encapsulated Ethernet packet transmitted to the far end.

split-horizon-group *group-name* **—** Specifies the name of the split horizon group to which the SDP belongs.

spoke-sdp

Syntax **spoke-sdp** *sdp-id*[**:***vc-id*]
no spoke-sdp *sdp-id*[**:***vc-id*]

Context config>service>ies>interface

Description This command binds a service to an existing Service Distribution Point (SDP).

A spoke SDP is treated like the equivalent of a traditional bridge "port" where flooded traffic received on the spoke SDP is replicated on all other "ports" (other spoke and mesh SDPs or SAPs) and not transmitted on the port it was received.

The SDP has an operational state which determines the operational state of the SDP within the service. For example, if the SDP is administratively or operationally down, the SDP for the service will be down.

The SDP must already be defined in the **config>service>sdp** context in order to associate an SDP with an IES service. If the **sdp** *sdp-id* is not already configured, an error message is generated. If the *sdp-id* does exist, a binding between that *sdp-id* and the service is created.

SDPs must be explicitly associated and bound to a service. If an SDP is not bound to a service, no far-end devices can participate in the service.

The **no** form of this command removes the SDP binding from the service. The SDP configuration is not affected; only the binding of the SDP to a service. Once removed, no packets are forwarded to the far-end router. The spoke SDP must be shut down first before it can be deleted from the configuration.

Default No *sdp-id* is bound to a service.

Special Cases **IES —** At most, only one *sdp-id* can be bound to an IES service.

Parameters *sdp-id* — The SDP identifier. Allowed values are integers in the range of 1 and 17407 for existing SDPs.

vc-id — The virtual circuit identifier.

Values 1 — 4294967295

egress

Syntax **egress**

Context config>service>vpls>mesh-sdp
config>service>vpls>spoke-sdp
config>service>ies>if>spoke-sdp

Description This command configures the egress SDP context.

ingress

Syntax **ingress**

Context config>service>vpls>mesh-sdp
config>service>vpls>spoke-sdp
config>service>ies>if>spoke-sdp

Description This command configures the ingress SDP context.

vc-label

Syntax [**no**] **vc-label** *egress-vc-label*

Context config>service>vpls>mesh-sdp>egress
config>service>vpls>spoke-sdp>egress
config>service>ies>if>spoke-sdp>egress

Description This command configures the egress VC label.

Parameters *vc-label* — A VC egress value that indicates a specific connection.

Values 16 — 1048575

vc-label

Syntax [**no**] **vc-label** *ingress-vc-label*

Context config>service>vpls>mesh-sdp>ingress
config>service>vpls>spoke-sdp>ingress
config>service>ies>if>spoke-sdp>ingress

Description This command configures the ingress VC label.

Parameters *vc-label* — A VC ingress value that indicates a specific connection.

Values 2048 — 18431

vlan-vc-tag

Syntax **vlan-vc-tag** *0..4094*
no vlan-vc-tag [*0..4094*]

Context config>service>vpls>spoke-sdp
config>service>vpls>mesh-sdp

Description This command specifies an explicit dot1q value used when encapsulating to the SDP far end. When signaling is enabled between the near and far end, the configured dot1q tag can be overridden by a received TLV specifying the dot1q value expected by the far end. This signaled value must be stored as the remote signaled dot1q value for the binding. The provisioned local dot1q tag must be stored as the administrative dot1q value for the binding.

When the dot1q tag is not defined, the default value of zero is stored as the administrative dot1q value. Setting the value to zero is equivalent to not specifying the value.

The **no** form of this command disables the command

Default no vlan-vc-tag

Parameters *0..4094* — Specifies a valid VLAN identifier to bind an 802.1Q VLAN tag ID.

avg-frame-overhead

Syntax **avg-frame-overhead** *percent*
no avg-frame-overhead

Context config>service>vpls>sap>egress>queue-override>queue

Description This command configures the average frame overhead to define the average percentage that the offered load to a queue will expand during the frame encapsulation process before sending traffic on-the-wire. While the avg-frame-overhead value may be defined on any queue, it is only used by the system for queues that egress a Sonet or SDH port or channel. Queues operating on egress Ethernet ports automatically calculate the frame encapsulation overhead based on a 20 byte per packet rule (8 bytes for preamble and 12 bytes for Inter-Frame Gap).

When calculating the frame encapsulation overhead for port scheduling purposes, the system determines the following values:

- Offered-load — The offered-load of a queue is calculated by starting with the queue depth in octets, adding the received octets at the queue and subtracting queue discard octets. The result is the number of octets the queue has available to transmit. This is the packet based offered-load.
- Frame encapsulation overhead — Using the avg-frame-overhead parameter, the frame encapsulation overhead is simply the queues current offered-load (how much has been received by the queue) multiplied by the avg-frame-overhead. If a queue had an offered load of 10000 octets and

the avg-frame-overhead equals 10%, the frame encapsulation overhead would be 10000 x 0.1 or 1000 octets.

For egress Ethernet queues, the frame encapsulation overhead is calculated by multiplying the number of offered-packets for the queue by 20 bytes. If a queue was offered 50 packets then the frame encapsulation overhead would be 50 x 20 or 1000 octets.

- Frame based offered-load — The frame based offered-load is calculated by adding the offered-load to the frame encapsulation overhead. If the offered-load is 10000 octets and the encapsulation overhead was 1000 octets, the frame based offered-load would equal 11000 octets.
- Packet to frame factor — The packet to frame factor is calculated by dividing the frame encapsulation overhead by the queues offered-load (packet based). If the frame encapsulation overhead is 1000 octets and the offered-load is 10000 octets then the packet to frame factor would be 1000 / 10000 or 0.1. When in use, the avg-frame-overhead will be the same as the packet to frame factor making this calculation unnecessary.
- Frame based CIR — The frame based CIR is calculated by multiplying the packet to frame factor with the queues configured CIR and then adding that result to that CIR. If the queue CIR is set at 500 octets and the packet to frame factor equals 0.1, the frame based CIR would be 500 x 1.1 or 550 octets.
- Frame based within-cir offered-load — The frame based within-cir offered-load is the portion of the frame based offered-load considered to be within the frame-based CIR. The frame based within-cir offered-load is the lesser of the frame based offered-load and the frame based CIR. If the frame based offered-load equaled 11000 octets and the frame based CIR equaled 550 octets, the frame based within-cir offered-load would be limited to 550 octets. If the frame based offered-load equaled 450 octets and the frame based CIR equaled 550 octets, the frame based within-cir offered-load would equal 450 octets (or the entire frame based offered-load).

  As a special case, when a queue or associated intermediate scheduler is configured with a CIR-weight equal to 0, the system automatically sets the queues frame based within-cir offered-load to 0, preventing it from receiving bandwidth during the port schedulers within-cir pass.
- Frame based PIR — The frame based PIR is calculated by multiplying the packet to frame factor with the queues configured PIR and then adding the result to that PIR. If the queue PIR is set to 7500 octets and the packet to frame factor equals 0.1, the frame based PIR would be 7500 x 1.1 or 8250 octets.
- Frame based within-pir offered-load — The frame based within-pir offered-load is the portion of the frame based offered-load considered to be within the frame based PIR. The frame based within-pir offered-load is the lesser of the frame based offered-load and the frame based PIR. If the frame based offered-load equaled 11000 octets and the frame based PIR equaled 8250 octets, the frame based within-pir offered-load would be limited to 8250 octets. If the frame based offered-load equaled 7000 octets and the frame based PIR equaled 8250 octets, the frame based within-pir offered load would equal 7000 octets.

Port scheduler operation using frame transformed rates — The port scheduler uses the frame based rates to figure the maximum rates that each queue may receive during the within-cir and above-cir bandwidth allocation passes. During the within-cir pass, a queue may receive up to its frame based within-cir offered-load. The maximum it may receive during the above-cir pass is the difference between the frame based within-pir offered load and the amount of actual bandwidth allocated during the within-cir pass.

SAP and subscriber SLA-profile average frame overhead override — The average frame overhead parameter on a sap-egress may be overridden at an individual egress queue basis. On each SAP and

within the sla-profile policy used by subscribers an avg-frame-overhead command may be defined under the queue-override context for each queue. When overridden, the queue instance will use its local value for the average frame overhead instead of the sap-egress defined overhead.

The **no** form of this command restores the average frame overhead parameter for the queue to the default value of 0 percent. When set to 0, the system uses the packet based queue statistics for calculating port scheduler priority bandwidth allocation. If the no avg-frame-overhead command is executed in a queue-override queue id context, the avg-frame-overhead setting for the queue within the sap-egress QoS policy takes effect.

Default 0

Parameters *percent* — This parameter sets the average amount of packet-to-frame encapsulation overhead expected for the queue. This value is not used by the system for egress Ethernet queues.

Values 0 — 100

queue-override

Syntax [**no**] **queue-override**

Context config>service>vpls>sap>egress
config>service>vpls>sap>ingress

Description This command enables the context to configure override values for the specified SAP egress or ingress QoS queue. These values override the corresponding ones specified in the associated SAP egress or ingress QoS policy.

queue

Syntax [**no**] **queue** *queue-id*

Context config>service>vpls>sap>egress>queue-override
config>service>vpls>sap>ingress>queue-override

Description This command specifies the ID of the queue whose parameters are to be overridden.

Parameters *queue-id* — The queue ID whose parameters are to be overridden.

Values 1 — 32

adaptation-rule

Syntax **adaptation-rule** [**pir** {**max** | **min** | **closest**}] [**cir** {**max** | **min** | **closest**}]
no adaptation-rule

Context config>service>vpls>sap>egress>queue-override>queue
config>service>vpls>sap>ingress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's adaptation rule parameters. The adaptation rule controls the method used by the system to derive the operational CIR and PIR settings when the queue is provisioned in hardware. For the CIR and PIR parameters individually, the system attempts to find the best operational rate depending on the defined constraint.

The **no** form of the command removes any explicitly defined constraints used to derive the operational CIR and PIR created by the application of the policy. When a specific **adaptation-rule** is removed, the default constraints for **rate** and **cir** apply.

Default no adaptation-rule

Parameters **pir —** The **pir** parameter defines the constraints enforced when adapting the PIR rate defined within the **queue** *queue-id* **rate** command. The **pir** parameter requires a qualifier that defines the constraint used when deriving the operational PIR for the queue. When the **rate** command is not specified, the default applies.

max — The **max** (maximum) option is mutually exclusive with the **min** and **closest** options. When **max** is defined, the operational PIR for the queue will be equal to or less than the administrative rate specified using the **rate** command.

min — The **min** (minimum) option is mutually exclusive with the **max** and **closest** options. When **min** is defined, the operational PIR for the queue will be equal to or greater than the administrative rate specified using the **rate** command.

closest — The **closest** parameter is mutually exclusive with the **min** and **max** parameter. When **closest** is defined, the operational PIR for the queue will be the rate closest to the rate specified using the **rate** command.

cir — The **cir** parameter defines the constraints enforced when adapting the CIR rate defined within the **queue** *queue-id* **rate** command. The **cir** parameter requires a qualifier that defines the constraint used when deriving the operational CIR for the queue. When the **cir** parameter is not specified, the default constraint applies.

cbs

Syntax **cbs** *size-in-kbytes*
no cbs

Context config>service>vpls>sap>egress>queue-override>queue
config>service>vpls>sap>ingress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's CBS parameters.

It is permissible, and possibly desirable, to oversubscribe the total CBS reserved buffers for a given access port egress buffer pool. Oversubscription may be desirable due to the potential large number of

service queues and the economy of statistical multiplexing the individual queue's CBS settings into the defined reserved total.

When oversubscribing the reserved total, it is possible for a queue depth to be lower than its CBS setting and still not receive a buffer from the buffer pool for an ingress frame. As more queues are using their CBS buffers and the total in use exceeds the defined reserved total, essentially the buffers are being removed from the shared portion of the pool without the shared in use average and total counts being decremented. This can affect the operation of the high and low priority RED slopes on the pool, causing them to miscalculate when to start randomly drop packets.

If the CBS value is larger than the MBS value, an error will occur, preventing the CBS change.

The **no** form of this command returns the CBS size to the default value.

Default no cbs

Parameters *size-in-kbytes* — The size parameter is an integer expression of the number of kilobytes reserved for the queue. If a value of 10KBytes is desired, enter the value 10. A value of 0 specifies that no reserved buffers are required by the queue (a minimal reserved size can still be applied for scheduling purposes).

Values 0 — 131072 or default

high-prio-only

Syntax **high-prio-only** *percent*
no high-prio-only

Context config>service>vpls>sap>egress>queue-override>queue
config>service>vpls>sap>ingress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's high-prio-only parameters. The **high-prio-only** command configures the percentage of buffer space for the queue, used exclusively by high priority packets.

The priority of a packet can only be set in the SAP ingress QoS policy and is only applicable on the ingress queues for a SAP. The **high-prio-only** parameter is used to override the default value derived from the **network-queue** command.

The defined **high-prio-only** value cannot be greater than the MBS size of the queue. Attempting to change the MBS to a value smaller than the high priority reserve will generate an error and fail execution. Attempting to set the **high-prio-only** value larger than the current MBS size will also result in an error and fail execution.

The **no** form of this command restores the default high priority reserved size.

Parameters *percent* — The *percent* parameter is the percentage reserved for high priority traffic on the queue. If a value of 10KBytes is desired, enter the value 10. A value of 0 specifies that none of the MBS of the queue will be reserved for high priority traffic. This does not affect RED slope operation for packets attempting to be queued.

Values 0 — 100 | default

mbs

Syntax **mbs** {*size-in-kbytes* | **default**}
no mbs

Context config>service>vpls>sap>egress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's MBS parameters. The MBS is a mechanism to override the default maximum size for the queue.

The sum of the MBS for all queues on an egress access port can oversubscribe the total amount of buffering available. When congestion occurs and buffers become scarce, access to buffers is controlled by the RED slope a packet is associated with. A queue that has not exceeded its MBS size is not guaranteed that a buffer will be available when needed or that the packets RED slope will not force the discard of the packet. Setting proper CBS parameters and controlling CBS oversubscription is one major safeguard to queue starvation (when a queue does not receive its fair share of buffers). Another is properly setting the RED slope parameters for the needs of services on this port or channel.

If the CBS value is larger than the MBS value, an error will occur, preventing the MBS change.

The **no** form of this command returns the MBS size assigned to the queue.

Default default

Parameters *size-in-kbytes* — The size parameter is an integer expression of the maximum number of kilobytes of buffering allowed for the queue.For a value of 100 kbps, enter the value 100. A value of 0 causes the queue to discard all packets.

Values 0 — 131072 or default

mbs

Syntax **mbs** {*size-in-kbytes* | **default**}
no mbs

Context config>service>vpls>sap>ingress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's MBS parameters. The MBS value is used by a queue to determine whether it has exhausted all of its buffers while enqueuing packets. Once the queue has exceeded the amount of buffers allowed by MBS, all packets are discarded until packets have been drained from the queue.

The sum of the MBS for all queues on an ingress access port can oversubscribe the total amount of buffering available. When congestion occurs and buffers become scarce, access to buffers is controlled by the RED slope a packet is associated with. A queue that has not exceeded its MBS size is not guaranteed that a buffer will be available when needed or that the packets RED slope will not force the discard of the packet. Setting proper CBS parameters and controlling CBS oversubscription is one major safeguard to queue starvation (when a queue does not receive its fair share of buffers). Another is properly setting the RED slope parameters for the needs of services on this port or channel.

If the CBS value is larger than the MBS value, an error will occur, preventing the MBS change.

The defined high-prio-only value cannot be greater than the MBS size of the queue. Attempting to change the MBS to a value smaller than the high priority reserve will generate an error and fail execu-

tion. Attempting to set the high-prio-only value larger than the current MBS size will also result in an error and fail execution.

The **no** form of this command returns the MBS size assigned to the queue to the value.

Default default

Parameters *size-in-kbytes* — The size parameter is an integer expression of the maximum number of kilobytes of buffering allowed for the queue. For a value of 100 kbps, enter the value 100. A value of 0 causes the queue to discard all packets.

Values 0 — 131072 or default

rate

Syntax **rate** *pir-rate* [**cir** *cir-rate*]
no rate

Context config>service>vpls>sap>egress>queue-override>queue
config>service>vpls>sap>ingress>queue-override>queue

Description This command can be used to override specific attributes of the specified queue's Peak Information Rate (PIR) and the Committed Information Rate (CIR) parameters.

The PIR defines the maximum rate that the queue can transmit packets out an egress interface (for SAP egress queues). Defining a PIR does not necessarily guarantee that the queue can transmit at the intended rate. The actual rate sustained by the queue can be limited by oversubscription factors or available egress bandwidth.

The CIR defines the rate at which the system prioritizes the queue over other queues competing for the same bandwidth. In-profile packets are preferentially queued by the system at egress and at subsequent next hop nodes where the packet can traverse. To be properly handled as in- or out-of-profile throughout the network, the packets must be marked accordingly for profiling at each hop.

The CIR can be used by the queue's parent commands *cir-level* and *cir-weight* parameters to define the amount of bandwidth considered to be committed for the child queue during bandwidth allocation by the parent scheduler.

The **rate** command can be executed at anytime, altering the PIR and CIR rates for all queues created through the association of the SAP egress QoS policy with the *queue-id*.

The **no** form of the command returns all queues created with the *queue-id* by association with the QoS policy to the default PIR and CIR parameters (**max**, 0).

Default **rate max cir 0 —** The **max** default specifies the amount of bandwidth in kilobits per second (thousand bits per second). The **max** value is mutually exclusive to the **pir-rate** value.

Parameters *pir-rate* — Defines the administrative PIR rate, in kilobits, for the queue. When the **rate** command is executed, a valid PIR setting must be explicitly defined. When the **rate** command has not been executed, the default PIR of **max** is assumed.
Fractional values are not allowed and must be given as a positive integer.

The actual PIR rate is dependent on the queue's **adaptation-rule** parameters and the actual hardware where the queue is provisioned.

Values 1 — 100000000

Default **max**

cir-rate — The **cir** parameter overrides the default administrative CIR used by the queue. When the **rate** command is executed, a CIR setting is optional. When the **rate** command has not been executed or the **cir** parameter is not explicitly specified, the default CIR (0) is assumed. Fractional values are not allowed and must be given as a positive integer.

Values 0 — 100000000, **max**

Default 0

scheduler-override

Syntax [**no**] **scheduler-override**

Context config>service>vpls>sap>egress
config>service>vpls>sap>ingress

Description This command specifies the set of attributes whose values have been overridden via management on this virtual scheduler. Clearing a given flag will return the corresponding overridden attribute to the value defined on the SAP's ingress scheduler policy.

scheduler

Syntax **scheduler** *scheduler-name*
no scheduler *scheduler-name*

Context config>service>vpls>sap>egress>sched-override

Description This command can be used to override specific attributes of the specified scheduler name.

A scheduler defines a bandwidth control that limits each child (other schedulers and queues) associated with the scheduler. Scheduler objects are created within the hierarchical tiers of the policy. It is assumed that each scheduler created will have queues or other schedulers defined as child associations. The scheduler can be a child (take bandwidth from a scheduler in a higher tier, except for schedulers created in tier 1). A total of 32 schedulers can be created within a single scheduler policy with no restriction on the distribution between the tiers.

Each scheduler must have a unique name within the context of the scheduler policy; however the same name can be reused in multiple scheduler policies. If *scheduler-name* already exists within the policy tier level (regardless of the inclusion of the keyword create), the context changes to that scheduler name for the purpose of editing the scheduler parameters. Modifications made to an existing scheduler are executed on all instantiated schedulers created through association with the policy of the edited scheduler. This can cause queues or schedulers to become orphaned (invalid parent association) and adversely affect the ability of the system to enforce service level agreements (SLAs).

If the *scheduler-name* exists within the policy on a different tier (regardless of the inclusion of the keyword create), an error occurs and the current CLI context will not change.

If the *scheduler-name* does not exist in this or another tier within the scheduler policy, it is assumed that an attempt is being made to create a scheduler of that name. The success of the command execution is dependent on the following:

1. The maximum number of schedulers has not been configured.
2. The provided *scheduler-name* is valid.
3. The **create** keyword is entered with the command if the system is configured to require it (enabled in the **environment create** command).

When the maximum number of schedulers has been exceeded on the policy, a configuration error occurs and the command will not execute, nor will the CLI context change.

If the provided scheduler-name is invalid according to the criteria below, a name syntax error will occur, the command will not execute, and the CLI context will not change.

Parameters *scheduler-name* — The name of the scheduler.

Values Valid names consist of any string up to 32 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

Default **None.** Each scheduler must be explicitly created.

create — This optional keyword explicitly specifies that it is acceptable to create a scheduler with the given *scheduler-name*. If the **create** keyword is omitted, **scheduler-name** is not created when the system environment variable create is set to true. This safeguard is meant to avoid accidental creation of system objects (such as schedulers) while attempting to edit an object with a mistyped name or ID. The keyword has no effect when the object already exists.

rate

Syntax **rate** *pir-rate* [**cir** *cir-rate*]
no rate

Context config>service>vpls>sap>egress>sched-override>scheduler

Description This command can be used to override specific attributes of the specified scheduler rate. The **rate** command defines the maximum bandwidth that the scheduler can offer its child queues or schedulers. The maximum rate is limited to the amount of bandwidth the scheduler can receive from its parent scheduler. If the scheduler has no parent, the maximum rate is assumed to be the amount available to the scheduler. When a parent is associated with the scheduler, the CIR parameter provides the amount of bandwidth to be considered during the parent scheduler's 'within CIR' distribution phase.

The actual operating rate of the scheduler is limited by bandwidth constraints other then its maximum rate. The scheduler's parent scheduler may not have the available bandwidth to meet the scheduler's needs or the bandwidth available to the parent scheduler could be allocated to other child schedulers or child queues on the parent based on higher priority. The children of the scheduler may not need the maximum rate available to the scheduler due to insufficient offered load or limits to their own maximum rates.

When a scheduler is defined without specifying a rate, the default rate is **max**. If the scheduler is a root scheduler (no parent defined), the default maximum rate must be changed to an explicit value. Without this explicit value, the scheduler will assume that an infinite amount of bandwidth is available and allow all child queues and schedulers to operate at their maximum rates.

The **no** form of this command returns all queues created with this *queue-id* by association with the QoS policy to the default PIR and CIR parameters.

Parameters *pir-rate* — The **pir** parameter accepts a step multiplier value that specifies the multiplier used to determine the PIR rate at which the queue will operate. A value of 0 to 100000000 or the keyword **max** is accepted. Any other value will result in an error without modifying the current PIR rate.

To calculate the actual PIR rate, the rate described by the queue's **rate** is multiplied by the *pir-rate*.

The SAP ingress context for PIR is independent of the defined forwarding class (fc) for the queue. The default **pir** and definable range is identical for each class. The PIR in effect for a queue defines the maximum rate at which the queue will be allowed to forward packets in a given second, thus shaping the queue's output.

The PIR parameter for SAP ingress queues do not have a negate (**no**) function. To return the queue's PIR rate to the default value, that value must be specified as the PIR value.

Values 1 — 100000000, **max**

Default **max**

cir cir-rate — The **cir** parameter accepts a step-multiplier value that specifies the multiplier used to determine the CIR rate at which the queue will operate. A value of 0 to 250 or the keyword max is accepted. Any other value will result in an error without modifying the current CIR rate.

To calculate the actual CIR rate, the rate described by the **rate pir** *pir-rate* is multiplied by the cir *cir-rate*. If the **cir** is set to max, then the CIR rate is set to infinity.

The SAP ingress context for CIR is dependent on the defined forwarding class (fc) for the queue. The default CIR and definable range is different for each class. The CIR in effect for a queue defines both its profile (in or out) marking level as well as the relative importance compared to other queues for scheduling purposes during congestion periods.

Values 0 — 10000000, **max**, **sum**

Default **sum**

match-qinq-dot1p

Syntax **match-qinq-dot1p** {**top** | **bottom**}
no match-qinq-dot1p

Context config>service>vpls>sap>ingress
config>service>ies>if>sap>ingress
config>service>vprn>sub-if>grp-if>sap>ingress

Description This command specifies which Dot1Q tag position Dot1P bits in a QinQ encapsulated packet should be used to evaluate Dot1P QoS classification.

The **match-qinq-dot1p** command allows the top or bottom PBits to be used when evaluating the applied sap-ingress QoS policy's Dot1P entries. The **top** and **bottom** keywords specify which position should be evaluated for QinQ encapsulated packets.

The **no** form of the command restores the default dot1p evaluation behavior for the SAP.

By default, the bottom-most service delineating Dot1Q tag's Dot1P bits are used. Table 5 defines the default behavior for Dot1P evaluation when the **match-qinq-dot1p** command is not executed.

Table 5: Default QinQ and TopQ SAP Dot1P Evaluation

Port / SAP Type	Existing Packet Tags	PBits Used for Match
Null	None	None
Null	Dot1P (VLAN-ID 0)	Dot1P PBits
Null	Dot1Q	Dot1Q PBits
Null	TopQ BottomQ	TopQ PBits
Null	TopQ (No BottomQ)	TopQ PBits
Dot1Q	None (Default SAP)	None
Dot1Q	Dot1P (Default SAP VLAN-ID 0)	Dot1P PBits
Dot1Q	Dot1Q	Dot1Q PBits
QinQ / TopQ	TopQ	TopQ PBits
QinQ / TopQ	TopQ BottomQ	TopQ PBits
QinQ / QinQ	TopQ BottomQ	BottomQ PBits

Default no match-qinq-dot1p (no filtering based on p-bits)
(top or bottom must be specified to override the default QinQ dot1p behavior)

Parameters **top —** The top parameter is mutually exclusive to the bottom parameter. When the top parameter is specified, the top most PBits are used (if existing) to match any dot1p dot1p-value entries. Table 6 defines the dot1p evaluation behavior when the top parameter is specified.

Table 6: Top Position QinQ and TopQ SAP Dot1P Evaluation

Port / SAP Type	Existing Packet Tags	PBits Used for Match
Null	None	None
Null	Dot1P (VLAN-ID 0)	Dot1P PBits
Null	Dot1Q	Dot1Q PBits
Null	TopQ BottomQ	TopQ PBits
Null	TopQ (No BottomQ)	TopQ PBits
Dot1Q	None (Default SAP)	None

Table 6: Top Position QinQ and TopQ SAP Dot1P Evaluation (Continued)

Port / SAP Type	Existing Packet Tags	PBits Used for Match
Dot1Q	Dot1P (Default SAP VLAN-ID 0)	Dot1P PBits
Dot1Q	Dot1Q	Dot1Q PBits
QinQ / TopQ	TopQ	TopQ PBits
QinQ / TopQ	TopQ BottomQ	TopQ PBits
QinQ / QinQ	TopQ BottomQ	TopQ PBits

bottom — The bottom parameter is mutually exclusive to the top parameter. When the bottom parameter is specified, the bottom most PBits are used (if existing) to match any dot1p dot1p-value entries. Table 7 defines the dot1p evaluation behavior when the bottom parameter is specified.

Table 7: Bottom Position QinQ and TopQ SAP Dot1P Evaluation

Port / SAP Type	Existing Packet Tags	PBits Used for Match
Null	None	None
Null	Dot1P (VLAN-ID 0)	Dot1P PBits
Null	Dot1Q	Dot1Q PBits
Null	TopQ BottomQ	BottomQ PBits
Null	TopQ (No BottomQ)	TopQ PBits
Dot1Q	None (Default SAP)	None
Dot1Q	Dot1P (Default SAP VLAN-ID 0)	Dot1P PBits
Dot1Q	Dot1Q	Dot1Q PBits
QinQ / TopQ	TopQ	TopQ PBits
QinQ / TopQ	TopQ BottomQ	BottomQ PBits
QinQ / QinQ	TopQ BottomQ	BottomQ PBits

discard-unknown-source

Syntax [no] **discard-unknown-source**

Context config>service>vpls>sap
config>service>vpls>spoke-sdp

Description When this command is enabled, packets received on a SAP or on a spoke SDP with an unknown source MAC address will be dropped only if the maximum number of MAC addresses for that SAP or spoke SDP (see max-nbr-mac-addr on page 146) has been reached. If max-nbr-mac-addr has not been set for the SAP or spoke SDP, enabling discard-unknown-source has no effect.

When disabled, the packets are forwarded based on the destination MAC addresses.

The **no** form of this command causes packets with an unknown source MAC addresses to be forwarded by destination MAC addresses in VPLS.

Default **no discard-unknown**

ima — Specifies Inverse Multiplexing over ATM. An IMA Group is a collection of physical links bundled together and assigned to an ATM Port.

qtag1, qtag2 — Specifies the encapsulation value used to identify the SAP on the port or sub-port. If this parameter is not specificially defined, the default value is 0.

Values

qtag1:	0 — 4094
qtag2 :	*, 0 — 4094

The values depends on the encapsulation type configured for the interface. The following table describes the allowed values for the port and encapsulation types..

Port Type	Encap-Type	Allowed Values	Comments
Ethernet	Null	0	The SAP is identified by the port.
Ethernet	Dot1q	0 - 4094	The SAP is identified by the 802.1Q tag on the port. Note that a 0 qtag1 value also accepts untagged packets on the dot1q port.
Ethernet	QinQ	qtag1: 0 - 4094 qtag2: 0 - 4094	The SAP is identified by two 802.1Q tags on the port. Note that a 0 qtag1 value also accepts untagged packets on the dot1q port.
SONET/SDH	IPCP	-	The SAP is identified by the channel. No BCP is deployed and all traffic is IP.
SONET/SDH TDM	BCP-Null	0	The SAP is identified with a single service on the channel. Tags are assumed to be part of the customer packet and not a service delimiter.
SONET/SDH TDM	BCP-Dot1q	0 - 4094	The SAP is identified by the 802.1Q tag on the channel.
SONET/SDH TDM	Frame Relay	16 — 991	The SAP is identified by the data link connection identifier (DLCI).
SONET/SDH ATM	ATM	vpi (NNI) 0 — 4095 vpi (UNI) 0 — 255 vci 1, 2, 5 — 65535	The SAP is identified by the PVC identifier (vpi/vci).

create — Keyword used to create a SAP instance.

split-horizon-group *group-name* **—** Specifies the name of the split horizon group to which the SAP belongs.

bpdu-translation

Syntax **bpdu-translation** {**auto** | **pvst** | **stp**}
no bpdu-translation

Context config>service>vpls>sap
config>service>vpls>spoke-sdp

Description This command enables the translation of BPDUs to a given format, meaning that all BPDUs transmitted on a given SAP or spoke SDP will have a specified format.

The **no** form of this command reverts to the default setting.

Default no bpdu-translation

Parameters **auto —** Specifies that appropriate format will be detected automatically, based on type of bpdus received on such port.

pvst — Specifies the BPDU-format as PVST. Note that the correct VLAN tag is included in the payload (depending on encapsulation value of outgoing SAP).

stp — Specifies the BPDU-format as STP.

l2pt-termination

Syntax [**no**] **l2pt-termination**

Context config>service>vpls>sap
config>service>vpls>spoke-sdp

Description This commands enables L2PT termination on a given SAP or spoke SDP. L2PT termination will be supported only for STP BPDUs. PDUs of other protocols will be discarded.

This feature can be enabled only if STP is disabled in the context of the given VPLS service.

Default no l2pt-termination

def-mesh-vc-id

Syntax [**no**] **def-mesh-vc-id** *vc-id*

Context config>service>vpls

Description This command configures the value used by each end of a tunnel to identify the VC. If this command is not configured, then the service ID value is used as the VC-ID.

This VC-ID is used instead of a label to identify a virtual circuit.The VC-ID is significant between peer SRs on the same hierarchical level. The value of a VC-ID is conceptually independent from the value of the label or any other datalink specific information of the VC.

The **no** form of this command disables the VC-ID.

Default none

Values 1 — 4294967295

mac-move

Syntax **[no] mac-move**

Context config>service>vpls

Description This command enables the context to configure MAC move attributes. A sustained high re-learn rate can be a sign of a loop somewhere in the VPLS topology. Typically, STP detects loops in the topology, but for those networks that do not run STP, the mac-move feature is an alternative way to protect your network against loops.

When enabled in a VPLS, **mac-move** monitors the re-learn rate of each MAC. If the rate exceeds the configured maximum allowed limit, it disables the SAP where the source MAC was last seen. The SAP can be disabled permanently (until a **shutdown**/**no shutdown** command is executed) or for a length of time that grows linearly with the number of times the given SAP was disabled. You have the option of marking a SAP as non-blockable in the **config>service>vpls>sap>limit-mac-move** or **config>service>vpls>spoke-sdp>limit-mac-move** contexts, see page 104. This means that when the re-learn rate has exceeded the limit, another (blockable) SAP will be disabled instead.

The **mac-move** command enables the feature at the service level for SAPs and spoke SDPs, as only those objects can be blocked by this feature. Mesh SDPs are never blocked, but their re-learn rates (sap-to-mesh/spoke-to-mesh or vice versa) are still measured.

The operation of this feature is the same on the SAP and spoke SDP. For example, if a MAC address moves from SAP to SAP, from SAP to spoke SDP, or between spoke SDPs, one will be blocked to prevent thrashing. If the MAC address moves between a SAP and mesh SDP or spoke SDP and mesh SDP combinations, the respective SAP or spoke SDP will be blocked.

The re-learn rate is computed as the number of times a MAC moves in a 5 second interval. Therefore, the fastest a loop can be detected and broken is 5 seconds.

The **no** form of this command disables MAC move.

Default not enabled

mac-protect

Syntax **mac-protect**

Context config>service>vpls

Description This command indicates whether or not this MAC is protected. When enabled, the agent will protect the MAC from being learned or re-learned on a SAP that has restricted learning enabled.

Default disabled

mac

Syntax [**no**] **mac** *ieee-address*

Context config>service>vpls>mac-protect

Description This command specifies the 48-bit IEEE 802.3 MAC address.

Parameters *ieee-address* — Specifies the 48-bit MAC address in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers.

mac-subnet-length

Syntax **mac-subnet-length** *subnet-length*
no mac-subnet-length

Context config>service>vpls

Description This command specifies the number of bits to be considered when performing MAC learning (MAC source) and MAC switching (MAC destination). Specifically, this value identifies how many bits, starting from the beginning of the MAC address are used. For example, if the mask-value of 28 is used, MAC learning will only do a lookup for the first 28 bits of the source MAC address when comparing with existing FIB entries. Then, it will install the first 28 bits in the FIB while zeroing out the last 20 bits of the MAC address. When performing switching in the reverse direction, only the first 28 bits of the destination MAC address will be used to perform a FIB lookup to determine the next hop.

The **no** form of this command switches back to full MAC lookup.

Parameters *subnet-length* — Specifies the number of bits to be considered when performing MAC learning or MAC switching.

Values 24 — 48

mcr-default-gtw

Syntax **mcr-default-gtw**

Context config>service>vpls

Description This command enables the context to configure the default gateway information when using Dual Homing in L2-TPSDA. The IP and MAC address of the default gateway used for subscribers on an L2 MC-Ring are configured in this context. After a ring heals or fails, the system will send out a gratuitous ARP on an active ring SAP in order to attract traffic from subscribers on the ring with connectivity to that SAP.

ip

Syntax **ip** *address*
no ip

Context config>service>vpls>mcr-default-gtw

Description This command relates to a system configured for Dual Homing in L2-TPSDA. It defines the IP address used when the system sends out a gratuitous ARP on an active SAP after a ring heals or fails in order to attract traffic from subscribers on the ring with connectivity to that SAP.

Default no ip

Parameters *address* — Specifies the IP address in a.b.c.d. format.

mac

Syntax **mac** *ieee-address*
no mac

Context config>service>vpls>mcr-default-gtw

Description This command relates to a system configured for Dual Homing in L2-TPSDA. It defines the MAC address used when the system sends out a gratuitous ARP on an active SAP after a ring heals or fails in order to attract traffic from subscribers on the ring with connectivity to that SAP.

Default no mac

Parameters *ieee-address* — Specifies the address in xx:xx:xx:xx:xx:xx or xx-xx-xx-xx-xx-xx format (cannot be all zeros).

move-frequency

Syntax **move-frequency** *frequency*
no move-frequency

Context config>service>vpls>mac-move

Description This objects indicates the maximum rate at which MAC's can be re-learned in the VPLS service, before the SAP where the moving MAC was last seen is automatically disabled in order to protect the system against undetected loops or duplicate MAC's.

The rate is computed as the maximum number of re-learns allowed in a 5 second interval. For example, the default rate of 10 relearns per second corresponds to 50 relearns in a 5 second period.

The **no** form of the command reverts to the default value.

Default 2 (when mac-move is enabled)

Parameters *frequency* — Specifies the rate, in 5-second intervals for the maximum number of relearns.

Values 1 — 100

retry-timeout

Syntax **retry-timeout** *timeout*
no retry-timeout

Context config>service>vpls>mac-move

Description This objects indicates the time in seconds to wait before a SAP that has been disabled after exceeding the maximum relearn rate is reenabled.

A zero value indicates that the SAP will not be automatically re-enabled after being disabled. If, after the SAP is reenabled it is disabled again, the effective retry timeout is doubled in order to avoid thrashing.

The **no** form of the command reverts to the default value.

Default 10 (when mac-move is enabled)

Parameters *timeout* — Specifies the time, in seconds, to wait before a SAP that has been disabled after exceeding the maximum relearn rate is reenabled.

Values 0 — 120

mfib-table-high-wmark

Syntax [**no**] **mfib-table-high-wmark** *high-water-mark*

Context config>service>vpls

Description This command specifies the multicast FIB high watermark. When the percentage filling level of the multicast FIB exceeds the configured value, a trap is generated and/or a log entry is added.

Parameters *high-water-mark* — Specifies the multicast FIB high watermark as a percentage.

Values 1 — 100

Default 95%

mfib-table-low-wmark

Syntax [**no**] **mfib-table-low-wmark** *low-water-mark*

Context config>service>vpls

Description This command specifies the multicast FIB low watermark. When the percentage filling level of the Multicast FIB drops below the configured value, the corresponding trap is cleared and/or a log entry is added.

Parameters *low-water-mark* — Specifies the multicast FIB low watermark as a percentage.

Values 1 — 100

Default 90%

mfib-table-size

Syntax **mfib-table-size** *size*
no mfib-table-size

Context config>service>vpls

Description This command specifies the maximum number of (s,g) entries in the multicast forwarding database (MFIB) for this VPLS instance.

The *mfib-table-size* parameter specifies the maximum number of multicast database entries for both learned and static multicast addresses for the VPLS instance.

When a table-size limit is set on the mfib of a service which is lower than the current number of dynamic entries present in the mfib then the number of entries remains above the limit.

The **no** form of this command removes the configured maxium MFIB table size.

Default none

Parameters *size* — The maximum number of (s,g) entries allowed in the Multicast FIB.

Values 1 — 16383

send-flush-on-failure

Syntax [**no**] **send-flush-on-failure**

Context config>service>vpls

Description This command enables sending out "flush-all-from-ME" messages to all LDP peers included in affected VPLS, in the event of physical port failures or "oper-down" events of individual SAPs. This feature provides an LDP-based mechanism for recovering a physical link failure in a dual-homed connection to a VPLS service. This method provides an alternative to RSTP solutions where dual homing redundancy and recovery, in the case of link failure, is resolved by RSTP running between a PE router and CE devices.

This feature cannot be enabled on management VPLS.

Default no send-flush-on-failure

restrict-protected-src

Syntax [**no**] **restrict-protected-src**

Context config>service>vpls>split-horizon-group
config>service>vpls>sap

Description This command indicates how the agent will handle relearn requests for protected MAC addresses. When enabled, requests to relearn a protected MAC address will be ignored, and the SAP where the protected source MAC was seen will be brought operationally down.

Default no restrict-protected-src

restrict-unprotected-dst

Syntax [**no**] **restrict-unprotected-dst**

Context config>service>vpls>split-horizon-group
config>service>vpls>sap

Description This command indicates how the system will forward packets destined to an unprotected MAC address. When enabled, packets destined to an unprotected MAC address will be dropped.

Default no restrict-unprotected-dst

DHCP Commands

dhcp

Syntax **dhcp**

Context config>service>vpls>sap
config>service>vpls>spoke-sdp
config>service>vpls>mesh-sdp
config>service>ies>interface
config>service>vprn>interface
config>service>ies>subscriber-interface>group-interface
config>service>ies>subscriber-interface

Description This command enables the context to configure DHCP parameters.

gi-address

Syntax **gi-address** *ip-address* [*src-ip-addr*]
no gi-address

Context config>service>ies>if>dhcp
config>service>vprn>interface>dhcp
config>service>ies>subscriber-interface>grp-if>dhcp
config>service>ies>subscriber-interface>dhcp

Description This command configures the gateway interface address for the DHCP relay. A subscriber interface can include multiple group interfaces with multiple SAPs. The GI address is needed, when the router functions as a DHCP relay, to distinguish between the different subscriber interfaces and potentially between the group interfaces defined.

By default, the GI address used in the relayed DHCP packet is the primary IP address of a normal IES interface. Specifying the GI address allows the user to choose a secondary address. For group interfaces a GI address must be specified under the group interface DHCP context or subscriber-interface DHCP context in order for DHCP to function.

Default no gi-address

Parameters *ip-address* — Specifies the host IP address to be used for DHCP relay packets.

src-ip-address — Specifies that this GI address is to be the source IP address for DHCP relay packets.

lease-populate

Syntax **lease-populate** [*nbr-of-leases*]
lease-populate [*nbr-of-leases*] **l2-header** [**mac** *ieee-address*]
no lease-populate

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp
config>service>vpls>sap>dhcp
config>service>ies>interface>dhcp
config>service>vprn>interface>dhcp
config>service>ies>sub-if>grp-if>dhcp
config>service>vprn>sub-if>grp-if>dhcp
config>service>vprn>sub-if>dhcp

Description This command enables and disables dynamic host DHCPv4 lease state management for SAPs.

For VPLS, DHCP snooping must be explicitly enabled (using the **snoop** command) at all points where DHCP messages requiring snooping enter the VPLS instance (both from the DHCP server and from the subscribers). Lease state information is extracted from snooped DHCP ACK messages to populate lease state table entries for the SAP.

The optional number-of-entries parameter defines the number lease state table entries allowed.

- for this SAP in case of a VPLS service
- for this interface in case of an IES or VPRN interface
- for each SAP in case of an IES or VPRN group-interface
- for this interface in case of an IES or VPRN retail subscriber-interface

If number-of-entries is omitted, only a single entry is allowed. Once the maximum number of entries has been reached, subsequent lease state entries are not allowed and subsequent DHCP ACK messages are discarded.

The retained lease state information representing dynamic hosts may be used to:

- Populate a SAP based anti-spoof filter table to provide dynamic anti-spoof filtering. If the system is unable to populate the dynamic host information in the anti-spoof filter table on the SAP, the DHCP ACK message must be discarded without adding new lease state entry or updating an existing lease state entry.
- Populate the system's ARP cache based on the arp-populate configuration. Applicable to IES and VPRN interfaces or group-interfaces.
- Populate managed entries into a VPLS forwarding database. VPLS forwarding database population is an implicit feature that automatically places the dynamic host's MAC address into the VPLS FDB. When a dynamic host's MAC address is placed in the lease state table, it will automatically be populated into the VPLS forwarding database associated with the SAP on which the host is learned. The dynamic host MAC address will override any static MAC entries using the same MAC and prevent dynamic learning of the MAC on another interface. Existing static MAC entries with the same MAC address as the dynamic host are marked as inactive but not deleted. If all entries in the lease state table associated with the MAC address are removed, the static MAC may be populated. New static MAC definitions for the VPLS instance may be created while a dynamic host exists associated with the static MAC address
- Generate dynamic ARP replies if **arp-reply-agent** is enabled. Applicable to VPLS service SAPs

Default no lease-populate

Parameters *nbr-of-leases* — Specifies the number of DHCPv4 leases allowed.

Values 1 — 32767
1 — 65535 (chassis-mode d, SF/CPM-4 or later)
1 — 262143 (chassis-mode d, SF/CPM-4 or later, retail subscriber interfaces only)

l2-header — Indicates a mode of operation where anti-spoof entry associated with the given DHCP state is created based on the MAC address from the Layer 2 header. The Layer 2 header flag is not set by default. This parameter is only applicable for group-interfaces.

mac — Specifies that the provisioned ieee-address will be used in the anti-spoofing entries for this SAP. The parameter may be changed mid-session. Existing sessions will not be re-programmed unless a tools perform command is issues for the lease. This parameter is only applicable for group-interfaces.

match-circuit-id

Syntax [no] match-circuit-id

Context config>service>ies>sub-if>grp-if>dhcp

Description This command enables Option 82 circuit ID on relayed DHCP packet matching.

For Routed CO, the group interface DHCP relay process is stateful. When packets are relayed to the server the virtual router ID, transaction ID, SAP ID, and client hardware MAC address of the relayed packet are tracked. When get a response back from the server the virtual router ID, transaction ID, and client HW MAC address must be matched to determine the SAP on which to send the packet out. In some cases, the virtual router ID, transaction ID, and client HW MAC address are not guaranteed to be unique.

When the **match-circuit-id** command is enabled this part of the key is used to guarantee correctness in our lookup. This is really only needed when dealing with an IP aware DSLAM that proxies the client HW mac address.

Default no match-circuit-id

option

Syntax [no] option

Context config>service>vpls>sap>dhcp
config>service>ies>if>dhcp
config>service>vprn>if>dhcp
config>service>ies>subscriber-interface>grp-if>dhcp

Description This command enables DHCP Option 82 (Relay Agent Information Option) parameters processing and enters the context for configuring Option 82 sub-options.

The **no** form of this command returns the system to the default.

Default no option

action

Syntax **action** {**replace** | **drop** | **keep**}
no action

Context config>service>vpls>sap>dhcp>option
config>service>ies>interface>dhcp>option
config>service>vprn>interface>dhcp>option
config>service>ies>subscriber-interface>grp-if>dhcp

Description This command configures the Relay Agent Information Option (Option 82) processing.

The **no** form of this command returns the system to the default value.

Default The default is to keep the existing information intact.

Parameters **replace —** In the upstream direction (from the user), the Option 82 field from the router is inserted in the packet (overwriting any existing Option 82 field). In the downstream direction (towards the user) the Option 82 field is stripped (in accordance with RFC 3046).

drop — The DHCP packet is dropped if an Option 82 field is present, and a counter is incremented.

keep — The existing information is kept in the packet and the router does not add any additional information. In the downstream direction the Option 82 field is not stripped and is forwarded towards the client.

circuit-id

Syntax **circuit-id** [**ascii-tuple** | **vlan-ascii-tuple**]
no circuit-id

Context config>service>vpls>sap>dhcp>option

Description When enabled, the router sends an ASCII-encoded tuple in the **circuit-id** sub-option of the DHCP packet. This ASCII-tuple consists of the access-node-identifier, service-id, and SAP-ID, separated by "|".

If disabled, the **circuit-id** sub-option of the DHCP packet will be left empty.

The **no** form of this command returns the system to the default.

Default circuit-id

Parameters **ascii-tuple —** Specifies that the ASCII-encoded concatenated tuple consisting of the access-node-identifier, service-id, and interface-name is used.

vlan-ascii-tuple — Specifies that the format will include VLAN-id and dot1p bits in addition to what is included in ascii-tuple already. The format is supported on dot1q and qinq ports only. Thus, when the option 82 bits are stripped, dot1p bits will be copied to the Ethernet header of an outgoing packet.

circuit-id

Syntax **circuit-id** [**ascii-tuple** | **ifindex** | **sap-id** | **vlan-ascii-tuple**]
no circuit-id

Context config>service>ies>if>dhcp>option
config>service>vprn>if>dhcp>option
config>service>vprn>subscriber-interface>grp-if>dhcp>option

Description When enabled, the router sends an ASCII-encoded tuple in the **circuit-id** sub-option of the DHCP packet. This ASCII-tuple consists of the access-node-identifier, service-id, and SAP-ID, separated by "|".

If disabled, the **circuit-id** sub-option of the DHCP packet will be left empty.

The **no** form of this command returns the system to the default.

Default circuit-id

ascii-tuple — Specifies that the ASCII-encoded concatenated tuple will be used which consists of the access-node-identifier, service-id, and interface-name, separated by "|".

ifindex — Specifies that the interface index will be used. (The If Index of a router interface can be displayed using the command `show>router>interface>detail`)

sap-id — Specifies that the SAP identifier will be used.

vlan-ascii-tuple — Specifies that the format will include VLAN-id and dot1p bits in addition to what is included in ascii-tuple already. The format is supported on dot1q-encapsulated ports only. Thus, when the option 82 bits are stripped, dot1p bits will be copied to the Ethernet header of an outgoing packet.

remote-id

Syntax **remote-id** [**mac** | **string** *string*]
no remote-id

Context config>service>vpls>sap>dhcp>option
config>service>ies>interface>dhcp>option
config>service>vprn>interface>dhcp>option
config>service>ies>subscriber-interface>grp-if>dhcp
config>subscr-mgmt>msap-policy>vpls-only>dhcp>option

Description This command specifies what information goes into the remote-id sub-option in the DHCP Relay packet.

If disabled, the **remote-id** sub-option of the DHCP packet will be left empty.

The **no** form of this command returns the system to the default.

Default remote-id

Parameters **mac —** This keyword specifies the MAC address of the remote end is encoded in the sub-option.

string *string* **—** Specifies the remote-id.

snoop

Syntax [**no**] **snoop**

Context config>service>vpls>sap>dhcp -
config>service>vpls>spoke-sdp>dhcp
config>service>vpls>mesh-sdp>dhcp

Description This command enables DHCP snooping of DHCP messages on the SAP or SDP. Enabling DHCP snooping on interfaces (SAPs and SDP bindings) is required where DHCP messages important to lease state table population are received, or where Option 82 information is to be inserted. This includes interfaces that are in the path to receive messages from either DHCP servers or from subscribers.

Use the **no** form of the command to disable DHCP snooping on the specified VPLS SAP or SDP binding.

Default no snoop

server

Syntax **server** *server1* [*server2*...(up to 8 max)]

Context config>service>ies>if>dhcp
config>service>vprn>if>dhcp
config>service>ies>subscriber-interface>grp-if>dhcp

Description This command specifies a list of servers where requests will be forwarded. The list of servers can be entered as either IP addresses or fully qualified domain names. There must be at least one server specified for DHCP relay to work. If there are multiple servers then the request is forwarded to all of the servers in the list.

There can be a maximum of 8 DHCP servers configured.

Default no server

Parameters *server* — Specify the DHCP server IP address.

trusted

Syntax [**no**] **trusted**

Context config>service>ies>if>dhcp
config>service>vprn>if>dhcp
config>service>ies>subscriber-interface>grp-if>dhcp

Description According to RFC 3046, *DHCP Relay Agent Information Option*, a DHCP request where the giaddr is 0.0.0.0 and which contains a Option 82 field in the packet, should be discarded, unless it arrives on a "trusted" circuit. If trusted mode is enabled on an IP interface, the Relay Agent (the router) will modify the request's giaddr to be equal to the ingress interface and forward the request.

Note that this behavior only applies when the action in the Relay Agent Information Option is "keep". In the case where the option 82 field is being replaced by the Relay Agent (action = "replace"), the original Option 82 information is lost anyway, and there is thus no reason for enabling the trusted option.

The **no** form of this command returns the system to the default.

Default not enabled

Egress Multicast Group Commands

egress-multicast-group

Syntax **egress-multicast-group** *egress-multicast-group-name*
no egress-multicast-group *group-name*

Context config>service

Description This command creates an egress multicast group (EMG) context. An EMG is created as an object used to group VPLS SAPs that are allowed to participate in efficient multicast replication (EMR). EMR is a method to increase the performance of egress multipoint forwarding by sacrificing some destination-based features. Eliminating the requirement to perform unique features for each destination allows the egress forwarding plane to chain together multiple destinations into a batch replication process. In order to perform this batch replication function, similar characteristics are required on each SAP within the EMG.

Only SAPs defined on Ethernet access ports are allowed into an egress-multicast-group.

In order to understand the purpose of an egress-multicast-group, an understanding of the system's use of flooding lists is required. A flooding list is maintained at the egress forwarding plane to define a set of destinations to which a packet must be replicated. Multipoint services make use of flooding lists to enable forwarding a single packet to many destinations. Examples of multipoint services that use flooding lists are VPLS, IGMP snooping and IP multicast routing. Currently, the egress forwarding plane will only use efficient multicast replication for VPLS and IGMP snooping flooding lists.

In VPLS services, a unique flooding list is created for each VPLS context. The flooding list is used when a packet has a broadcast, multicast or unknown destination MAC address. From a system perspective, proper VPLS handling requires that a broadcast, multicast or unknown destined packet be sent to all destinations that are in the forwarding state. The ingress forwarding plane ensures the packet gets to all egress forwarding planes that include a destination in the VPLS context. It is the egress forwarding plane's job to replicate the packet to the subset of the destinations that are reached through its interfaces and each of these destinations are included in the VPLS context's flooding list.

For IGMP snooping, a unique flooding list is created for each IP multicast (s,g) record. This (s,g) record is associated with an ingress VPLS context and may be associated with VPLS destinations in the source VPLS instance or other VPLS instances (in the case of MVR). Again, the ingress forwarding plane ensures that an ingress IP multicast packet matching the (s,g) record gets to all egress forwarding planes that have a VPLS destination associated with the (s,g) record. The egress forwarding plane uses the flooding list owned by the (s,g) record to replicate the packet to all VPLS destinations in the flooding list. The IGMP Snooping function identifies which VPLS destinations should be associated with the (s,g) record.

With normal multicast replication, the egress forwarding plane examines which features are enabled for each destination. This includes ACL filtering, mirroring, encapsulation and queuing. The resources used to perform this per destination multicast processing are very expensive to the egress forwarding plane when high replication bandwidth is required. If destinations with similar egress functions can be grouped together, the egress forwarding plane can process them in a more efficient manner and maximize replication bandwidth.

The egress-multicast-group object is designed to allow the identification of SAPs with similar egress characteristics. When a SAP is successfully provisioned into an egress-multicast-group, the system is

ensured that it may be batched together with other SAPs in the same group at the egress forwarding plane for efficient multicast replication. A SAP that does not meet the common requirements is not allowed into the egress-multicast-group.

At the forwarding plane level, a VPLS flooding list is categorized into chainable and non-chainable destinations. Currently, the only chainable destinations are SAPs within an egress-multicast-group. The chainable destinations are further separated by egress-multicast-group association. Chains are then created following the rules below:

- A replication batch chain may only contain SAPs from the same egress-multicast-group
- A replication batch chain length may not exceed the dest-chain-limit of the egress-multicast-group to which the SAPs are members

Further subcategories are created for an IGMP (s,g) flooding list. A Layer 2 (s,g) record is created in a specific VPLS instance (the instance the (s,g) flow ingresses). SAPs within that VPLS context that join the (s,g) record are considered native SAPs within the flooding list. SAPs that join the (s,g) flooding list through the multicast VPLS registration process (MVR) from another VPLS context using the **from-vpls** command are considered alien SAPs. The distinction between native and alien in the list is maintained to allow the forwarding plane to enforce or suspend split-horizon-group (SHG) squelching. When the source of the (s,g) matching packet is in the same SHG as a native SAP, the packet must not be replicated to that SAP. For a SAP in another VPLS context, the source SHG of the packet has no meaning and the forwarding plane must disregard SHG matching between the native source of the packet and the alien destination. Because the SHG squelch decision is done for the whole chain based on the first SAP in the chain, all SAPs in the chain must be all native or all alien SAPs. Chains for IGMP (s,g) flooding lists are created using the following rules:

1. A replication batch chain may only contain SAPs from the same egress-multicast-group.
2. A replication batch chain may only contain all alien or all native SAPs.
3. A replication batch chain length may not exceed the dest-chain-limit of the egress-multicast-group to which the SAPs are members

When a packet associated with a flooding list is received by the egress forwarding plane, it processes the packet by evaluating each destination on the list sequentially in a replication context. If the current entry being processed in the list is a non-chained destination, the forwarding plane processes the packet for that destination and then moves on to process other packets currently in the forwarding plane before returning to process the next destination in the list. If the current entry being processed is a chained destination, the forwarding plane remains in the replication context until it has forwarded to each entry in that chain. Once the replication context finishes with the last entry in the chain, it moves on to process other packets waiting for egress processing before returning to the replication context. Processing continues in this manner until the packet has been forwarded to all destinations in the list.

Batch chain processing of a chain of SAPs improves replication efficiency by bypassing the functions that perform egress mirroring decisions on SAPs within the chain and making a single ACL filtering decision for the whole chain. Each destination in the chain may have a unique egress QoS policy and per destination queuing is still performed for each destination in the chain. Also, while each SAP in the chain must be on access ports with the same encap-type, if the encap-type is dot1q, each SAP may have a unique dot1q tag.

One caveat to each SAP having a unique egress QoS policy in the chain is that only the Dot1P marking decisions for the first SAP in the list is enforced. If the first SAP's QoS policy forwarding class action states that the packet should not be remarked, none of the replicated packets in the chain will have the dot1P bits remarked. If the first SAP's QoS policy forwarding class action states that the packet should be remarked with a specific dot1P value, all the replicated packets for the remaining SAPs in the chain will have the same dot1P marking.

While the system supports 32 egress multicast groups, a single group would usually suffice. An instance where multiple groups would be needed is when all the SAPs requiring efficient multicast replication cannot share the same common requirements. In this case, an egress multicast group would be created for each set of common requirements. An egress multicast group may contain SAPs from many different VPLS instances. It should be understood that an egress multicast group is not equivalent to an egress forwarding plane flooding list. An egress multicast group only identifies which SAPs may participate in efficient multicast replication. As stated above, entries in a flooding list are populated due to VPLS destination creation or IGMP snooping events.

The **no** form of the command removes a specific egress multicast group. Deleting an egress multicast group will only succeed when the group has no SAP members. To remove SAP members, use the **no multicast-group** *group-name* command under each SAP's egress context.

Note: Efficient multicast replication will only be performed on IOMs that support chassis mode b If an IOM does not support mode b operation, egress-multicast-group membership is ignored on that IOM's egress forwarding planes. The chassis need not be placed into mode b for efficient multicast replication to be performed on the capable IOMs.

Parameters *group-name* — Multiple egress multicast groups may be created on the system. Each must have a unique name. The egress-multicast-group-name is an ASCII string up to 16 characters in length and follows all the naming rules as other named policies in the system. The group's name is used throughout the system to uniquely identify the Egress Multicast Group and is used to provision a SAP into the group.

Default None, each egress multicast group must be explicitly configured.

Values Up to 32 egress multicast groups may be created on the system.

description

Syntax **description** *description-string*
no description

Context config>service>egress-multicast-group

Description This command defines an ASCII string associated with egress-multicast-group-name.

The **no** form of the command removes an existing description string from egress-multicast-group.

Default none

Parameters *description-string* — The description command accepts a description-string parameter. The description-string parameter is an ASCII string of up to 80 characters in length. Only printable 127 bit ASCII characters are allowed. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

Values An ASCII string up to 80 characters in length.

dest-chain-limit

Syntax **dest-chain-limit** *destinations per pass*
no dest-chain-limit

Context config>service>egress-multicast-group

Description This command defines the maximum length of an egress forwarding plane efficient multicast replication chain for an egress-multicast-group. Varying the maximum length of chains created for an egress multicast group has the effect of efficient multicast batched chain replication on other packets flowing through the egress forwarding plane. While replicating for the SAPs within a replication chain, other packets are waiting for the forwarding plane to finish. As the chain length increases, forwarding latency for the other waiting packets may increase. When the chain length decreases, a loss of efficiency in the replication process will be observed.

The **no** form of the command restores the default value of 10 to the dest-chain-limit parameter for the egress-multicast-group.

Default no dest-chain-limit

Parameters *destinations per pass* — This parameter must be specified when executing the **dest-chain-limit** command. When executed, the command will use the number-of-destinations parameter to reorganize all efficient multicast SAP chains that contain members from the egress-multicast-group.

The *destinations per pass* parameter can be modified at any time. Be aware that when changing the maximum chain length, the system will rebuild the chains according to the new limit. When this happens, it is possible that packets will not be replicated to a destination while it is being reorganized in the flooding lists' chains. Only the chains associated with the egress-multicast-group context the command is executed in will be affected by changing the parameter.

It is expected that the optimal replication chain length will be between 10 and 16. Since so many variables affect efficient multicast (i.e. ingress packet rate, number of chains, size of replicated packets), only proper testing in the environment that replication will be performed will identify the best dest-chain-limit value for each Egress Multicast Group.

Setting the *destinations per pass* parameter to a value of 0 has the effect of removing from all egress forwarding planes all chains with members from the egress-multicast-group. Replication to each destination SAP from the group is performed using the normal method (non-efficient replication). The value 0 is not considered a normal value for dest-chain-limit and is provided for debugging purposes only. Setting the value to 0 is persistent between reboots of the system.

Setting the *destinations per pass* parameter to a value of 1 has the effect of placing each egress-multicast-group member SAP into a chain with a single SAP. The value 1 is not considered a normal value for the **dest-chain-limit** and is provided for debugging purposes only. Setting the value to 1 is persistent between reboots of the system.

Values 0 — 255

Default 10

sap-common-requirements

Syntax **sap-common-requirements**

Context config>service>egress-multicast-group

Description This command configures the common SAP parameter requirements. The SAP common requirements are used to evaluate each SAP for group membership. If a SAP does not meet the specified requirements, the SAP is not allowed into the egress-multicast-group. Once a SAP is a member of the group, attempting to change the parameters on the SAP will fail.

egress-filter

Syntax **egress-filter** [**ip** *ip-filter-id*]
egress-filter [**ipv6** *ipv6-filter-id*]
egress-filter [**mac** *mac-filter-id*]
no egress-filter [**ip** *ip-filter-id*] [**ipv6** *ipv6-filter-id*][**mac** *mac-filter-id*]

Context config>service>egress-multicast-group>sap-common-requirements

Description This command identifies the type of filter and actual filter ID that must be provisioned on the SAP prior to the SAP being made a member of the egress-multicast-group. If the SAP does not have the specified filter applied, the SAP cannot be provisioned into the group. It is important that the egress filter applied to each SAP within the egress-multicast-group be the same since the batch replication process on an efficient multicast replication chain will apply the first SAP's ACL decision to all other SAPs on the chain.

Once the SAP is made a member of the egress-multicast-group, the SAP's egress filter cannot be changed on the SAP.

Changing the **egress-filter** parameters within the **sap-common-requirements** node automatically changes the egress filter applied to each member SAP. If the filter cannot be changed on the SAP due to resource constraints, the modification will fail.

The specified egress-filter does not contain an entry that is defined as an egress mirror-source. Once the filter is associated with the egress-multicast-group, attempting to define one of its entries as an egress mirror source will fail.

The **no** form of the command removes the egress-filter from each member SAP. The **no egress-filter** command specifies that an egress filter (IP or MAC)(IP, IPv6 or MAC) is not applied to a new member SAP within the egress-multicast-group.

Default **no filter**. The egress filter ID must be defined with the associated **ip** or **mac** keyword. If an egress-filter is not specified or the no egress-filter command is executed in the sap-common-requirements node, a new member SAP does not have an egress IP or MAC filter defined.

Parameters **ip** *ip-filter-id* **—** Specifies IP filter policy. The filter ID must already exist within the created IP filters.

Values 1 — 65535

ipv6 *ipv6-filter-id* **—** Specifies the IPv6 filter policy. The filter ID must already exist within the created IPv6 filters.

Values 1 — 65535

mac *mac-filter-id* **—** Specifies the MAC filter policy. The specified filter ID must already exist within the created MAC filters. The filter policy must already exist within the created MAC filters.

Values 1 — 65535

encap-type

Syntax **encap-type** {**dot1q** | **null**}
no encap-type

Context config>service>egress-multicast-group>sap-common-requirements

Description This command specifies the encapsulation type that must exist on the SAP's access port to allow the SAP membership within the egress-multicast-group. The **config>port>ethernet>access>encap-type** command is used to define the encapsulation type for the Ethernet port. The allowed encapsulation type values are dot1q and null. If the SAP does not exist on a port with the specified encap-type, it will not be allowed into the egress-multicast-group.

If at least one SAP is currently a member of the efficient-multicast-group, the **encap-type** cannot be changed within the sap-common-requirements node. If the efficient-multicast-group does not contain any member SAPs, the **encap-type** may be changed at anytime.

There is no interaction between an efficient-multicast-group and the corresponding access ports associated with its members since all SAPs must be deleted from a port before its encap-type can be changed. When the SAPs are deleted from the port, they are also automatically deleted from the efficient-multicast-group.

The **no** form of the command returns the egress-multicast-group required encapsulation type for SAPs to dot1q. If the current encap-type is set to null, the command cannot be executed when SAPs exist within the egress-multicast-group.

Default **dot1q** — For an egress-multicast-group.
null — If member SAPs are on a null encapsulated access port.

Parameters **null —** The **null** keyword is mutually exclusive with the **dot1q** keyword. When the encap-type within the sap-common-requirements is specified to be null, the encapsulation type for the access ports associated with all SAPs within the egress-multicast-group must be set to null.

dot1q — The **dot1q** keyword is mutually exclusive with the **null** keyword. When the encap-type within the sap-common-requirements is specified to be dot1q, the encapsulation type for the access ports associated with all SAPs within the egress-multicast-group must be set to dot1q.

dot1q-etype

Syntax **dot1q-etype** [0x0600..0xffff]
no dot1q-etype

Context config>service>egress-multicast-group>sap-common-requirements

Description This command specifies the dot1q EtherType that must exist on the SAP's access port to allow the SAP membership within the egress-multicast-group. The **config>port>ethernet>access**>**dot1q-**

etype command is used to define the EtherType used when encapsulating a packet with a dot1q tag on the Ethernet port. Any valid EtherType is allowed on the port.

If the current encap-type for the egress-multicast-group is set to null, the dot1q-etype EtherType is ignored when evaluating SAP membership in the group. If the encap-type is set to dot1q (the default), a member SAP's access port must be configured with the same dot1q-etype EtherType as the egress-multicast-group.

If at least one SAP is currently a member of the efficient-multicast-group, the dot1q-etype value cannot be changed within the sap-common-requirements node. If the efficient-multicast-group does not contain any member SAPs, the dot1q-etype value may be changed at anytime.

If an access port currently has SAPs associated with it that are defined within an egress-multicast-group and the port is currently set to encap-type dot1q, the dot1q-etype value defined on the port cannot be changed.

The **no** form of the command returns the egress-multicast-group dot1q EtherType to the default value of 0x8100. If the current encap-type is set to a value other then 0x8100, the command cannot be executed when SAPs exist within the egress-multicast-group.

Default The default dot1q-etype is 0x8100 for an egress-multicast-group.

Parameters *ethertype* — Defines the dot1q EtherType that must be associated with a SAP's access port when the encap-type is set to dot1q. Any valid EtherType may be specified.

Values [0x0600 — 0xffff]: [1536 — 65535] in decimal or hex

Default 0x8100

Interface Commands

interface

Syntax **interface** *ip-int-name*
no interface *ip-int-name*

Context config>service>vprn

Description This command creates a logical IP routing interface for a Virtual Private Routed Network (VPRN). Once created, attributes like an IP address and service access point (SAP) can be associated with the IP interface.

The **interface** command, under the context of services, is used to create and maintain IP routing interfaces within VPRN service IDs. The **interface** command can be executed in the context of an VPRN service ID. The IP interface created is associated with the service core network routing instance and default routing table. The typical use for IP interfaces created in this manner is for subscriber internet access.

Interface names are case sensitive and must be unique within the group of defined IP interfaces defined for **config router interface** and **config service vprn interface**. Interface names must not be in the dotted decimal notation of an IP address. For example, the name "1.1.1.1" is not allowed, but "int-1.1.1.1" is allowed. Show commands for router interfaces use either interface names or the IP addresses. Use unique IP address values and IP address names to maintain clarity. It could be unclear to the user if the same IP address and IP address name values are used. Although not recommended, duplicate interface names can exist in different router instances.

The available IP address space for local subnets and routes is controlled with the **config router service-prefix** command. The **service-prefix** command administers the allowed subnets that can be defined on service IP interfaces. It also controls the prefixes that may be learned or statically defined with the service IP interface as the egress interface. This allows segmenting the IP address space into **config router** and **config service** domains.

When a new name is entered, a new logical router interface is created. When an existing interface name is entered, the user enters the router interface context for editing and configuration.

By default, there are no default IP interface names defined within the system. All VPRN IP interfaces must be explicitly defined. Interfaces are created in an enabled state.

The **no** form of this command removes IP the interface and all the associated configuration. The interface must be administratively shutdown before issuing the **no interface** command.

For VPRN services, the IP interface must be shutdown before the SAP on that interface may be removed. VPRN services do not have the **shutdown** command in the SAP CLI context. VPRN service SAPs rely on the interface status to enable and disable them.

Parameters *ip-int-name* — Specifies the name of the IP interface. Interface names must be unique within the group of defined IP interfaces for **config router interface** and config service vprn interface commands. An interface name cannot be in the form of an IP address. Interface names can be from 1 to 32 alphanumeric characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

If *ip-int-name* already exists within the service ID, the context will be changed to maintain that IP interface. If *ip-int-name* already exists within another service ID or is an IP interface defined within the **config router** commands, an error will occur and context will not be changed to that IP interface. If *ip-int-name* does not exist, the interface is created and context is changed to that interface for further command processing.

interface

Syntax **interface** *ip-int-name*
no interface *ip-int-name*

Context config>service>ies

Description This command creates a logical IP routing interface for an Internet Ethernet Service (IES). Once created, attributes like an IP address and service access point (SAP) can be associated with the IP interface.

The **interface** command, under the context of services, is used to create and maintain IP routing interfaces within IES service IDs. The **interface** command can be executed in the context of an IES, service ID. The IP interface created is associated with the service core network routing instance and default routing table. The typical use for IP interfaces created in this manner is for subscriber internet access.

Interface names are case sensitive and must be unique within the group of defined IP interfaces defined for **config router interface** and **config service ies interface** (that is, the network core router instance). Interface names must not be in the dotted decimal notation of an IP address. For example, the name "1.1.1.1" is not allowed, but "int-1.1.1.1" is allowed. Show commands for router interfaces use either interface names or the IP addresses. Use unique IP address values and IP address names to maintain clarity. It could be unclear to the user if the same IP address and IP address name values are used. Although not recommended, duplicate interface names can exist in different router instances.

The available IP address space for local subnets and routes is controlled with the **config router service-prefix** command. The **service-prefix** command administers the allowed subnets that can be defined on IES IP interfaces. It also controls the prefixes that may be learned or statically defined with the IES IP interface as the egress interface. This allows segmenting the IP address space into **config router** and **config service** domains.

When a new name is entered, a new logical router interface is created. When an existing interface name is entered, the user enters the router interface context for editing and configuration.
By default, there are no default IP interface names defined within the system. All IES IP interfaces must be explicitly defined. Interfaces are created in an enabled state.

The **no** form of this command removes the IP interface and all the associated configuration. The interface must be administratively shutdown before issuing the **no interface** command.

For IES services, the IP interface must be shutdown before the SAP on that interface may be removed. IES services do not have the **shutdown** command in the SAP CLI context. IES service SAPs rely on the interface status to enable and disable them.

Parameters *ip-int-name* — Specifies the name of the IP interface. Interface names must be unique within the group of defined IP interfaces for **config router interface** and **config service ies interface** commands. An interface name cannot be in the form of an IP address. Interface names can be from 1 to 32 alphanumeric characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

If *ip-int-name* already exists within the service ID, the context will be changed to maintain that IP interface. If *ip-int-name* already exists within another service ID or is an IP interface defined within the **config router** commands, an error will occur and context will not be changed to that IP interface. If *ip-int-name* does not exist, the interface is created and context is changed to that interface for further command processing.

address

Syntax **address** {*ip-address/mask*|*ip-address netmask*} [**broadcast all-ones**|**host-ones**] [**track-srrp** *srrp-instance*]
no address

Context config>service>ies>interface
config>service>vprn>interface

Description This command assigns an IP address, IP subnet, and broadcast address format to an IES IP router interface. Only one IP address can be associated with an IP interface.

An IP address must be assigned to each IES IP interface. An IP address and a mask are used together to create a local IP prefix. The defined IP prefix must be unique within the context of the routing instance. It cannot overlap with other existing IP prefixes defined as local subnets on other IP interfaces in the same routing context within the .

The local subnet that the **address** command defines must be part of the services' address space within the routing context using the **config router service-prefix** command. The default is to disallow the complete address space to services. Once a portion of the address space is allocated as a service prefix, that portion can be made unavailable for IP interfaces defined within the **config router interface** CLI context for network core connectivity with the **exclude** option in the **config router service-prefix** command.

The IP address for the interface can be entered in either CIDR (Classless Inter-Domain Routing) or traditional dotted decimal notation. The show commands display CIDR notation and is stored in configuration files.

By default, no IP address or subnet association exists on an IP interface until it is explicitly created.

Use the **no** form of this command to remove the IP address assignment from the IP interface. When the **no address** command is entered, the interface becomes operationally down.

Address	Admin State	Oper State
No address	up	down
No address	down	down
1.1.1.1	up	up
1.1.1.1	down	down

The operational state is a read-only variable and the only controlling variables are the address and admin states. The address and admin states are independent and can be set independently. If an interface is in an adminstratively up state and an address is assigned, it becomes operationally up and the protocol interfaces and the MPLS LSPs associated with that IP interface will be reinitialized.

ip-address — The IP address of the IP interface. The *ip-address* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

/ — The forward slash is a parameter delimiter and separates the *ip-address* portion of the IP address from the mask that defines the scope of the local subnet. No spaces are allowed between the *ip-address*, the "/" and the *mask-length* parameter. If a forward slash is not immediately following the *ip-address*, a dotted decimal mask must follow the prefix.

mask-length — The subnet mask length when the IP prefix is specified in CIDR notation. When the IP prefix is specified in CIDR notation, a forward slash (/) separates the *ip-address* from the *mask-length* parameter. The mask length parameter indicates the number of bits used for the network portion of the IP address; the remainder of the IP address is used to determine the host portion of the IP address. Allowed values are integers in the range 0 – 31. Note that a mask length of 32 is reserved for loopback addresses (includes system addresses).

mask — The subnet mask in dotted decimal notation. When the IP prefix is not specified in CIDR notation, a space separates the *ip-address* from a traditional dotted decimal mask. The *mask* parameter indicates the complete mask that will be used in a logical 'AND' function to derive the local subnet of the IP address. Allowed values are dotted decimal addresses in the range 128.0.0.0 – 255.255.255.252. Note that a mask of 255.255.255.255 is reserved for system IP addresses.

broadcast — The optional **broadcast** parameter overrides the default broadcast address used by the IP interface when sourcing IP broadcasts on the IP interface. If no broadcast format is specified for the IP address, the default value is **host-ones** which indictates a subnet broadcast address. Use this parameter to change the broadcast address to **all-ones** or revert back to a broadcast address of **host-ones**.

The broadcast format on an IP interface can be specified when the IP address is assigned or changed.

This parameter does not affect the type of broadcasts that can be received by the IP interface. A host sending either the local broadcast (**all-ones**) or the valid subnet broadcast address (**host-ones**) will be received by the IP interface.

Default host-ones

all-ones — The **all-ones** keyword following the **broadcast** parameter specifies the broadcast address used by the IP interface for this IP address will be 255.255.255.255, also known as the local broadcast.

host-ones — The **host-ones** keyword following the **broadcast** parameter specifies that the broadcast address used by the IP interface for this IP address will be the subnet broadcast address. This is an IP address that corresponds to the local subnet described by the *ip-address* and the *mask-length* or *mask* with all the host bits set to binary one. This is the default broadcast address used by an IP interface.

The **broadcast** parameter within the **address** command does not have a negate feature, which is usually used to revert a parameter to the default value. To change the **broadcast** type to **host-ones** after being changed to **all-ones**, the **address** command must be executed with the **broadcast** parameter defined.

allow-directed-broadcast

Syntax [**no**] **allow-directed-broadcast**

Context config>service>ies>interface
config>service>vprn>interface

Description This command enables the forwarding of directed broadcasts out of the IP interface.

A directed broadcast is a packet received on a local router interface destined for the subnet broadcast address on another IP interface. The **allow-directed-broadcasts** command on an IP interface enables or disables the transmission of packets destined to the subnet broadcast address of the egress IP interface.

When enabled, a frame destined to the local subnet on this IP interface will be sent as a subnet broadcast out this interface. Care should be exercised when allowing directed broadcasts as it is a well-known mechanism used for denial-of-service attacks.

When disabled, directed broadcast packets discarded at this egress IP interface will be counted in the normal discard counters for the egress SAP.

By default, directed broadcasts are not allowed and will be discarded at this egress IP interface.

The **no** form of this command disables the forwarding of directed broadcasts out of the IP interface.

Default **no allow-directed-broadcasts** — Directed broadcasts are dropped

loopback

Syntax [**no**] **loopback**

Context config>service>ies>interface

Description This command specifies that the associated interface is a loopback interface that has no associated physical interface. As a result, the associated IES interface cannot be bound to a SAP.

Note that you can configure an IES interface as a loopback interface by issuing the **loopback** command instead of the **sap** *sap-id* command. The loopback flag cannot be set on an interface where a SAP is already defined and a SAP cannot be defined on a loopback interface.

Default None

mac

Syntax **mac** *ieee-address*
no mac

Context config>service>ies>interface
config>service>ies>sub-if>grp-if

Description This command assigns a specific MAC address to an IES IP interface.

The **no** form of the command returns the MAC address of the IP interface to the default value.

Default The physical MAC address associated with the Ethernet interface that the SAP is configured on (the default MAC address assigned to the interface, assigned by the system).

Parameters *ieee-address* — Specifies the 48-bit MAC address for the static ARP in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

sap

Syntax [**no**] **sap** *sap-id* [**create**]

Context config>service>ies>interface
config>service>ies>sub-if>grp-if
config>service>vprn>interface
config>service>vprn>sub-if>grp-if

Description This command creates a Service Access Point (SAP) within a service. A SAP is a combination of port and encapsulation parameters which identifies the service access point on the interface and within the router. Each SAP must be unique.

All SAPs must be explicitly created. If no SAPs are created within a service or on an IP interface, a SAP will not exist on that object.

Enter an existing SAP without the **create** keyword to edit SAP parameters. The SAP is owned by the service in which it was created.

A SAP can only be associated with a single service. A SAP can only be defined on a port that has been configured as an access port using the **config interface** *port-type port-id* **mode access** command.

If a port is shutdown, all SAPs on that port become operationally down. When a service is shutdown, SAPs for the service are not displayed as operationally down although all traffic traversing the service will be discarded. The operational state of a SAP is relative to the operational state of the port on which the SAP is defined.

Note that you can configure an IES interface as a loopback interface by issuing the **loopback** command instead of the **sap** *sap-id* command. The loopback flag cannot be set on an interface where a SAP is already defined and a SAP cannot be defined on a loopback interface.

The **no** form of this command deletes the SAP with the specified port. When a SAP is deleted, all configuration parameters for the SAP will also be deleted. For IES, the IP interface must be shutdown before the SAP on that interface may be removed.

Default No SAPs are defined.

Special Cases **IES —** A SAP is defined within the context of an IP routed interface. Each IP interface is limited to a single SAP definition. Attempts to create a second SAP on an IP interface will fail and generate an error; the original SAP will not be affected.

secondary

Syntax **secondary** {*ip-address/mask* | *ip-address netmask*} [**broadcast all-ones** | **host-ones**] [**igp-inhibit**]
no secondary *ip-address*

Context config>service>ies>interface

This command assigns a secondary IP address/IP subnet/broadcast address format to the interface.

Default none

Parameters *ip-address* — The IP address of the IP interface. The *ip-address* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

mask — The subnet mask in dotted decimal notation. When the IP prefix is not specified in CIDR notation, a space separates the *ip-address* from a traditional dotted decimal mask. The *mask* parameter indicates the complete mask that will be used in a logical 'AND' function to derive the local subnet of the IP address. Allowed values are dotted decimal addresses in the range 128.0.0.0 – 255.255.255.252. Note that a mask of 255.255.255.255 is reserved for system IP addresses.

netmask — Specifies a string of 0s and 1s that mask or screen out the network part of an IP address so that only the host computer part of the address remains.

broadcast — The optional **broadcast** parameter overrides the default broadcast address used by the IP interface when sourcing IP broadcasts on the IP interface. If no broadcast format is specified for the IP address, the default value is **host-ones** which indictates a subnet broadcast address. Use this parameter to change the broadcast address to **all-ones** or revert back to a broadcast address of **host-ones**.

The broadcast format on an IP interface can be specified when the IP address is assigned or changed.

This parameter does not affect the type of broadcasts that can be received by the IP interface. A host sending either the local broadcast (**all-ones**) or the valid subnet broadcast address (**host-ones**) will be received by the IP interface. *(Default: host-ones)*

all-ones — The **all-ones** keyword following the **broadcast** parameter specifies the broadcast address used by the IP interface for this IP address will be 255.255.255.255, also known as the local broadcast.

host-ones — The **host-ones** keyword following the **broadcast** parameter specifies that the broadcast address used by the IP interface for this IP address will be the subnet broadcast address. This is an IP address that corresponds to the local subnet described by the *ip-address* and the *mask-length* or *mask* with all the host bits set to binary one. This is the default broadcast address used by an IP interface.
The **broadcast** parameter within the **address** command does not have a negate feature, which is usually used to revert a parameter to the default value. To change the **broadcast** type to **host-ones** after being changed to **all-ones**, the **address** command must be executed with the **broadcast** parameter defined.

igp-inhibit — The optional **igp-inhibit** parameter signals that the given secondary IP interface should not be recognized as a local interface by the running IGP. For OSPF and IS-IS, this means

that the specified secondary IP interfaces will not be injected and used as passive interfaces and will not be advertised as internal IP interfaces into the IGP's link state database. For RIP, this means that these secondary IP interfaces will not source RIP updates.

tos-marking-state

Syntax **tos-marking-state** {**trusted** | **untrusted**}
no tos-marking-state

Context config>service>ies>interface
config>service>ies>sub-if>grp-if

Description This command is used to change the default trusted state to a non-trusted state. When unset or reverted to the trusted default, the ToS field will not be remarked by egress network IP interfaces unless the egress network IP interface has the remark-trusted state set, in which case the egress network interface treats all IES and network IP interfaces as untrusted.

When the ingress interface is set to untrusted, all egress network IP interfaces will remark IP packets received on the network interface according to the egress marking definitions on each network interface. The egress network remarking rules also apply to the ToS field of IP packets routed using IGP shortcuts (tunneled to a remote next-hop). However, the tunnel QoS markings are always derived from the egress network QoS definitions.

Egress marking and remarking is based on the internal forwarding class and profile state of the packet once it reaches the egress interface. The forwarding class is derived from ingress classification functions. The profile of a packet is either derived from ingress classification or ingress policing.

The default marking state for network IP interfaces is trusted. This is equivalent to declaring no tos-marking-state on the network IP interface. When undefined or set to tos-marking-state trusted, the trusted state of the interface will not be displayed when using show config or show info unless the detail parameter is given. The **save config** command will not store the default tos-marking-state trusted state for network IP interfaces unless the detail parameter is also specified.

The **no** tos-marking-state command is used to restore the trusted state to a network IP interface. This is equivalent to executing the tos-marking-state trusted command.

Default trusted

Parameters **trusted —** The default prevents the ToS field to not be remarked by egress network IP interfaces unless the egress network IP interface has the remark-trusted state set.

untrusted — Specifies that all egress network IP interfaces will remark IP packets received on the network interface according to the egress marking definitions on each network interface.

address

Syntax **address** {*ip-address/mask* | *ip-address netmask*} [**gw-ip-address** *ip-address*] [**track-srrp** *srrp-inst*] [**holdup-time** *msec*]
no address

Context configure>service>ies>sub-if
configure>service>vprn>sub-if

Description This command will configure the subscriber-interface address along with additional parameters related to multi-chassis redundancy.

Default none

Parameters *ip-address* — The IP address of the IP interface. The *ip-address* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

/ — The forward slash is a parameter delimiter and separates the *ip-address* portion of the IP address from the mask that defines the scope of the local subnet. No spaces are allowed between the *ip-address*, the "/" and the *mask-length* parameter. If a forward slash is not immediately following the *ip-address*, a dotted decimal mask must follow the prefix.

mask — The subnet mask in dotted decimal notation. When the IP prefix is not specified in CIDR notation, a space separates the *ip-address* from a traditional dotted decimal mask. The *mask* parameter indicates the complete mask that will be used in a logical AND function to derive the local subnet of the IP address. Allowed values are dotted decimal addresses in the range 128.0.0.0 – 255.255.255.252. Note that a mask of 255.255.255.255 is reserved for system IP addresses.

netmask — The subnet mask in dotted decimal notation.

Values 0.0.0.0 - 255.255.255.255

track-srrp *srrp-inst* **—** This command will enable the *subscriber-interface* route to track the SRRP state of the specified SRRP instance. The route will update its state attribute to reflect the *state* of SRRP instance:

•Master = srrp-master

•Any other = srrp-non-master

Routing policy can be applied towards the state attribute in order to customize the advertisement of the route. Only one SRRP instance can be tracked per subscriber-interface route. Tracked SRRP instance can be part of the Fate Sharing Group. This command can be enabled at any time.

holdup-time *msec* **—** Time to wait for the route before it accepts the new state attribute. This timer is used to prevent fluctuations in route advertisement caused by short lived SRRP instabilities, in the case that such condition arises.

Values *msec* [100…5000] msec

link-local-address

Syntax **link-local-address** *ipv6-address*
no link-local-address

Context configure>service>ies>sub-if>ipv6
configure>service>vprn>sub-if>ipv6

Description This command will configure the IPv6 Link Local address that will be used as a virtual SRRP IPv6 address by the Master SRRP node. This address will be sent in the Router Advertisements initiated by

the Master SRRP node. Clients will use this address as IPv6 default-gateway. Both SRRP nodes, Master and Backup, must be configured with the same Link Local address.

Default none

Parameters *ipv6-address* — IPv6 address in the form:

x:x:x:x:x:x:x:x:x:x:x:x:d.d.d.d
where:
x - [0..FF]
d - [0..255]

monitor-oper-group

Syntax **monitor-oper-group** *name* **priority-step** *step*
no monitor-oper-group

Context configure>service>ies>sub-if>grp-if>srrp
configure>service>vprn>sub-if>grp-if>srrp

Description This command will configure the association between the SRRP instance in a Fate Sharing Group and the operational-group that contains messaging SAPs. A state transition of a messaging SAP within an operational-group will trigger calculation of the priority for all SRRP instances that are associated with that operational-group.

Default none

Parameters *name* — Name of the operational-group that is tracking operational state of SRRP messaging SAPs

priority-step — The priority step for which the priority of an SRRP instance will be changed. If a messaging SAP within an operational-group transition to a non-UP state, the priority will be decreased by the step value. If the messaging SAP within the operational-group transition into the UP state, the priority of the SRRP instance will be increased by the step value.

step — The step for which the SRRP priority is modified expressed as a decimal integer.

Values 0 — 253

oper-group

Syntax **oper-group** *name*
no oper-group

Context configure>service>epipe>spoke-sdp
configure>service>ies>sub-if>grp-if>sap
configure>service>vprn>sub-if>grp-if>sap

Description This command will configure an epipe or a (messaging) SAP to be the member of the oper-group.

Epipe:

The epipe status can be monitored by the SRRP messaging SAP. The messaging SAP will transition into the DOWN state if the epipe is either DOWN or has a STANDBY status. In order for the

messaging SAP to assume the DOWN state, both RX and TX side of the PW must be shut. In other words, a PW in standby mode also must have the local TX disabled by the virtue of the 'slave' flag (standby-signaling-slave command under the spoke-sdp hierarchy). Without the TX disabled, the SAP monitoring the PW would not transition in the down state. The messaging SAP will be in the UP state if the epipe is in the UP state (Active staus).

(SRRP messaging) SAP:

The state of the messaging SAPs will be monitored by SRRP instances in a Fate Sharing Group. A state change of any of the messaging SAPs defined under the *group-interface* and within the oper-group will trigger recalculation of SRRP priority.

Default none

Parameters *name* — Specify name of the operational-group that contains the member epipe.

srrp-enabled-routing

Syntax **srrp-enabled-routing** [**hold-time** *decisec*]
no srrp-enabled-routing

Context configure>service>ies>sub-if>grp-if
configure>service>vprn>sub-if>grp-if

Description This command will enable SRRP state tracking by managed (IPv4 only) and subscriber-routes. Managed and subscriber-routes that are installed in the Route Table Manager (RTM) would be modified by the source (SRRP would update the route's *state* attribute - srrp-master, srrp-non-master) and this would trigger policy reevaluation with the corresponding action.

Default none

Parameters **hold-time —** Waiting period before which the route's state attribute is updated. The purpose of this command is to avoid propagation of quick successive SRRP state transitions into the routing.

decisec — Specify in deci seconds

Values 1-50

track-srrp

Syntax **track-srrp** *srrp-id*
no track-srrp

Context configure>service>vpls>sap>

Description This is a capture SAP level command. This command is important in PPPoE deployments with MSAPs. PPPoE operation requires that the MAC address learned by the client at the very beginning of the session negotiation phase remains unchanged for the lifetime of the session (RFC 2516). This command will ensure that that the virtual MAC address used during the PPPoE session negotiation phase on the capture SAP is the same virtual MAC address that is used by the SRRP on the group-interface on which the session is established. Therefore, it is mandated that the SRRP instance (and implicitly the group-interface) where the session belongs to is known in advance. If the group-

interface name for the session is returned by the RADIUS, it must be ensured that this group-interface is the one on which the tracked SRRP instance is configured. PPPoE sessions on the same capture SAP cannot be shared across multiple group-interfaces, but instead they all must belong to a single group-interface that is known in advance.

The same restrictions will apply to IPoE clients in MC Redundancy scenario if they are to be supported concurrently on the same capture SAP as PPPoE.

The supported capture SAP syntax is this:

sap <port-id>:X.* capture-sap

The capture SAP syntax that is NOT supported is this:

sap <port-id>:*.* capture-sap

Default none

Parameters *srrp-id* — Specify SRRP instance number.

Values 1..4294967295

srrp

Syntax [**no**] **srrp** *srrp-id*

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command creates a Subscriber Router Redundancy Protocol (SRRP) instance on a group IP interface. An SRRP instance manages all subscriber subnets within the group interfaces subscriber IP interface or other subscriber IP interfaces that are associated through a wholesale/retail relationship. Only one unique SRRP instance can be configured per group interface.

The **no** form of the command removes an SRRP instance from a group IP interface. Once removed, the group interface ignores ARP requests for the SRRP gateway IP addresses that may exist on subscriber subnets associated with the group IP interface. Then the group interface stops routing using the redundant IP interface associated with the group IP interface and will stop routing with the SRRP gateway MAC address. Ingress packets destined to the SRRP gateway MAC will also be silently discarded. This is the same behavior as a group IP interface that is disabled (shutdown).

Default no srrp

Parameters *srrp-id* — Specifies a 32 bit instance ID that must be unique to the system. The instance ID must also match the instance ID used by the remote router that is participating in the same SRRP context. SRRP is intended to perform a function similar to VRRP where adjacent IP hosts within local subnets use a default gateway to access IP hosts on other subnets.

Values 1 — 4294967295

bfd-enable

Syntax [**no**] **bfd-enable** [*service-id*] **interface** *interface-name* **dst-ip** *ip-address*

Context config>service>ies>sub-if>grp-if>srrp
config>service>vprn>sub-if>grp-if>srrp

Description This commands assigns a bi-directional forwarding (BFD) session providing heart-beat mechanism for the given VRRP/SRRP instance. There can be only one BFD session assigned to any given VRRP/SRRP instance, but there can be multiple SRRP/VRRP sessions using the same BFD session.

BFD control the state of the associated interface. By enabling BFD on a given protocol interface, the state of the protocol interface is tied to the state of the BFD session between the local node and the remote node. The parameters used for the BFD are set via the BFD command under the IP interface.

The **no** form of this command removes BFD from the configuration.

Default none

Parameters *service-id* — Specifies the service ID of the interface running BFD.

Values service-id: 1 — 214748364
svc-name: A string up to 64 characters in length.

interface *interface-name* **—** Specifies the name of the interface running BFD.

dst-ip *ip-address* **—** Specifies the destination address of the interface running BFD.

gw-mac

Syntax **gw-mac** *mac-address*
no gw-mac

Context config>service>ies>sub-if>grp-if>srrp
config>service>vprn>sub-if>grp-if>srrp

Description This command overrides the default SRRP gateway MAC address used by the SRRP instance. Unless specified, the system uses the same base MAC address for all SRRP instances with the last octet overridden by the lower 8 bits of the SRRP instance ID. . The same SRRP gateway MAC address should be in-use by both the local and remote routers participating in the same SRRP context.

One reason to change the default SRRP gateway MAC address is if two SRRP instances sharing the same broadcast domain are using the same SRRP gateway MAC. The system will use the SRRP instance ID to separate the SRRP messages (by ignoring the messages that does not match the local instance ID), but a unique SRRP gateway MAC is essential to separate the routed packets for each gateway IP address.

The **no** form of the command removes the explicit SRRP gateway MAC address from the SRRP instance. The SRRP gateway MAC address can only be changed or removed when the SRRP instance is shutdown.

Parameters *mac-address* — Specifies a MAC address that is used to override the default SRRP base MAC address

Values Any MAC address except all zeros, broadcast or multicast addresses. The offset is expressed in normal Ethernet MAC address notation. The defined gw-mac cannot be 00:00:00:00:00:00, ff:ff:ff:ff:ff:ff or any multicast address.

If not specified, the system uses the default SRRP gateway MAC address with the last octet set to the 8 least significant bits of the SRRP instance ID.

keep-alive-interval

Syntax **keep-alive-interval** *interval*
no keep-alive-interval

Context config>service>ies>sub-if>grp-if>srrp
config>service>vprn>sub-if>grp-if>srrp

Description This command defines the interval between SRRP advertisement messages sent when operating in the master state. The interval is also the basis for setting the master-down timer used to determine when the master is no longer sending. The system uses three times the keep-alive interval to set the timer. Every time an SRRP advertisement is seen that is better then the local priority, the timer is reset. If the timer expires, the SRRP instance assumes that a master does not exist and initiates the attempt to become master.

When in backup state, the SRRP instance takes the keep-alive interval of the master as represented in the masters SRRP advertisement message. Once in master state, the SRRP instance uses its own configured keep-alive interval.
The keep-alive-interval may be changed at anytime, but will have no effect until the SRRP instance is in the master state.

The **no** form of the command restores the default interval.

Parameters *interval* — Specifies the interval between SRRP advertisement messages sent when operating in the master state.

Values 1 — 100 hundreds of milli-seconds

Default 10

message-path

Syntax **message-path** *sap-id*
no message-path

Context config>service>ies>sub-if>grp-if>srrp
config>service>vprn>sub-if>grp-if>srrp

Description This command defines a specific SAP for SRRP in-band messaging. A message-path SAP must be defined prior to activating the SRRP instance. The defined SAP must exist on the SRRP instances group IP interface for the command to succeed and cannot currently be associated with any dynamic or static subscriber hosts. Once a group IP interface SAP has been defined as the transmission path for SRRP Advertisement messages, it cannot be administratively shutdown, will not support static or dynamic subscriber hosts and cannot be removed from the group IP interface.

The SRRP instance message-path command may be executed at anytime on the SRRP instance. Changing the message SAP will fail if a dynamic or static subscriber host is associated with the new SAP. Once successfully changed, the SRRP instance will immediately disable anti-spoof on the SAP and start sending SRRP Advertisement messages if the SRRP instance is activated.

Changing the current SRRP message SAP on an active pair of routers should be done in the following manner:

1. Shutdown the backup SRRP instance.
2. Change the message SAP on the shutdown node.
3. Change the message SAP on the active master node.
4. Re-activate the shutdown SRRP instance.

Shutting down the backup SRRP instance prevents the SRRP instances from becoming master due to temporarily using differing message path SAPs.

If an MCS peering is operational between the redundant nodes and the SRRP instance has been associated with the peering, the designated message path SAP will be sent from each member.

The **no** form of the command can only be executed when the SRRP instance is shutdown. Executing no message-path allows the existing SAP to be used for subscriber management functions. A new message-path SAP must be defined prior to activating the SRRP instance.

Parameters *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

one-garp-per-sap

Syntax **[no] one-garp-per-sap**

Context config>service>ies>sub-if>grp-if>srrp
config>service>vprn>sub-if>grp-if>srrp

Description This command is applicable to PPPoE only deployments in which there are multiple subnets under the subscriber-interface. In such case, if the switchover occurs, it will be sufficient to send a single Gratuitous ARP on every VLAN to update the Layer 2 forwarding path in the access aggregation network. This single gratuitous ARP will contain the IP address of the first gw-adddress found under the subscriber-interface address.

prefix

Syntax **prefix** *ipv6-address/prefix-length* **[pd] [wan-host] track-srrp** *srrp-instance* **[holdup-time** *milli-seconds*]
no prefix

Context configure>service>vprn>sub-if>ipv6>sub-pfx
configure>service>ies>sub-if>ipv6>sub-pfx

Description This command will configure the IPv6 subscriber-interface address along with additional parameters related to multi-chassis redundancy.

Default none

Parameters *ip-address* — The IP address of the IP interface. The *ip-address* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address

must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

/ — The forward slash is a parameter delimiter and separates the *ip-address* portion of the IP address from the mask that defines the scope of the local subnet. No spaces are allowed between the *ip-address*, the "/" and the *mask-length* parameter. If a forward slash is not immediately following the *ip-address*, a dotted decimal mask must follow the prefix.

mask — The subnet mask in dotted decimal notation. When the IP prefix is not specified in CIDR notation, a space separates the *ip-address* from a traditional dotted decimal mask. The *mask* parameter indicates the complete mask that will be used in a logical AND function to derive the local subnet of the IP address. Allowed values are dotted decimal addresses in the range 128.0.0.0 – 255.255.255.252. Note that a mask of 255.255.255.255 is reserved for system IP addresses.

netmask — The subnet mask in dotted decimal notation.

Values 0.0.0.0 - 255.255.255.255

track-srrp *srrp-inst* **—** This command will enable the subscriber-interface IPv6 route to track the SRRP state of the specified SRRP instance. The route will update its state attribute to reflect the state of SRRP instance:

Master = srrp-master

Any other = srrp-non-master

Routing policy can be applied towards the state attribute in order to customize the advertisement of the route. Only one SRRP instance can be tracked per subscriber-interface route. Tracked SRRP instance can be part of the Fate Sharing Group. This command can be enabled at any time.

holdup-time *msec* **—** Time to wait for the route before it accepts the new state attribute. This timer is used to prevent fluctuations in route advertisement caused by short lived SRRP instabilities, in the case that such condition arises.

msec [100…5000] msec

policy

Syntax [**no**] **policy** *vrrp-policy-id*

Context config>service>ies>sub-if>grp-if>srrp
config>service>vprn>sub-if>grp-if>srrp

Description This command associates one or more VRRP policies with the SRRP instance. A VRRP policy is a collection of connectivity and verification tests used to manipulate the in-use priorities of VRRP and SRRP instances. A VRRP policy can test the link state of ports, ping IP hosts, discover the existence of routes in the routing table or the ability to reach L2 hosts. When one or more of these tests fail, the VRRP policy has the option of decrementing or setting an explicit value for the in-use priority of an SRRP instance.

More than one VRRP policy may be associated with an SRRP instance. When more than one VRRP policy is associated with an SRRP instance the delta decrement of the in-use priority is cumulative unless one or more test fail that have explicit priority values. When one or more explicit tests fail, the lowest priority value event takes effect for the SRRP instance. When the highest delta-in-use-limit is

used to manage the lowest delta derived in-use priority for the SRRP instance.
VRRP policy associations may be added and removed at anytime. A maximum of two VRRP policies can be associated with a single SRRP instance.

The **no** form of the command removes the association with vrrp-policy-id from the SRRP instance.

Parameters *vrrp-policy-id* — Specifies one or more VRRP policies with the SRRP instance.

Values 1 — 9999

preempt

Syntax **[no] preempt**

Context configure>service>ies>sub-if>grp-if>srrp
configure>service>vprn>sub-if>grp-if>srrp

Description When preempt is enabled, a newly initiated SRRP instance can overrides an existing Master SRRP instance if its priority value is higher than the priority of the current Master.

If preempt is disabled, an SRRP instance only becomes Master if the master down timer expires before an SRRP advertisement message is received from the adjacent SRRP enabled node.

Default preempt

priority

Syntax **priority** *priority*
no priority

Context config>service>ies>sub-if>grp-if>srrp
config>service>vprn>sub-if>grp-if>srrp

Description This command overrides the default base priority for the SRRP instance. The SRRP instance priority is advertised by the SRRP instance to its neighbor router and is compared to the priority received from the neighbor router. The router with the best (highest) priority enters the master state while the other router enters the backup state. If the priority of each router is the same, the router with the lowest source IP address in the SRRP advertisement message assumes the master state.

The base priority of an SRRP instance can be managed by VRRP policies. A VRRP policy defines a set of connectivity or verification tests which, when they fail, may lower an SRRP instances base priority (creating an in-use priority for the instance). Every time an SRRP instances in-use priority changes when in master state, it sends an SRRP advertisement message with the new priority. If the dynamic priority drops to zero or receives an SRRP Advertisement message with a better priority, the SRRP instance transitions to the *becoming backup* state.

When the priority command is not specified, or the no priority command is executed, the system uses a default base priority of 100. The priority command may be executed at anytime.

The **no** form of the command restores the default base priority to the SRRP instance. If a VRRP policy is associated with the SRRP instance, it will use the default base priority as the basis for any modifications to the SRRP instances in-use priority.

Parameters *priority* — Specifies a base priority for the SRRP instance to override the default.

Values 1 — 254

Default 100

arp-populate

Syntax **[no] arp-populate**

Context config>service>ies>interface
config>service>ies>sub-if>grp-if
config>service>vprn>interface

Description This command, when enabled, disables dynamic learning of ARP entries. Instead, the ARP table is populated with dynamic entries from the DHCP Lease State Table (enabled with **lease-populate**), and optionally with static entries entered with the **host** command.

Enabling the **arp-populate** command will remove any dynamic ARP entries learned on this interface from the ARP cache.

The **arp-populate** command will fail if an existing static ARP entry exists for this interface.

The **arp-populate** command will fail if an existing static subscriber host on the SAP does not have both MAC and IP addresses specified.

Once **arp-populate** is enabled, creating a static subscriber host on the SAP without both an IP address and MAC address will fail.

When **arp-populate** is enabled, the system will not send out ARP requests for hosts that are not in the ARP cache. Only statically configured and DHCP learned hosts are reachable through an IP interface with **arp-populate** enabled. The **arp-populate** command can only be enabled on IES and VPRN interfaces supporting Ethernet encapsulation.

Use the **no** form of the command to disable ARP cache population functions for static and dynamic hosts on the interface. All static and dynamic host information for this interface will be removed from the system's ARP cache.

Default not enabled

arp-timeout

Syntax **arp-timeout** *seconds*
no arp-timeout

Context config>service>ies>interface
config>service>vprn>interface
config>service>ies>sub-if>grp-if

Description This command configures the minimum time in seconds an ARP entry learned on the IP interface will be stored in the ARP table. ARP entries are automatically refreshed when an ARP request or gratuitous ARP is seen from an IP host, otherwise, the ARP entry is aged from the ARP table. If **arp-timeout** is set to a value of zero seconds, ARP aging is disabled.

When the **arp-populate** and **lease-populate** commands are enabled on an IES interface, the ARP table entries will no longer be dynamically learned, but instead by snooping DHCP ACK message from a DHCP server. In this case the configured **arp-timeout** value has no effect.

The default value for **arp-timeout** is 14400 seconds (4 hours).

The **no** form of this command restores **arp-timeout** to the default value.

Default 14400 seconds

Parameters *seconds* — The minimum number of seconds a learned ARP entry will be stored in the ARP table, expressed as a decimal integer. A value of zero specifies that the timer is inoperative and learned ARP entries will not be aged.

Values 0 — 65535

host-connectivity-verify

Syntax **host-connectivity-verify** [**source** {**vrrp** | **interface**}] [**interval** *interval*] [**action** {**remove** | **alarm**}]

Context config>service>ies>if

Description This command enables subscriber host connectivity verification for all hosts on this interface. This tool will periodically scan all known hosts (from dhcp-state) and perform UC ARP requests. The subscriber host connectivity verification will maintain state (connected vs. not-connected) for all hosts.

Default no host-connectivity-verify

Parameters **source** {**vrrp** | **interface**} — Specifies the source to be used for generation of subscriber host connectivity verification packets. The **vrrp** keyword specifies that the VRRP state should be used to select proper IP and MAC (active uses VRID, back-up uses interface addresses). The **interface** keyword forces the use of the interface mac and ip addresses. Note that there are up to 16 possible subnets on a given interface, therefore the subscriber host connectivity verification tool will use always an address of the subnet to which the given host is pertaining. In case of group-interfaces, one of the parent subscriber-interface subnets (depending on host's address) will be used.

interval ***interval*** **—** The interval, expressed in minutes, which specifies when all known sources should be verified. The actual rate is then dependent on number of known hosts and interval.

Values 1— 6000

Note that a zero value can be used by the SNMP agent to disable host-connectivity-verification.

action {**remove** | **alarm**} **—** Defines the action taken on a subscriber host connectivity verification failure for a given host. The **remove** keyword raises an alarm and removes dhcp-state and releases all allocated resources (queues, table entries, etc.). The **alarm** keyword raises an alarm indicating that the host is disconnected.

icmp

Syntax **icmp**

Context config>service>ies>interface
config>service>ies>sub-if>grp-if
config>service>vprn>interface

Description This command enables the contex to configure Internet Control Message Protocol (ICMP) parameters on a service.

ip-mtu

Syntax **ip-mtu** *octets*
no ip-mtu

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command specifies the maximum size of IP packets on this group-interface. Packets larger than this will be fragmented.

The ip-mtu applies to all IPoE host types (DHCP, ARP, static). For PPP/L2TP sessions, the ip-mtu is not taken into account for the mtu negotiation; the ppp-mtu in the ppp-policy should be used instead.

The **no** form of the command removes the octets value from the configuration.

Default none

Parameters *octets* — Specifies the largest frame size (in octets) that this interface can handle.

Values 512 — 9000

private-retail-subnets

Syntax [**no**] **private-retail-subnets**

Context config>service>vprn>sub-if

Description This command controls the export of subnets to the forwarding service. When this attribute is configured, subnets defined on this retail subscriber interface will no longer be exported to the associated wholesale VPRN and will remain private to the retail VPRN. This is useful in a PPPoE business service context as it allows retail services to use overlapping IP address spaces even if these services are associated with the same wholesale service.

PPPoE sessions are actually terminated in the retail service although their traffic transits on a SAP belonging to the wholesale service. This configuration is incompatible, however, with IPoE host management (DHCP, static-host and ARP-host) as these host types require that the retail subnets are exported to the wholesale VPRN. Thus, if PPPoE sessions need to coexist with IPoE hosts, this attribute should not be configured on this retail interface.

This command will fail if the subscriber interface is not associated with a wholesale service.

If the retail VPRN is of the type **hub**, this attribute is mandatory. Then, it will be enabled by default and it will not be possible to deconfigure it.

unnumbered

Syntax **unnumbered** [*ip-int-name*|*ip-address*]
no unnumbered

Context config>service>vprn>sub-if
config>service>ies>sub-if

Description This command can be configured only for subscriber-interfaces that do not have an IPv4 address explicitly configured and is therefore operationally in a DOWN state. By configuring this command, the subscriber-interface will borrow the IPv4 address from the referenced interface (directly or indirectly via IP address) that must be operationally UP and located in the same routing instance as the subscriber-interface. This will allow the subscriber-interface to becomes operationally UP and consequently allow forwarding of the subscriber traffic.

Such interface is referred as unnumbered interface, since it does not have explicitly configured a unique IP address. Subscriber-hosts under the unnumbered subscriber-interface are installed in the fib as /32 hosts.

Without this command the subscriber-interface is operationally DOWN and subscriber-host instantiation is not possible.

This command is mutually exclusive with the allow-unmatched-subnets command under the same CLI hierarchy.

The operation of IPv6 host is not affected by this command.

Default no unnumbered

Parameters *ip-int-name* — Specifies the interface name from which an IPv4 address will be borrowed.

ip-address — The IP address from an optionationally up interface that will be used for subscriber interface.

ipv6

Syntax **ipv6**

Context config>service>ies>sub-if>grp-if
config>service>ies>sub-if
config>service>vprn>sub-if

Description This command enables the context to enable IPv6 IPoE bridged mode.

ipoe-bridged-mode

Syntax [**no**] **ipoe-bridged-mode**

Context config>service>ies>sub-if>grp-if>ipv6
config>service>vprn>sub-if>grp-if>ipv6

Description This command enters the context to enable IPv6 IPoE bridged mode.

The **no** form of the command disables the IPv6 IPoE bridged mode.

allow-multiple-wan-addresses

Syntax [**no**] **allow-multiple-wan-addresses**

Context config>service>ies>sub-if>grp-if>ipv6
config>service>vprn>sub-if>grp-if>ipv6

Description This command enables host to have two WAN addresses, one from DHCP IA_NA and one from SLAAC assignment.

Default no allow-multiple-wan-addresses

nd

Syntax **nd**

Context config>service>vprn>sub-if>group-interface>ipv6
config>service>ies>sub-if>group-interface>ipv6

Description This command enables the context to configure neighbor discovery parameters.

dad-snooping

Syntax [**no**] **dad-snooping**

Context config>service>vprn>sub-if>group-interface>ipv6>nd
config>service>ies>sub-if>group-interface>ipv6>nd

Description This command allows the router to populate the neighbor discovery table through snooping subscribers' duplicate address detection messages.

Default no dad-snooping

neighbor-limit

Syntax **neighbor-limit** [1..8]
no neighbor-limit

Context config>service>vprn>sub-if>group-interface>ipv6>nd
config>service>ies>sub-if>group-interface>ipv6>nd

Description This command configures the maximum number of neighbors learned.

Parameters 1..8 — Specifies the maximum number of neighbors learned.

router-advertisements

Syntax [**no**] **router-advertisements**

Context config>service>ies>sub-if>group-interface>ipv6
config>service>vprn>sub-if>ipv6
config>service>ies>sub-if>ipv6

Description This command configures IPv6 router advertisements for this group-interface.

current-hop-limit

Syntax [**no**] **current-hop-limit** *limit*

Context config>service>ies>sub-if>group-interface>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command configures the hop-limit advertised for this group-interface.

Default 64

Parameters *limit* — Specifies the default value to be placed in the current hop limit field in router advertisements sent from this interface.

Values 0 — 255

dns-options

Syntax [**no**] **dns-options**

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command enables the context to configure IPv6 DNS options for SLAAC hosts

include-dns

Syntax [**no**] **include-dns**

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv>dns-opt
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv>dns-opt
config>service>vprn>sub-if>ipv6>rtr-adv>dns-opt
config>service>ies>sub-if>ipv6>rtr-adv>dns-opt

Description This command specifies to include the Recursive DNS Server (RDNSS) Option as defined in RFC 6106 in IPv6 Router Advertisements for DNS name resolution of IPv6 SLAAC hosts

Default no include-dns

rdnss-lifetime

Syntax **rdnss-lifetime** *seconds*
rdnss-lifetime infinite
no rdnss-lifetime

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv>dns-opt
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv>dns-opt
config>service>vprn>sub-if>ipv6>rtr-adv>dns-opt
config>service>ies>sub-if>ipv6>rtr-adv>dns-opt

Description Specify the maximum time in seconds that the RDNSS address may be used for name resolution.

Default rdnss-lifetime 3600

Parameters *seconds* — Specifies the time in seconds.

Values 900 — 3600

infinite — The RDNSS address can be used permanently.

force-mcast

Syntax **force-mcast** [**ip**] [**mac**]
no force-mcast

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv

config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command configures the multicast router advertisements on this interface, either IP or MAC.

managed-configuration

Syntax [**no**] **managed-configuration**

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command sets or resets managed address configuration flag for this group-interface.

max-advertisement

Syntax **max-advertisement** *seconds*
no max-advertisement

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command specifies the maximum time allowed between sending unsolicited router advertisements from this interface.

Parameters *seconds* — Specifies the maximum advertisement interval in seconds for this group-interface.

Values 900 — 11800

min-advertisement

Syntax **min-advertisement** *seconds*
no min-advertisement

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command specifies the minimum time allowed between sending unsolicited router advertisements from this interface.

Parameters *seconds* — Specifies the minimum advertisement interval in seconds for this group-interface.

Values 900 — 1350

mtu

Syntax **mtu** *bytes*
no mtu

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command specifies the value to be placed in link MTU options sent by the router on this interface.

Parameters *bytes* — Sets the advertised MTU value in bytes for this group-interface.

Values 1280 — 9212

other-stateful-configuration

Syntax [**no**] **other-stateful-configuration**

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command sets and resets the other-stateful-configuration flag for this group-interface.

prefix-options

Syntax [**no**] **prefix-options**

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command enables the context to configure prefix options for this group-interface.

autonomous

Syntax [**no**] **autonomous**

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv

Description This command enables or disables the option that determines whether or not the prefix can be used for stateless address autoconfiguration.

on-link

Syntax [**no**] **on-link**

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv

Description This command specifies whether the prefix will be assigned to an interface on the specified link.

preferred-lifetime

Syntax **preferred-lifetime** *seconds*
preferred-lifetime infinite
no preferred-lifetime

reachable-time

Syntax **reachable-time** *milli-seconds*
no reachable-time

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command configures the value to be placed in the reachable time field in router advertisement messages sent from this interface.

Default 0

Parameters *milli-seconds* — Specifies the reachable time in milli-seconds for advertisements from this group-interface.

Values 0 — 3600000

retransmit-time

Syntax **retransmit-time** *milli-seconds*
no retransmit-time

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command configures the value to be placed in the retransmit timer field in router advertisements sent from this interface.

Default 0

Parameters *milli-seconds* — Specifies the retransmit time in milli-seconds for advertisement from this group-interface.

Values 0 — 1800000

router-lifetime

Syntax **router-lifetime** *seconds*
router-lifetime no-default-router
no router-lifetime

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv
config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command configures the value to be placed in the router lifetime field of router advertisements sent from this interface.

Default 4500

Parameters *seconds* — Specifies the router lifetime in seconds for this group-interface.

Values 2700 — 9000

no-default-router — Specifies that the router is not to be used as a default router.

router-solicit

Syntax **router-solicit**

Context config>service>ies>sub-if>grp-if>ipv6
config>service>vprn>sub-if>grp-if>ipv6
config>service>vprn>sub-if>ipv6
config>service>ies>sub-if>ipv6

Description This command enables the context to configure parameters used for router-solicit based authentication.

inactivity-timer

Syntax **inactivity-timer** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no inactivity-timer

Context config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command specifies the time before an inactive host is removed.

Default no interactive-timer

Parameters **infinite** — An idle host is never removed.

days *days* — An idle host is removed if idle within the number of specified days.

hrs *hours* — An idle host is removed if idle within the number of specified hours.

min *minutes* — An idle host is removed if idle within the number of specified minutes.

sec *seconds* — An idle host is removed if idle within the number of specified seconds.

min-auth-interval

Syntax **min-auth-interval** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no min-auth-interval

Context config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command specify the minimum interval between two consecutive authentication attempts from the same host.

Default no min-auth-interval

Parameters **days** *days* — The number of days that a user must wait for the next authentication attempt.

hrs *hours* — The number of hours that a user must wait for the next authentication attempt.

min *minutes* — The number of minutes that a user must wait for the next authentication attempt.

sec *seconds* — The number of seconds that a user must wait for the next authentication attempt.

user-db

Syntax [**no**] **user-db**

Context config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command enables the use of the local-user-database for authentication.

Default no user-db

Parameters *local-user-db-name* — Specifies the name of the local-user-database to authenticate the router-solicit. The local-user-database can also return a static prefix or a pool name for address assignment.

shutdown

Syntax [**no**] **shutdown**

Context config>service>ies>sub-if>grp-if>ipv6>rtr-sol
config>service>ies>sub-if>grp-if>ipv6>rtr-sol

Description This command enables or disables SLAAC triggered host creation.

Default no shutdown

local-proxy-arp

Syntax [**no**] **local-proxy-arp**

Context config>service>ies>interface
config>service>ies>sub-if>grp-if
config>service>vprn>interface

Description This command enables local proxy ARP. When local proxy ARP is enabled on an IP interface, the system responds to all ARP requests for IP addresses belonging to the subnet with its own MAC address, and thus will become the forwarding point for all traffic between hosts in that subnet.

When local-proxy-arp is enabled, ICMP redirects on the ports associated with the service are automatically blocked.

Default no local-proxy-arp

mask-reply

Syntax [**no**] **mask-reply**

Context config>service>ies>if>icmp
config>service>ies>sub-if>grp-if
config>service>vprn>interface

Description This command enables responses to Internet Control Message Protocol (ICMP) mask requests on the router interface.

If a local node sends an ICMP mask request to the router interface, the **mask-reply** command configures the router interface to reply to the request.

By default, the router instance will reply to mask requests.

The **no** form of this command disables replies to ICMP mask requests on the router interface.

Default **mask-reply**

proxy-arp-policy

Syntax [**no**] **proxy-arp-policy** *policy-name* [*policy-name*...(up to 5 max)]

Context config>service>ies>interface
config>service>ies>sub-if>grp-if
config>service>vprn>interface

Description This command configures a proxy ARP policy for the interface.

The **no** form of this command disables the proxy ARP capability.

Default no proxy-arp-policy

Parameters *policy-name* — The export route policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

The specified name(s) must already be defined.

redirects

Syntax **redirects** [*number seconds*]
no redirects

Context config>service>ies>if>icmp
config>service>ies>sub-if>grp-if
config>service>vprn>interface

Description This command configures the rate for Internet Control Message Protocol (ICMP) redirect messages issued on the router interface.

When routes are not optimal on this router and another router on the same subnetwork has a better route, the router can issue an ICMP redirect to alert the sending node that a better route is available.

The **redirects** command enables the generation of ICMP redirects on the router interface. The rate at which ICMP redirects is issued can be controlled with the optional *number* and *seconds* parameters by indicating the maximum number of redirect messages that can be issued on the interface for a given time interval.

By default, generation of ICMP redirect messages is enabled at a maximum rate of 100 per 10 second time interval. (*Default: redirects 100 10*)

The **no** form of this command disables the generation of icmp redirects on the router interface.

Default **redirects 100 10** — Maximum of 100 redirect messages in 10 seconds.

Parameters *number* — The maximum number of ICMP redirect messages to send. This parameter must be specified with the *second* parameter.

Values 10 — 1000

seconds — The time frame in seconds used to limit the *number* of ICMP redirect messages that can be issued.

Values 1 — 60

remote-proxy-arp

Syntax [**no**] **remote-proxy-arp**

Context config>service>ies>interface
config>service>vprn>interface
config>service>ies>sub-if>grp-if

Description This command enables remote proxy ARP on the interface.

Remote proxy ARP is similar to proxy ARP. It allows the router to answer an ARP request on an interface for a subnet that is not provisioned on that interface. This allows the router to forward to the other subnet on behalf of the requester. To distinguish remote proxy ARP from local proxy ARP, local proxy ARP performs a similar function but only when the requested IP is on the receiving interface.

Default no remote-proxy-arp

static-arp

Syntax **static-arp** *ip-address ieee-mac-address*
no static-arp *ip-address ieee-mac-address*

Context config>service>ies>interface
config>service>vprn>interface

Description This command configures a static address resolution protocol (ARP) entry associating a subscriber IP address with a MAC address for the core router instance. This static ARP will appear in the core routing ARP table. A static ARP can only be configured if it exists on the network attached to the IP interface.

If an entry for a particular IP address already exists and a new MAC address is configured for the IP address, the existing MAC address will be replaced with the new MAC address.

The **no** form of this command removes a static ARP entry.

Default none

Parameters *ip-address* — Specifies the IP address for the static ARP in IP address dotted decimal notation.

ieee-mac-address — Specifies the 48-bit MAC address for the static ARP in the form *aa***:***bb***:***cc***:***dd***:***ee***:***ff* or *aa***-***bb***-***cc***-***dd***-***ee***-***ff* where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

ttl-expired

Syntax **ttl-expired** *number seconds*
no ttl-expired

Context config>service>ies>if>icmp

Description This command configures the rate Internet Control Message Protocol. (ICMP) TTL expired messages are issued by the IP interface.
By default, generation of ICMP TTL expired messages is enabled at a maximum rate of 100 per 10 second time interval.

The **no** form of this command disables the limiting the rate of TTL expired messages on the router interface.

Default ttl-expired 100 10

Parameters *number* — The maximum number of ICMP TTL expired messages to send, expressed as a decimal integer. This parameter must be specified with the *seconds* parameter.

Values 10 — 1000

seconds — The time frame in seconds used to limit the *number* of ICMP TTL expired messages that can be issued, expressed as a decimal integer.

Values 1 — 60

unreachables

Syntax **unreachables** [*number seconds*]
no unreachables

Context config>service>ies>if>icmp

Description This command configures the rate for ICMP host and network destination unreachable messages issued on the router interface.

The **unreachables** command enables the generation of ICMP destination unreachables on the router interface. The rate at which ICMP unreachables is issued can be controlled with the optional *number* and *seconds* parameters by indicating the maximum number of destination unreachable messages which can be issued on the interface for a given time interval.
By default, generation of ICMP destination unreachables messages is enabled at a maximum rate of 100 per 10 second time interval.

The **no** form of this command disables the generation of icmp destination unreachables on the router interface.

Default **unreachables 100 10**

Parameters *number* — The maximum number of ICMP unreachable messages to send. This parameter must be specified with the *seconds* parameter.

Values 10 — 1000

seconds — The time frame in seconds used to limit the *number* of ICMP unreachable messages that can be issued.

Values 1 — 60

Interface IPv6 Commands

ipv6

Syntax [**no**] **ipv6**

Context config>service>ies>interface
config>service>ies>sub-if>grp-if

Description This command enables the context to configure IPv6 for an interface.

address

Syntax **address** *ipv6-address/prefix-length* [**eui-64**]
no address *ipv6-address/prefix-length*

Context config>service>ies>if>ipv6

Description This command assigns an IPv6 address to the IES interface.

Parameters *ipv6-address/prefix-length* — Specify the IPv6 address on the interface.

Values		
ipv6-address	x:x:x:x:x:x:x:x	(eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d	
	x [0 — FFFF]H	
	d [0 — 255]D	
prefix-length	1 — 128	

eui-64 — When the **eui-64** keyword is specified, a complete IPv6 address from the supplied prefix and 64-bit interface identifier is formed. The 64-bit interface identifier is derived from MAC address on Ethernet interfaces. For interfaces without a MAC address, for example ATM interfaces, the Base MAC address of the chassis is used.

default-dns

Syntax **default-dns** *ipv6-address* [**secondary** *ipv6-address*]
no default-dns

Context config>service>ies>sub-if>ipv6
config>service>vprn>sub-if>ipv6

Description Configure last resort IPv6 DNS addresses that can be used for name resolution by IPoEv6 hosts (IA_NA, IA_PD and SLAAC) and PPPoEv6 hosts (IA_NA, IA_PD and SLAAC)

Default no default-dns

Parameters *ipv6-addres* — s - IPv6 address of the primary DNS server

secondary *ipv6-address* — IPv6 address of the secondary DNS server (optional)

allow-unmatching-prefixes

Syntax [**no**] **allow-unmatching-prefixes**

Context configure>service>vprn>sub-if>ipv6
configure>service>ies>sub-if>ipv6

Description This command allows address assignments for IPoEv6 and PPPoEv6 hosts in cases where the subscriber host assigned IPv6 address or prefix falls outside of the subscriber-prefix range explicitly configured for the subscriber-interface (**configure>service>vprn/ies>sub-if>ipv6**> or the subscriber-prefix is not configured at all.

SLAAC hosts will be installed in the FIB as /64 entries, the length of the installed DHCP-PD prefix will be dictated by the prefix-length and the DHCP-NA host will be installed as /128 entries.

IPv4 subscriber hosts are unaffected by this command.

Default no allow-unmatching-prefixes

delegated-prefix-length

Syntax **delegated-prefix-length** *bits*
delegated-prefix-length variable
no delegated-prefix-length

Context configure>service>vprn>sub-if>ipv6
configure>service>ies>sub-if>ipv6

Description This command configures the subscriber-interface level setting for delegated prefix length. The delegated prefix length for a subscriber- interface can be either set to a fixed value that is explicitly configured under the subscriber-interface CLI hierarchy or a variable value that can be obtained from various sources. This command can be changed only when no IPv6 prefixes are configured under the subscriber-interface.

Default no delegated-prefix-length This means that the delegated prefix length is 64.

Parameters *bits* — The delegated prefix length in bits. This value will beapplicable to the entire subscriber-interface. In case that the delegated prefix length is also supplied via other means (LUDB, RADIUS or DHCP Server), such supplied value must match the value configured under the subscriber-interface. Otherwise the prefix instantiation in 7x50 will fail.

Values 48 — 64

variable — The delegated prefix value can be of any length between 48..64. The value itself can vary between the prefixes and it will be provided at the time of prefix instantiation. The order of priority for the source of the delegated prefix length is:

- LUDB
- RADIUS
- DHCPv6 server

subscriber-prefixes

Syntax [**no**] **subscriber-prefixes**

Context config>services>ies>sub-if>ipv6
config>services>vprn>sub-if>ipv6

Description This command specifies aggregate off-link subscriber prefixes associated with this subscriber interface. Individual prefixes are specified under the prefix context list aggregate routes in which the next-hop is indirect via the subscriber interface.

prefix

Syntax **prefix** *ipv6-address/prefix-length* [**pd**] [**wan-host**]
no prefix *ipv6-address/prefix-length*

Context config>services>ies>sub-if>ipv6>sub-prefixes
config>services>vprn>sub-if>ipv6>sub-prefixes

Description This command allows a list of prefixes(using the prefix command multiple times) to be routed to hosts associated with this subscriber interface. Each prefix will be represented in the associated FIB with a reference to the subscriber interface. Prefixes are defined as being for prefix delegation (pd) or use on a WAN interface or host (wan-host).

Parameters *ipv6-address* — Specifies the 128-bit IPv6 address.

Values 128-bit hexadecimal IPv6 address in compressed form.

prefix-length — Specifies the length of any associated aggregate prefix.

Values 32-63

pd — Specifies that this aggregate is used by IPv6 ESM hosts for DHCPv6 prefix-delegation.

wan-host — Specifies that this aggregate is used by IPv6 ESM hosts for local addressing or by a routing gateway's WAN interface.

dhcp6-relay

Syntax [**no**] **dhcp6-relay**

Context config>service>ies>if>ipv6

Description This command enables the context to configure DHCPv6 relay parameters for the IES interface.

The **no** form of the command disables DHCP6 relay.

lease-populate

Syntax **lease-populate** [*nbr-of-leases*]
lease-populate [*nbr-of-leases*] **route-populate** [**pd**] **na** [**ta**]
lease-populate [*nbr-of-leases*] **route-populate pd** [**na**] [**ta**] [**exclude**]
lease-populate [*nbr-of-leases*] **route-populate** [**pd**] [**na**] **ta**
no lease-populate

Context config>service>ies>if>ipv6>dhcp6-relay
config>service>vprn>if>ipv6>dhcp6-relay

Description This command specifies the maximum number of DHCPv6 lease states allocated by the DHCPv6 relay function, allowed on this interface.

Optionally, by specifying "route-populate" parameter, system could:

- Create routes based on the IA_PD/IA_NA/IA_TA prefix option in relay-reply message.
- Create black hole routes based on OPTION_PD_EXCLUDE in IA_PD in relay-reply message.

These routes could be redistributed into IGP/BGP by using route-policy, following protocol types that could be used in "from protocol":

- dhcpv6-pd
- dhcpv6-na
- dhcpv6-ta
- dhcpv6-pd-excl

The **no** form of the command disables dynamic host lease state management.

Default no lease-populate

Parameters *nbr-of-leases* — Defines the number lease state table entries allowed for this interface. If this parameter is omitted, only a single entry is allowed. Once the maximum number of entries has been reached, subsequent lease state entries are not allowed and subsequent DHCP6 ACK messages are discarded.

Values 1 — 8000

route-populate — Create routes based on options in relay-reply messages.

Values pd/na/ta — Create route based on specified option.
exclude — Create blackhole route based on OPTION_PD_EXCLUDE

neighbor-resolution

Syntax [**no**] **neighbor-resolution**

Context config>service>ies>if>ipv6>dhcp6-relay

Description This command enables neighbor resolution with DHCPv6 relay.

The **no** form of the command disables neighbor resolution.

remote-id

Syntax [**no**] **remote-id**

Context config>service>ies>if>ipv6>dhcp6>option

Description This command enables the sending of remote ID option in the DHCPv6 relay packet.

The client DHCP Unique Identifier (DUID) is used as the remote ID.

option

Syntax [**no**] **option**

Context config>service>ies>if>ipv6>dhcp6-relay

Description This command enables the context to configure DHCPv6 relay information options.

The **no** form of the command disables DHCPv6 relay information options.

interface-id

Syntax **interface-id**
interface-id ascii-tuple
interface-id ifindex
interface-id sap-id
no interface-id

Context config>service>ies>if>ipv6>dhcp6>option

Description This command enables the sending of interface ID options in the DHCPv6 relay packet.

The **no** form of the command disables the sending of interface ID options in the DHCPv6 relay packet

Parameters **ascii-tuple —** Specifies that the ASCII-encoded concatenated tuple will be used which consists of the access-node-identifier, service-id, and interface-name, separated by "|".

ifindex — Specifies that the interface index will be used. (The If Index of a router interface can be displayed using the command `show>router>interface>detail`)

sap-id — Specifies that the SAP identifier will be used.

The **no** form of the command disables the sending of remote ID option in the DHCPv6 relay packet.

icmp6

Syntax **icmp6**

Context config>service>ies>if>ipv6

Description This command configures ICMPv6 parameters for the interface.

packet-too-big

Syntax **packet-too-big** [*number seconds*]
no packet-too-big

Context config>service>ies>if>ipv6>icmp6

Description This command specifies whether “packet-too-big” ICMP messages should be sent. When enabled, ICMPv6 “packet-too-big” messages are generated by this interface.

The **no** form of the command disables the sending of ICMPv6 “packet-too-big” messages.

Default 100 10

Parameters *number* — Specifies the number of “packet-too-big” ICMP messages to send in the time frame specified by the *seconds* parameter.

Values 10 — 1000

Default 100

seconds — Specifies the time frame in seconds that is used to limit the number of “packet-too-big” ICMP messages issued.

Values 1 — 60

Default 10

param-problem

Syntax **param-problem** [*number seconds*]
no packet-too-big

Context config>service>ies>if>ipv6>icmp6

Description This command specifies whether “parameter-problem” ICMP messages should be sent. When enabled', “parameter-problem” ICMP messages are generated by this interface.

The **no** form of the command disables the sending of “parameter-problem” ICMP messages.

Default 100 10

number — Specifies the number of "parameter-problem" ICMP messages to send in the time frame specified by the *seconds* parameter.

Values 10 — 1000

Default 100

seconds — Specifies the time frame in seconds that is used to limit the number of "parameter-problem" ICMP messages issued.

Values 1 — 60

Default 10

redirects

Syntax **redirects** [*number seconds*]
no redirects

Context config>service>ies>if>ipv6>icmp6

Description This command configures ICMPv6 redirect messages. When enabled, ICMPv6 redirects are generated when routes are not optimal on this router and another router on the same subnetwork has a better route in order to alert that node that a better route is available.

When disabled, ICMPv6 redirects are not generated.

Default 100 10

number — Specifies the number of version 6 redirects are to be issued in the time frame specified by the *seconds* parameter.

Values 10 — 1000

Default 100

seconds — Specifies the time frame in seconds that is used to limit the number of version 6 redirects issued.

Values 1 — 60

Default 10

time-exceeded

Syntax **time-exceeded** [*number seconds*]
no time-exceeded

Context config>service>ies>if>ipv6>icmp6

Description This command specifies whether "time-exceeded" ICMP messages should be sent. When enabled, ICMPv6 "time-exceeded" messages are generated by this interface.

When disabled, ICMPv6 "time-exceeded" messages are not sent.

Default 100 10

number — Specifies the number of "time-exceeded" ICMP messages are to be issued in the time frame specified by the *seconds* parameter.

Values 10 — 1000

Default 100

seconds — Specifies the time frame in seconds that is used to limit the number of "time-exceeded" ICMP message to be issued.

Values 1 — 60

Default 10

unreachables

Syntax **unreachables** [*number seconds*]
no unreachables

Context config>service>ies>if>ipv6>icmp6

Description This command specifies that ICMPv6 host and network unreachable messages are generated by this interface.

When disabled, ICMPv6 host and network unreachable messages are not sent.

Default 100 10

number — Specifies the number of destination unreachable ICMPv6 messages are issued in the time frame specified by the *seconds* parameter.

Values 10 — 1000

Default 100

seconds — Specifies the time frame in seconds that is used to limit the number of destination unreachable ICMPv6 messages to be issued.

Values 1 — 60

Default 10

local-proxy-nd

Syntax [**no**] **local-proxy-nd**

Context config>service>ies>if>ipv6

Description When this command is enabled, the interface will reply to neighbor solicitation requests when both the hosts are on the same subnet. In this case, ICMP redirects will be disabled. When this command is disabled, the interface will not reply to neighbor solicitation requests if both the hosts are on the same subnet.

Default disabled

neighbor

Syntax **neighbor** *ipv6-address mac-address*
no neighbor *ipv6-address*

Context config>service>ies>if>ipv6

Description This command configures IPv6-to-MAC address mapping on the IES interface.

Parameters *ipv6-address* — The IPv6 address of the interface for which to display information.

Values x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x: [0 — FFFF]H
d: [0 — 255]D
prefix-length [1..128]

mac-address — Specifies the 48-bit MAC address for the IPv6-to-MAC address mapping in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

proxy-nd-policy

Syntax **proxy-nd-policy** *policy-name* [*policy-name*...(up to 5 max)]
no proxy-nd-policy

Context config>service>ies>if>ipv6

Description This command configures a proxy neighbor discovery policy for the interface. This policy determines networks and sources for which proxy ND will be attempted, when local proxy neighbor discovery is enabled.

The **no** form of this command reverts to the default value.

Default no proxy-nd-policy

Parameters *policy-name* — The export route policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

The specified name(s) must already be defined.

Show Commands

egress-label

Syntax **egress-label** *egress-label1* [*egress-label2*]

Context show>service

Description Display services using the range of egress labels.

If only the mandatory *egress-label1* parameter is specified, only services using the specified label are displayed.

If both *egress-label1* and *egress-label2* parameters are specified, the services using the range of labels X where *egress-label1* <= X <= *egress-label2* are displayed.

Use the **show router ldp bindings** command to display dynamic labels.

Parameters *egress-label1* — The starting egress label value for which to display services using the label range. If only *egress-label1* is specified, services only using *egress-label1* are displayed.

Values 0, 2049 — 131071

egress-label2 — The ending egress label value for which to display services using the label range.

Default The *egress-label1* value.

Values 2049 — 131071

Output **Show Service Egress Command Output —** The following table describes show service egress label output fields.

Label	Description
Svc Id	The ID that identifies a service.
Sdp Id	The ID that identifies an SDP.
Type	Indicates whether the SDP binding is a spoke or a mesh.
I. Lbl	The VC label used by the far-end device to send packets to this device in this service by the SDP.
E. Lbl	The VC label used by this device to send packets to the far-end device in this service by the SDP.
Number of bindings found	The total number of SDP bindings that exist within the specified egress label range.

Sample Output

```
A:ALA-12# show service egress-label 0 10000
==============================================================================
Martini Service Labels
==============================================================================
Svc Id     Sdp Id             Type I.Lbl        E.Lbl
------------------------------------------------------------------------------
1          10:1               Mesh 0            0
1          20:1               Mesh 0            0
1          30:1               Mesh 0            0
1          100:1              Mesh 0            0
...
1          107:1              Mesh 0            0
1          108:1              Mesh 0            0
1          300:1              Mesh 0            0
1          301:1              Mesh 0            0
1          302:1              Mesh 0            0
1          400:1              Mesh 0            0
1          500:2              Spok 131070       2001
1          501:1              Mesh 131069       2000
100        300:100            Spok 0            0
200        301:200            Spok 0            0
300        302:300            Spok 0            0
400        400:400            Spok 0            0
------------------------------------------------------------------------------
Number of Bindings Found : 23
==============================================================================
A:ALA-12#
```

fdb-info

Syntax **fdb-info**

Context show>service

Description This command displays global FDB usage information.

Output **Show FDB-Info Command Output —** The following table describes show FDB-Info command output.

Label	Description
Service ID	The ID that identifies a service.
Mac Move	Indicates the administrative state of the MAC movement feature associated with the service.
Mac Move Rate	The maximum rate at which MACs can be re-learned in this service, before the SAP where the moving MAC was last seen is automatically disabled in order to protect the system against undetected loops or duplicate MACs. The rate is computed as the maximum number of re-learns allowed in a 5 second interval: for example, the default rate of 10 re-learns per second corresponds to 50 re-learns in a 5 second period.

Label	Description (Continued)
Mac Move Timeout	Indicates the time in seconds to wait before a SAP that has been disabled after exceeding the maximum re-learn rate is re-enabled. A value of zero indicates that the SAP will not be automatically re-enabled after being disabled. If after the SAP is re-enabled it is disabled again, the effective retry timeout is doubled in order to avoid thrashing.
Table Size	The maximum number of learned and static entries allowed in the FDB.
Total Count	The current number of entries (both learned and static) in the FDB.
Learned Count	The current number of learned entries in the FDB.
Static Count	The current number of static entries in the FDB.
Remote Age	The number of seconds used to age out FDB entries learned on an SDP. These entries correspond to MAC addresses learned on remote SAPs.
Local Age	The number of seconds used to age out FDB entries learned on local SAPs.
High WaterMark	The utilization of the FDB table of this service at which a 'table full' alarm is raised by the agent.
Low WaterMark	The utilization of the FDB table of this service at which a 'table empty' alarm is raised by the agent.
Mac Learning	Specifies whether the MAC learning process is enabled in this service.
Discard Unknown	Specifies whether frames received with an unknown destination MAC are discarded in this service.
MAC Aging	Specifies whether the MAC aging process is enabled in this service.
MAC Pinning	Specifies whether MAC Pinning is enabled in this service.
Relearn Only	When enabled, indicates that either the FDB table of this service is full or that the maximum system-wide number of MACs supported by the agent has been reached, and thus MAC learning is temporary disabled, and only MAC re-learns can take place.
Total Service FDBs	The current number of service FDBs configured on this node.
Total FDB Size	The sum of configured FDBs.
Total FDB Entries In Use	The total number of entries (both learned and static) in use.

Sample Output

```
A:ALA-12# show service fdb-info
===============================================================================
Forwarding Database (FDB) Information
===============================================================================
Service Id        : 700                 Mac Move          : Disabled
Mac Move Rate     : 10                  Mac Move Timeout  : 10
Table Size        : 250                 Total Count       : 0
Learned Count     : 0                   Static Count      : 0
Remote Age        : 900                 Local Age         : 300
High WaterMark    : 95%                 Low Watermark     : 90%
Mac Aging         : Enabl               Relearn Only      : False

Service Id        : 725                 Mac Move          : Disabled
Mac Move Rate     : 10                  Mac Move Timeout  : 10
Table Size        : 250                 Total Count       : 0
Learned Count     : 0                   Static Count      : 0
Remote Age        : 900                 Local Age         : 300
High WaterMark    : 95%                 Low Watermark     : 90%
Mac Learning      : Enabl               Discard Unknown   : Dsabl
Mac Aging         : Enabl               Relearn Only      : False

Service Id        : 740                 Mac Move          : Disabled
Mac Move Rate     : 10                  Mac Move Timeout  : 10
Table Size        : 250                 Total Count       : 0
Learned Count     : 0                   Static Count      : 0
Remote Age        : 900                 Local Age         : 300
High WaterMark    : 95%                 Low Watermark     : 90%
Mac Learning      : Enabl               Discard Unknown   : Dsabl
Mac Aging         : Enabl               Relearn Only      : False
...
-------------------------------------------------------------------------------
Total Service FDBs : 7
Total FDB Configured Size : 1750
Total FDB Entries In Use  : 0
-------------------------------------------------------------------------------
===============================================================================
*A:ALA-48#
```

fdb-mac

Syntax **fdb-mac** *ieee-address*

Context show>service

Description Displays the FDB entry for a given MAC address.

Parameters *ieee-address* — The 48-bit MAC address for which to display the FDB entry in the form *aa*:*bb*:*cc*:*dd*:*ee*:*ff* or *aa-bb-cc-dd-ee-ff* where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers.

Output **Show FDB-MAC Command Output —** The following table describes the show FDB MAC command output fields:

Label	Description
Service ID	The value that identifies a specific service.
MAC	The specified MAC address
Source-Identifier	The location where the MAC is defined.
Type	Static – FDB entries created by management.
	Learned – Dynamic entries created by the learning process.
	OAM – Entries created by the OAM process.

Sample Output

```
A:ALA-12# show service fdb-mac 00:99:00:00:00:00
===============================================================================
Services Using Forwarding Database Mac 00:99:00:00:00:00
===============================================================================
ServId  MAC                    Source-Identifier       Type/Age Last Change
-------------------------------------------------------------------------------
1       00:99:00:00:00:00             sap:1/2/7:0               Static
===============================================================================
A:ALA-12#
```

ingress-label

Syntax **ingress-label** *ingress-label1* [*ingress-label2*]

Context show>service

Description Display services using the range of ingress labels.

If only the mandatory *ingress-label1* parameter is specified, only services using the specified label are displayed.

If both *ingress-label1* and *ingress-label2* parameters are specified, the services using the range of labels X where *ingress-label1* <= X <= *ingress-label2* are displayed.

Use the **show router** *vprn-service-id* **ldp bindings** command to display dynamic labels.

Parameters *ingress-label1* — The starting ingress label value for which to display services using the label range. If only *ingress-label1* is specified, services only using *ingress-label1* are displayed.

Values 0, 2048 —131071

ingress-label2 — The ending ingress label value for which to display services using the label range.

Default The *ingress-label1* value.

Values 2048 — 131071

Output **Show Service Ingress Label —** The following table describes show service ingress label output fields:

Label	Description
Svc ID	The value that identifies a specific service.
SDP Id	The SDP identifier.
Type	Indicates whether the SDP is a spoke or a mesh.
I.Lbl	The ingress label used by the far-end device to send packets to this device in this service by the SDP.
E.Lbl	The egress label used by this device to send packets to the far-end device in this service by the SDP.
Number of Bindings Found	The number of SDP bindings within the label range specified.

Sample Output

```
A:ALA-12# show service ingress label 0
===============================================================================
Martini Service Labels
===============================================================================
Svc Id     Sdp Id             Type I.Lbl        E.Lbl
-------------------------------------------------------------------------------
1          10:1               Mesh 0            0
1          20:1               Mesh 0            0
1          30:1               Mesh 0            0
1          50:1               Mesh 0            0
1          100:1              Mesh 0            0
1          101:1              Mesh 0            0
1          102:1              Mesh 0            0
1          103:1              Mesh 0            0
1          104:1              Mesh 0            0
1          105:1              Mesh 0            0
1          106:1              Mesh 0            0
1          107:1              Mesh 0            0
1          108:1              Mesh 0            0
1          300:1              Mesh 0            0
1          301:1              Mesh 0            0
1          302:1              Mesh 0            0
1          400:1              Mesh 0            0
1          500:2              Spok 131070       2001
1          501:1              Mesh 131069       2000
100        300:100            Spok 0            0
200        301:200            Spok 0            0
300        302:300            Spok 0            0
400        400:400            Spok 0            0
-------------------------------------------------------------------------------
Number of Bindings Found : 23
-------------------------------------------------------------------------------
A:ALA-12#
```

sap-using

Syntax **sap-using** [**sap** *sap-id*]
sap-using interface [*ip-address* | *ip-int-name*]
sap-using [**ingress** | **egress**] **atm-td-profile** *td-profile-id*
sap-using [**ingress** | **egress**] **filter** *filter-id*
sap-using [**ingress** | **egress**] **qos-policy** *qos-policy-id*
sap-using authentication-policy *auth-plcy-name*

Context show>service

Description Displays SAP information.

If no optional parameters are specified, the command displays a summary of all defined SAPs.

The optional parameters restrict output to only SAPs matching the specified properties.

Parameters **ingress —** Specifies matching an ingress policy.

egress — Specifies matching an egress policy.

qos-policy *qos-policy-id* **—** The ingress or egress QoS Policy ID for which to display matching SAPs.

Values 1 — 65535

atm-td-profile *td-profile-id* **—** Displays SAPs using this traffic description.

filter *filter-id* **—** The ingress or egress filter policy ID for which to display matching SAPs.

Values 1 — 65535

authentication *auth-plcy-name* **—** The session authentication policy for which to display matching SAPs.

sap-id — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

interface — Specifies matching SAPs with the specified IP interface.

ip-addr — The IP address of the interface for which to display matching SAPs.

Values 1.0.0.0 — 223.255.255.255

ip-int-name — The IP interface name for which to display matching SAPs.

Output **Show Service SAP —** The following table describes show service SAP output fields:

Label	Description
Port ID	The ID of the access port where the SAP is defined.
Svc ID	The service identifier.
SapMTU	The SAP MTU value.
I.QoS	The SAP ingress QoS policy number specified on the ingress SAP.
I.MAC/IP	The MAC or IP filter policy ID applied to the ingress SAP.

Label	Description (Continued)
E.QoS	The SAP egress QoS policy number specified on the egress SAP.
E.Mac/IP	The MAC or IP filter policy ID applied to the egress SAP
A.Pol	The accounting policy ID assigned to the SAP.
Adm	The administrative state of the SAP.
Opr	The operational state of the SAP.

Sample Output

```
A:ALA-12# show service sap-using sap 1/1
===============================================================================
Service Access Points
===============================================================================
PortId          SvcId      SapMTU I.QoS I.Mac/IP E.QoS E.Mac/IP A.Pol  Adm  Opr
-------------------------------------------------------------------------------
1/1/7:0         1          1518   10    8        10    none     none   Up   Up
1/1/11:0        100        1514   1     none     1     none     none   Down Down
1/1/7:300       300        1518   10    none     10    none     1000   Up   Up
-------------------------------------------------------------------------------
Number of SAPs : 3
-------------------------------------------------------------------------------
A:ALA-12#
```

sdp

Syntax **sdp** [*sdp-id* | **far-end** *ip-addr*] [**detail**]

Context show>service>id

Description Displays information for the SDPs associated with the service.

If no optional parameters are specified, a summary of all associated SDPs is displayed.

Parameters *sdp-id* — Displays only information for the specified SDP ID.

Default All SDPs

Values 1 — 17407

far-end *ip-addr* **—** Displays only SDPs matching with the specified far-end IP address.

Default SDPs with any far-end IP address.

detail — Displays detailed SDP information.

Output **Show Service-ID SDP —** The following table describes show service-id SDP output fields:

Label	Description
Sdp Id	The SDP identifier.

Label	Description (Continued)
Type	Indicates whether the SDP is a spoke or a mesh.
Split Horizon Group	Name of the split horizon group that the SAP belongs.
VC Type	Displays the VC type: ether, vlan, or vpls.
VC Tag	Displays the explicit dot1Q value used when encapsulating to the SDP far end.
I. Lbl	The VC label used by the far-end device to send packets to this device in this service by the SDP.
Admin Path MTU	The operating path MTU of the SDP is equal to the admin path MTU (when one is set) or the dynamically computed tunnel MTU, when no admin path MTU is set (the default case.)
Oper Path MTU	The actual largest service frame size (in octets) that can be transmitted through this SDP to the far-end router, without requiring the packet to be fragmented.
Far End	Specifies the IP address of the remote end of the GRE or MPLS tunnel defined by this SDP.
Delivery	Specifies the type of delivery used by the SDP: GRE or MPLS.
Admin State	The administrative state of this SDP.
Oper State	The current status of the KeepAlive protocol.
Ingress Label	The label used by the far-end device to send packets to this device in this service by this SDP.
Egress Label	The label used by this device to send packets to the far-end device in this service by the SDP.
Last Changed	The date and time of the most recent change to the SDP.
Signaling	Specifies the signaling protocol used to obtain the ingress and egress labels used in frames transmitted and received on this SDP.
Admin State	The administrative state of the keepalive process.
Oper State	The operational state of the keepalive process.
Hello Time	Specifies how often the SDP echo request messages are transmitted.
Max Drop Count	Specifies the maximum number of consecutive SDP echo request messages that can be unacknowledged before the keepalive protocol reports a fault.
Hello Msg Len	Specifies the length of the transmitted SDP echo request messages.
Hold Down Time	Specifies the amount of time to wait before the keepalive operating status is eligible to enter the alive state.

Label	Description (Continued)
I. Fwd. Pkts.	Specifies the number of forwarded ingress packets.
I. Dro. Pkts	Specifies the number of dropped ingress packets.
E. Fwd. Pkts.	Specifies the number of forwarded egress packets.
E. Fwd. Octets	Specifies the number of forwarded egress octets.
Associated LSP List	When the SDP type is MPLS, a list of LSPs used to reach the far-end router displays. All the LSPs in the list must terminate at the IP address specified in the far end field. If the SDP type is GRE, then the following message displays: SDP delivery mechanism is not MPLS

Sample Output

```
*A:ALA-48# show service id 700 sdp 2
===============================================================================
Service Destination Point (Sdp Id : 2)
===============================================================================
SdpId            Type IP address      Adm     Opr       I.Lbl       E.Lbl
-------------------------------------------------------------------------------
2:222            Spok 10.10.10.104    Up      Down      0           0
2:700            Mesh 10.10.10.104    Up      Down      0           0
===============================================================================
*A:ALA-48#
```

sdp-using

Syntax **sdp-using** [*sdp-id*[:*vc-id*] | far-end *ip-address*]

Context show>service

Description Display services using SDP or far-end address options.

Parameters *sdp-id* — Displays only services bound to the specified SDP ID.

Values 1 — 17407

vc-id — The virtual circuit identifier.

Values 1 — 4294967295

far-end *ip-address* — Displays only services matching with the specified far-end IP address.

Default Services with any far-end IP address.

Output **Show Service SDP Using X —** The following table describes **sdp-using** output fields.

Label	Description
Svc ID	The value identifying a service.

Label	Description (Continued)
Spd ID	The SPD identifier.
Type	Type of SDP: Spoke or Mesh.
Far End	The far-end address of the SDP.
Oper State	The operational state of the service.
Ingress Label	The label used by the far-end device to send packets to this device in this service by this SDP.
Egress Label	The label used by this device to send packets to the far-end device in this service by this SDP.

Sample Output

```
A:ALA-1# show service sdp-using 300
===============================================================================
Service Destination Point (Sdp Id : 300)
===============================================================================
SvcId       SdpId               Type Far End        Opr State I.Label  E.Label
-------------------------------------------------------------------------------
1           300:1               Mesh 10.0.0.13      Up        131071   131071
2           300:2               Spok 10.0.0.13      Up        131070   131070
100         300:100             Mesh 10.0.0.13      Up        131069   131069
101         300:101             Mesh 10.0.0.13      Up        131068   131068
102         300:102             Mesh 10.0.0.13      Up        131067   131067
-------------------------------------------------------------------------------
Number of SDPs : 5
===============================================================================
A:ALA-1#
```

service-using

Syntax **service-using** [**ies**] [**vpls**] [**vprn**] [**sdp** *sdp-id*]

Context show>service

Description This command displays the services matching certain usage properties.

If no optional parameters are specified, all services defined on the system are displayed.

Parameters **ies —** Displays matching IES instances.

vpls — Displays matching VPLS instances.

vprn — Displays matching VPRN instances.

sdp *sdp-id* **—** Displays only services bound to the specified SDP ID.

Default Services bound to any SDP ID.

Values 1 — 17407

Output **Show Service Service-Using —** The following table describes show **service-using** output fields:

Label	Description
Service Id	The value that identifies a service.
Type	Specifies the service type configured for the service ID.
Adm	The administrative state of the service.
Opr	The operational state of the service.
CustomerID	The value that identifies a specific customer.
Last Mgmt Change	The date and time of the most recent management-initiated change to this service.

Sample Output

```
*A:ALA-48>show>service# service-using vpls
===============================================================================
Services [vpls]
===============================================================================
ServiceId    Type      Adm    Opr        CustomerId        Last Mgmt Change
-------------------------------------------------------------------------------
700          VPLS      Up     Down       7                 04/11/2007 09:36:36
725          VPLS      Down   Down       7                 04/11/2007 09:36:36
740          VPLS      Down   Down       1                 04/11/2007 09:36:36
750          VPLS      Down   Down       7                 04/11/2007 09:36:36
1730         VPLS      Down   Down       1730              04/11/2007 09:36:36
9000         VPLS      Up     Down       6                 04/11/2007 09:36:36
90001        VPLS      Up     Down       6                 04/11/2007 09:36:36
-------------------------------------------------------------------------------
Matching Services : 7
===============================================================================
*A:ALA-48>show>service#
```

active-subscribers

Syntax **active-subscribers detail**
active-subscribers mirror
active-subscribers summary

Context show>service

Description This command displays active subscriber information.

Parameters **summary —** Displays active subscriber information in a brief format.

detail — Displays detailed output.

Sample Output

```
*A:Dut-C# show service active-subscribers
===============================================================================
```

```
Active Subscribers
===============================================================================
-------------------------------------------------------------------------------
Subscriber hpolSub1 (hpolSubProf2)
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
(1) SLA Profile Instance sap:lag-1:2000.1 - sla:hpolSlaProf1
-------------------------------------------------------------------------------
IP Address
                MAC Address       PPPoE-SID Origin
-------------------------------------------------------
200.1.4.194
                00:01:00:00:03:c1 1         IPCP
-------------------------------------------------------------------------------
(2) SLA Profile Instance sap:lag-1:2000.1 - sla:hpolSlaProf2
-------------------------------------------------------------------------------
IP Address
                MAC Address       PPPoE-SID Origin
-------------------------------------------------------
200.1.4.35
                00:01:00:00:03:22 N/A       ARP-Host
200.1.4.195
                00:01:00:00:03:c2 1         IPCP
-------------------------------------------------------------------------------
Subscriber hpolSub16 (hpolSubProf1)
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
(1) SLA Profile Instance sap:[lag-1:2000.2] - sla:hpolSlaProf1
-------------------------------------------------------------------------------
IP Address
                MAC Address       PPPoE-SID Origin
-------------------------------------------------------
200.1.4.224
                00:01:00:00:03:df 1         IPCP
-------------------------------------------------------------------------------
Subscriber hpolSub2 (hpolSubProf1)
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
(1) SLA Profile Instance sap:lag-1:2000.1 - sla:hpolSlaProf1
-------------------------------------------------------------------------------
IP Address
                MAC Address       PPPoE-SID Origin
-------------------------------------------------------
200.1.4.196
                00:01:00:00:03:c3 1         IPCP
-------------------------------------------------------------------------------
Number of active subscribers : 3
===============================================================================
*A:Dut-C#
```

credit-control

Syntax **credit-control credit-control** [**subscriber** *sub-ident-string*]
credit-control out-of-credit [**action** *action*] [**summary**]

Context show>service>active-subscribers

Description This command displays active subscriber credit control information.

filter

Syntax **filte**r [**subscriber** *sub-ident-string*] [**origin** *origin*]

Context show>service>active-subscribers

Description This command displays active subscriber filter information.

hierarchy

Syntax **hierarchy** [**subscriber** *sub-ident-string*]

Context show>service>active-subscribers

Description This command displays active subscriber hierarchy information.

host-tracking

Syntax **host-tracking** [**subscriber** *sub-ident-string*]
host-tracking [**subscriber** *sub-ident-string*] **detail**
host-tracking [**subscriber** *sub-ident-string*] **summary**
host-tracking [**subscriber** *sub-ident-string*] **statistics**

Context show>service>active-subscribers

Description This command displays active subscriber host tracking information.

groups

Syntax **groups** [**group** *group-ip-address*]
groups group *group-ip-address*] **detail**
groups group *group-ip-address*] **summary**

Context show>service>active-subscribers

Description This command displays active subscriber host tracking groups information.

igmp

Syntax **igmp** [**subscriber** *sub-ident-string*][**detail**]

Context show>service>active-subscribers

Description This command displays active subscriber IGMP information.

Sample Output

```
*B:Dut-C# show service active-subscribers igmp
===============================================================================
Active Subscribers
===============================================================================
Subscriber                      IGMP-Policy
  HostAddr                      GrpItf                            NumGroups
-------------------------------------------------------------------------------
sub_1                           pol1
  112.112.1.1                   gi_1_1                            1
  112.112.1.2                   gi_1_1                            2
sub_2                           pol1
  112.112.1.3                   gi_1_2                            0
-------------------------------------------------------------------------------
Number of Subscribers : 2
===============================================================================
*B:Dut-C#


*B:Dut-C# show service active-subscribers igmp detail
===============================================================================
Active Subscribers Detail
===============================================================================
Subscriber                      IGMP-Policy
  HostAddr                      GrpItf                            NumGroups
    GrpAddr                     Type            Up-Time           Mode
      SrcAddr                   Type                              Blk/Fwd
-------------------------------------------------------------------------------
sub_1                           pol1
  112.112.1.1                   gi_1_1                            1
    225.0.0.1                   Dynamic         0d 00:00:53       Include
      11.11.0.1                 Dynamic                           Fwd
      11.11.0.2                 Dynamic                           Fwd
  112.112.1.2                   gi_1_1                            2
    225.0.0.1                   Dynamic         0d 00:00:44       Exclude
      11.11.0.1                 Dynamic                           Blk
    225.0.0.2                   Dynamic         0d 00:00:44       Exclude
      11.11.0.1                 Dynamic                           Blk
sub_2                           pol1
  112.112.1.3                   gi_1_2                            0
-------------------------------------------------------------------------------
Number of Subscribers : 2
===============================================================================
*B:Dut-C#

*B:Dut-C# show service active-subscribers igmp subscriber "sub_1" detail
===============================================================================
Active Subscribers Detail
===============================================================================
Subscriber                      IGMP-Policy
```

```
  HostAddr                        GrpItf                          NumGroups
    GrpAddr                       Type            Up-Time         Mode
      SrcAddr                     Type                            Blk/Fwd
-------------------------------------------------------------------------------
sub_1                             pol1
  112.112.1.1                     gi_1_1                          1
    225.0.0.1                     Dynamic         0d 00:01:04     Include
      11.11.0.1                   Dynamic                         Fwd
      11.11.0.2                   Dynamic                         Fwd
  112.112.1.2                     gi_1_1                          2
    225.0.0.1                     Dynamic         0d 00:00:55     Exclude
      11.11.0.1                   Dynamic                         Blk
    225.0.0.2                     Dynamic         0d 00:00:55     Exclude
      11.11.0.1                   Dynamic                         Blk
-------------------------------------------------------------------------------
Number of Subscribers : 1
===============================================================================
B:Dut-C#
```

subscriber

Syntax **subscriber** *sub-ident-string*
subscriber *sub-ident-string* **detail**
subscriber *sub-ident-string* **mirror**
subscriber *sub-ident-string* **sap** *sap-id* **sla-profile** *sla-profile-name*
subscriber *sub-ident-string* **sap** *sap-id* **sla-profile** *sla-profile-name* **detail**
subscriber *sub-ident-string* **sap** *sap-id* **sla-profile** *sla-profile-name* **mirror**

Context show>service>active-subscribers

Description This command displays active subscriber information for a subscriber.

Sample Output

```
*A:Dut-C# show service active-subscribers subscriber "hpolSub1"
===============================================================================
Active Subscribers
===============================================================================
-------------------------------------------------------------------------------
Subscriber hpolSub1 (hpolSubProf2)
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
(1) SLA Profile Instance sap:lag-1:2000.1 - sla:hpolSlaProf1
-------------------------------------------------------------------------------
IP Address
                MAC Address       PPPoE-SID Origin
-------------------------------------------------------
200.1.4.194
                00:01:00:00:03:c1 1         IPCP
-------------------------------------------------------------------------------
(2) SLA Profile Instance sap:lag-1:2000.1 - sla:hpolSlaProf2
-------------------------------------------------------------------------------
IP Address
                MAC Address       PPPoE-SID Origin
-------------------------------------------------------
200.1.4.35
```

```
                00:01:00:00:03:22 N/A       ARP-Host
200.1.4.195
                00:01:00:00:03:c2 1         IPCP
===============================================================================
*A:Dut-C#


*A:Dut-C# show service active-subscribers subscriber "hpolSub1"
sap lag-1:2000.1 sla-profile "hpolSlaProf2"
===============================================================================
Active Subscribers
===============================================================================
-------------------------------------------------------------------------------
Subscriber hpolSub1 (hpolSubProf2)
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
(1) SLA Profile Instance sap:lag-1:2000.1 - sla:hpolSlaProf2
-------------------------------------------------------------------------------
IP Address
                MAC Address       PPPoE-SID Origin
-------------------------------------------------------
200.1.4.35
                00:01:00:00:03:22 N/A       ARP-Host
200.1.4.195
                00:01:00:00:03:c2 1         IPCP
===============================================================================
*A:Dut-C#


*A:Dut-C# show service active-subscribers subscriber "hpolSub1"
sap lag-1:2000.1 sla-profile "hpolSlaProf1" detail
===============================================================================
Active Subscribers
===============================================================================
-------------------------------------------------------------------------------
Subscriber hpolSub1 (hpolSubProf2)
-------------------------------------------------------------------------------
I. Sched. Policy : N/A
E. Sched. Policy : N/A                              E. Agg Rate Limit: 6071693
I. Policer Ctrl. : N/A
E. Policer Ctrl. : N/A
Q Frame-Based Ac*: Disabled
Acct. Policy     : N/A                              Collect Stats    : Disabled
Rad. Acct. Pol.  : hpolRadAcctPol
Dupl. Acct. Pol. : N/A
ANCP Pol.        : N/A
HostTrk Pol.     : N/A
IGMP Policy      : N/A
Sub. MCAC Policy : N/A
NAT Policy       : N/A
Def. Encap Offset: none                             Encap Offset Mode: auto
Avg Frame Size   : 120
Sub. ANCP-String : "hpolSub1"
Sub. Int Dest Id : "2000"
Host Trk Rate Adj: N/A
RADIUS Rate-Limit: 10220541
Oper-Rate-Limit  : 10220541
-------------------------------------------------------------------------------
(1) SLA Profile Instance
    - sap:lag-1:2000.1 (VPRN 2000 - grp-Vprn-1)
    - sla:hpolSlaProf1
```

```
-------------------------------------------------------------------------------
Description          : SLA Profile Id hpolSlaProf1
Host Limit           : No Limit
Ingress Qos-Policy   : 2                      Egress Qos-Policy : 2 (vport)
Ingress Queuing Type : Service-queuing (non policer)
Ingr IP Fltr-Id      : n/a                    Egr IP Fltr-Id    : n/a
Ingr IPv6 Fltr-Id    : n/a                    Egr IPv6 Fltr-Id  : n/a
Ingress Report-Rate  : N/A
Egress Report-Rate   : N/A
Egress Remarking     : from Sap Qos
Credit Control Pol.  : N/A
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
IP Address
                MAC Address       PPPoE-SID Origin
-------------------------------------------------------
200.1.4.194
                00:01:00:00:03:c1 1         IPCP
-------------------------------------------------------------------------
SLA Profile Instance statistics
-------------------------------------------------------------------------
                        Packets                 Octets
Off. HiPrio           : 0                       0
Off. LowPrio          : 0                       0
Off. Uncolor          : 0                       0

Queueing Stats (Ingress QoS Policy 2)
Dro. HiPrio           : 0                       0
Dro. LowPrio          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Queueing Stats (Egress QoS Policy 2)
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0
-------------------------------------------------------------------------
SLA Profile Instance per Queue statistics
-------------------------------------------------------------------------
                        Packets                 Octets
Egress Queue 1
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Egress Queue 2
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Egress Queue 3
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Egress Queue 4
Dro. InProf           : 0                       0
```

```
Dro. OutProf          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Egress Queue 5
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Egress Queue 6
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Egress Queue 7
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Egress Queue 8
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0
-------------------------------------------------------------------------------
SLA Profile Instance per Policer statistics
-------------------------------------------------------------------------------
                        Packets                 Octets
Ingress Policer 1 (Stats mode: minimal)
Off. All              : 0                       0
Dro. All              : 0                       0
For. All              : 0                       0
===============================================================================
*A:Dut-C#
```

id

Syntax **id** *service-id*

Context show>service

Description Enables the context to display information for a particular service-id.

Parameters *service-id* — The unique service identification number that identifies the service in the service domain.

all — Displays detailed information about the service.

arp — Displays ARP entries for the service.

arp-host — Displays ARP host related information.

base — Displays basic service information.

fdb — Displays FDB entries.

host — Displays static hosts configured on the specified service.

labels — Displays labels being used by this service.

sap — Displays SAPs associated to the service.

sdp — Displays SDPs associated with the service.

split-horizon-group — Display split horizon group information.

stp — Displays STP information.

all

Syntax **all**

Context show>service>id

Description Displays detailed information for all aspects of the service.

Output **Show All Service-ID Output —** The following table describes the show all service-id command output fields:

Label	Description
Service Id	The value that identifies a service.
VPN Id	The number that identifies the VPN.
Service Type	Specifies the type of service.
SDP Id	The SDP identifier.
Description	Text string describing general information about the service.
Customer Id	The customer identifier.
Last Mgmt Change	The date and time of the most recent management-initiated change to this customer.
SAP Count	The number of SAPs specified for this service.
SDP Bind Count	The number of SDPs bound to this service.
Split Horizon Group	Name of the split horizon group for this service.
Description	Text string describing the split horizon group.
Last Changed	The date and time of the most recent management-initiated change to this split horizon group.
SDP Id	The SDP identifier.
Type	Indicates whether this Service SDP binding is a spoke or a mesh.

Label	Description (Continued)
Admin Path MTU	The desired largest service frame size (in octets) that can be transmitted through this SDP to the far-end router, without requiring the packet to be fragmented.
Oper Path MTU	The actual largest service frame size (in octets) that can be transmitted through this SDP to the far-end router, without requiring the packet to be fragmented.
Delivery	Specifies the type of delivery used by the SDP: GRE or MPLS.
Admin State	The administrative state of this SDP.
Oper State	The operational status of the KeepAlive protocol.
Ingress Label	The label used by the far-end device to send packets to this device in this service by this SDP.
Egress Label	The label used by this device to send packets to the far-end device in this service by this SDP.
Ingress Filter	The ID of the ingress filter policy.
Egress Filter	The ID of the egress filter policy.
Far End	Specifies the IP address of the remote end of the GRE or MPLS tunnel defined by this SDP.
Last Changed	The date and time of the most recent change to this customer.
Signaling	Specifies the signaling protocol used to obtain the ingress and egress labels used in frames transmitted and received on this SDP.
Admin State	Specifies the operating status of the SDP.
Oper State	The operational state of the SDP.
Hello Time	Specifies how often the SDP echo request messages are transmitted on this SDP.
Hello Msg Len	Specifies the length of the SDP echo request messages transmitted on this SDP.
Max Drop Count	Specifies the maximum number of consecutive SDP echo request messages that can be unacknowledged before the keepalive protocol reports a fault.
Hold Down Time	Specifies the amount of time to wait before the keepalive operating status is eligible to enter the alive state.
SDP Delivery Mechanism	When the SDP type is MPLS, a list of LSPs used to reach the far-end router displays. All the LSPs in the list must terminate at the IP address specified in the Far End field. If the SDP type is GRE, then the following message displays: `SDP Delivery Mechanism is not MPLS`

Label	Description (Continued)
Number of SDPs	The total number SDPs applied to this service ID.
Service Access Points	
Service Id	The value that identifies a service.
Port Id	The ID of the access port where this SAP is defined.
Description	Generic information about the SAP.
Encap Value	The value of the label used to identify this SAP on the access port.
Admin State	The desired state of the SAP.
Oper State	The operating state of the SAP.
Last Changed	The date and time of the last change.
Admin MTU	The desired largest service frame size (in octets) that can be transmitted through this SDP to the far-end router, without requiring the packet to be fragmented.
Oper MTU	The actual largest service frame size (in octets) that can be transmitted through this SDP to the far-end router, without requiring the packet to be fragmented.
Ingress qos-policy	The SAP ingress QoS policy ID.
Egress qos-policy	The SAP egress QoS policy ID.
Ingress Filter-Id	The SAP ingress filter policy ID.
Egress Filter-Id	The SAP egress filter policy ID.
Multi Svc Site	Indicates the multi-service site in which the SAP is a member.
Ingress sched-policy	Indicates the ingress QoS scheduler for the SAP.
Egress sched-policy	Indicates the egress QoS scheduler for the SAP.
Acct. Pol	Indicates the accounting policy applied to the SAP.
Collect Stats	Specifies whether accounting statistics are collected on the SAP.
Dropped	The number of packets or octets dropped.
Offered Hi Priority	The number of high priority packets, as determined by the SAP ingress QoS policy.
Offered Low Priority	The number of low priority packets, as determined by the SAP ingress QoS policy.
Forwarded In Profile	The number of in-profile packets or octets (rate below CIR) forwarded.

Label	Description (Continued)
Forwarded Out Profile	The number of out-of-profile packets or octets (rate above CIR) forwarded.
Dropped In Profile	The number of in-profile packets or octets discarded.
Dropped Out Profile	The number of out-of-profile packets or octets discarded.
Forwarded In Profile	The number of in-profile packets or octets (rate below CIR) forwarded.
Forwarded Out Profile	The number of out-of-profile packets or octets (rate above CIR) forwarded.
Ingress Queue 1	The index of the ingress QoS queue of this SAP.
High priority offered	The packets or octets count of the high priority traffic for the SAP.
High priority dropped	The number of high priority traffic packets/octets dropped.
Low priority offered	The packets or octets count of the low priority traffic.
Low priority dropped	The number of low priority traffic packets/octets dropped.
In profile forwarded	The number of in-profile packets or octets (rate below CIR) forwarded.
Out profile forwarded	The number of out-of-profile octets (rate above CIR) forwarded.
Egress Queue 1	The index of the egress QoS queue of the SAP.
In profile forwarded	The number of in-profile packets or octets (rate below CIR) forwarded.
In profile dropped	The number of in-profile packets or octets dropped for the SAP.
Out profile forwarded	The number of out-of-profile packets or octets (rate above CIR) forwarded.
Out profile dropped	The number of out-of-profile packets or octets discarded.
State	Specifies whether DHCP relay is enabled on this SAP.
Info Option	Specifies whether Option 82 processing is enabled on this SAP.
Action	Specifies the Option 82 processing on this SAP or interface: keep, replace or drop.
Circuit ID	Specifies whether the If index is inserted in Circuit ID sub-option of Option 82.
Remote ID	Specifies whether the far-end MAC address is inserted in remote ID sub-option of Option 82

Label	Description (Continued)
Managed by Service	Specifies the service-id of the management VPLS managing this SAP.
Managed by SAP	Specifies the sap-id inside the management VPLS managing this SAP.
Prune state	Specifies the STP state inherited from the management VPLS.
Managed by Service	Specifies the service-id of the management VPLS managing this spoke SDP.
Managed by Spoke	Specifies the sap-id inside the management VPLS managing this spoke SDP.
Prune state	Specifies the STP state inherited from the management VPLS.

Sample Output

```
A:ALA-12# show service id 9000 all
===============================================================================
Service Detailed Information
===============================================================================
Service Id        : 9000               Vpn Id            : 0
Service Type      : VPLS
Description       : This is a distributed VPLS.
Customer Id       : 6                  Last Mgmt Change  : 01/18/2007 10:31:58
Adm               : Up                 Oper              : Down
MTU               : 1514               Def. Mesh VC Id   : 750
SAP Count         : 1                  SDP Bind Count    : 3
-------------------------------------------------------------------------------
Split Horizon Group specifics
-------------------------------------------------------------------------------
Split Horizon Group : splitgroup1
-------------------------------------------------------------------------------
Description       : Split horizon group 1
Instance Id       : 1                  Last Changed      : 01/18/2007 10:31:58
-------------------------------------------------------------------------------
Service Destination Points(SDPs)
-------------------------------------------------------------------------------
Sdp Id 2:22  -(10.10.10.104)
-------------------------------------------------------------------------------
Description     : GRE-10.10.10.104
SDP Id             : 2:22                    Type              : Spoke
VC Type            : Ether                   VC Tag            : n/a
Admin Path MTU     : 0                       Oper Path MTU     : 0
Far End            : 10.10.10.104            Delivery          : GRE
Flags              : SdpOperDown
                     NoIngVCLabel NoEgrVCLabel
                     PathMTUTooSmall
Admin State        : Up                      Oper State        : Down
Ingress Label      : 0                       Egress Label      : 0
Ingress Filter     : n/a                     Egress Filter     : n/a
Last Changed       : 01/18/2007 10:31:58     Signaling         : TLDP

KeepAlive Information :
Admin State        : Disabled                Oper State        : Disabled
Hello Time         : 10                      Hello Msg Len     : 0
Max Drop Count     : 3                       Hold Down Time    : 10
```

```
Statistics            :
I. Fwd. Pkts.      : 0                        I. Dro. Pkts.     : 0
E. Fwd. Pkts.      : 0                        E. Fwd. Octets    : 0

Associated LSP LIST :
SDP Delivery Mechanism is not MPLS
-------------------------------------------------------------------------------
Rstp Service Destination Point specifics
-------------------------------------------------------------------------------
Mac Move           : Blockable
Rstp Admin State   : Up                       Rstp Oper State   : Down
Core Connectivity  : Down
Port Role          : N/A                      Port State        : Discarding
Port Number        : 2049                     Port Priority     : 128
Port Path Cost     : 10                       Auto Edge         : Enabled
Admin Edge         : Disabled                 Oper Edge         : N/A
Link Type          : Pt-pt                    BPDU Encap        : Dot1d
Designated Bridge  : N/A                      Designated Port Id: 0
Active Protocol    : N/A

Fwd Transitions    : 0                        Bad BPDUs rcvd    : 0
Cfg BPDUs rcvd     : 0                        Cfg BPDUs tx      : 0
TCN BPDUs rcvd     : 0                        TCN BPDUs tx      : 0
RST BPDUs rcvd     : 0                        RST BPDUs tx      : 0
-------------------------------------------------------------------------------
 Sdp Id 5:750  -(128.251.10.49)
-------------------------------------------------------------------------------
SDP Id             : 5:750                    Type              : Mesh
VC Type            : Ether                    VC Tag            : n/a
Admin Path MTU     : 0                        Oper Path MTU     : 0
Far End            : 128.251.10.49            Delivery          : GRE
Flags              : SdpOperDown
                     NoIngVCLabel NoEgrVCLabel
                     PathMTUTooSmall
Admin State        : Up                       Oper State        : Down
Ingress Label      : 0                        Egress Label      : 0
Ingress Filter     : n/a                      Egress Filter     : n/a
Last Changed       : 01/18/2007 10:31:58      Signaling         : TLDP

KeepAlive Information :
Admin State        : Disabled                 Oper State        : Disabled
Hello Time         : 10                       Hello Msg Len     : 0
Max Drop Count     : 3                        Hold Down Time    : 10

Statistics            :
I. Fwd. Pkts.      : 0                        I. Dro. Pkts.     : 0
E. Fwd. Pkts.      : 0                        E. Fwd. Octets    : 0

Associated LSP LIST :
SDP Delivery Mechanism is not MPLS
-------------------------------------------------------------------------------
 Sdp Id 7:750  -(10.10.10.106)
-------------------------------------------------------------------------------
Description     : to-MPLS-10.10.10.49
SDP Id             : 7:750                    Type              : Mesh
VC Type            : Ether                    VC Tag            : n/a
Admin Path MTU     : 0                        Oper Path MTU     : 0
Far End            : 10.10.10.106             Delivery          : MPLS
Flags              : SdpOperDown
                     NoIngVCLabel NoEgrVCLabel
```

```
                    PathMTUTooSmall
Admin State        : Up                        Oper State        : Down
Ingress Label      : 0                         Egress Label      : 0
Ingress Filter     : n/a                       Egress Filter     : n/a
Last Changed       : 01/18/2007 10:31:58       Signaling         : TLDP

KeepAlive Information :
Admin State        : Disabled                  Oper State        : Disabled
Hello Time         : 10                        Hello Msg Len     : 0
Max Drop Count     : 3                         Hold Down Time    : 10

Statistics           :
I. Fwd. Pkts.      : 0                         I. Dro. Pkts.     : 0
E. Fwd. Pkts.      : 0                         E. Fwd. Octets    : 0

Associated LSP LIST :
Lsp Name           : to-49
Admin State        : Down                      Oper State        : Down
Time Since Last Tr*: 02h01m08s
-------------------------------------------------------------------------------
Number of SDPs : 3
-------------------------------------------------------------------------------
Service Access Points
-------------------------------------------------------------------------------
SAP 1/2/5:0
-------------------------------------------------------------------------------
Service Id         : 9000
SAP                : 1/2/5:0                   Encap             : q-tag
Dot1Q Ethertype    : 0x8100                    QinQ Ethertype    : 0x8100

Admin State        : Up                        Oper State        : Down
Flags              : PortOperDown
Last Status Change : 04/11/2007 15:56:40
Last Mgmt Change   : 04/11/2007 17:24:54
Max Nbr of MAC Addr: No Limit                  Total MAC Addr    : 0
Learned MAC Addr   : 0                         Static MAC Addr   : 0
Admin MTU          : 1518                      Oper MTU          : 1518
Ingress qos-policy : 1                         Egress qos-policy : 1
Ingress Filter-Id  : n/a                       Egress Filter-Id  : n/a
Mac Learning       : Enabled                   Discard Unkwn Srce: Disabled
Mac Aging          : Enabled

Multi Svc Site     : None
Acct. Pol          : None                      Collect Stats     : Disabled
-------------------------------------------------------------------------------
Rstp Service Access Point specifics
-------------------------------------------------------------------------------
Mac Move           : Blockable
Rstp Admin State   : Up                        Rstp Oper State   : Down
Core Connectivity  : Down
Port Role          : N/A                       Port State        : Discarding
Port Number        : 2048                      Port Priority     : 128
Port Path Cost     : 10                        Auto Edge         : Enabled
Admin Edge         : Disabled                  Oper Edge         : N/A
Link Type          : Pt-pt                     BPDU Encap        : Dot1d
Designated Bridge  : N/A                       Designated Port Id: 0
Active Protocol    : N/A

Forward transitions: 0                         Bad BPDUs rcvd    : 0
Cfg BPDUs rcvd     : 0                         Cfg BPDUs tx      : 0
TCN BPDUs rcvd     : 0                         TCN BPDUs tx      : 0
```

```
RST BPDUs rcvd     : 0                          RST BPDUs tx      : 0
-------------------------------------------------------------------------------
Sap Statistics
-------------------------------------------------------------------------------
                         Packets                  Octets
Forwarding Engine Stats
Dropped                : 0                        0
Off. HiPrio            : 0                        0
Off. LowPrio           : 0                        0
Off. Uncolor           : 0                        0

Queueing Stats(Ingress QoS Policy 1)
Dro. HiPrio            : 0                        0
Dro. LowPrio           : 0                        0
For. InProf            : 0                        0
For. OutProf           : 0                        0

Queueing Stats(Egress QoS Policy 1)
Dro. InProf            : 0                        0
Dro. OutProf           : 0                        0
For. InProf            : 0                        0
For. OutProf           : 0                        0
-------------------------------------------------------------------------------
Sap per Queue stats
-------------------------------------------------------------------------------
                         Packets                  Octets
Ingress Queue 1 (Unicast) (Priority)
Off. HiPrio            : 0                        0
Off. LoPrio            : 0                        0
Dro. HiPrio            : 0                        0
Dro. LoPrio            : 0                        0
For. InProf            : 0                        0
For. OutProf           : 0                        0

Ingress Queue 11 (Multipoint) (Priority)
Off. HiPrio            : 0                        0
Off. LoPrio            : 0                        0
Dro. HiPrio            : 0                        0
Dro. LoPrio            : 0                        0
For. InProf            : 0                        0
For. OutProf           : 0                        0

Egress Queue 1
For. InProf            : 0                        0
For. OutProf           : 0                        0
Dro. InProf            : 0                        0
Dro. OutProf           : 0                        0
-------------------------------------------------------------------------------
VPLS Rapid Spanning Tree Information
-------------------------------------------------------------------------------
VPLS oper state    : Down                     Core Connectivity : Down
Rstp Admin State   : Up                       Rstp Oper State   : Down
Mode               : Rstp                     Vcp Active Prot.  : N/A

Bridge Id          : 80:01.14:30:ff:00:00:01  Bridge Instance Id: 1
Bridge Priority    : 32768                    Tx Hold Count     : 6
Topology Change    : Inactive                 Bridge Hello Time : 2
Last Top. Change   : 0d 00:00:00              Bridge Max Age    : 20
Top. Change Count  : 0                        Bridge Fwd Delay  : 15

Root Bridge        : N/A
```

```
Primary Bridge     : N/A

Root Path Cost     : 0                        Root Forward Delay: 15
Rcvd Hello Time    : 2                        Root Max Age      : 20
Root Priority      : 32769                    Root Port         : N/A
-------------------------------------------------------------------------------
Forwarding Database specifics
-------------------------------------------------------------------------------
Service Id         : 9000               Mac Move          : Disabled
Mac Move Rate      : 10                 Mac Move Timeout  : 10
Table Size         : 250                Total Count       : 0
Learned Count      : 0                  Static Count      : 0
Remote Age         : 900                Local Age         : 300
High WaterMark     : 95%                Low Watermark     : 90%
Mac Learning       : Enabl              Discard Unknown   : Dsabl
Mac Aging          : Enabl
===============================================================================
*A:ALA-48#
```

arp

Syntax **arp** [*ip-address*] | [**mac** *ieee-address*] | [**sap** *sap-id*] | [**interface** *ip-int-name*]

Context show>service>id

Description Displays the ARP table for the IES instance.

Parameters *ip-address* — Displays only ARP entries in the ARP table with the specified IP address.

Default All IP addresses.

mac *ieee-address* — Displays only ARP entries in the ARP table with the specified 48-bit MAC address. The MAC address can be expressed in the form *aa*:*bb*:*cc*:*dd*:*ee*:*ff* or *aa-bb-cc-dd-ee-ff* where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers.

Default All MAC addresses.

sap *sap-id* — Displays SAP information for the specified SAP ID. See Common Service Commands on page 2168 for *sap-id* command syntax.

ip-int-name — The IP interface name for which to display matching ARPs.

Output **Show Service-ID ARP —** The following table describes show service-id ARP output fields.

Label	Description
Service ID	The value identifying the service.
MAC	The specified MAC address
Source-Identifier	The location the MAC is defined.
Type	Static – FDB entries created by management.
	Learned – Dynamic entries created by the learning process.

Label	Description (Continued)
	OAM — Entries created by the OAM process.
Age	The time lapsed since the service was enabled.
Interface	The interface applied to the service.
Port	The port where the SAP is applied.

Sample Output

```
A:ALA-12# show service id 2 arp
===============================================================================
ARP Table
===============================================================================
IP Address      MAC Address       Type    Age       Interface         Port
-------------------------------------------------------------------------------
190.11.1.1      00:03:fa:00:08:22 Other   00:00:00  ies-100-190.11.1  1/1/11:0
===============================================================================
A:ALA-12#
```

arp-host

Syntax **arp-host** [**wholesaler** *service-id*] [**sap** *sap-id* | **interface** *interface-name* | **ip-address** *ip-address*[*/mask*] | **mac** *ieee-address* | {[**port** *port-id*] [**no-inter-dest-id** | i**nter-dest-id** *inter-dest-id*]}] [**detail**]
arp-host statistics [**sap** *sap-id* | **interface** *interface-name*]
arp-host summary [**interface** *interface-name*]

Context show>service>id

Description This command displays ARP host related information.

Sample Output

```
*A:Dut-C# show service id 2 arp-host
===============================================================================
ARP host table, service 2
===============================================================================
IP Address      Mac Address       Sap Id              Remaining           MC
                                                      Time                Stdby
-------------------------------------------------------------------------------
128.128.1.2     00:80:00:00:00:01 2/1/5:2             00h04m41s
128.128.1.3     00:80:00:00:00:02 2/1/5:2             00h04m42s
128.128.1.4     00:80:00:00:00:03 2/1/5:2             00h04m43s
128.128.1.5     00:80:00:00:00:04 2/1/5:2             00h04m44s
128.128.1.6     00:80:00:00:00:05 2/1/5:2             00h04m45s
128.128.1.7     00:80:00:00:00:06 2/1/5:2             00h04m46s
128.128.1.8     00:80:00:00:00:07 2/1/5:2             00h04m47s
128.128.1.9     00:80:00:00:00:08 2/1/5:2             00h04m48s
128.128.1.10    00:80:00:00:00:09 2/1/5:2             00h04m49s
128.128.1.11    00:80:00:00:00:0a 2/1/5:2             00h04m50s
-------------------------------------------------------------------------------
```

```
Number of ARP hosts : 10
===============================================================================
*A:Dut-C#


*A:Dut-C# show service id 2 arp-host ip-address 128.128.1.2 detail
===============================================================================
ARP hosts for service 2
===============================================================================
Service ID           : 2
IP Address           : 128.128.1.2
MAC Address          : 00:80:00:00:00:01
SAP                  : 2/1/5:2
Remaining Time       : 00h04m58s

Sub-Ident            : "alu_1_2"
Sub-Profile-String   : ""
SLA-Profile-String   : ""
App-Profile-String   : ""
ARP host ANCP-String : ""
ARP host Int Dest Id : ""
RADIUS-User-Name     : "128.128.1.2"

Session Timeout (s)  : 301
Start Time           : 02/09/2009 16:35:07
Last Auth            : 02/09/2009 16:36:34
Last Refresh         : 02/09/2009 16:36:38
Persistence Key      : N/A
-------------------------------------------------------------------------------
Number of ARP hosts : 1
===============================================================================
*A:Dut-C#


*A:Dut-C# show service id 2 arp-host statistics
===============================================================================
ARP host statistics
===============================================================================
Num Active Hosts             : 20
Received Triggers            : 70
Ignored Triggers             : 10
Ignored Triggers (overload)  : 0
SHCV Checks Forced           : 0
Hosts Created                : 20
Hosts Updated                : 40
Hosts Deleted                : 0
Authentication Requests Sent : 40
===============================================================================
*A:Dut-C#


*A:Dut-C# show service id 2 arp-host summary
============================================================
ARP host Summary, service 2
============================================================
Sap                    Used        Provided    Admin State
------------------------------------------------------------
sap:2/1/5:2            20          8000        inService
------------------------------------------------------------
Number of SAPs : 1
------------------------------------------------------------
```

```
===============================================================
*A:Dut-C#
```

base

Context show>service>id

This command displays basic information about the service ID including service type, description, SAPs and SDPs.

Output **Show Service-ID Base —** The following table describes show service-id base output fields:

Label	Description
Service Id	The service identifier.
Vpn Id	Specifies the VPN ID assigned to the service.
Service Type	The type of service.
Description	Generic information about the service.
Customer Id	The customer identifier.
Last Mgmt Change	The date and time of the most recent management-initiated change to this customer.
Adm	The administrative state of the service.
Oper	The operating state of the service.
Mtu	The largest frame size (in octets) that the service can handle.
Def. Mesh VC Id	This object is only valid in services that accept mesh SDP bindings. It is used to validate the VC ID portion of each mesh SDP binding defined in the service.
SAP Count	The number of SAPs defined on the service.
SDP Bind Count	The number of SDPs bound to the service.
Identifier	Specifies the service access (SAP) and destination (SDP) points.
Type	Specifies the signaling protocol used to obtain the ingress and egress labels used in frames transmitted and received on the SDP.
AdmMTU	Specifies the desired largest service frame size (in octets) that can be transmitted through this SDP to the far-end ESR, without requiring the packet to be fragmented.
OprMTU	Specifies the actual largest service frame size (in octets) that can be transmitted through this SDP to the far-end ESR, without requiring the packet to be fragmented.

Label	Description (Continued)
Opr	The operational state of the SDP.

Sample Output

```
*A:ALA-48>show>service>id# base
===============================================================================
Service Basic Information
===============================================================================
Service Id        : 750                Vpn Id            : 750
Service Type      : VPLS
Description       : Distributed VPLS services.
Customer Id       : 7
Last Status Change: 04/11/2007 09:36:33
Last Mgmt Change  : 04/11/2007 09:36:36
Admin State       : Down               Oper State        : Down
MTU               : 1514               Def. Mesh VC Id   : 750
SAP Count         : 1                  SDP Bind Count    : 2
-------------------------------------------------------------------------------
Service Access & Destination Points
-------------------------------------------------------------------------------
Identifier                      Type         AdmMTU  OprMTU  Adm      Opr
-------------------------------------------------------------------------------
sap:1/1/7:0                     q-tag        1518    1518    Up       Down
sdp:1:22 S(10.10.10.49)         TLDP         0       0       Up       Down
sdp:8:750 M(10.10.10.104)       TLDP         0       0       Up       Down
===============================================================================
*A:ALA-48>show>service>id#
```

fdb

Syntax **fdb** [**sap** *sap-id*] | [**sdp** *sdp-id*] | [**mac** *ieee-address*] | [**detail**]

Context show>service>id
show>service>fdb-mac

Description This command displays FDB entry for a given MAC address.

Parameters **sap** *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp *sdp-id* — The SDP identifier.

Values 1 — 17407

mac *ieee-address* — Specifies to display information pertaining to the MAC address.

detail — Displays detailed information.

Sample Output

```
*A:ALA-48>show>service>id# fdb mac
===============================================================================
Service Forwarding Database
```

```
===============================================================================
ServId    MAC               Source-Identifier     Type/Age  Last Change
-------------------------------------------------------------------------------
6         00:aa:00:00:00:00 sap:lag-2             L/0       04/11/2007
15:04:31
6         00:aa:00:00:00:01 sap:lag-2             L/0       04/11/2007
15:04:31
6         00:aa:00:00:00:02 sap:lag-2             L/0       04/11/2007
15:04:31
6         00:aa:00:00:00:03 sap:lag-2             L/0       04/11/2007
15:04:31
6         00:aa:00:00:00:04 sap:lag-2             L/0       04/11/2007
15:04:31
10        12:12:12:12:12:12 sap:1/1/1:100         S         04/11/2007
10:03:29
===============================================================================
*A:ALA-48>show>service>id#
```

host

Syntax **host** [**sap** *sap-id*]

Context show>service>id

Description This command displays static hosts configured on this service.

Parameters *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

Sample Output

```
*A:ALA-48>config>service>vpls>sap# show service id 700 host sap 1/1/9:0
===============================================================================
Static Hosts for service 700
===============================================================================
Sap                       IP Address      Configured MAC    Dynamic MAC
  Subscriber
-------------------------------------------------------------------------------
1/1/9:0                   10.10.10.104    N/A               N/A
   N/A
-------------------------------------------------------------------------------
Number of static hosts : 1
===============================================================================
*A:ALA-48>config>service>vpls>sap#
```

labels

Syntax **labels**

Context show>service>id

Description Displays the labels being used by the service.

Output **Show Service-ID Labels —** The following table describes show service-id labels output fields:

Label	Description
Svc Id	The service identifier.
Sdp Id	The SDP identifier.
Type	Indicates whether the SDP is a spoke or a mesh.
I. Lbl	The VC label used by the far-end device to send packets to this device in this service by the SDP.
E. Lbl	The VC label used by this device to send packets to the far-end device in this service by the SDP.

Sample Output

```
A:ALA-12# show service id 1 labels
===============================================================================
Martini Service Labels
===============================================================================
Svc Id     Sdp Id             Type I.Lbl        E.Lbl
-------------------------------------------------------------------------------
1          10:1               Mesh 0            0
1          20:1               Mesh 0            0
1          30:1               Mesh 0            0
1          40:1               Mesh 130081       131061
1          60:1               Mesh 131019       131016
1          100:1              Mesh 0            0
-------------------------------------------------------------------------------
Number of Bound SDPs : 6
-------------------------------------------------------------------------------
A:ALA-12#
```

mfib

Syntax **mfib brief**
mfib [**group** *grp-address*]
mfib statistics [**group** *grp-address*]

Context show>service>id

Description This command displays the multicast FIB on the VPLS service.

Parameters **group** *grp-ip-address* — Displays the multicast FIB for a specific multicast group address.

statistics — Displays statistics on the multicast FIB.

Output **Show Output —** The following table describes the command output fields:

Label	Description
Source Address	IPv4 unicast source address.
Group Address	IPv4 multicast group address.
SAP/SDP ID	Indicates the SAP/SDP to which the corresponding multicast stream will be forwarded/blocked.
Forwarding/Block-ing	Indicates whether the corresponding multicast stream will be blocked/ forwarded.
Number of Entries	Number of entries in the MFIB.
Forwarded Packets	Indicates the number of multicast packets forwarded for the corresponding source/group.

Sample Output

```
A:ALA-1>show>service>id # mfib
===============================================================================
IGMP Snooping MFIB for service 10
===============================================================================
Source Address  Group Address   Sap/Sdp Id             Fwd/Blk
-------------------------------------------------------------------------------
*               225.0.0.1       sap:2/1/5:1            Fwd
*               225.0.0.7       sap:2/1/5:7            Fwd
-------------------------------------------------------------------------------
Number of entries: 2


*A:rbae_C# show service id 1 mfib statistics
===============================================================================
Multicast FIB Statistics, Service 1
===============================================================================
Source Address  Group Address       Matched Pkts          Matched Octets
-------------------------------------------------------------------------------
*               *                   838                   50280
11.11.0.0       225.0.0.0           8                     480
11.11.0.0       225.0.0.1           0                     0
*               * (MLD)             0                     0
*               33:33:00:00:00:01   2650                  159000
*               33:33:00:00:00:02   0                     0
-------------------------------------------------------------------------------
Number of entries: 6
===============================================================================
*A:rbae_C#
```

mld-snooping

Syntax **mld-snooping**

Context show>service>id

Description This command displays MLD snooping information.

all

Syntax **all**

Context show>service>id>mld-snooping

Description This command displays detailed information about MLD snooping.

Sample Output

```
*A:rbae_C# show service id 1 mld-snooping all
===============================================================================
MLD Snooping info for service 1
-------------------------------------------------------------------------------
MLD Snooping Base info
-------------------------------------------------------------------------------
Admin State : Up
Querier     : FE80::12 on SAP 2/1/5
-------------------------------------------------------------------------------
Sap/Sdp                  Oper    MRtr  Send      Max Num   MVR        Num
Id                       State   Port  Queries   Groups    From-VPLS  Groups
-------------------------------------------------------------------------------
sap:1/1/4                Up      No    Disabled  No Limit  Local      0
sap:2/1/5                Up      Yes   Disabled  No Limit  Local      0
sdp:31:1                 Up      No    Disabled  No Limit  N/A        0
sdp:36:1                 Up      No    Disabled  No Limit  N/A        0
-------------------------------------------------------------------------------
MLD Snooping Querier info
-------------------------------------------------------------------------------
Sap Id                 : 2/1/5
IP Address             : FE80::12
Expires                : 11s
Up Time                : 0d 00:05:05
Version                : 2

General Query Interval  : 10s
Query Response Interval : 1.0s
Robust Count            : 2
-------------------------------------------------------------------------------
MLD Snooping Multicast Routers
-------------------------------------------------------------------------------
MRouter
                 Sap/Sdp Id             Up Time        Expires   Version
-------------------------------------------------------------------------------
FE80::12
                 2/1/5                  0d 00:05:05    11s       2
-------------------------------------------------------------------------------
Number of mrouters: 1
```

```
-------------------------------------------------------------------------------
MLD Snooping Proxy-reporting DB
-------------------------------------------------------------------------------
Group Address
                 Mode     Up Time        Num Sources
-------------------------------------------------------------------------------
Number of groups: 0
-------------------------------------------------------------------------------
MLD Snooping SAP 1/1/4 Port-DB
-------------------------------------------------------------------------------
Group Address
                Mode    Type    From-VPLS  Up Time        Expires  Num   MC
                                                                    Src   Stdby
-------------------------------------------------------------------------------
Number of groups: 0
-------------------------------------------------------------------------------
MLD Snooping SAP 2/1/5 Port-DB
-------------------------------------------------------------------------------
Group Address
                Mode    Type    From-VPLS  Up Time        Expires  Num   MC
                                                                    Src   Stdby
-------------------------------------------------------------------------------
Number of groups: 0
-------------------------------------------------------------------------------
MLD Snooping SDP 31:1 Port-DB
-------------------------------------------------------------------------------
Group Address
                Mode    Type    From-VPLS  Up Time        Expires  Num Src
-------------------------------------------------------------------------------
Number of groups: 0
-------------------------------------------------------------------------------
MLD Snooping SDP 36:1 Port-DB
-------------------------------------------------------------------------------
Group Address
                Mode    Type    From-VPLS  Up Time        Expires  Num Src
-------------------------------------------------------------------------------
Number of groups: 0
-------------------------------------------------------------------------------
MLD Snooping Static Source Groups
-------------------------------------------------------------------------------
MLD Snooping Statistics
-------------------------------------------------------------------------------
Message Type            Received      Transmitted   Forwarded
-------------------------------------------------------------------------------
General Queries         43            0             129
Group Queries           0             0             0
Group-Source Queries    0             0             0
V1 Reports              0             0             0
V2 Reports              4             35            0
V1 Done                 0             0             0
Unknown Type            0             N/A           0
-------------------------------------------------------------------------------
Drop Statistics
-------------------------------------------------------------------------------
Bad Length              : 0
Bad MLD Checksum        : 0
Bad Encoding            : 0
No Router Alert         : 0
Zero Source IP          : 0
Wrong Version           : 0
Lcl-Scope Packets       : 0
```

```
Rsvd-Scope Packets      : 0

Send Query Cfg Drops    : 0
Import Policy Drops     : 0
Exceeded Max Num Groups : 0
MCAC Policy Drops       : 0
MCS Failures            : 0

MVR From VPLS Cfg Drops : 0
MVR To SAP Cfg Drops    : 0
-------------------------------------------------------------------------------
MLD Snooping Multicast VPLS Registration info
-------------------------------------------------------------------------------
MLD Snooping Admin State  : Up

MVR Admin State           : Down
MVR Policy                : None
-------------------------------------------------------------------------------
Local SAPs/SDPs
-------------------------------------------------------------------------------
Svc Id     Sap/Sdp               Oper      From       Num Local
           Id                    State     VPLS       Groups
-------------------------------------------------------------------------------
1          sap:1/1/4             Up        Local      0
1          sap:2/1/5             Up        Local      0
1          sdp:31:1              Up        N/A        0
1          sdp:36:1              Up        N/A        0
-------------------------------------------------------------------------------
MVR SAPs (from-vpls=1)
-------------------------------------------------------------------------------
Svc Id     Sap/Sdp               Oper      From       Num MVR
           Id                    State     VPLS       Groups
-------------------------------------------------------------------------------
No MVR SAPs found.
===============================================================================
*A:rbae_C#
```

base

Syntax **base**

Context show>service>id>mld-snooping

Description This command displays basic MLD snooping information.

mrouters

Syntax **mrouters** [**detail**]

Context show>service>id>mld-snooping

Description This command displays all multicast routers.

Sample Output

```
*A:rbae_C# show service id 1 mld-snooping mrouters
===============================================================================
MLD Snooping Multicast Routers for service 1
===============================================================================
MRouter
                 Sap/Sdp Id             Up Time        Expires   Version
-------------------------------------------------------------------------------
FE80::12
                 2/1/5                  0d 00:05:55    11s       2
-------------------------------------------------------------------------------
Number of mrouters: 1
===============================================================================
*A:rbae_C#


*A:rbae_C#  show service id 1 mld-snooping mrouters detail
===============================================================================
MLD Snooping Multicast Routers for service 1
-------------------------------------------------------------------------------
MRouter FE80::12
-------------------------------------------------------------------------------
Sap Id                  : 2/1/5
Expires                 : 18s
Up Time                 : 0d 00:06:28
Version                 : 2
-------------------------------------------------------------------------------
Number of mrouters: 1
===============================================================================
```

mvr

Syntax **mvr**

Context show>service>id>mld-snooping

Description This command displays multicast VPLS registration information.

port-db

Syntax **port-db sap** *sap-id*
port-db sap *sap-id* **detail**
port-db sap *sap-id* **group** *grp-ipv6-address*
port-db sdp *sdp-id*:*vc-id* [**detail**]
port-db sdp *sdp-id*:*vc-id* **group** *grp-ipv6-address*

Context show>service>id>mld-snooping

Description This command displays MLD snooping information related to a specific SAP.

Sample Output

```
*A:rbae_C# show service id 1 mld-snooping port-db sap 1/1/4
===============================================================================
MLD Snooping SAP 1/1/4 Port-DB for service 1
===============================================================================
Group Address
                Mode    Type    From-VPLS  Up Time         Expires  Num   MC
                                                                    Src   Stdby
-------------------------------------------------------------------------------
FF04::1
                include dynamic local      0d 00:00:19    0s       1
FF04::2
                include dynamic local      0d 00:00:18    0s       1
-------------------------------------------------------------------------------
Number of groups: 2
===============================================================================
*A:rbae_C#

*A:rbae_C# show service id 1 mld-snooping port-db sap 1/1/4 detail
===============================================================================
MLD Snooping SAP 1/1/4 Port-DB for service 1
-------------------------------------------------------------------------------
MLD Group FF04::1
-------------------------------------------------------------------------------
Mode             : include              Type             : dynamic
Up Time          : 0d 00:00:33          Expires          : 0s
Compat Mode      : MLD Version 2
V1 Host Expires  : 0s                                    :
MVR From-VPLS    : local                MVR To-SAP       : local
MC Standby       : no
-------------------------------------------------------
Source Address
                Up Time      Expires  Type     Fwd/Blk
-------------------------------------------------------
2011::1
                0d 00:00:33  20s      dynamic  Fwd
-------------------------------------------------------------------------------
MLD Group FF04::2
-------------------------------------------------------------------------------
Mode             : include              Type             : dynamic
Up Time          : 0d 00:00:32          Expires          : 0s
Compat Mode      : MLD Version 2
V1 Host Expires  : 0s                                    :
MVR From-VPLS    : local                MVR To-SAP       : local
MC Standby       : no
-------------------------------------------------------
Source Address
                Up Time      Expires  Type     Fwd/Blk
-------------------------------------------------------
2011::1
                0d 00:00:33  20s      dynamic  Fwd
-------------------------------------------------------------------------------
Number of groups: 2
===============================================================================
*A:rbae_C#
```

proxy-db

Syntax **proxy-db** [**detail**]
proxy-db group *grp-ipv6-address*

Context show>service>id>mld-snooping

Description This command displays proxy-reporting database entries.

Sample Output

```
*A:rbae_C# show service id 1 mld-snooping proxy-db
===============================================================================
MLD Snooping Proxy-reporting DB for service 1
===============================================================================
Group Address
                  Mode     Up Time         Num Sources
-------------------------------------------------------------------------------
FF04::1
                  include  0d 00:01:01    1
FF04::2
                  include  0d 00:01:00    1
-------------------------------------------------------------------------------
Number of groups: 2
===============================================================================
*A:rbae_C#


*A:rbae_C# show service id 1 mld-snooping proxy-db detail
===============================================================================
MLD Snooping Proxy-reporting DB for service 1
-------------------------------------------------------------------------------
MLD Group FF04::1
-------------------------------------------------------------------------------
Up Time : 0d 00:01:03                  Mode : include
-------------------------------------------------------------------------
Source Address                                                  Up Time
-------------------------------------------------------------------------
2011::1                                                         0d 00:01:03
-------------------------------------------------------------------------------
MLD Group FF04::2
-------------------------------------------------------------------------------
Up Time : 0d 00:01:02                  Mode : include
-------------------------------------------------------------------------
Source Address                                                  Up Time
-------------------------------------------------------------------------
2011::1                                                         0d 00:01:02
-------------------------------------------------------------------------------
Number of groups: 2
===============================================================================
*A:rbae_C#
```

querier

Syntax **querier**

Context show>service>id>mld-snooping

Description This command displays information about the current querier.

Sample Output

```
*A:rbae_C# show service id 1 mld-snooping querier
===============================================================================
MLD Snooping Querier info for service 1
===============================================================================
Sap Id                  : 2/1/5
IP Address              : FE80::12
Expires                 : 11s
Up Time                 : 0d 00:13:35
Version                 : 2

General Query Interval  : 10s
Query Response Interval : 1.0s
Robust Count            : 2
===============================================================================
*A:rbae_C#
```

static

Syntax **static** [**sap** *sap-id* | **sdp** *sdp-id:vc-id*]

Context show>service>id>mld-snooping

Description This command displays MLD snooping static group membership data.

Sample Output

```
*A:rbae_C# show service id 1 mld-snooping static
===============================================================================
MLD Snooping Static Source Groups for service 1
-------------------------------------------------------------------------------
MLD Snooping Static Source Groups for SDP 36:1
-------------------------------------------------------------------------------
Source
                Group
-------------------------------------------------------------------------------
2011::1
                FF04::2
*
                FF04::3
-------------------------------------------------------------------------------
Static (*,G)/(S,G) entries: 2
===============================================================================
*A:rbae_C#
```

statistics

Syntax **statistics**[**sap** *sap-id* | **sdp** *sdp-id:vc-id*]

Context show>service>id>mld-snooping

Description This command displays MLD snooping statistics.

Sample Output

```
*A:rbae_C# show service id 1 mld-snooping statistics
===============================================================================
MLD Snooping Statistics for service 1
===============================================================================
Message Type            Received      Transmitted   Forwarded
-------------------------------------------------------------------------------
General Queries         109           0             327
Group Queries           0             0             0
Group-Source Queries    0             0             0
V1 Reports              0             0             0
V2 Reports              438           87            0
V1 Done                 0             0             0
Unknown Type            0             N/A           0
-------------------------------------------------------------------------------
Drop Statistics
-------------------------------------------------------------------------------
Bad Length              : 0
Bad MLD Checksum        : 0
Bad Encoding            : 0
No Router Alert         : 0
Zero Source IP          : 0
Wrong Version           : 0
Lcl-Scope Packets       : 0
Rsvd-Scope Packets      : 0

Send Query Cfg Drops    : 0
Import Policy Drops     : 0
Exceeded Max Num Groups : 0
MCAC Policy Drops       : 0
MCS Failures            : 0

MVR From VPLS Cfg Drops : 0
MVR To SAP Cfg Drops    : 0
===============================================================================
*A:rbae_C#
```

mstp-configuration

Syntax **mstp-configuration**

Context show>service>id

Description This command displays the MSTP specific configuration data. This command is only valid on a managment VPLS.

sap

Syntax **sap** *sap-id* [**detail**]

Context show>service>id

Description This command displays information for the SAPs associated with the service.

If no optional parameters are specified, a summary of all associated SAPs is displayed.

Parameters *sap-id* — The ID that displays SAP information. See Common Service Commands on page 2168 for *sap-id* command syntax.

detail — Displays detailed information for the SAP.

Output **Show Service-ID SAP —** The following table describes show service SAP fields:

Label	Description
Service Id	The service identifier.
SAP	The SAP and qtag.
Encap	The encapsulation type of the SAP.
Ethertype	Specifies an Ethernet type II Ethertype value.
Admin State	The administrative state of the SAP.
Oper State	The operational state of the SAP.
Flags	Specifies the conditions that affect the operating status of this SAP.
Last Status Change	Specifies the time of the most recent operating status change to this SAP
Last Mgmt Change	Specifies the time of the most recent management-initiated change to this SAP.
Admin MTU	The desired largest service frame size (in octets) that can be transmitted through the SAP to the far-end router, without requiring the packet to be fragmented.

Label	Description (Continued)
Oper MTU	The actual largest service frame size (in octets) that can be transmitted through the SAP to the far-end router, without requiring the packet to be fragmented.
Ingress qos-policy	The ingress QoS policy ID assigned to the SAP.
Egress qos-policy	The egress QoS policy ID assigned to the SAP.
Ingress Filter-Id	The ingress filter policy ID assigned to the SAP.
Egress Filter-Id	The egress filter policy ID assigned to the SAP.
Acct. Pol	The accounting policy ID assigned to the SAP.
Collect Stats	Specifies whether collect stats is enabled.
Dropped	The number of packets and octets dropped due to SAP state, ingress MAC or IP filter, same segment discard, bad checksum, etc.
Off. HiPrio	The number of high priority packets and octets, as determined by the SAP ingress QoS policy, offered by the Pchip to the Qchip.
Off. LowPrio	The number of low priority packets and octets, as determined by the SAP ingress QoS policy, offered by the Pchip to the Qchip.
Off. Uncolor	The number of uncolored packets and octets, as determined by the SAP ingress QoS policy, offered by the Pchip to the Qchip.
Dro. HiPrio	The number of high priority packets and octets, as determined by the SAP ingress QoS policy, dropped by the Qchip due to: MBS exceeded, buffer pool limit exceeded, etc.
Dro. LowPrio	The number of low priority packets and octets, as determined by the SAP ingress QoS policy, dropped by the Qchip due to: MBS exceeded, buffer pool limit exceeded, etc.
For. InProf	The number of in-profile packets and octets (rate below CIR) forwarded by the ingress Qchip.
For. OutProf	The number of out-of-profile packets and octets discarded by the egress Qchip due to MBS exceeded, buffer pool limit exceeded, etc.
Dro. InProf	The number of in-profile packets and octets discarded by the egress Qchip due to MBS exceeded, buffer pool limit exceeded, etc.
Dro. OutProf	The number of out-of-profile packets and octets discarded by the egress Qchip due to MBS exceeded, buffer pool limit exceeded, etc.
For. InProf	The number of in-profile packets and octets (rate below CIR) forwarded by the egress Qchip.
For. OutProf	The number of out-of-profile packets and octets (rate above CIR) forwarded by the egress Qchip.

```
Max Nbr of MAC Addr: No Limit                Total MAC Addr    : 0
Learned MAC Addr   : 0                       Static MAC Addr   : 0
Admin MTU          : 1518                    Oper MTU          : 1518
Ingress qos-policy : 1                       Egress qos-policy : 1
Ingress Filter-Id  : n/a                     Egress Filter-Id  : n/a
Mac Learning       : Enabled                 Discard Unkwn Srce: Disabled
Mac Aging          : Enabled

Multi Svc Site     : West
E. Sched Pol       : SLA1
Acct. Pol          : None                    Collect Stats     : Disabled
===============================================================================
*A:ALA-48>show>service>id#


*A:ALA-48>show>service>id# sap 1/1/7:0 detail
===============================================================================
Service Access Points(SAP)
===============================================================================
Service Id         : 750
SAP                : 1/1/7:0                 Encap             : q-tag
Dot1Q Ethertype    : 0x8100                  QinQ Ethertype    : 0x8100

Admin State        : Up                      Oper State        : Down
Flags              : PortOperDown
Last Status Change : 04/09/2007 09:23:26
Last Mgmt Change   : 04/09/2007 09:23:28
Max Nbr of MAC Addr: No Limit                Total MAC Addr    : 0
Learned MAC Addr   : 0                       Static MAC Addr   : 0
Admin MTU          : 1518                    Oper MTU          : 1518
Ingress qos-policy : 100                     Egress qos-policy : 1
Shared Q plcy      : default                 Multipoint shared : Enabled
Ingr IP Fltr-Id    : n/a                     Egr IP Fltr-Id    : 10
Ingr Mac Fltr-Id   : n/a                     Egr Mac Fltr-Id   : n/a
Ingr IPv6 Fltr-Id  : n/a                     Egr IPv6 Fltr-Id  : n/a
tod-suite          : None                    qinq-pbit-marking : both
ARP Reply Agent    : Enabled                 Host Conn Verify  : Enabled
Mac Learning       : Enabled                 Discard Unkwn Srce: Disabled
Mac Aging          : Enabled                 Mac Pinning       : Disabled
L2PT Termination   : Disabled                BPDU Translation  : Disabled

Multi Svc Site     : None
I. Sched Pol       : SLA1
E. Sched Pol       : SLA1
Acct. Pol          : None                    Collect Stats     : Disabled

Anti Spoofing      : None                    Nbr Static Hosts  : 1
MCAC Policy Name   :                         MCAC Const Adm St : Enable
MCAC Max Unconst BW: no limit                MCAC Max Mand BW  : no limit
MCAC In use Mand BW: 0                       MCAC Avail Mand BW: unlimited
MCAC In use Opnl BW: 0                       MCAC Avail Opnl BW: unlimited
Auth Policy        : none
Egr MCast Grp      :
-------------------------------------------------------------------------------
Rstp Service Access Point specifics
-------------------------------------------------------------------------------
Mac Move           : Blockable
Rstp Admin State   : Up                      Rstp Oper State   : Down
Core Connectivity  : Down
Port Role          : N/A                     Port State        : Discarding
Port Number        : 2048                    Port Priority     : 128
```

```
Port Path Cost     : 10                        Auto Edge         : Enabled
Admin Edge         : Disabled                  Oper Edge         : N/A
Link Type          : Pt-pt                     BPDU Encap        : Dot1d
Designated Bridge  : N/A                       Designated Port Id: 0
Active Protocol    : N/A

Forward transitions: 0                         Bad BPDUs rcvd    : 0
Cfg BPDUs rcvd     : 0                         Cfg BPDUs tx      : 0
TCN BPDUs rcvd     : 0                         TCN BPDUs tx      : 0
RST BPDUs rcvd     : 0                         RST BPDUs tx      : 0
-------------------------------------------------------------------------------
Sap Statistics
-------------------------------------------------------------------------------
                         Packets                 Octets
Forwarding Engine Stats
Dropped               : 0                       0
Off. HiPrio           : 0                       0
Off. LowPrio          : 0                       0
Off. Uncolor          : 0                       0

Queueing Stats(Ingress QoS Policy 1)
Dro. HiPrio           : 0                       0
Dro. LowPrio          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Queueing Stats(Egress QoS Policy 1)
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0
-------------------------------------------------------------------------------
Sap per Queue stats
-------------------------------------------------------------------------------
                         Packets                 Octets

Ingress Queue 1 (Unicast) (Priority)
Off. HiPrio           : 0                       0
Off. LoPrio           : 0                       0
Dro. HiPrio           : 0                       0
Dro. LoPrio           : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Ingress Queue 11 (Multipoint) (Priority)
Off. HiPrio           : 0                       0
Off. LoPrio           : 0                       0
Dro. HiPrio           : 0                       0
Dro. LoPrio           : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0

Egress Queue 1
For. InProf           : 0                       0
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
===============================================================================
*A:ALA-48>show>service>id#
```

sdp

Syntax **sdp** [*sdp-id* | **far-end** *ip-addr*] [**detail**]

Context show>service>id

Description Displays information for the SDPs associated with the service.

If no optional parameters are specified, a summary of all associated SDPs is displayed.

Parameters *sdp-id* — Displays only information for the specified SDP ID.

Default All SDPs.

Values 1 — 17407

far-end *ip-addr* — Displays only SDPs matching with the specified far-end IP address.

Default SDPs with any far-end IP address.

detail — Displays detailed SDP information.

Output **Show Service-ID SDP —** The following table describes show service-id SDP output fields:

Label	Description
Sdp Id	The SDP identifier.
Type	Indicates whether the SDP is a spoke or a mesh.
Split Horizon Group	Name of the split horizon group that the SAP belongs to.
VC Type	Displays the VC type: ether, vlan, or vpls.
VC Tag	Displays the explicit dot1Q value used when encapsulating to the SDP far end.
I. Lbl	The VC label used by the far-end device to send packets to this device in this service by the SDP.
Admin Path MTU	The operating path MTU of the SDP is equal to the admin path MTU (when one is set) or the dynamically computed tunnel MTU, when no admin path MTU is set (the default case.)
Oper Path MTU	The actual largest service frame size (in octets) that can be transmitted through this SDP to the far-end router, without requiring the packet to be fragmented.
Far End	Specifies the IP address of the remote end of the GRE or MPLS tunnel defined by this SDP.
Delivery	Specifies the type of delivery used by the SDP: GRE or MPLS.
Admin State	The administrative state of this SDP.
Oper State	The current status of the SDP.

Label	Description (Continued)
Ingress Label	The label used by the far-end device to send packets to this device in this service by this SDP.

Sample Output

```
A:ALA-12#  show service id 9000 sdp 2:22 detail
===============================================================================
Service Destination Point (Sdp Id : 2:22) Details
-------------------------------------------------------------------------------
 Sdp Id 2:22  -(10.10.10.103)
-------------------------------------------------------------------------------
Description     : GRE-10.10.10.103
SDP Id             : 2:22                       Type              : Spoke
Split Horiz Grp : (DSL-group1
VC Type            : Ether                      VC Tag            : n/a
Admin Path MTU     : 4462                       Oper Path MTU     : 4462
Far End            : 10.10.10.103               Delivery          : GRE
Admin State        : Up                         Oper State        : TLDP Down
Ingress Label      : 0                          Egress Label      : 0
Ingress Filter     : n/a                        Egress Filter     : n/a
Last Changed       : 04/11/2007 11:48:20        Signaling         : TLDP

KeepAlive Information :
Admin State        : Disabled                   Oper State        : Disabled
Hello Time         : 10                         Hello Msg Len     : 0
Max Drop Count     : 3                          Hold Down Time    : 10

Statistics            :
I. Fwd. Pkts.      : 0                          I. Dro. Pkts.     : 0
E. Fwd. Pkts.      : 0                          E. Fwd. Octets    : 0

Associated LSP LIST :
SDP Delivery Mechanism is not MPLS
-------------------------------------------------------------------------------
Rstp Service Destination Point specifics
-------------------------------------------------------------------------------
Mac Move           : Disabled
Rstp Admin State   : Up                         Rstp Oper State   : Down
Core Connectivity  : Down
Port Role          : N/A                        Port State        : Discarding
Port Number        : 2049                       Port Priority     : 128
Port Path Cost     : 10                         Auto Edge         : Enabled
Admin Edge         : Disabled                   Oper Edge         : N/A
Link Type          : Pt-pt                      BPDU Encap        : Dot1d
Designated Bridge  : N/A                        Designated Port Id: 0
Active Protocol    : N/A

Fwd Transitions    : 0                          Bad BPDUs rcvd    : 0
Cfg BPDUs rcvd     : 0                          Cfg BPDUs tx      : 0
TCN BPDUs rcvd     : 0                          TCN BPDUs tx      : 0
RST BPDUs rcvd     : 0                          RST BPDUs tx      : 0
-------------------------------------------------------------------------------
Number of SDPs : 1
===============================================================================
A:ALA-12#
```

gsmp

Syntax **gsmp**

Context show>service>id

Description This enables the command to display GSMP information.

neighbors

Syntax **neighbors group** [*name*] [*ip-address*]

Context show>service>id>gsmp

Description This command display GSMP neighbor information.

Parameters **group —** A GSMP group defines a set of GSMP neighbors which have the same properties.

name — Specifies a GSMP group name is unique only within the scope of the service in which it is defined.

ip-address — Specifies the ip-address of the neighbor.

Output **Show Service-ID GSMP Neighbors Group —** The following table describes show service-id gsmp neighbors group output fields:

Label	Description
Group	Displays the group name.
Neighbor	Displays the neighbor IP address.
AdminState	Displays the administrative state of the neighbor.
Sessions	Displays the number of sessions (open TCP connections) for each configured neighbor.

Sample Output

These commands show the configured neighbors per service, regardless that there exists an open TCP connection with this neighbor. The admin state is shown because for a neighbor to be admin enabled, the service, gsmp node, group node and the neighbor node in this service must all be in 'no shutdown' state. Session gives the number of session (open TCP connections) for each configured neighbor.

```
A:active>show>service>id>gsmp# neighbors
===============================================================================
GSMP neighbors
===============================================================================
Group                          Neighbor           AdminState  Sessions
-------------------------------------------------------------------------------
dslam1                         192.168.1.2        Enabled     0
dslam1                         192.168.1.3        Enabled     0
```

```
-------------------------------------------------------------------------------
Number of neighbors shown: 2
===============================================================================
A:active>show>service>id>gsmp#

A:active>show>service>id>gsmp# neighbors group dslam1
===============================================================================
GSMP neighbors
===============================================================================
Group                           Neighbor           AdminState  Sessions
-------------------------------------------------------------------------------
dslam1                          192.168.1.2       Enabled     0
dslam1                          192.168.1.3       Enabled     0
-------------------------------------------------------------------------------
Number of neighbors shown: 2
===============================================================================
A:active>show>service>id>gsmp#


A:active>show>service>id>gsmp# neighbors group dslam1 192.168.1.2
===============================================================================
GSMP neighbors
===============================================================================
Group                           Neighbor           AdminState  Sessions
-------------------------------------------------------------------------------
dslam1                          192.168.1.2       Enabled     0
===============================================================================
A:active>show>service>id>gsmp#
```

sessions

Syntax **sessions** [**group** *name*] **neighbor** *ip-address*] [**port** *port-number*] [**association**] [**statistics**]

Context show>service>id>gsmp

Description This command displays GSMP sessions information.

Parameters **group —** A GSMP group defines a set of GSMP neighbors which have the same properties.

name — Specifies a GSMP group name is unique only within the scope of the service in which it is defined.

ip-address — Specifies the ip-address of the neighbor.

port — Specifies the neighbor TCP port number use for this ANCP session.

Values 0 — 65535

association — Displays to what object the ANCP-string is associated.

statistics — Displays statistics information about an ANCP session known to the system.

Output **Show Service-ID GSMP sessions — The following table describes service ID GSMP sessions output fields:**

Label	Description
Port	Displays the port ID number.
Ngbr-IpAddr	Displays the neighbor IP address.
Gsmp-Group	Displays the GSMP group ID.
State	The GSMP state of this TCP connection.
Peer Instance	Together with the peer port and peer name output, displays a unique GSMP ID for each end of the GSMP connection.
Peer Port	Together with the peer instance and peer name output, displays a unique GSMP ID for each end of the GSMP connection.
Peer Name	Together with the peer port and peer instance output, displays a unique GSMP ID for each end of the GSMP connection.
timeouts	Displays the number of successive timeouts for this session.
Peer Timer	Displays the GSMP keepalive timer.
Capabilities	Displays the ANCP capabilities negotiated for this session.
Conf Capabilities	Displays the ANCP capabilities configured for this session.
Priority Marking	Displays the priority marking configured for this session.
Local Addr	Displays the IP address used by the box's side of the TCP connection.
Conf. Local Addr.	Displays the configured IP address used by the box's side of the TCP connection.
Sender Instance	The instance sent to the neighbor in this session.
Sender Port	The port sent to the neighbor in this session.
Sender Name	The name sent to the neighbor in this session.
Max. Timeouts	The maximum number of successive timeouts configured for this session.
Sender Timer	Indicates the timeout value that will be announced towards the neighbor. The neighbor uses this timeout value while waiting for an acknowledgment from this system.

Sample Output

This show command gives information about the open TCP connections with DSLAMs.

```
A:active>show>service>id>gsmp# sessions
=======================================================
GSMP sessions for service 999 (VPRN)
=======================================================
Port   Ngbr-IpAddr     Gsmp-Group
```

```
-------------------------------------------------------
40590  192.168.1.2     dslam1
-------------------------------------------------------
Number of GSMP sessions : 1
=======================================================
A:active>show>service>id>gsmp#


A:active>show>service>id>gsmp# sessions neighbor 192.168.1.2 port 40590
===============================================================================
GSMP sessions for service 999 (VPRN), neighbor 192.168.1.2, Port 40590
===============================================================================
State           : Established
Peer Instance   : 1                  Sender Instance : a3cf58
Peer Port       : 0                  Sender Port     : 0
Peer Name       : 12:12:12:12:12:12  Sender Name     : 00:00:00:00:00:00
timeouts        : 0                  Max. Timeouts   : 3
Peer Timer      : 100                Sender Timer    : 100
Capabilities      : DTD OAM
Conf Capabilities : DTD OAM
Priority Marking  : dscp nc2
Local Addr.       : 192.168.1.4
Conf Local Addr.  : N/A
===============================================================================
A:active>show>service>id>gsmp#
A:active>show>service>id>gsmp# sessions neighbor 192.168.1.2 port 40590 association
===============================================================================
ANCP-Strings
===============================================================================
ANCP-String                                                  Assoc. State
-------------------------------------------------------------------------------
No ANCP-Strings found
===============================================================================
A:active>show>service>id>gsmp#
A:active>show>service>id>gsmp# sessions neighbor 192.168.1.2 port 40590 statistics
===============================================================
GSMP session stats, service 999 (VPRN), neigbor 192.168.1.2, Port 40590
===============================================================
Event                                Received  Transmitted
---------------------------------------------------------------
Dropped                              0         0
Syn                                  1         1
Syn Ack                              1         1
Ack                                  14        14
Rst Ack                              0         0
Port Up                              0         0
Port Down                            0         0
OAM Loopback                         0         0
===============================================================
A:active>show>service>id>gsmp#
```

Note: The association command gives an overview of each ANCP string received from this session.

```
A:active>show>service>id>gsmp# sessions neighbor 192.168.1.2 port 40590 association
===============================================================================
ANCP-Strings
===============================================================================
ANCP-String                                                  Assoc.
State
-------------------------------------------------------------------------------
7330-ISAM-E47 atm 1/1/01/01:19425.64048                      ANCP    Up
```

```
-------------------------------------------------------------------------------
Number of ANCP-Strings : 1
===============================================================================
A:active>show>service>id>gsmp
```

host

Syntax **host** [**sap** *sap-id*] [**wholesaler** *service-id*] [**port** *port-id*] [**inter-dest-id** *intermediate-destination-id*] [**detail**]
host [**sap** *sap-id*] [**wholesaler** *service-id*] [**port** *port-id*] **no-inter-dest-id** [**detail**]
host summary

Context show>service>id

Description This command displays information about static host configured on this service.

Parameters **sap** *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

intermediate-destination-id — Specifies the intermediate destination identifier which is encoded in the identification strings.

Values Up to 32 characters maximum

summary — Displays summary static host information.

detail — Displays detailed static host information.

wholesaler *service-id* **—** The service ID of the wholesaler.

Values 1 — 2147483647

interface

Syntax **interface** [{[*ip-address*|*ip-int-name*] [*interface-type*] [**detail**] [**family**]}|**summary**]

Context show>service>id

Description This command displays service interface information.

Parameters *ip-address* — Displays information for the specified IP address.

ip-int-name — Displays information for the specified interface name.

detail — Displays detailed interface information.

family *family* **—** Specifies to display only information belonging to the address family IPv4 or IPv6. Only these two values will be accepted.

summary — Displays detailed infterface information.

Sample Output

```
A:cses-E11>config>service>vprn# show service id 10 interface "gi-2-01" detail
===============================================================================
```

```
Interface Table
===============================================================================
-------------------------------------------------------------------------------
Interface
-------------------------------------------------------------------------------
If Name      : gi-2-01
Sub If Name  : si-2
Red If Name  :
Admin State  : Up                                Oper (v4/v6)     : Up/Down
Protocols    : None
-------------------------------------------------------------------------------
Details
-------------------------------------------------------------------------------
Description  : (Not Specified)
If Index     : 6                                 Virt. If Index   : 6
Last Oper Chg: 11/27/2012 13:19:28               Global If Index  : 380
Mon Oper Grp : None
Srrp En Rtng : Disabled                          Hold time        : N/A
Group Port   : 1/1/2
TOS Marking  : Trusted                           If Type          : VPRN Grp
SNTP B.Cast  : False
MAC Address  : d2:30:01:01:00:02                 Mac Accounting   : Disabled
Ingress stats: Disabled
Arp Timeout  : 14400                             IPv6 Nbr ReachTi*: 30
IP Oper MTU  : 1500                              ICMP Mask Reply  : True
Arp Populate : Disabled                          Host Conn Verify : Disabled
Cflowd       : None
LdpSyncTimer : None
LSR Load Bal*: system
uRPF Chk     : disabled
uRPF Ipv6 Chk: disabled
Rx Pkts      : 0                                 Rx Bytes         : 0
Rx V4 Pkts   : 0                                 Rx V4 Bytes      : 0
Rx V6 Pkts   : 0                                 Rx V6 Bytes      : 0
Tx Pkts      : 32                                Tx Bytes         : 3392
Tx V4 Pkts   : 32                                Tx V4 Bytes      : 3392
Tx V4 Discar*: 0                                 Tx V4 Discard By*: 0
Tx V6 Pkts   : 0                                 Tx V6 Bytes      : 0
Tx V6 Discar*: 0                                 Tx V6 Discard By*: 0

Proxy ARP Details
Rem Proxy ARP: Disabled                          Local Proxy ARP  : Disabled
Policies     : none

Proxy Neighbor Discovery Details
Local Pxy ND : Disabled
Policies     : none

DHCP no local server

DHCP Details
Description  : (Not Specified)
Admin State  : Down                              Lease Populate   : 0
Gi-Addr      : Not configured                    Gi-Addr as Src Ip: Disabled
Action       : Keep                              Trusted          : Disabled

DHCP Proxy Details
Admin State  : Down
Lease Time   : N/A
Emul. Server : Not configured
```

```
Subscriber Authentication Details
Auth Policy  : None

DHCP6 Relay Details
Description  : (Not Specified)
Admin State  : Down                              Lease Populate   : 0
Oper State   : Down                              Nbr Resolution   : Disabled
If-Id Option : None                              Remote Id        : Disabled
Src Addr     : Not configured

DHCP6 Server Details
Admin State  : Down                              Max. Lease States: 8000

ISA Tunnel redundant next-hop information
Static Next-*:
Dynamic Next*:

ICMP Details
Redirects    : Number - 100                      Time (seconds)   - 10
Unreachables : Number - 100                      Time (seconds)   - 10
TTL Expired  : Number - 100                      Time (seconds)   - 10

IPCP Address Extension Details
Peer IP Addr*: Not configured
Peer Pri DNS*: Not configured
Peer Sec DNS*: Not configured
-------------------------------------------------------------------------------
Qos Details
-------------------------------------------------------------------------------

Ing Qos Poli*: (none)                            Egr Qos Policy   : (none)
Ingress FP Q*: (none)                            Egress Port QGrp : (none)
Ing FP QGrp *: (none)                            Egr Port QGrp In*: (none)
-------------------------------------------------------------------------------
Interfaces : 1
===============================================================================
* indicates that the corresponding row element may have been truncated.
A:cses-E11>config>service>vprn#
```

retailers

Syntax **retailers**

Context show>service>id

Description This command displays service retailer information.

Sample Output

```
*A:ALA-48>config# show service id 101 retailers
===============================================================================
Retailers for service 101
===============================================================================
Retailer Svc ID              Num Static Hosts         Num Dynamic Hosts
-------------------------------------------------------------------------------
102                          3                        1
```

```
105                           0                       1
-------------------------------------------------------------------------------
Number of retailers : 2
===============================================================================
*A:ALA-48>config#
```

wholesalers

Syntax **wholesalers**

Context show>service>id

Description This command displays service wholesaler information.

Sample Output

```
*A:ALA-48>config# show service id 102 wholesalers
===============================================================================
Wholesalers for service 102
===============================================================================
Wholesaler Svc ID             Num Static Hosts         Num Dynamic Hosts
-------------------------------------------------------------------------------
101                           3                        1
-------------------------------------------------------------------------------
Number of wholesalers : 1
===============================================================================
*A:ALA-48>config#
```

Wholesaler information can also be displayed in the lease-state context.

```
*A:ALA-48>config# show service id 105 dhcp lease-state  wholesaler 101
===============================================================================
DHCP lease state table, service 105
===============================================================================
IP Address      Mac Address       Sap/Sdp Id          Remaining  Lease    MC
                                                      LifeTime   Origin   Stdby
-------------------------------------------------------------------------------
Wholesaler 101 Leases
-------------------------------------------------------------------------------
103.3.2.62      00:00:1f:bd:00:c6 lag-1:105           00h00m39s  RADIUS
-------------------------------------------------------------------------------
Number of lease states : 1
===============================================================================
*A:ALA-48>config#
```

split-horizon-group

Syntax **split-horizon-group** [*group-name*]

Context show>service>id

Description This command displays service split horizon groups.

Parameters *group-name* — Specifies a group name up to 32 characters in length.

Sample Output

```
A:ALA-1# show service id 700 split-horizon-group
===============================================================================
Service: Split Horizon Group
===============================================================================
Name                            Description
-------------------------------------------------------------------------------
DSL-group1                      Split horizon group for DSL
-------------------------------------------------------------------------------
No. of Split Horizon Groups: 1
===============================================================================
A:ALA-1#

A:ALA-1# show service id 700 split-horizon-group DSL-group1
===============================================================================
Service: Split Horizon Group
===============================================================================
Name                            Description
-------------------------------------------------------------------------------
DSL-group1                      Split horizon group for DSL
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
SAP                             1/1/3:1

SDP                             108:1
SDP                             109:1
-------------------------------------------------------------------------------
SAPs Associated : 1             SDPs Associated : 2
===============================================================================
A:ALA-1#
```

static-host

Syntax **static-host** [**sap** *sap-id*] [**wholesaler** *service-id*] [**port** *port-id*][**inter-dest-id** *intermediate-destination-id*] [**detail**]
static-host [**sap** *sap-id*] [**wholesaler** *service-id*] [**port** *port-id*] **no-inter-dest-id** [**detail**]
static-host summary

Context show>service>id

Description This command displays Display static hosts configured on this service.

Parameters **sap** *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

intermediate-destination-id — Specifies the intermediate destination identifier which is encoded in the identification strings.

Values Up to 32 characters maximum

summary — Displays summary static host information.

detail — Displays detailed static host information.

wholesaler *service-id* **—** The service ID of the wholesaler.

Values 1 — 2147483647

Sample Output

```
*A:ALA-48# show service id 88 static-host
===============================================================================
Static Hosts for service 88
===============================================================================
Sap                         IP Address      Configured MAC    Dynamic MAC
  Subscriber                                  Admin State       Fwding State
-------------------------------------------------------------------------------
1/2/20:0                    10.10.10.104    N/A               N/A
   N/A                                        Down              Not Fwding
3/2/4:50/5                  143.144.145.1   N/A               N/A
   N/A                                        Up                Fwding
-------------------------------------------------------------------------------
Number of static hosts : 2
===============================================================================
*A:ALA-48#
```

stp

Syntax **stp** [**detail**]

Context show>service>id

Description Displays information for the spanning tree protocol instance for the service.

Parameters **detail** — Displays detailed information.

Output **Show Service-ID STP Output —** The following table describes show service-id STP output fields:

Label	Description
RSTP Admin State	Indicates the administrative state of the Rapid Spanning Tree Protocol instance associated with this service.
Core Connectivity	Indicates the connectivity status to the core.
RSTP Oper State	Indicates the operational state of the Rapid Spanning Tree Protocol instance associated with this service. This field is applicable only when STP is enabled on the router.
Bridge-id	Specifies the MAC address used to identify this bridge in the network.
Hold Time	Specifies the interval length during which no more than two Configuration BPDUs shall be transmitted by this bridge.
Bridge fwd delay	Specifies how fast a bridge changes its state when moving toward the forwarding state.
Bridge Hello time	Specifies the amount of time between the transmission of Configuration BPDUs.
Bridge max age	Specifies the maximum age of spanning tree protocol information learned from the network on any port before it is discarded. This is the actual value that this bridge is currently using.
Bridge priority	Defines the priority of the spanning tree protocol instance associated with this service.
Topology change	Specifies whether a topology change is currently in progress.
Last Top. change	Specifies the time (in hundredths of a second) since the last time a topology change was detected by the Spanning Tree Protocol instance associated with this service.
Top. change count	Specifies the total number of topology changes detected by the Spanning Tree Protocol instance associated with this service since the management entity was last reset or initialized.

Sample Output

```
A:ALA-12# show service id 1 stp
===============================================================================
Spanning Tree Information
===============================================================================
VPLS Spanning Tree Information
-------------------------------------------------------------------------------
RSTP Admin State  : Up                  RSTP Oper State   : Down
Core Connectivity : Down
Bridge-id         : 04:67:ff:00:00:01

Hold Timer        : 1                   Bridge fwd delay  : 15
Bridge Hello time : 1                   Bridge max age    : 20
Bridge priority   : 1                   Topology change   : Inactive
Last Top. change  : 0d 00:00:00         Top. change count : 0

Root bridge-id    : 00:03:fa:00:00:00

Root path cost    : 1                   Root forward delay: 15
Root hello time   : 1                   Root max age      : 20
Root priority     : 0                   Root port         : vcp

-------------------------------------------------------------------------------
Spanning Tree Specifics
-------------------------------------------------------------------------------
SAP Identifier    : 1/1/7:0             RSTP State        : Down
STP Port State    : Forwarding          BPDU encap        : dot1d
Port Number       : 2048                Priority          : 128
Cost              : 10                  Fast Start        : Disabled
Designated Port   : 34816               Designated Bridge : 02:fa:00:04:54:01
===============================================================================
A:ALA-12#
```

authentication

Syntax **authentication**

Context show>service>id

Description This command enables the context to show session authentication information.

statistics

Syntax **statistics** [**policy** *name*] [**sap** *sap-id*]

Context show>service>id>authentication

Description This command displays session authentication statistics for this service.

Parameters **policy** *name* — Specifies an existing authentication policy name.

sap-id — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

Sample Output

```
*A:ALA-48# show service id 700 authentication statistics
===============================================================
Authentication Statistics for service 700
===============================================================
Client Packets Authenticate Fail  : 0
Client Packets Authenticate Ok    : 0
===============================================================
*A:ALA-48#
```

subscriber-hosts

Syntax **subscriber-hosts** [**sap** *sap-id*] [**ip** *ip-address*[/*mask*]] [**mac** *ieee-address*] [**sub-profile** *sub-profile-name*] [**sla-profile** *sla-profile-name*] [**detail**]

Context show>service>id

Description This command displays subscriber host information.

Parameters **sap** *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

ip ***ip-address*[/*mask*]** — Shows information for the specified IP address and mask.

mac *ieee-address* — Displays information only for the specified 48-bit MAC address. The MAC address can be expressed in the form *aa*:*bb*:*cc*:*dd*:*ee*:*ff* or *aa-bb-cc-dd-ee-ff* where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers.

profile *sub-profile-name* — Displays an existing subscriber profile name to be associated with the static subscriber host. The subscriber profile is configured in the **config>subscr-mgmt>sub-profile** context.

sla-profile *sla-profile-name* — Displays this optional parameter to specify an existing SLA profile name.

detail — Displays detailed information.

Output **Show Service-ID subscriber hosts —** The following table describes show service-id subscriber hosts output fields:

Label	Description
Sap	Displays the SAP ID number.
IP Address	Displays the IP address.
MAC Address	Displays the MAC address
Origin Subscriber	The ID of the originating subscriber.
Redirection filter id	Displays the Redirection Filter ID number.
Status: active/inactive	Displays the status of one-time HTTP redirection.
Filter-id-source	Displays source of the HTTP filter.

Sample Output

```
*A:Dut-C>#  show service id 3 subscriber-hosts
===============================================================
Subscriber Host table
===============================================================
Sap                    Subscriber
  IP Address
    MAC Address          PPPoE-SID     Origin       Fwding State
---------------------------------------------------------------
2/1/5:2                    TEACAHEH74
  11.11.1.61
    00:80:00:00:00:0a          N/A               ARP-Host        Fwding
[pw-11:11]                  VIACAHEH74
  11.11.1.2
    00:00:11:11:01:02          N/A               ARP-Host        Fwding
[pw-11:12]                  pw-11:12
  11.11.1.3
    00:00:11:11:01:03          N/A               ARP-Host        Fwding
[pw-11:13]                  pw-11:13
  11.11.1.4
    00:00:11:11:01:04          N/A               ARP-Host        Fwding
[pw-22:22]                  XMACAHEH74
  22.22.1.2
    00:00:22:22:01:02          N/A               ARP-Host        Fwding

[pw-33:33]                  IUASAHEH74
  33.33.1.2
    00:00:33:33:01:02          N/A               ARP-Host        Fwding
---------------------------------------------------------------
Number of subscriber hosts: 6
===============================================================
*A:Dut-C>#


A:Dut-A# show service id 100 subscriber-hosts ip 10.100.1.5
===============================================================================
Subscriber Host table
===============================================================================
Sap                    IP Address      MAC Address       Origin(*) Subscriber
-------------------------------------------------------------------------------
1/2/1:102              10.100.1.5      00:10:00:00:00:03 -/D/- alcatel_100
-------------------------------------------------------------------------------
Number of subscriber hosts : 1
===============================================================================
(*) S=Static Host, D=DHCP Lease, N=Non-Sub-Traffic
A:Dut-A#
```

sdp

Syntax **sdp** *sdp-id* **pw-port** [*pw-port-id*]
sdp *sdp-id* **pw-port**
sdp *sdp-id* **pw-port** [*pw-port-id*] [**statistics]**
sdp [**consistent | inconsistent | na] egressifs**
sdp *sdp-id* **keep-alive-history**
sdp far-end *ip-address* | *ipv6-address* **keep-alive-history**
sdp [*sdp-id*] detail

sdp far-end *ip-address* | *ipv6-address* **detail**

Context show>service>sdp

Description This command displays SDP information.

If no optional parameters are specified, a summary SDP output for all SDPs is displayed.

Parameters *sdp-id* — The SDP ID for which to display information.

Default All SDPs.

Values 1 — 17407

pw-port *pw-port-id* **—** Displays the SAP identifier for PW-SAPs.

Values 1 — 10239

far-end *ip-address* **—** Displays only SDPs matching with the specified far-end IP address.

Default SDPs with any far-end IP address.

detail — Displays detailed SDP information.

Default SDP summary output.

keep-alive-history — Displays the last fifty SDP keepalive events for the SDP.

Default SDP summary output.

Sample Output

```
===============================================================================
*A:ALA-12>config>service# show service sdp 1 pw-port
===============================================================================
Service Destination Point (sdp Id 1 Pw-Port)
===============================================================================
Pw-port   VC-Id     Adm     Encap       Opr     VC Type     Egr       Monitor
                                                            Shaper    Oper
                                                            VPort     Group
-------------------------------------------------------------------------------
1         1         up      dot1q       up      ether
2         2         up      qinq        up      ether
3         3         up      dot1q       up      ether
4         4         up      qinq        up      ether
-------------------------------------------------------------------------------
Entries found : 4
===============================================================================

*A:ALA-12>config>service# show service sdp 1 pw-port 3
===============================================================================
Service Destination Point (Sdp Id 1 Pw-Port 3)
===============================================================================
SDP Binding port     : lag-1
VC-Id                : 3                    Admin Status       : up
Encap                : dot1q                Oper Status        : up
VC Type              : ether
Oper Flags           : (Not Specified)
Monitor Oper-Group   : (Not Specified)
===============================================================================
```

```
*A:ALA-12>config>service# show service sdp 1 pw-port 3 statistics
===============================================================================
Service Destination Point (Sdp Id 1 Pw-Port 3)
===============================================================================
SDP Binding port     : lag-1
VC-Id                : 3                    Admin Status       : up
Encap                : dot1q                Oper Status        : up
VC Type              : ether
Oper Flags           : (Not Specified)
Monitor Oper-Group   : (Not Specified)

Statistics            :
I. Fwd. Pkts.        : 0                    I. Dro. Pkts.      : 0
I. Fwd. Octs.        : 0                    I. Dro. Octs.      : 0
E. Fwd. Pkts.        : 0                    E. Fwd. Octets     : 0
===============================================================================
```

subscriber-using

Syntax **subscriber-using** [**service-id** *service-id*] [**sap-id** *sap-id*] [**interface** *ip-int-name*] [**ip** *ip-address*[*/mask*]] [**mac** *ieee-address*] [**sub-profile** *sub-profile-name*] [**sla-profile** *sla-profile-name*] [**app-profile** *app-profile-name*] [**port** *port-id*] [**no-inter-dest-id** | **inter-dest-id** *intermediate-destination-id*]

Context show>service

Description This command displays selective subscriber information using specific options.

Parameters **service-id** *service-id* — Displays information for the specifies ID that uniquely identifies a service.

sap-id *sap-id* — Displays the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

interface *ip-int-name* — Shows DHCP statistics on the specified interface.

port *port-id* — Indicates the SAP or SDP for which this entry contains information.

ip *ip-address*[*/mask*] — Shows information for the specified IP address and mask.

mac *ieee-address* — Displays information only for the specified 48-bit MAC address. The MAC address can be expressed in the form *aa*:*bb*:*cc*:*dd*:*ee*:*ff* or *aa-bb-cc-dd-ee-ff* where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers.

sub-profile *sub-profile-name* — Displays an existing subscriber profile name to be associated with the static subscriber host. The subscriber profile is configured in the **config>subscr-mgmt>sub-profile** context.*sla-profile-name*

sla-profile — Displays this optional parameter to specify an existing SLA profile name.

app-profile — Displays the application specified profile.

inter-dest-id *intermediate-destination-id* — Indicates the intermediate destination identifier received from either the DHCP or the RADIUS server or the local user database.

Sample Output

```
A:Dut-A# show service subscriber-using service-id 100
===============================================================
Subscribers
===============================================================
Subscriber                      Sub Profile
---------------------------------------------------------------
alcatel_100                     sub_prof100
---------------------------------------------------------------
Matching Subscribers : 1
===============================================================
A:Dut-A#

A:Dut-A# show service subscriber-using
===============================================================
Subscribers
===============================================================
Subscriber                      Sub Profile
---------------------------------------------------------------
alcatel_100                     sub_prof100
alcatel_110                     sub_prof110
```

```
alcatel_120                     sub_prof120
alcatel_130                     sub_prof130
alcatel_80                      sub_prof80
alcatel_90                      sub_prof90
client_PC1                      sub_profPC1
static                          sub_default
------------------------------------------------------------------
Matching Subscribers : 8
==================================================================
A:Dut-A#
```

redundancy

Syntax **redundancy**

Context show

Description This command enables the context to show multi-chassis redundancy information.

multi-chassis

Syntax **multi-chassis all**
multi-chassis mc-lag peer *ip-address* [**lag** *lag-id*]
multi-chassis mc-lag [**peer** *ip-address* [**lag** *lag-id*]] **statistics**
multi-chassis sync [**peer** *ip-address*] [**detail**]
multi-chassis sync [**peer** *ip-address*] **statistics**

Context show>redundancy

Description This command displays multi-chassis redundancy information.

Parameters **all —** Displays all multi-chassis information.

mc-lag — Displays multi-chassis LAG information.

peer *ip-address* **—** Displays the address of the multi-chassis peer.

lag *lag-id* **—** Displays the specified LAG ID on this system that forms an multi-chassis LAG configuration with the indicated peer.

statistics — Displays statistics for the multi-chassis peer.

sync — Displays synchronization information.

detail — Displays detailed information.

Sample Output

```
A:pc1# show redundancy multi-chassis all
===============================================================================
Multi-Chassis Peers
===============================================================================
Peer IP         Src IP          Auth            Peer Admin
  MCS Admin       MCS Oper        MCS State       MC-LAG Admin    MC-LAG Oper
```

```
-------------------------------------------------------------------------------
10.10.10.102    10.10.10.101    hash            Enabled
  Enabled         Enabled         inSync          Enabled         Enabled
10.10.20.1      0.0.0.0         None            Disabled
  --              --              --              Disabled        Disabled
===============================================================================
A:pc1#


*A:Dut-C# show redundancy multi-chassis mc-lag peer 10.10.10.1
===============================================================================
Multi-Chassis MC-Lag Peer 10.10.10.1
===============================================================================
Last State chg: 09/24/2007 07:58:03
Admin State: Up      Oper State   : Up
KeepAlive: 10 deci-seconds     Hold On Ngbr Failure : 3
-------------------------------------------------------------------------------
Lag Id Lacp Key Remote Lag Id System Id  Sys Prio Last State Changed
-------------------------------------------------------------------------------
1      326661      00:00:00:33:33:33  32888  09/24/2007 07:56:35
-------------------------------------------------------------------------------
Number of LAGs : 1
===============================================================================
*A:Dut-C#

A:pc1# show redundancy multi-chassis mc-lag statistics
===============================================================================
Multi-Chassis Statistics
===============================================================================
Packets Rx                        : 129816
Packets Rx Keepalive              : 129798
Packets Rx Config                 : 3
Packets Rx Peer Config            : 5
Packets Rx State                  : 10
Packets Dropped KeepaliveTask     : 0
Packets Dropped Packet Too Short  : 0
Packets Dropped Verify Failed     : 0
Packets Dropped Tlv Invalid Size  : 0
Packets Dropped Out of Seq        : 0
Packets Dropped Unknown Tlv       : 0
Packets Dropped Tlv Invalid LagId : 0
Packets Dropped MD5               : 0
Packets Dropped Unknown Peer      : 0
Packets Tx                        : 77918
Packets Tx Keepalive              : 77879
Packets Tx Config                 : 6
Packets Tx Peer Config            : 26
Packets Tx State                  : 7
Packets Tx Failed                 : 0
===============================================================================
A:pc1#


A:pc1# show redundancy multi-chassis mc-lag peer 10.10.10.102 lag 2 statistics
===============================================================================
Multi-Chassis Statistics, Peer 10.10.10.102 Lag 2
===============================================================================
Packets Rx Config                 : 1
Packets Rx State                  : 4
Packets Tx Config                 : 2
Packets Tx State                  : 3
```

```
Packets Tx Failed                : 0
===============================================================================
A:pc1#


A:pc1#show redundancy multi-chassis mc-lag peer 10.10.10.102 statistics
===============================================================================
Multi-Chassis Statistics, Peer 10.10.10.102
===============================================================================
Packets Rx                       : 129918
Packets Rx Keepalive             : 129900
Packets Rx Config                : 3
Packets Rx Peer Config           : 5
Packets Rx State                 : 10
Packets Dropped State Disabled   : 0
Packets Dropped Packets Too Short : 0
Packets Dropped Tlv Invalid Size  : 0
Packets Dropped Tlv Invalid LagId : 0
Packets Dropped Out of Seq       : 0
Packets Dropped Unknown Tlv      : 0
Packets Dropped MD5              : 0
Packets Tx                       : 77979
Packets Tx Keepalive             : 77940
Packets Tx Peer Config           : 26
Packets Tx Failed                : 0
===============================================================================
A:pc1#


A:pc1# show redundancy multi-chassis sync
===============================================================================
Multi-chassis Peer Table
===============================================================================
Peer
-------------------------------------------------------------------------------
Peer IP Address         : 10.10.10.102
Description             : CO1
Authentication          : Enabled
Source IP Address       : 10.10.10.101
Admin State             : Enabled
-------------------------------------------------------------------------------
Sync-status
-------------------------------------------------------------------------------
Client Applications     :
Sync Admin State        : Up
Sync Oper State         : Up
DB Sync State           : inSync
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
===============================================================================
Peer
-------------------------------------------------------------------------------
Peer IP Address         : 10.10.20.1
Authentication          : Disabled
Source IP Address       : 0.0.0.0
Admin State             : Disabled
===============================================================================
```

```
A:pc1#

pc1# show redundancy multi-chassis sync peer 10.10.10.102
===============================================================================
Multi-chassis Peer Table
===============================================================================
Peer
-------------------------------------------------------------------------------
Peer IP Address         : 10.10.10.102
Description             : CO1
Authentication          : Enabled
Source IP Address       : 10.10.10.101
Admin State             : Enabled
-------------------------------------------------------------------------------
Sync-status
-------------------------------------------------------------------------------
Client Applications     :
Sync Admin State        : Up
Sync Oper State         : Up
DB Sync State           : inSync
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
===============================================================================
MCS Application Stats
===============================================================================
Application             : igmp
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
-------------------------------------------------------------------------------
Application             : igmpSnooping
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
-------------------------------------------------------------------------------
Application             : subMgmt
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
-------------------------------------------------------------------------------
Application             : srrp
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
```

```
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
===============================================================================
A:pc1#

A:pc1# show redundancy multi-chassis sync peer 10.10.10.102 detail
===============================================================================
Multi-chassis Peer Table
===============================================================================
Peer
-------------------------------------------------------------------------------
Peer IP Address         : 10.10.10.102
Description             : CO1
Authentication          : Enabled
Source IP Address       : 10.10.10.101
Admin State             : Enabled
-------------------------------------------------------------------------------
Sync-status
-------------------------------------------------------------------------------
Client Applications     :
Sync Admin State        : Up
Sync Oper State         : Up
DB Sync State           : inSync
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
===============================================================================
MCS Application Stats
===============================================================================
Application             : igmp
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
-------------------------------------------------------------------------------
Application             : igmpSnooping
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
-------------------------------------------------------------------------------
Application             : subMgmt
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
-------------------------------------------------------------------------------
Application             : srrp
```

```
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
===============================================================================
Ports synced on peer 10.10.10.102
===============================================================================
Port/Encap                    Tag
-------------------------------------------------------------------------------
1/1/1
  1-2                         r1
===============================================================================
A:pc1#

A:pc1# show redundancy multi-chassis sync statistics
===============================================================================
Multi-chassis Peer Sync Stats
===============================================================================
Peer IP Address         : 10.10.10.102
Packets Tx Total        : 511
Packets Tx Hello        : 510
Packets Tx Data         : 0
Packets Tx Other        : 1
Packets Tx Error        : 0
Packets Rx Total        : 511
Packets Rx Hello        : 510
Packets Rx Data         : 0
Packets Rx Other        : 1
Packets Rx Error        : 0
Packets Rx Header Err   : 0
Packets Rx Body Err     : 0
Packets Rx Seq Num Err  : 0
===============================================================================
Peer IP Address         : 10.10.20.1
Packets Tx Total        : 0
Packets Tx Hello        : 0
Packets Tx Data         : 0
Packets Tx Other        : 0
Packets Tx Error        : 0
Packets Rx Total        : 0
Packets Rx Hello        : 0
Packets Rx Data         : 0
Packets Rx Other        : 0
Packets Rx Error        : 0
Packets Rx Header Err   : 0
Packets Rx Body Err     : 0
Packets Rx Seq Num Err  : 0
===============================================================================
A:pc1#

A:pc1# show redundancy multi-chassis sync peer 10.10.10.102 statistics
===============================================================================
Multi-chassis Peer Sync Stats
===============================================================================
Peer IP Address         : 10.10.10.102
Packets Tx Total        : 554
Packets Tx Hello        : 553
Packets Tx Data         : 0
```

```
Packets Tx Other        : 1
Packets Tx Error        : 0
Packets Rx Total        : 554
Packets Rx Hello        : 553
Packets Rx Data         : 0
Packets Rx Other        : 1
Packets Rx Error        : 0
Packets Rx Header Err   : 0
Packets Rx Body Err     : 0
Packets Rx Seq Num Err  : 0
===============================================================================
A:pc1#
```

mc-ipsec

Syntax **mc-ipsec peer** *addr* [**tunnel-group** *group-id*]

Context show>redundancy>multi-chassis

Description This command displays the IPsec multi-chassis states. Optionally, only the states of the specified tunnel-groups will be displayed.

Parameters *addr* — Specifies the address of the peer.

group-id — Specifies the tunnel-group ID.

Sample Output

```
===============================================================================
Multi-Chassis MC-IPSec
===============================================================================
Peer Name       : (Not Specified)
Peer Addr       : 2.2.2.2
Keep Alive Intvl: 10                  Hold on Nbr Fail     : 3
BFD Intf Name   : None
BFD Dest Addr   :
Last update     : 03/20/2012 22:48:55

===============================================================================
Multi-Chassis IPsec Multi Active Tunnel-Group Table
===============================================================================
ID             Peer Group     Priority  Preempt   Admin State    Mastership
-------------------------------------------------------------------------------
1              1              100       Disabled  Up             eligible
-------------------------------------------------------------------------------
Multi Active Tunnel Group Entries found: 1
===============================================================================
```

mc-ring

Syntax **mc-ring peer** *ip-address* **statistics**
mc-ring peer *ip-address* [**ring** *sync-tag* [**detail**|**statistics**]]
mc-ring peer *ip-address* **ring** *sync-tag* **ring-node** [*ring-node-name* [**detail**|**statistics**]]
mc-ring global-statistics

Context show>redundancy>multi-chassis

Description This command displays multi-chassis ring information.

Parameters *ip-address* — Specifies the address of the multi-chassis peer to display.

ring *sync-tag* **—** Specifies a synchronization tag to be displayed that was used while synchronizing this port with the multi-chassis peer.

node *ring-node-name* **—** Specifies a ring-node name.

global-statistics — Displays global statistics for the multi-chassis ring.

detail — Displays detailed peer information for the multi-chassis ring.

Output **Show mc-ring peer ip-address ring Output —** The following table describes mc-ring peer ip-address ring output fields.

Label	Description
Sync Tag	Displays the synchronization tag that was used while synchronizing this port with the multi-chassis peer.
Oper State	noPeer – The peer has no corresponding ring configured. connected – The inband control connection with the peer is operational. broken – The inband control connection with the peer has timed out. conflict – The inband control connection with the peer has timed out but the physical connection is still OK; the failure of the inband signaling connection is caused by a misconfiguration. For example, a conflict between the configuration of this system and its peer, or a misconfiguration on one of the ring access node systems. testingRing – The inband control connection with the peer is being set up. Waiting for result. waitingForPeer – Verifying if this ring is configured on the peer. configErr – The ring is administratively up, but a configuration error prevents it from operating properly. halfBroken – The inband control connection indicates that the ring is broken in one direction (towards the peer).

Label	Description (Continued)
	localBroken – The inband control connection with the peer is known to be broken due to local failure or local administrative action. shutdown – The ring is shutdown.
Failure Reason	
No. of MC Ring entries	

Sample Output

```
show redundancy multi-chassis mc-ring peer 10.0.0.2 ring ring11 detail
===============================================================================
Multi-Chassis MC-Ring Detailed Information
===============================================================================
Peer           : 10.0.0.2
Sync Tag       : ring11
Port ID        : 1/1/3
Admin State    : inService
Oper State     : connected
Admin Change   : 01/07/2008 21:40:07
Oper Change    : 01/07/2008 21:40:24
Failure Reason : None
-------------------------------------------------------------------------------
In Band Control Path
-------------------------------------------------------------------------------
Service ID     : 10
Interface Name : to_an1
Oper State     : connected
Dest IP        : 10.10.0.2
Src  IP        : 10.10.0.1
-------------------------------------------------------------------------------
VLAN Map B Path Provisioned
-------------------------------------------------------------------------------
range 13-13
range 17-17
-------------------------------------------------------------------------------
VLAN Map Excluded Path Provisioned
-------------------------------------------------------------------------------
range 18-18
-------------------------------------------------------------------------------
VLAN Map B Path Operational
-------------------------------------------------------------------------------
range 13-13
range 17-17
-------------------------------------------------------------------------------
VLAN Map Excluded Path Operational
-------------------------------------------------------------------------------
range 18-18
===============================================================================
```

```
*A:ALA-48>show>redundancy>multi-chassis# mc-ring peer 192.251.10.104
===============================================================================

MC Ring entries
===============================================================================
Sync Tag                          Oper State      Failure Reason
-------------------------------------------------------------------------------
No. of MC Ring entries: 0
===============================================================================

show redundancy multi-chassis mc-ring peer 10.0.0.2

===============================================================================
MC Ring entries
===============================================================================
Sync Tag                          Oper State      Failure Reason
-------------------------------------------------------------------------------
ring11                            connected       None
ring12                            shutdown        None
-------------------------------------------------------------------------------
No. of MC Ring entries: 4
===============================================================================


show redundancy multi-chassis mc-ring peer 10.0.0.2 ring ring11 ring-node an1 detail
===============================================================================
Multi-Chassis MC-Ring Node Detailed Information
===============================================================================
Peer           : 10.0.0.2
Sync Tag       : ring11
Node Name      : an1
Oper State Loc : connected
Oper State Rem : notTested
In Use         : True
Admin Change   : 01/07/2008 21:40:07
Oper Change    : 01/07/2008 21:40:25
Failure Reason : None
-------------------------------------------------------------------------------
Ring Node Connectivity Verification
-------------------------------------------------------------------------------
Admin State    : inService
Service ID     : 11
VLAN Tag       : 11
Dest IP        : 10.11.3.1
Src  IP        : None
Interval       : 1 minutes
Src MAC        : None
===============================================================================

show redundancy multi-chassis mc-ring peer 10.0.0.2 ring ring11 ring-node
===============================================================================
MC Ring Node entries
===============================================================================
Name                              Loc Oper St.      Failure Reason
  In Use                            Rem Oper St.
-------------------------------------------------------------------------------
an1                               connected         None
  Yes                               notTested
an2                               connected         None
  Yes                               notTested
-------------------------------------------------------------------------------
```

```
No. of MC Ring Node entries: 2
===============================================================================
```

show redundancy multi-chassis ring peer statistics Output — The following table describes multi-chassis ring peer output fields

Label	Description
Message	Displays the message type.
Received	Indicates the number of valid MC-Ring signaling messages received from the peer.
Transmitted	Indicates the number of valid MC-Ring signaling messages transmitted from the peer.
MCS ID Request	Displays the number of valid MCS ID requests were received from the peer.
MCS ID Response	Displays the number of valid MCS ID responses were received from the peer.
Ring Exists Request	Displays the number of valid 'ring exists' requests were received from the peer.
Ring Exists Response	Displays the number of valid ring exists' responses were received from the peer.
Keepalive	Displays the number of valid MC-Ring control packets of type 'keepalive' were received from the peer.

```
*A:ALA-48>show>redundancy>multi-chassis# mc-ring peer 192.251.10.104 statistics
===============================================================================
MC Ring statistics for peer 192.251.10.104
===============================================================================
Message                                                  Received     Transmitted
-------------------------------------------------------------------------------
MCS ID Request                                           0            0
MCS ID Response                                          0            0
Ring Exists Request                                      0            0
Ring Exists Response                                     0            0
Keepalive                                                0            0
-------------------------------------------------------------------------------
Total                                                    0            0
===============================================================================
*A:ALA-48>show>redundancy>multi-chassis#
```

show mc-ring ring-node Output

Label	Description
Oper State	Displays the state of the connection verification (both local and remote).

Label	Description (Continued)
	notProvisioned — Connection verification is not provisioned. configErr — Connection verification is provisioned but a configuration error prevents it from operating properly. notTested — Connection verification is administratively disabled or is not possible in the current situation. testing — Connection Verification is active, but no results are yet available. connected — The ring node is reachable. disconnected — Connection verification has timed out.
In Use	Displays “True” if the ring node is referenced on an e-pipe or as an inter-dest-id on a static host or dynamic lease.

show mc-ring global-statistics Output

Label	Description
Rx	Displays the number of MC-ring signaling packets were received by this system.
Rx Too Short	Displays the number of MC-ring signaling packets were received by this system that were too short.
Rx Wrong Authentication	Displays the number of MC-ring signaling packets were received by this system with invalid authentication.
Rx Invalid TLV	Displays the number of MC-ring signaling packets were received by this system with invalid TLV.
Rx Incomplete	Displays the number of MC-ring signaling packets were received by this system that were incomplete.
Rx Unknown Type	Displays the number of MC-ring signaling packets were received by this system that were of unknown type.
Rx Unknown Peer	Displays the number of MC-ring signaling packets were received by this system that were related to an unknown peer.
Rx Unknown Ring	Displays the number of MC-ring signaling packets were received by this system that were related to an unknown ring.
Rx Unknown Ring Node	Displays the number of MC-ring signaling packets were received by this system that were related to an unknown ring node.

Label	Description (Continued)
Tx	Displays the number of MC-ring signaling packets were transmitted by this system.
Tx No Buffer	Displays the number of MC-ring signaling packets could not be transmitted by this system due to a lack of packet buffers.
Tx Transmission Failed	Displays the number of MC-ring signaling packets could not be transmitted by this system due to a transmission failure.
Tx Unknown Destination	Displays the number of MC-ring **unknown destination** signaling packets were transmitted by this system.
Missed Configuration Events	Displays the number of missed configuration events on this system.
Missed BFD Events	Displays the number of missed BFD events on this system.

Sample Output

```
*A:ALA-48>show>redundancy>multi-chassis# mc-ring global-statistics
===============================================================================
Global MC Ring statistics
===============================================================================
Rx                          : 0
Rx Too Short                : 0
Rx Wrong Authentication     : 0
Rx Invalid TLV              : 0
Rx Incomplete               : 0
Rx Unknown Type             : 0
Rx Unknown Peer             : 0
Rx Unknown Ring             : 0
Rx Unknown Ring Node        : 0
Tx                          : 36763
Tx No Buffer                : 0
Tx Transmission Failed      : 0
Tx Unknown Destination      : 0
Missed Configuration Events : 0
Missed BFD Events           : 0
===============================================================================
*A:ALA-48>show>redundancy>multi-chassis#
```

lease-state

Syntax **lease-state** [**wholesaler** *service-id*] [**sap** *sap-id* | **sdp** *sdp-id*:*vc-id* | **interface** *interface-name* | **ip-address** *ip-address[/mask]* | **chaddr** *ieee-address* | **mac** *ieee-address* | {[**port** *port-id*] [**no-inter-dest-id** | **inter-dest-id** *inter-dest-id*]}] [**detail**]

Context show>service>id>dhcp

Description This command displays DHCP lease state information. Note that the **wholesaler** *service-id* parameter is applicable only in the VPRN context.

Parameters **wholesaler** *service-id* **—** The service ID of the wholesaler. When specified in this context, SAP, SDP, interface, IP address and MAC parameters are ignored.

Values service-id: 1 — 214748364
svc-name: A string up to 64 characters in length.

sap *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp *sdp-id* — The SDP identifier.

Values 1 — 17407

vc-id — The virtual circuit identifier. This value is used to validate the VC ID portion of each mesh SDP binding defined in the service. The default value of this object is equal to the service ID.

Values 1 — 4294967295

ip ***ip-address***[/***mask***] **—** Shows information for the specified IP address and mask.

port *port-id* **—** The DHCP lease state local specifies that the DHCP lease state is learned by either a SAP or SDP. When the value is SAP, the value indicates the SAP for which this entry contains information.

chaddr — Specifies the MA address of the DHCP lease state.

interface *interface-name* **—** Shows information for the specified IP interface.

detail — Displays detailed lease state information.

inter-dest-id — Indicates the intermediate destination identifier received from either the DHCP or the RADIUS server or the local user database.

Sample Output

```
*A:ALA-48>config# show service id 101 dhcp lease-state
===============================================================================
DHCP lease state table, service 101
===============================================================================
IP Address      Mac Address       Sap/Sdp Id          Remaining  Lease    MC
                                                      LifeTime   Origin   Stdby
-------------------------------------------------------------------------------
102.1.1.52      00:00:1f:bd:00:bb lag-1:101           00h02m56s  DHCP-R
103.3.2.62      00:00:1f:bd:00:c6 lag-1:105           00h02m59s  RADIUS
-------------------------------------------------------------------------------
Number of lease states : 2
===============================================================================
*A:ALA-48>config#


*A:ALA-48>config# show service id 105 dhcp lease-state  wholesaler 101
===============================================================================
DHCP lease state table, service 105
===============================================================================
IP Address      Mac Address       Sap/Sdp Id          Remaining  Lease    MC
                                                      LifeTime   Origin   Stdby
-------------------------------------------------------------------------------
Wholesaler 101 Leases
-------------------------------------------------------------------------------
103.3.2.62      00:00:1f:bd:00:c6 lag-1:105           00h00m39s  RADIUS
-------------------------------------------------------------------------------
```

```
Number of lease states : 1
===============================================================================
*A:ALA-48>config#
```

statistics

Syntax **statistics** [[**sap** *sap-id*]|[**sdp** *sdp-id:vc-id*]|[**interface** *interface-name*]]

Context show>service>id>dhcp

Description This command displays DHCP relay statistics.

Parameters **interface** *ip-int-name* — Display DHCP statistics on the specified interface.

interface *interface-name* — Displays DHCP statistics for the specified interface name.

sap *sap-id* — Displays DHCP statistics for the specified SAP. See Common Service Commands on page 2168 for *sap-id* command syntax.

Sample Output

```
*A:ALA-48# show service id 88 dhcp statistics interface SpokeTerm
===============================================================
DHCP Statistics for interface SpokeTerm
===============================================================
Rx Packets                          : 0
Tx Packets                          : 0
Rx Malformed Packets                : 0
Rx Untrusted Packets                : 0
Client Packets Discarded            : 0
Client Packets Relayed              : 0
Client Packets Snooped              : 0
Client Packets Proxied (RADIUS)     : 0
Client Packets Proxied (Lease-Split) : 0
Server Packets Discarded            : 0
Server Packets Relayed              : 0
Server Packets Snooped              : 0
DHCP RELEASEs Spoofed               : 0
DHCP FORCERENEWs Spoofed            : 0
===============================================================
*A:ALA-48#
```

summary

Syntax **summary** [**interface** *interface-name* | **saps**]

Context show>service>id>dhcp

Description This command displays DHCP configuration summary information.

Parameters **interface** *interface-name* — Displays summary information for the specified existing interface.

sap — Displays summary information for SAPs per interface.

Sample Output

```
IES:
*A:ALA-48>show>service>id>dhcp# summary
===============================================================
DHCP Summary, service 700
===============================================================
Sap/Sdp                 Snoop  Used/       Info     Admin
                               Provided    Option   State
---------------------------------------------------------------
sap:1/1/9:0             No     0/0         Keep     Down
sap:1/1/25:0            No     0/0         Keep     Down
sdp:8:700               No     N/A         N/A      N/A
---------------------------------------------------------------
Number of Entries : 3
---------------------------------------------------------------
*A:ALA-48>show>service>id>dhcp#


VPLS:
*A:ALA-49>show>service# id 700 dhcp summary
===============================================================================
DHCP Summary, service 700
===============================================================================
Sap/Sdp                 Snoop  Used/       Arp Reply   Info     Admin
                               Provided    Agent       Option   State
-------------------------------------------------------------------------------
sap:1/1/9:0             No     0/0         No          Keep     Down
sdp:2:222               No     N/A         N/A         N/A      N/A
sdp:2:700               No     N/A         N/A         N/A      N/A
-------------------------------------------------------------------------------
Number of Entries : 3
-------------------------------------------------------------------------------
*A:ALA-49>show>service#


VPRN:
*A:ALA-49>show>service# id 1 dhcp summary
===============================================================================
DHCP Summary, service 1
===============================================================================
Interface Name                  Arp      Used/                Info    Admin
  SapId/Sdp                     Populate Provided             Option  State
-------------------------------------------------------------------------------
SpokeSDP                        No       0/0                  Keep    Down
  sdp:spoke-3:4                          0/0
test                            No       0/0                  Keep    Down
  sap:9/1/4:50/5                         0/0
to-ce1                          No       0/0                  Keep    Up
  sap:1/1/10:1                           0/0
-------------------------------------------------------------------------------
Interfaces: 3
===============================================================================
*A:ALA-49>show>service#

*A:ALA-48# show service id 88 dhcp summary saps
===============================================================================
DHCP Summary, service 88
===============================================================================
Interface Name                  Arp      Used/                Info    Admin
  SapId/Sdp                     Populate Provided             Option  State
```

```
-------------------------------------------------------------------------------
SpokeTerm                         No       0/0                  Keep    Up
  sdp:spoke-3:3                            0/0
new-if                            No       0/1                  Keep    Up
  sap:1/2/19:0                             0/1
test123                           No       0/0                  Keep    Up
  sap:3/2/4:50/5                           0/0
testabc                           No       0/0                  Keep    Up
  sap:1/2/20:0                             0/0
-------------------------------------------------------------------------------
Interfaces: 4
===============================================================================
*A:ALA-48#


*A:ALA-48# show service id 88 dhcp summary interface SpokeTerm
===============================================================================
DHCP Summary, service 88
===============================================================================
Interface Name                    Arp      Used/                Info    Admin
  SapId/Sdp                       Populate Provided             Option  State
-------------------------------------------------------------------------------
SpokeTerm                         No       0/0                  Keep    Up
  sdp:spoke-3:3                            0/0
-------------------------------------------------------------------------------
Interfaces: 1
===============================================================================
*A:ALA-48#
```

statistics

Syntax **statistics** [**interface** *ip-int-name* | *ip-address*]

Context show>router>dhcp

Description This command displays statistics for DHCP relay and DHCP snooping. If no IP address or interface name is specified, then all configured interfaces are displayed. If an IP address or interface name is specified, then only data regarding the specified interface is displayed.

Parameters **interface** *ip-int-name* | *ip-address* — Displays statistics for the specified IP interface or IP address.

Output **Show DHCP Statistics Output —** The following table describes the output fields for DHCP statistics.

Label	Description
Received Packets	The number of packets received from the DHCP clients.
Transmitted Packets	The number of packets transmitted to the DHCP clients.
Received Malformed Packets	The number of malformed packets received from the DHCP clients.
Received Untrusted Packets	The number of untrusted packets received from the DHCP clients.

Label	Description (Continued)
Client Packets Discarded	The number of packets received from the DHCP clients that were discarded.
Client Packets Relayed	The number of packets received from the DHCP clients that were forwarded.
Client Packets Snooped	The number of packets received from the DHCP clients that were snooped.
Server Packets Discarded	The number of packets received from the DHCP server that were discarded.
Server Packets Relayed	The number of packets received from the DHCP server that were forwarded.
Server Packets Snooped	The number of packets received from the DHCP server that were snooped.
Client packets proxied (RADIUS)	The number of packets that were generated from RADIUS data and not relayed from a server
Client packets proxied (Lease-Split)	Indicates the total number of client packets proxied by the DHCP relay agent based on data received from a RADIUS server
DHCP RELEASEs spoofed	Indicates the total number of DHCP release messages spoofed by the DHCP relay agent to the DHCP server.
DHCP FORCERENEWs spoofed	The number of DHCP force-renew packets sent to DHCP clients.

Sample Output

```
A:SUB-Dut-A# show router 1000 dhcp statistics
===============================================================
DHCP Global Statistics (Service: 1000)
===============================================================
Rx Packets                          : 16000
Tx Packets                          : 15041
Rx Malformed Packets                : 0
Rx Untrusted Packets                : 0
Client Packets Discarded            : 423
Client Packets Relayed              : 0
Client Packets Snooped              : 0
*Client Packets Proxied (RADIUS)    : 0
Client Packets Proxied (Lease-Split) : 0   *
Server Packets Discarded            : 0
Server Packets Relayed              : 0
Server Packets Snooped              : 0
*DHCP RELEASEs Spoofed              : 0
DHCP FORCERENEWs Spoofed            : 0   *
===============================================================
A:SUB-Dut-A#
```

summary

Syntax **summary**

Context show>router>dhcp

Description Display the status of the DHCP Relay and DHCP Snooping functions on each interface.

Output **Show DHCP Summary Output —** The following table describes the output fields for DHCP summary.

Label	Description
Interface Name	Name of the router interface.
ARP Populate	Indicates whether ARP populate is enabled.
Used/Provided	Indicates the number of used and provided DHCP leases.
Info Option	Indicates whether Option 82 processing is enabled on the interface.
Admin State	Indicates the administrative state.

Sample Output

```
*A:ALA-48>show>router>dhcp# summary
===============================================================================
Interface Name                   Arp      Used/     Info    Admin
                                 Populate Provided  Option  State
-------------------------------------------------------------------------------
ccaiesif                         No       0/0       Keep    Down
ccanet6                          No       0/0       Keep    Down
iesBundle                        No       0/0       Keep    Up
spokeSDP-test                    No       0/0       Keep    Down
test                             No       0/0       Keep    Up
test1                            No       0/0       Keep    Up
test2                            No       0/0       Keep    Up
testA                            No       0/0       Keep    Up
testB                            No       0/0       Keep    Up
testIES                          No       0/0       Keep    Up
to-web                           No       0/0       Keep    Up
-------------------------------------------------------------------------------
Interfaces: 11
===============================================================================
*A:ALA-48>show>router>dhcp#
```

IGMP Snooping Show Commands

igmp-snooping

Syntax **igmp-snooping**

Context show>service>id>

Description This command enables the context to display IGMP snooping information.

all

Syntax **all**

Context show>service>id>igmp-snooping

Description Displays detailed information for all aspects of IGMP snooping on the VPLS service.

Output **Show All Service-ID —** The following table describes the show all service-id command output fields:

Label	Description
Admin State	The administrative state of the IGMP instance.
Querier	Displays the address of the IGMP querier on the IP subnet to which the interface is attached.
Sap/Sdp Id	Displays the SAP and SDP IDs of the service ID.
Oper State	Displays the operational state of the SAP and SDP IDs of the service ID.
Mrtr Port	Specifies there the port is a multicast router port.
Send Queries	Specifies whether the send-queries command is enabled or disabled.
Max Num Groups	Specifies the maximum number of multicast groups that can be joined on this SAP or SDP.
MVR From VPLS	Specifies MVR from VPLS.
Num Groups	Specifies the actual number of multicast groups that can be joined on this SAP or SDP.

Sample Output

```
*A:ALA-48>show>service>id>igmp-snooping>snooping# all
===============================================================================
IGMP Snooping info for service 750
===============================================================================
IGMP Snooping Base info
-------------------------------------------------------------------------------
Admin State : Up
Querier     : No querier found
-------------------------------------------------------------------------------
Sap/Sdp                 Oper      MRtr  Send      Max Num   Num
Id                      State     Port  Queries   Groups    Groups
-------------------------------------------------------------------------------
sap:1/1/7:0             Down      No    Disabled  No Limit  0
sdp:1:22                Down      No    Disabled  No Limit  0
sdp:8:750               Down      No    Disabled  No Limit  0
-------------------------------------------------------------------------------
IGMP Snooping Querier info
-------------------------------------------------------------------------------
No querier found for this service.
-------------------------------------------------------------------------------
IGMP Snooping Multicast Routers
-------------------------------------------------------------------------------
MRouter          Sap/Sdp Id             Up Time        Expires   Version
-------------------------------------------------------------------------------
Number of mrouters: 0
-------------------------------------------------------------------------------
IGMP Snooping Proxy-reporting DB
-------------------------------------------------------------------------------
Group Address    Mode     Type     Up Time        Expires  Num Src
-------------------------------------------------------------------------------
Number of groups: 0
-------------------------------------------------------------------------------
IGMP Snooping SAP 1/1/7:0 Port-DB
-------------------------------------------------------------------------------
Group Address    Mode     Type     Up Time        Expires  Num Src
-------------------------------------------------------------------------------
Number of groups: 0
-------------------------------------------------------------------------------
IGMP Snooping SDP 1:22 Port-DB
-------------------------------------------------------------------------------
Group Address    Mode     Type     Up Time        Expires  Num Src
-------------------------------------------------------------------------------
Number of groups: 0
-------------------------------------------------------------------------------
IGMP Snooping SDP 8:750 Port-DB
-------------------------------------------------------------------------------
Group Address    Mode     Type     Up Time        Expires  Num Src
-------------------------------------------------------------------------------
Number of groups: 0
-------------------------------------------------------------------------------
IGMP Snooping Static Source Groups
-------------------------------------------------------------------------------
IGMP Snooping Statistics
-------------------------------------------------------------------------------
Message Type            Received      Transmitted      Forwarded
-------------------------------------------------------------------------------
General Queries         0             0                0
Group Queries           0             0                0
Group-Source Queries    0             0                0
```

```
V1 Reports              0             0               0
V2 Reports              0             0               0
V3 Reports              0             0               0
V2 Leaves               0             0               0
Unknown Type            0             N/A             0
-------------------------------------------------------------------------------
Drop Statistics
-------------------------------------------------------------------------------
Bad Length              : 0
Bad IP Checksum         : 0
Bad IGMP Checksum       : 0
Bad Encoding            : 0
No Router Alert         : 0
Zero Source IP          : 0

Send Query Cfg Drops    : 0
Import Policy Drops     : 0
Exceeded Max Num Groups : 0
===============================================================================
*A:ALA-48>show>service>id>snooping#
```

mrouters

Syntax **mrouters [detail]**

Context show>service>id>igmp-snooping

Description Displays all multicast routers.

Parameters **detail —** Displays detailed information.

Output **Show igmp-snooping mrouters —** The following table describes the show igmp-snooping mrouters output fields:

Label	Description
MRouter	Specifies the multicast router port.
Sap/Sdp Id	Specifies the SAP and SDP ID multicast router ports.
Up Time	Displays the length of time the mrouter has been up.
Expires	Displays the amount of time left before the query interval expires.
Version	Displays the configured version of IGMP running on this interface.

Sample Output

```
*A:ALA-48# show service id 700 igmp-snooping mrouters
===============================================================================
IGMP Snooping Multicast Routers for service 700
===============================================================================
MRouter          Sap/Sdp Id             Up Time        Expires   Version
-------------------------------------------------------------------------------
```

```
Number of mrouters: 0
===============================================================================
*A:ALA-48#
```

mvr

Syntax **mvr**

Context show>service>id>igmp-snooping

Description Displays Multicast VPLS Registration (MVR) information.

Output **Show igmp-snooping mvr —** The following table describes the show igmp-snooping mvr output fields:

Label	Description
IGMP Snooping Admin State	Displays the IGMP snooping administrative state.
MVR Admin State	Displays the MVR administrative state.
MVR Policy	Displays the MVR policy name.
Svc ID	Displays the service ID.
Sap/SDP	Displays the SAP/SDP ID.
Oper State	Displays the operational state.
From VPLS	Displays the originating VPLS name.
Num Local Groups	Displays the number of local groups.

Sample Output

```
A:ALA-1>show>service>id>snooping# mvr
===============================================================================
IGMP Snooping Multicast VPLS Registration info for service 10
===============================================================================
IGMP Snooping Admin State : Up

MVR Admin State           : Up
MVR Policy                : mvr-policy
-------------------------------------------------------------------------------
Local SAPs/SDPs
-------------------------------------------------------------------------------
Svc Id     Sap/Sdp               Oper      From       Num Local
           Id                    State     VPLS       Groups
-------------------------------------------------------------------------------
100         sap:1/1/10:10        Up       Local      100
100         sap:1/1/10:20        Up       Local      100
-------------------------------------------------------------------------------
MVR SAPs (from-vpls=10)
```

```
-------------------------------------------------------------------------------
Svc Id     Sap/Sdp                Oper      From       Num MVR
           Id                     State     VPLS       Groups
-------------------------------------------------------------------------------
20         sap:1/1/4:100          Up        10         100
30         sap:1/1/31:10.10       Up        10         100
===============================================================================
A:ALA-1>show>service>id>snooping#
```

port-db

Syntax **port-db sap** *sap-id* [**detail**]
port-db sap *sap-id* **group** *grp-address*
port-db sdp-*id*:*vc-id* [**detail**]
port-db sdp *sdp-id*:*vc-id* **group** *grp-address*

Context show>service>id>igmp-snooping

Description This command displays information on the IGMP snooping port database for the VPLS service.

Parameters **group** *grp-ip-address* — Displays the IGMP snooping port database for a specific multicast group address.

sap *sap-id* — Displays the IGMP snooping port database for a specific SAP. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp *sdp-id* — Displays only IGMP snooping entries associated with the specified mesh SDP or spoke SDP. For a spoke SDP, the VC ID must be specified; for a mesh SDP, the VC ID is optional.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID for which to display information.

Default For mesh SDPs only, all VC IDs

Values 1 — 4294967295

group *grp-address* — Displays IGMP snooping statistics matching the specified group address.

source *ip-address* — Displays IGMP snooping statistics matching one particular source within the multicast group.

Sample Output

```
A:ALA-1>show>service>id>snooping# port-db sap 1/1/2
===============================================================================
IGMP Snooping SAP 1/1/2 Port-DB for service 10
===============================================================================
Group Address    Mode     Type     Up Time        Expires   Num Sources
-------------------------------------------------------------------------------
225.0.0.1        include  dynamic  0d 00:04:44    0s        2
-------------------------------------------------------------------------------
Number of groups: 1
===============================================================================
```

```
A:ALA-1>show>service>id>snooping# port-db sap 1/1/2 detail
===============================================================================
IGMP Snooping SAP 1/1/2 Port-DB for service 10
===============================================================================
IGMP Group 225.0.0.1
-------------------------------------------------------------------------------
Mode             : include              Type             : dynamic
Up Time          : 0d 00:04:57          Expires          : 0s
Compat Mode      : IGMP Version 3
V1 Host Expires  : 0s                   V2 Host Expires  : 0s
-------------------------------------------------------
Source Address  Up Time      Expires  Type     Fwd/Blk
-------------------------------------------------------
1.1.1.1         0d 00:04:57  20s      dynamic  Fwd
1.1.1.2         0d 00:04:57  20s      dynamic  Fwd
-------------------------------------------------------------------------------
Number of groups: 1
===============================================================================
A:ALA-1>show>service>id>snooping#
```

proxy-db

Syntax **proxy-db** [**detail**]
proxy-db group *grp-address*

Context show>service>id>igmp-snooping

Description Displays information on the IGMP snooping proxy reporting database for the VPLS service.

Parameters **group** *grp-ip-address* — Displays the IGMP snooping proxy reporting database for a specific multicast group address.

Sample Output

```
A:ALA-1>show>service>id>snooping# proxy-db
===============================================================================
IGMP Snooping Proxy-reporting DB for service 10
===============================================================================
Group Address    Mode     Up Time        Num Sources
-------------------------------------------------------------------------------
225.0.0.1        include  0d 00:05:40    2
-------------------------------------------------------------------------------
Number of groups: 1
===============================================================================

A:ALA-1>show>service>id>snooping# proxy-db detail
===============================================================================
IGMP Snooping Proxy-reporting DB for service 10
===============================================================================
-------------------------------------------------------------------------------
IGMP Group 225.0.0.1
-------------------------------------------------------------------------------
Up Time : 0d 00:05:54                   Mode : include
------------------------------
Source Address  Up Time
------------------------------
1.1.1.1         0d 00:05:54
```

```
1.1.1.2         0d 00:05:54
-------------------------------------------------------------------------------
Number of groups: 1
===============================================================================
A:ALA-1>show>service>id>snooping#
```

querier

Syntax **querier**

Context show>service>id>igmp-snooping

Description Displays information on the IGMP snooping queriers for the VPLS service.

Sample Output

```
A:ALA-1>show>service>id>snooping# querier
===============================================================================
IGMP Snooping Querier info for service 10
===============================================================================
Sap Id                  : 1/1/1
IP Address              : 10.10.10.1
Expires                 : 6s
Up Time                 : 0d 00:56:50
Version                 : 3

General Query Interval  : 5s
Query Response Interval : 2.0s
Robust Count            : 2
===============================================================================
A:ALA-1>show>service>id>snooping#
```

static

Syntax **static** [**sap** *sap-id* | **sdp** *sdp-id:vc-id*]

Context show>service>id>igmp-snooping

Description Displays information on static IGMP snooping source groups for the VPLS service.

Parameters **sap** *sap-id* — Displays static IGMP snooping source groups for a specific SAP. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp *sdp-id* — Displays the IGMP snooping source groups for a specific spoke or mesh SDP.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID for which to display information.

Default For mesh SDPs only, all VC IDs

Values 1 — 4294967295

Sample Output

```
A:ALA-1>show>service>id>snooping# static
===============================================================================
IGMP Snooping Static Source Groups for SAP 1/1/2
-------------------------------------------------------------------------------
Source          Group
-------------------------------------------------------------------------------
*               225.0.0.2
*               225.0.0.3
-------------------------------------------------------------------------------
Static (*,G)/(S,G) entries: 2

-------------------------------------------------------------------------------
IGMP Snooping Static Source Groups for SDP 10:10
-------------------------------------------------------------------------------
Source          Group
-------------------------------------------------------------------------------
1.1.1.1         225.0.0.10
-------------------------------------------------------------------------------
Static (*,G)/(S,G) entries: 1
===============================================================================
A:ALA-1>show>service>id>snooping#
```

statistics

Syntax **statistics** [**sap** *sap-id* | **sdp** *sdp-id:vc-id*]

Context show>service>id>igmp-snooping

Description Displays IGMP snooping statistics for the VPLS service.

Parameters **sap** *sap-id* — Displays IGMP snooping statistics for a specific SAP. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp *sdp-id* — Displays the IGMP snooping statistics for a specific spoke or mesh SDP.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID for which to display information.

Default For mesh SDPs only, all VC IDs

Values 1 — 4294967295

Sample Output

```
A:ALA-1>show>service>id>snooping# statistics
===============================================================================
IGMP Snooping Statistics for service 1
===============================================================================
Message Type            Received      Transmitted   Forwarded
-------------------------------------------------------------------------------
General Queries         4             0             4
Group Queries           0             0             0
Group-Source Queries    0             0             0
V1 Reports              0             0             0
V2 Reports              0             0             0
V3 Reports              0             0             0
V2 Leaves               0             0             0
```

```
Unknown Type            0             N/A           0
-------------------------------------------------------------------------------
Drop Statistics
-------------------------------------------------------------------------------
Bad Length              : 0
Bad IP Checksum         : 0
Bad IGMP Checksum       : 0
Bad Encoding            : 0
No Router Alert         : 0
Zero Source IP          : 0

Send Query Cfg Drops    : 0
Import Policy Drops     : 0
Exceeded Max Num Groups : 0

MVR From VPLS Cfg Drops : 0
MVR To SAP Cfg Drops    : 0
===============================================================================
A:ALA-1>show>service>id>snooping#
```

mc-ecmp-balance

Syntax **mc-ecmp-balance** [**detail**]

Context show>router>pim

Description This command displays multicast balance information.

Parameters **detail —** Displays detailed information.

Sample Output

```
A:ALA-48>config>router>pim# show router pim mc-ecmp-balance
===============================================================================
PIM ECMP Balance
===============================================================================
MC-ECMP-Balance                  : Disabled
Rebalance in progress            : No
Last Rebalance Time              : 11/13/2007 09:03:10
Rebalance Type                   : Unknown
Optional Threshold Used          : 0
Mc Ecmp Balance Hold Time        : None
===============================================================================
A:ALA-48>config>router>pim#
```

mcast-management

Syntax **mcast-management**

Context show

Description This command shows multicast path management related information.

bandwidth-policy

Syntax **bandwidth-policy** *policy-name* [**detail**]

Context show>mcast-management

Description This command displays multicast path management bandwidth policy information.

Parameters *policy-name* — 32 char max

Output

```
Bandwidth Policies : 2
===============================================================================
*A:Dut-C# *show mcast-management bandwidth-policy detail*
===============================================================================
Bandwidth Policy Details
===============================================================================
Policy             : gie
-------------------------------------------------------------------------------
Admin BW Thd       : 10 kbps            Falling Percent RST: 50
Mcast Pool Total   : 10                 Mcast Pool Resv Cbs: 50
Slope Policy       : default
Primary
Limit              : 2000 mbps          Cbs                : 5.00
Mbs                : 7.00               High Priority      : 10
Secondary
Limit              : 1500 mbps          Cbs                : 30.00
Mbs                : 40.00              High Priority      : 10
Ancillary
Limit              : 5000 mbps          Cbs                : 65.00
Mbs                : 80.00              High Priority      : 10
-------------------------------------------------------------------------------
Policy             : default
-------------------------------------------------------------------------------
Admin BW Thd       : 10 kbps            Falling Percent RST: 50
Mcast Pool Total   : 10                 Mcast Pool Resv Cbs: 50
Slope Policy       : default
Primary
Limit              : 2000 mbps          Cbs                : 5.00
Mbs                : 7.00               High Priority      : 10
Secondary
Limit              : 1500 mbps          Cbs                : 30.00
Mbs                : 40.00              High Priority      : 10
Ancillary
Limit              : 5000 mbps          Cbs                : 65.00
Mbs                : 80.00              High Priority      : 10
===============================================================================
Bandwidth Policies : 2
===============================================================================
*A:Dut-C#
```

channel

Syntax **channel** [**router** *router-instance* | **vpls** s*ervice-id*] [**mda** *slot*[/*mda*]] [**group** *ip-address* [**source** *ip-address*]] [**path** *path-type*] [**detail**]

Context show>mcast-management

Description This command displays multicast path management channel related information.

Parameters **vpls** *service-id* — Specifies an existing VPLS service ID.

Values service-id: 1 — 214748364
svc-name: A string up to 64 characters in length.

ip-address — ipv4-address a.b.c.d

path-type — Specifies the path type.

Values primary, secondary, ancillary

Output

```
*A:Dut-C# *show mcast-management channel*
===============================================================================
Multicast Channels
===============================================================================
Legend :  D - Dynamic  E - Explicit
===============================================================================
Source Address                              Slot/Mda  Current Bw
Path       D/E
 Group Address                                    Highest Bw
-------------------------------------------------------------------------------
10.10.4.10                                  10/2      134646
Ancillary  D
 225.0.0.0                                        134646
===============================================================================
Multicast Channels : 1
===============================================================================
*A:Dut-C#


*A:Dut-C# *show mcast-management channel detail*
===============================================================================
Multicast Channels
===============================================================================
Source Address     : 10.10.4.10
Group Address      : 225.0.0.0
-------------------------------------------------------------------------------
Slot/Mda           : 10/2              Current Bw         : 134646 kbps
Dynamic/Explicit   : Dynamic           Current Path       : Ancillary
Oper Admin Bw      : 0 kbps            Preference         : 0
Ing last highest   : 134646            Ing sec highest    : 109532
Black-hole rate    : None              Blackhole          : No
Time remaining     : 30 seconds
===============================================================================
Multicast Channels : 1
===============================================================================
*A:Dut-C#
```

mcast-reporting-dest

Syntax **mcast-reporting-dest** [*mcast-reporting-dest-name*]

Context show>mcast-management

Description This command displays multicast path management reporting destination information.

mda

Syntax **mda** [**slot**[/*mda*]] [**path** *path-type*]

Context show>mcast-management

Description This command displays multicast path management MDA related information.

Parameters *path-type* — Specifies the path type.

Values primary, secondary, ancillary

Output

```
*A:Dut-C# *show mcast-management mda 10/2*
===============================================================================
MDA 10/2
===============================================================================
S/M  Bw-policy                        Type          Limit    In-use-Bw
Admin
-------------------------------------------------------------------------------
10/2 gie                              primary       0 Ms     0 Ms        up
     gie                              secondary     0 Ms     0 Ms        up
     gie                              ancillary     0 Ms      219. 64 Ms up
===============================================================================
*A:Dut-C#
```

group

Syntax **group** [*grp-ip-address*]
group summary

Context show>router>igmp

Description This command displays IGMP group information.

group-interface

Syntax **group-interface** [**fwd-service** *service-id*] [*ip-int-name*] [**detail**]

Context show>router>igmp

Description This command displays IGMP group-interface information.

hosts

Syntax **hosts** [**group** *grp-address*] [**detail**] [**fwd-service** *service-id*] [**grp-interface** *ip-int-name*]
hosts [**host** *ip-address*] [**group** *grp-address*] [**detail**]
hosts summary

Context show>router>igmp

Description This command displaysIGMP hosts information.

interface

Syntax **interface** [*ip-int-name*|*ip-address*] [**group**] [*grp-ip-address*] [**detail**]

Context show>router>igmp

Description This command displays IGMP interface information.

mcast-reporting-statistics

Syntax **mcast-reporting-statistics** [*ip-address*]

Context show>router>igmp

Description This command displays IGMP mcast reporting statistics.

ssm-translate

Syntax **ssm-translate** [*interface-name*]

Context show>router>igmp

Description This command displays SSM translate configuration information.

static

Syntax **static** [*ip-int-name*|*ip-addr*]

Context show>router>igmp

Description This command displaysIGMP static group/source configuration information.

statistics

Syntax **statistics** [*ip-int-name*|*ip-address*]
statistics host [*ip-address*]

Context show>router>igmp

Description This command displaysIGMP statistics information.

status

Syntax **status**

Context show>router>igmp

Description This command displays IGMP status information.

tunnel-interface

Syntax **tunnel-interface**

Context show>router>igmp

Description This command displaysIGMP tunnel-interface information.

Clear Commands

id

Syntax **id** *service-id*

Context clear>service
clear>service>statistics

Description This command clears the identification for a specific service.

Parameters *service-id* — The ID that uniquely identifies a service.

Values service-id: 1 — 214748364
svc-name: A string up to 64 characters in length.

arp-host

Syntax **arp-host**
arp-host { **mac** *ieee-address* | **sap** *sap-id* | **ip-address** *ip-address*[*/mask*] }
arp-host [**port** *port-id*] [**inter-dest-id** *intermediate-destination-id* | **no-inter-dest-id**]
arp-host statistics [**sap** *sap-id* | **interface** *interface-name*]

Context clear>service>id

Description This command clears ARP host data.

authentication

Syntax **authentication**

Context clear>service>id

Description This command enters the context to clear session authentication information.

msap

Syntax **msap** *msap-id*

Context clear>service>id

Description This command clears Managed SAP information.

Parameters *msap-id* — Specifies a Managed SAP ID.

Values		
	dot1q	[port-id | lag-id]:qtag1
	qinq	[port-id | lag-id]:qtag1.qtag2
	qtag1	0 — 4094
	qtag2	0 — 4094

msap-policy

Syntax **msap-policy** *msap-policy-name*

Context clear>service>id

Description This command clears Managed SAPs created by the Managed SAP policy.

Parameters *msap-policy-name* — Specifies an existing MSAP policy.

statistics

Syntax **statistics**

Context clear>service>id>authentication

Description This command clears session authentication statistics for this service.

statistics

Syntax statistics

Context clear>service

Description This command clears the statistics for a service.

subscriber

Syntax **subscriber** *sub-ident-string*

Context clear>service>statistics

Description This command clears the statistics for a particular subscriber.

Parameters *sub-ident-string* — Clears statistics for the specified subscriber identification string.

fdb

Syntax **fdb** {**all** | **mac** *ieee-address* | **sap** *sap-id*] | **mesh-sdp** *sdp-id*[**:***vc-id*] | **spoke-sdp** *sdp-id*:*vc-id*}

Context clear>service>id

Description This command clears FDB entries for the service.

Parameters **all —** Clears all FDB entries.

mac *ieee-address* **—** Clears only FDB entries in the FDB table with the specified 48-bit MAC address. The MAC address can be expressed in the form *aa*:*bb*:*cc*:*dd*:*ee*:*ff* or *aa-bb-cc-dd-ee-ff* where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers.

sap-id — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

mesh-sdp — Clears only service FDB entries associated with the specified mesh SDP ID. For a mesh SDP, the VC ID is optional.

spoke-sdp — Clears only service FDB entries associated with the specified spoke SDP ID. For a spoke SDP, the VC ID must be specified.

sdp-id — The SDP ID for which to clear associated FDB entries.

vc-id — The virtual circuit ID on the SDP ID for which to clear associated FDB entries.

Values			
	sdp-id[:vc-id]	*sdp-id*	1 — 17407
		vc-id	1 — 4294967295
	sdp-id:vc-id	sdp-id	1 — 17407
		vc-id	1 — 4294967295

mesh-sdp

Syntax **mesh-sdp** *sdp-id*[**:***vc-id*] **ingress-vc-label**

Context clear>service>id

Description Clears and resets the mesh SDP bindings for the service.

Parameters *sdp-id* — The mesh SDP ID to be reset.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID to be reset.

Default All VC IDs on the SDP ID.

Values 1 — 4294967295

spoke-sdp

Syntax **spoke-sdp** *sdp-id*:*vc-id* **ingress-vc-label**

Context clear>service>id

Description Clears and resets the spoke SDP bindings for the service.

Parameters *sdp-id* — The spoke SDP ID to be reset.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID to be reset.

Values 1 — 4294967295

sap

Syntax **sap** *sap-id* {**all** | **counters** | **stp**}

Context clear>service>statistics

Description Clears SAP statistics for a SAP.

Parameters *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

all — Clears all SAP queue statistics and STP statistics.

counters — Clears all queue statistics associated with the SAP.

stp — Clears all STP statistics associated with the SAP.

sdp

Syntax **sdp** *sdp-id* [**keep-alive**]

Context clear>service>statistics

Description Clears keepalive statistics associated with the SDP ID.

Parameters *sdp-id* — The SDP ID for which to clear statistics.

Values 1 — 17407

keep-alive — Clears the keepalive history.

counters

Syntax **counters**

Context clear>service>statistics>id

Description Clears all traffic queue counters associated with the service ID.

sap

Syntax **sap** *sap-id* {**all** | **counters** | **stp**}

Context clear>service>statistics>id

Description Clears statistics for the SAP bound to the service.

Parameters *sap-id* — Specifies the SAP ID for which to clear statistics. See Common Service Commands on page 2168 for *sap-id* command syntax.

all — Clears all queue statistics and STP statistics associated with the SAP.

counters — Clears all queue statistics associated with the SAP.

stp — Clears all STP statistics associated with the SAP.

spoke-sdp

Syntax **spoke-sdp** *sdp-id*[:*vc-id*] {**all** | **counters** | **stp**}

Context clear>service>statistics>id

Description Clears statistics for the spoke SDP bound to the service.

Parameters *sdp-id* — The spoke SDP ID for which to clear statistics.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID to be reset.

Values 1 — 4294967295

all — Clears all queue statistics and STP statistics associated with the SDP.

counters — Clears all queue statistics associated with the SDP.

stp — Clears all STP statistics associated with the SDP.

stp

Syntax **stp**

Context clear>service>statistics>id

Description Clears all spanning tree statistics for the service ID.

detected-protocols

Syntax **detected-protocols** {**all** | **sap** *sap-id* | **spoke-sdp** *sdp-id*[*:vc-id*]}

Context clear>service>id>stp

Description RSTP automatically falls back to STP mode when it receives an STP BPDU. The **clear detected-protocols** command forces the system to revert to the default RSTP mode on the SAP or spoke SDP.

Parameters **all —** Clears all detected protocol information.

sap-id — Clears the specified lease state SAP information. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp-id — The SDP ID to be cleared.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID to be cleared.

Values 1 — 4294967295

lease-state

Syntax **lease-state**[**no-dhcp-release**]
lease-state [**port** *port-id*] [**inter-dest-id** *intermediate-destination-id*] [**no-dhcp-release**]
lease-state [**port** *port-id*] **no-inter-dest-id** [**no-dhcp-release**]
lease-state ip-address *ip-address*[*/mask*] [**no-dhcp-release**]
lease-state mac *ieee-address* [**no-dhcp-release**]
lease-state sap *sap-id* [**no-dhcp-release**]
lease-state sdp *sdp-id*[*:vc-id* [**no-dhcp-release**]

Context clear>service>id>dhcp

Description Clears DHCP lease state information for this service.

Parameters **no-dhcp-release —** Specifies that the node will clear the state without sending the DHCP release message.

port *port-id* **—** The DHCP lease state local specifies that the DHCP lease state is learned by either a SAP or SDP. When the value is SAP, the value indicates the SAP for which this entry contains information.

ip-address — The IP address of the IP interface. The *ip-address* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

ieee-address — Specifies the 48-bit MAC address for the static ARP in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

intermediate-destination-id — Specifies the intermediate destination identifier which is encoded in the identification strings.

Values Up to 32 characters maximum

sap-id — Clears the specified lease state SAP information. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp-id — The SDP ID to be cleared.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID to be cleared.

Values 1 — 4294967295

statistics

Syntax **statistics** [**sap** *sap-id* | **sdp** *[sdp-id*[*:vc-id*]]

Context clear>service>id>dhcp

Description Clears DHCP statistics for this service.

port-db

Syntax **port-db** {**sap** *sap-id* | **sdp** *sdp-id:vc-id*} [**group** *grp-address* [**source** *ip-address*]]

Context clear>service>id>igmp-snooping

Description Clears the information on the IGMP snooping port database for the VPLS service.

Parameters **sap** *sap-id* — Clears IGMP snooping statistics matching the specified SAP ID and optional encapsulation value. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp *sdp-id* — Clears only IGMP snooping entries associated with the specified mesh SDP or spoke SDP. For a spoke SDP, the VC ID must be specified; for a mesh SDP, the VC ID is optional.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID for which to clear information.

Default For mesh SDPs only, all VC IDs.

Values 1 — 4294967295

group *grp-address* — Clears IGMP snooping statistics matching the specified group address.

source *ip-address* — Clears IGMP snooping statistics matching one particular source within the multicast group.

querier

Syntax **querier**

Context clear>service>id>igmp-snooping

Description Clears the information on the IGMP snooping queriers for the VPLS service.

statistics

Syntax **statistics** {**all** | **sap** *sap-id* | **sdp** *sdp-id:vc-id*}]

Context clear>service>id>igmp-snooping

Description Clears IGMP snooping statistics for the VPLS service.

Parameters **sap** *sap-id* — Clears IGMP snooping statistics matching the specified SAP ID and optional encapsulation value. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp *sdp-id* — Clears only IGMP snooping entries associated with the specified mesh SDP or spoke SDP. For a spoke SDP, the VC ID must be specified, for a mesh SDP, the VC ID is optional.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID for which to clear statistics.

Default For mesh SDPs only, all VC IDs

Values 1 — 4294967295

mfib

Syntax **mfib**

Context clear>service>id

Description Enter the context to clear multicast FIB info for the VPLS service.

statistics

Syntax **statistics** {**all** | **group** *grp-address*}

Context clear>service>id>mfib

Description Clears multicast FIB statistics for the VPLS service.

Parameters *grp-address* — Specifies an IGMP multicast group address that receives data on an interface.

mld-snooping

Syntax **mld-snooping**

Context clear>service>id

Description This command enables the context to clear MLD snooping-related data.

port-db

Syntax **port-db sap** *sap-id* [**group** *grp-ipv6-address*]
port-db sap *sap-id* **group** *grp-ipv6-address* **source** *src-ipv6-address*
port-db sdp *sdp-id*:*vc-id* [**group** *grp-ipv6-address*]
port-db sdp *sdp-id*:*vc-id* **group** *grp-ipv6-address* **source** *src-ipv6-address*

Context clear>service>id>mld-snooping

Description This command clears MLD snooping port-db group data.

querier

Syntax **querier**

Context clear>service>id>mld-snooping

Description This command clears MLD snooping querier information.

statistics

Syntax **statistics all**
statistics sap *sap-id*
statistics sdp *sdp-id*:*vc-id*

Context clear>service>id>mld-snooping

Description This command clears MLD snooping statistics.

Parameters **all** — Clears all MLD snooping statistics

sap *sap-id* — Clears all MLD snooping SAP statistics. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp *sdp-id:vc-id* — Clears all MLD snooping SDP statistics. See Common Service Commands on page 2168 for *sap-id* command syntax.

arp

Syntax **arp** {**all** | *ip-address*}
arp interface [*ip-int-name* | *ip-address*]

Context clear>router

Description This command clears all or specific ARP entries. The scope of ARP cache entries cleared depends on the command line option(s) specified.

Parameters **all —** Clears all ARP cache entries.

ip-address — Clears the ARP cache entry for the specified IP address.

interface *ip-int-name* **—** Clears all ARP cache entries for the IP interface with the specified name.

interface *ip-addr* **—** Clears all ARP cache entries for the specified IP interface with the specified IP address.

dhcp

Syntax **dhcp**

Context clear>router

Description This command enables the context to clear and reset DHCP entities.

statistics

Syntax **statistics** [**interface** *ip-int-name* | *ip-address*]

Context clear>router>dhcp

Description Clears DHCP statistics.

Debug Commands

mcast-reporting-dest

Syntax [**no**] **mcast-reporting-dest** [*dest-name*]

Context debug>mcast-mgmt

Description This command debugs multicast path management reporting destinations.

igmp

Syntax [**no**] **igmp** [**host** *ip-address*] [**group** *grp-address*]

Context debug>mcast-mgmt>mcast-rprt-dest

Description This command sets mcast reporting dest debug filtering options.

arp-host

Syntax [**no**] **arp-host**

Context debug>service>id

Description This command enables and ARP host debugging.

The **no** form of the command disables ARP host debugging

mld-snooping

Syntax [**no**] **mld-snooping**

Context debug>service>id

Description This command enables and configures MLD-snooping debugging.

The **no** form of the command disables MLD-snooping debugging

detail-level

Syntax **detail-level** {**low**|**medium**|**high**}
no detail-level

Context debug>service>id>mld

Description This command enables and configures the MLD tracing detail level.

The **no** form of the command disables the MLD tracing detail level.

mac

Syntax [**no**] **mac** *ieee-address*

Context debug>service>id>mld

Description This command shows MLD packets for the specified MAC address.

The **no** form of the command disables disables the MAC debugging.

mode

Syntax **mode** {**dropped-only**|**ingr-and-dropped**|**egr-ingr-and-dropped**}
no mode

Context debug>service>id>mld

Description This command enables and configures the MLD tracing mode.

The **no** form of the command disables the configures the MLD tracing mode.

sap

Syntax [**no**] **sap** *sap-id*

Context debug>service>id>mld

Description This command shows MLD packets for a specific SAP.

The **no** form of the command disables the debugging for the SAP.

sdp

Syntax [**no**] **sdp** *sdp-id:vc-id*

Context debug>service>id>mld

Description This command shows MLD packets for a specific SDP.

The **no** form of the command disables the debugging for the SDP.

DHCP Management

In This Chapter

This chapter provides information about using DHCP, including theory, supported features and configuration process overview.

Topics in this chapter include:

DHCP Principles

In a Triple Play network, client devices (such as a routed home gateway, a session initiation protocol (SIP) phone or a set-top box) use Dynamic Host Configuration Protocol (DHCP) to dynamically obtain their IP address and other network configuration information.

DHCP is defined and shaped by several RFCs and drafts in the IETF DHC working group including the following:

- RFC 1534, *Interoperation Between DHCP and BOOTP*
- RFC 2131, *Dynamic Host Configuration Protocol*
- RFC 2132, *DHCP Options and BOOTP Vendor Extensions*
- RFC 3046, *DHCP Relay Agent Information Option*

The DHCP operation is illustrated in Figure 14.

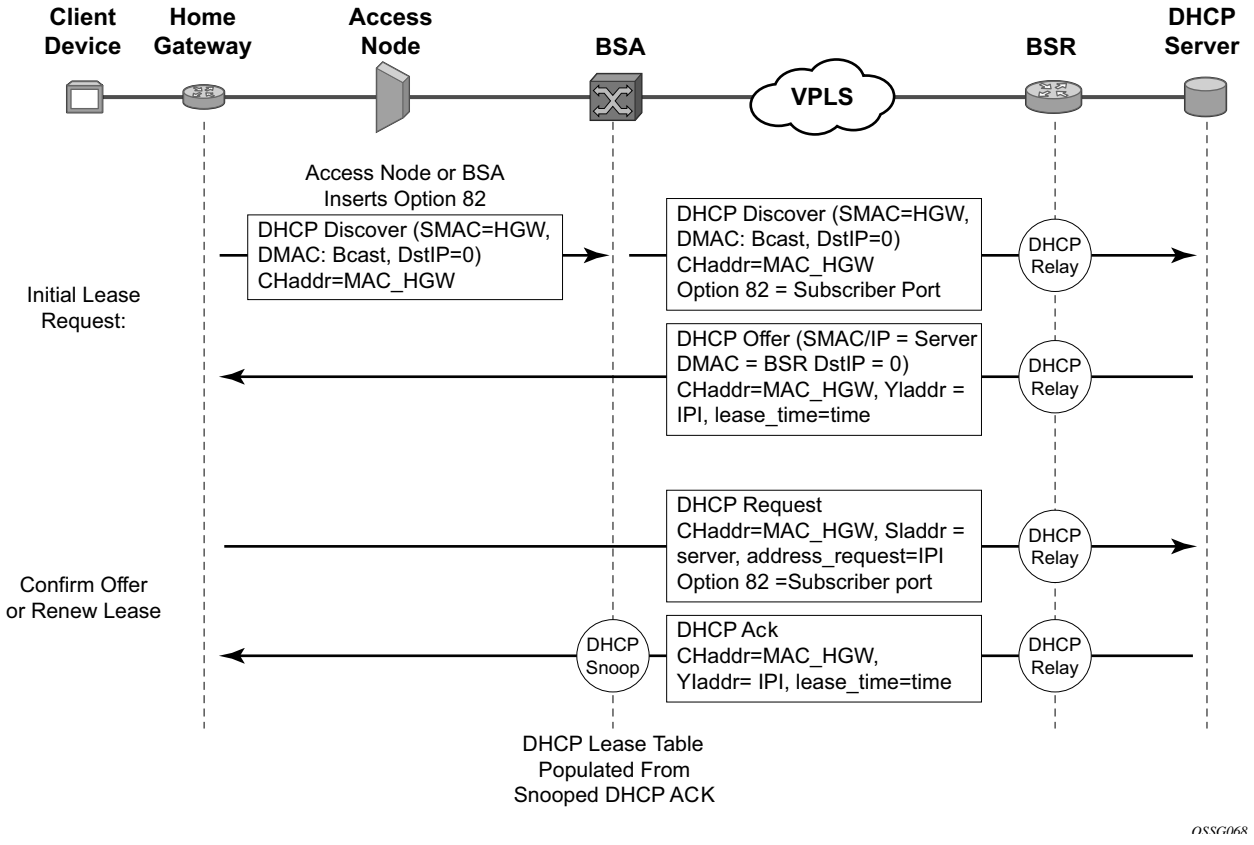


Figure 14: IP Address Assignment with DHCP

1. During boot-up, the client device sends a DHCP discover message to get an IP address from the DHCP Server. The message contains:
   - → Destination MAC address — broadcast
   - → Source MAC address — MAC of client device
   - → Client hardware address — MAC of client device

   If this message passes through a DSLAM or other access node, typically the Relay information option (Option 82) field is added, indicating shelf, slot, port, VPI, VCI etc. to identify the subscriber.

   DHCP relay is enabled on the first IP interface in the upstream direction. Depending on the scenario, the DSLAM, BSA or the BSR will relay the discover message as a unicast packet towards the configured DHCP server. DHCP relay is configured to insert the giaddr in order to indicate to the DHCP server in which subnet an address should be allocated.

2. The DHCP server will lookup the client MAC address and Option 82 information in its database. If the client is recognized and authorized to access the network, an IP address will be assigned and a DHCP offer message returned. The BSA or BSR will relay this back to the client device.
3. It is possible that the discover reached more than one DHCP server, and thus that more than one offer was returned. The client selects one of the offered IP addresses and confirms it wants to use this in a DHCP request message, sent as unicast to the DHCP server that offered it.
4. The DHCP server confirms that the IP address is still available, updates its database to indicate it is now in use, and replies with a DHCP ACK message back to the client. The ACK will also contain the Lease Time of the IP address.

DHCP Features

DHCP Relay

Since DHCP requests are broadcast packets that normally will not propagate outside of their IP subnet, a DHCP relay agent intercepts such requests and forwards them as unicast messages to a configured DHCP server.

When forwarding a DHCP message, the relay agent sets the giaddr (gateway IP address) in the packet to the IP address of its ingress interface. This allows DHCP clients to use a DHCP server on a remote network. From both a scalability and a security point of view, it is recommended that the DHCP relay agent is positioned as close as possible to the client terminals.

DHCP relay is practical only in a Layer 3 environment, and thus is only supported in IES and VPRN services. On VPRN interfaces, however they will only forward to DHCP servers that also participate in that VPRN.

While DHCP relay is not implemented in a VPLS, it is still possible to insert or modify Option 82 information

In a Routed CO environment, the subscriber interface's group interface DHCP relay is stateful.

DHCP Relay Enhancements

GRT-leaking can be used to relay DHCPv4 and DHCPv6 messages between a VRPN and the Global Routing Table (GRT) for network deployments where DHCP clients and server are in separate routing instances of which one is the Base routing instance.

In network deployments where DHCPv4 client subnets cannot be leaked in the DHCPv4 server routing instance, unicast renewals messages cannot be routed in the DHCPv4 server routing instance as illustrated in Figure 15:

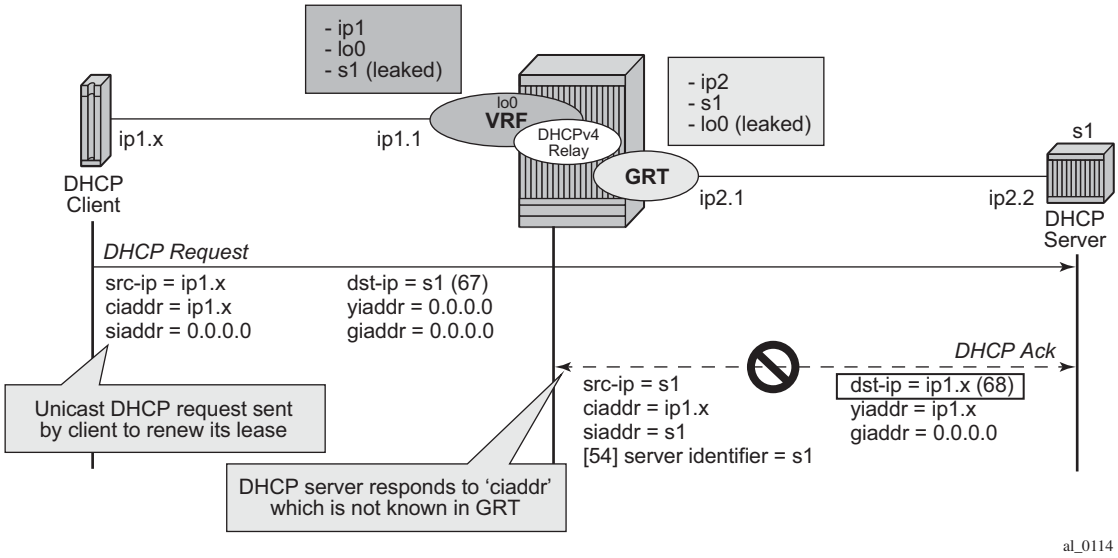


Figure 15: DHCPv4 Server Routing Instance

With the **relay-unicast-msg** command in the DHCPv4 relay on a regular interface or group-interface, it is possible to configure the gi-address of a DHCPv4 relayed message to any local address that is configured in the same routing instance. Unicast renewals are, in this case, relayed to the DHCPv4 server. In the upstream direction, update the source IP address and add the gateway IP address (gi-address) field before sending the message to the intended DHCP server (the message is not broadcasted to all configured DHCP servers). In the downstream direction, remove the gi-address and update the destination IP address to the value of the yiaddr (your IP address) field. By default, unicast DHCPv4 release messages are forwarded transparently. The optional **release-update-src-ip** flag, updates the source IP address with the value used for relayed DHCPv4 messages.

For retail subscriber interfaces, the **relay-unicast-msg** must be configured at the subscriber-interface dhcp CLI context as shown in the Example 1.

The **relay-unicast-msg** function is not supported in combination with a double DHCPv4 relay (L3 DHCPv4 relay in front of a 7750 DHCPv4 relay with "relay-unicast-msg" enabled).

Example 1

```
config>service>vprn>

            interface "lo0" create
                address 192.168.0.1/32
                loopback
            exit
            subscriber-interface "sub-int-1" create
                address 10.1.0.254/24
                group-interface "group-int-1-1" create
                    dhcp
                        server 172.16.1.1
```

```
                relay-unicast-msg release-update-src-ip
                gi-address 192.168.0.1 src-ip-addr
                no shutdown
            exit
        exit
    exit
```

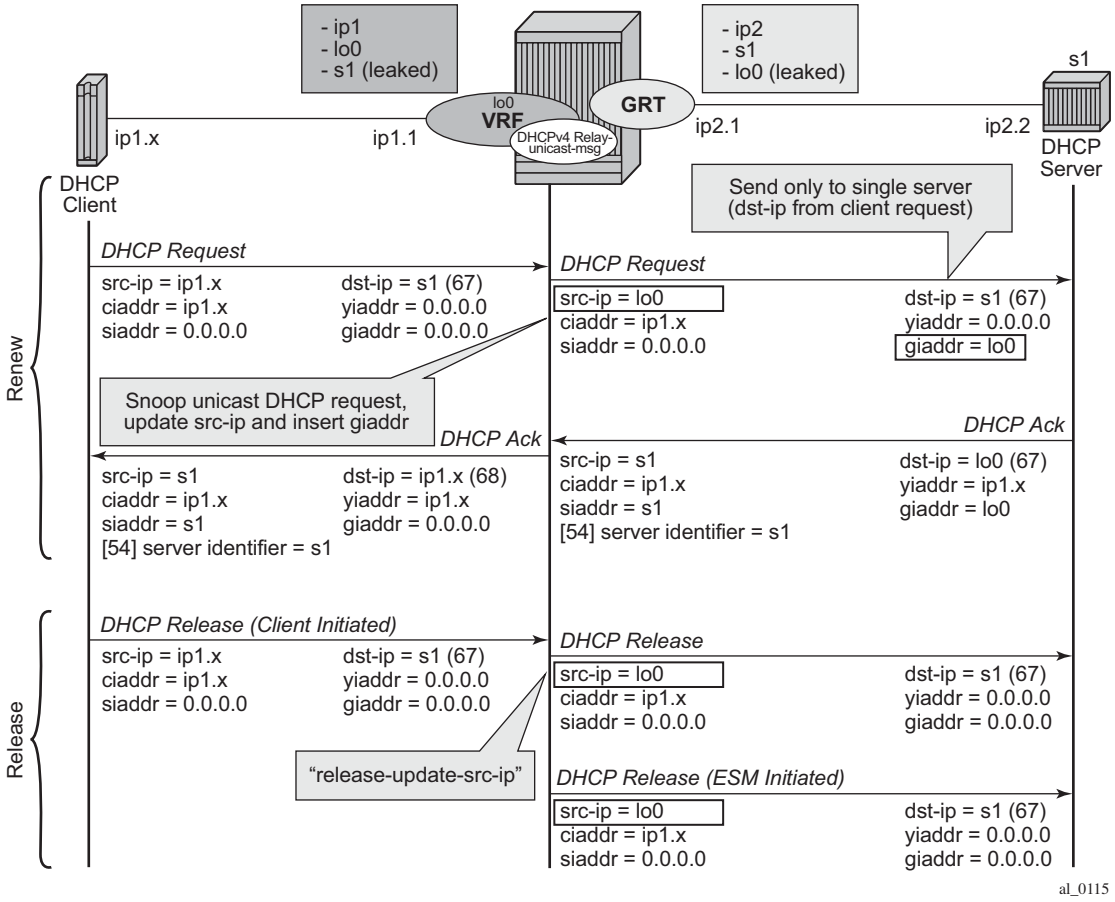


Figure 16: relay-unicast-msg Command in the DHCPv4 Relay

Subscriber Identification Using Option 82 Field

Option 82, or the relay information option is specified in RFC 3046, *DHCP Relay Agent Information Option*, and allows the router to append some information to the DHCP request that identifies where the original DHCP request came from.

There are two sub-options under Option 82:

- *Agent Circuit ID Sub-option* (RFC 3046, section 3.1): This sub-option specifies data which must be unique to the box that is relaying the circuit.
- *Remote ID Sub-option* (RFC 3046 section 3.2): This sub-option identifies the host at the other end of the circuit. This value must be globally unique.

Both sub-options are supported by the Alcatel-Lucent 7750 SR and can be used separately or together.

Inserting Option 82 information is supported independently of DHCP relay. However in a VPLS (when the 7750 SR is not configured for DHCP Relay), DHCP snooping must be enabled on the SAP to be able to insert Option 82 information.

When the circuit id sub-option field is inserted by the 7750 SR, it can take following values:

- *sap-id:* The SAP index (only under a IES or VPRN service)
- *ifindex:* The index of the IP interface (only under a IES or VPRN service)
- *ascii-tuple:* An ASCII-encoded concatenated tuple, consisting of [*system-name*|*service-id*|*interface-name*] (for VPRN or IES) or [*system-name*|*service-id*|*sap-id*] (for VPLS).
- *vlan-ascii-tuple*: An ASCII-encoded concatenated tuple, consisting of the ascii-tuple followed by Dot1p bits and Dot1q tags.

Note that for VPRN the ifindex is unique only within a VRF. The DHCP relay function automatically prepends the VRF ID to the ifindex before relaying a DHCP Request.

When a DHCP packet is received with Option 82 information already present, the system can do one of three things. The available actions are:

- Replace — On ingress the existing information-option is replaced with the information-option parameter configured on the 7750 SR. On egress (towards the customer) the information option is stripped (per the RFC).
- Drop — The DHCP packet is dropped and a counter is incremented.
- Keep — The existing information is kept on the packet and the router does not add any additional information. On egress the information option is not stripped and is sent on to the downstream node.

In accordance with the RFC, the default behavior is to keep the existing information; except if the giaddr of the packet received is identical to a local IP address on the router, then the packet is dropped and an error incremented regardless of the configured action.

The maximum packet size for a DHCP relay packet is 1500 bytes. If adding the Option 82 information would cause the packet to exceed this size, the DHCP relay request will be forwarded without the Option 82 information. This packet size limitation exists to ensure that there will be no fragmentation on the end Ethernet segment where the DHCP server attaches.

In the downstream direction, the inserted Option 82 information should not be passed back towards the client (as per RFC 3046, *DHCP Relay Agent Information Option*). To enable downstream stripping of the option 82 field, DHCP snooping should be enabled on the SDP or SAP connected to the DHCP server.

Trusted and Untrusted

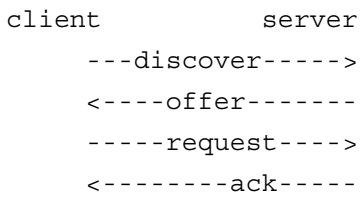
There is a case where the relay agent could receive a request where the downstream node added Option 82 information without also adding a giaddr (giaddr of 0). In this case the default behavior is for the router to drop the DHCP request. This behavior is in line with the RFC.

The 7750 SR supports a command `trusted`, which allows the router to forward the DHCP request even if it receives one with a giaddr of 0 and Option 82 information attached. This could occur with older access equipment. In this case the relay agent would modify the request's giaddr to be equal to the ingress interface. This only makes sense when the action in the information option is keep, and the service is IES or VPRN. In the case where the Option 82 information gets replaced by the relay agent, either through explicit configuration or the VPLS DHCP Relay case, the original Option 82 information is lost, and the reason for enabling the trusted option is lost.

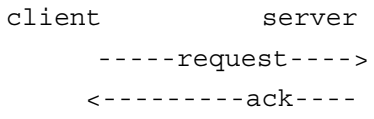
DHCP Snooping

This section discusses the Alcatel-Lucent 7750 SR acting as a Broadband Subscriber Aggregator (BSA) with Layer 2 aggregation towards a Broadband Subscriber Router (BSR).

A typical initial DHCP scenario is:



But, when the client already knows its IP address, it can skip the discover:



The BSA can copy packets designated to the standard UDP port for DHCP (port 67) to its control plane for inspection, this process is called DHCP snooping.

DHCP snooping can be performed in two directions:

1. From the client to the DHCP server (Discover or Request messages):
   - → to insert Option 82 information (when the system is not configured to do DHCP Relay), see Subscriber Identification Using Option 82 Field on page 353);
   - → to forward DHCP requests to a RADIUS server first, and not send them to the DHCP server unless the RADIUS server confirms positive identification. See section Anti-Spoofing Filters on page 738.

   For these applications, DHCP snooping must be enabled on the SAP towards the subscriber;

2. From the DHCP server (ACK messages):
   - → to remove the Option 82 field toward the client
   - → to build a dynamic DHCP lease state table for security purposes, see section DHCP Lease State Table on page 358
   - → to perform Enhanced Subscriber Management, see section Triple Play Enhanced Subscriber Management on page 929

   For these applications, DHCP snooping must be enabled on both the SAP or SDP towards the network and the SAP towards the subscriber.

   A major application for DHCP response snooping in the context of Triple Play is security: A malicious user A could send an IP packet (for example, requesting a big video stream) with as source the IP address of user B. Any return packets would be sent to B, and thus potentially jam the connection to B.

   As the snooped information is coming straight from the operator's DHCP server, it is considered reliable. The BSA and BSR can use the snooped information to build anti-spoofing filters, populate the ARP table, send ARP replies, etc.

DHCP Lease State Table

The DHCP lease state table has a central role in the BSA operation (Figure 17). For each SAP on each service it maintains the identities of the hosts that are allowed network access.

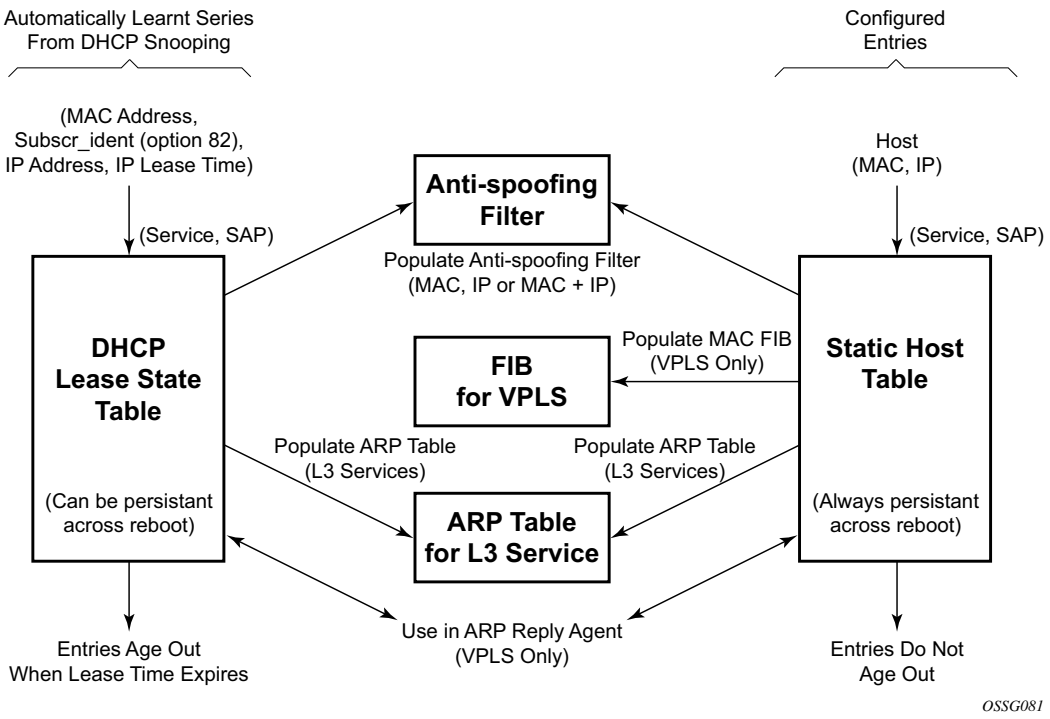


Figure 17: DHCP Lease State Table

When the command **lease-populate** is enabled on a SAP, the DHCP lease state table is populated by snooping DHCP ACK messages on that SAP, as described in the DHCP Snooping section above.

Entries in the DHCP lease state table remain valid for the duration of the IP address lease. When a lease is renewed, the expiry time is updated. If the lease expires and is not renewed, the entry is removed from the DHCP lease state table.

For VPLS, DHCP snooping must be explicitly enabled (using the **snoop** command) on the SAP and/or SDP where DHCP messages requiring snooping ingress the VPLS instance. For IES and VPRN IP interfaces, using the **lease-populate** command also enables DHCP snooping for the subnets defined under the IP interface. Lease state information is extracted from snooped or

relayed DHCP ACK messages to populate DHCP lease state table entries for the SAP or IP interface.

For IES and VPRN services, if ARP populate is configured, no statics ARPs are allowed. For IES and VPRN services, if ARP populate is not configured, then statics ARPs are allowed.

The retained DHCP lease state information representing dynamic hosts can be used in a variety of ways:

- To populate a SAP based anti-spoof filter table to provide dynamic anti-spoof filtering — Anti-spoof filtering is only available on VPLS SAPs, or IES IP interfaces terminated on a SAP or VPRN IP interfaces terminated on a SAP.
- To populate the system's ARP cache using the **arp-populate** feature — **arp-populate** functionality is only available for static and dynamic hosts associated with IES and VPRN SAP IP interfaces.
- To populate managed entries into a VPLS forwarding database — When a dynamic host's MAC address is placed in the DHCP lease state table, it will automatically be populated into the VPLS forwarding database associated with the SAP on which the host is learned. The dynamic host MAC address will override any static MAC entries using the same MAC and prevent learning of the MAC on another interface. Existing static MAC entries with the same MAC address as the dynamic host are marked as inactive but not deleted. If all entries in the DHCP lease state associated with the MAC address are removed, the static MAC may be populated. New static MAC definitions for the VPLS instance can be created while a dynamic host exists associated with the static MAC address. To support the Routed CO model, see Routed Central Office (CO) on page 1141.
- To support enhanced Subscriber management, see section RADIUS Authentication of Subscriber Sessions on page 935.

Note that if the system is unable to execute any of these tasks, the DHCP ACK message is discarded without adding a new lease state entry or updating an existing lease state entry; and an alarm is generated.

DHCP and Layer 3 Aggregation

The default mode of operation for DHCP snooping is that the DHCP snooping agent instantiates a DHCP lease state based on information in the DHCP packet, the client IP address and the client hardware address.

The mode of operation can be changed for DHCP snooping so that the Layer 2 header MAC address is used instead of the client hardware address from the DHCP packet for the DHCP lease state instantiation. This mode is selected by enabling l2-header in the **lease-populate** configuration command at the DHCP level. Because SR-Series routers do not have the ability to verify the DHCP information (both the **src-ip** and **src-mac** of the packet will be those of the previous relay point) anti-spoofing must be performed at the access node prior to the SR-Series routers. This mode provides compatibility with MAC concentrator devices, and cable modem termination system (CMTS) and WiiMAX Access Controller (WAC).

A configuration example of a cable/wireless network together with subscriber management is shown in Figure 18. The subnet used to connect to the CMTS/WAC must be defined as a subnet in the subscriber interface of the Layer 3 CO model under which the hosts will be defined. This means that all subscriber lease states instantiated on BSR must be from a “local” subscriber-subnet, even if those are behind the router, as there will be no additional layer 3 route installed pointing to them.

The important items to notice are static hosts at the subscriber interface side:

- IP-only static host pointing to CMTS/WAC WAN link is needed to allow BSR to reply to ARP requests originated from CMTS/WAC.
- IP-MAC static host pointing to CMTS/WAC access-facing interface is required to provide BSR with an arp entry for the DHCP relay address.

When dual-homing is used the CMTS/WAC may be configured with the same MAC for both upstream interfaces. If that is not possible the BSR can be configured with an optional MAC address. The BSR will then use the configured MAC address when instantiating the DHCP lease states.

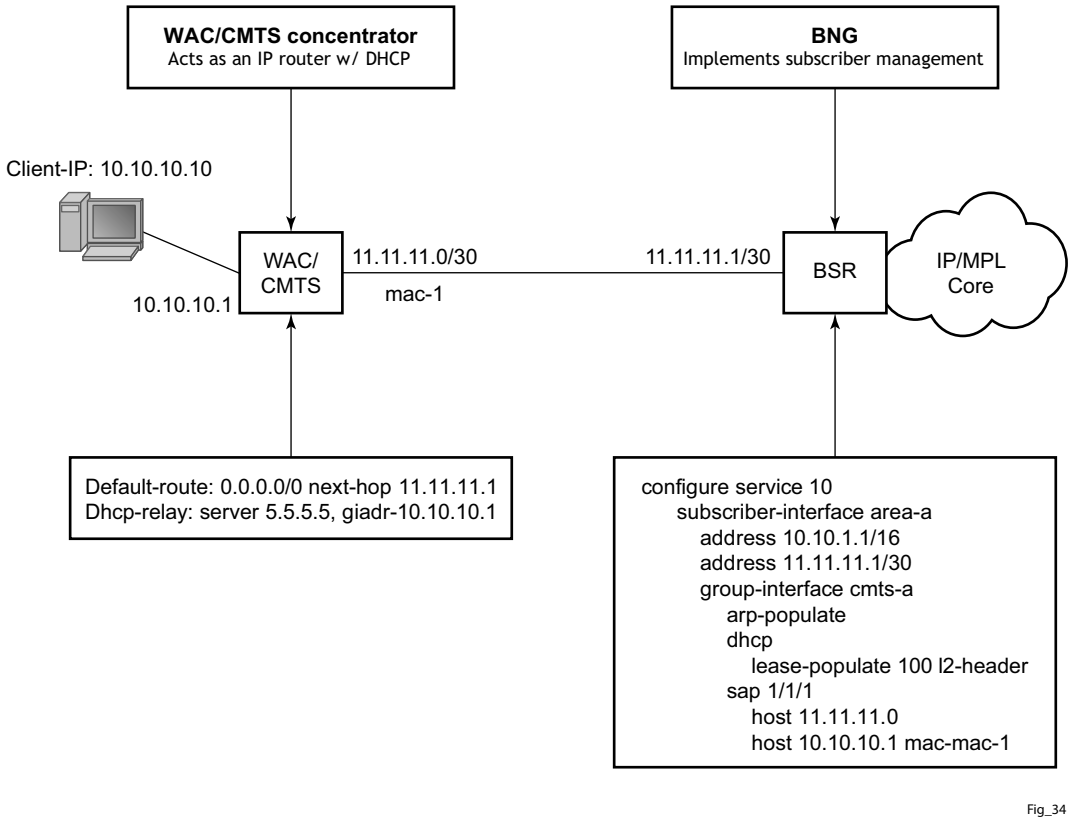


Figure 18: CMTS/WAC Network Configuration Example

Local DHCP Servers

Overview

The local-dhcp-server functions only if there is a relay (gateway) in front of it. Either a GI address is needed to find a subnet or Option 82, which is inserted by the relay, to perform authentication in the local-user-db.

A local DHCP server functions only if there is a relay agent (gateway) in front of it. The local DHCP server must be configured to assign addresses in one of the following ways:

1. Use a local user database authentication (user-db <local-user-db-name>)

   The host is matched against the specified local user database. A successful user lookup should return information on one of the following valid addresses:

   → A fixed IP address — The IP address should not overlap with the address ranges configured in the local dhcp server.

   → A pool name — A free address of any subnet in that pool is offered.

   → use-gi-address [scope <subnet | pool>] — The gi address is used to find a matching subnet. When scope is subnet, an address is allocated in the same subnet as the GI address only. When scope is pool, an address is allocated from any subnet within a local pool once that pool has been selected based on matching the "giaddr" field in the DHCP message with any of the configured subnets in the pool.

   → use-pool-from-client — The pool name specified in the DHCP client message options and added by the DHCP relay agent is used. A free address of any subnet in that pool is offered.

When no valid address information is returned from the local user database lookup, no IP address is offered to the client.

2. without local user database authentication (no user-db)

   One or both address assignment options must be configured:

   → Use a pool name (use-pool-from-client)
   The pool name specified in the DHCP client message options and added by the DHCP relay agent is used. A free address of any subnet in that pool is offered.

   → Use the gi address (use-gi-address [scope <subnet | pool>])
   The gi address is used to find a matching subnet. When scope is subnet, an address is allocated in the same subnet as the GI address only. When scope is pool, an address is allocated from any subnet within a local pool once that pool has been selected based on matching the "giaddr" field in the DHCP message with any of the configured subnets in the pool.

When both options are configured and a pool name is specified in the DHCP client message options, then the **use-pool-from-client** option has precedence over the **use-gi-address** option.

Note: The local dhcp server will not allocate any address if none of the above options are configured (no user-db, no use-gi-address, no use-pool-from-client).

Options and identification strings can be defined on several levels. In principle, these options are copied into the DHCP reply, but if the same option is defined several times, the following precedence is taken:

1. user-db host options
2. Subnet options
3. Pool options
4. From the client DHCP request.

A local DHCP server must be bound to a specified interface by referencing the server from that interface. The DHCP server will then be addressable by the IP address of that interface. A normal interface or a loopback interface can be used.

A DHCP client is defined by the MAC address and the circuit-id. This implies that for a certain combination of MAC and circuit-id, only one IP-address can be returned. If you ask 1 more, you get same address again. The same address will be returned if a re-request is made.

Local DHCP Server Support

Local DHCP servers provide a standards-based full DHCP server implementation which allows a service provider the option of decentralizing the IP address management into the network. Local DHCP servers are supported on 7750 SR-7, and 7750 SR-12 models. Note that the 7450 ESS-Series routers use DHCP relay and proxy DHCP server functionality.

Three applications are targeted for the local DHCP server:

- Subscriber aggregation in either a single node (routed CO) or TPSDA.
- Business services — A server can be defined in a VPRN service and associated with different interfaces. Locally attached hosts can get an address directly from the servers. Routed hosts will receive addresses through a relay point in the customer's network.
- PPP clients — Either in a single node or a separate PPPoE server node and a second DHCP server node. The PPPoE server node may be configured to query the DHCP server node for an address and options to provide to the PPPoE client. The PPPoE server will provide the information in PPP format to the client.

DHCP server scenarios include:

- DHCP servers can be integrated with Enhanced Subscriber Management (ESM) for DHCP clients, DHCP relays and PPPoE clients.
- A stand-alone DHCP server can support DHCP clients and DHCP relays.
- IPv4 is supported. DHCP servers provide increased management over the IPv4 address space across its subscriber base, with support for public and private addressing in the same router including overlapped private addressing in the form of VPRNs in the same SR-series router.

DHCP servers are configurable and can be used in the bridged CO, routed CO, VPRN wholesaler, and dual-homing models.

DHCPv6

In the stateful auto-configuration model, hosts obtain interface addresses and/or configuration information and parameters from a server. Servers maintain a database that keeps track of which addresses have been assigned to which hosts. The stateful auto-configuration protocol allows hosts to obtain addresses, other configuration information or both from a server.

DHCPv6 Relay Agent

When the server unicast option is present in a DHCP message from the server, the option is stripped from the message before sending to the clients.

DHCPv6 Prefix Options

The prefix delegation options described in RFC 3633, *IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6*, provide a mechanism for automated delegation of IPv6 prefixes using DHCP. This mechanism is intended for delegating a long-lived prefix from a delegating router to a requesting router, across an administrative boundary, where the delegating router does not require knowledge about the topology of the links in the network to which the prefixes will be assigned. For example, the delegating router can get a /48 prefix via DHCPv6 and assign /64 prefixes to multiple requesting routers. Prefix delegation is supported for the delegating router (not the requesting router).

Neighbor Resolution via DHCPv6 Relay

This is similar to ARP populate for IPv4. When it is turned on, an SR router needs to populate the link-layer address to IPv6 address mapping into the neighbor database based on the DHCPv6 lease information received.

If the IPv6 address of the host doesn’t belong to the subnets of the interface, such a neighbor record should not be created. This could happen when there is a downstream DHCPv6 relay router or prefix delegation requesting router.

DHCPv6 Lease Persistency

DHCPv6 lease persistency is supported.

The following features are enabled:

- DHCPv6 lease information is reconciled to the standby.
- DHCPv6 lease information can be stored on a flash card.
- When rebooted, DHCPv6 lease information stored on a flash card can be used to re-populate the DHCPv6 table as well as the neighbor database if neighbor-resolution is enabled.

Local Proxy Neighbor Discovery

Local proxy neighbor discovery is similar to local proxy ARP. It is useful in the residential bridging environment where end users are not allowed to talk to each other directly.

When local proxy ND is turned on for an interface, the router:

- Responds to all neighbor solicitation messages received on the interface for IPv6 addresses in the subnet(s) unless disallowed by policy.
- Forwards traffic between hosts in the subnet(s) of the interface.
- Drops traffic between hosts if the link-layer address information for the IPv6 destination has not been learned.

IPv6oE Hosts Behind Bridged CPEs

This feature adds support for dual-stack IPoE hosts behind bridged clients, receiving globally-routable address using SLAAC or DHCPv6. The feature also provides configurable support for handing out /128 addresses to bridged hosts from same /64 prefix or a unique /64 prefix per host. Bridged hosts that share the same /64 prefix are required to be all SLAAC hosts or DHCPv6 hosts, and are required to be associated with the same SAP. For SLAAC based assignment, downstream neighbor-discovery is automatically enabled to resolve the assigned address.

IPv6 Link-Address Based Pool Selection

This feature provides the capability to select prefix pools for WAN or PD allocations based on configured Link-Address. The scope of selection is the pool or a prefix range within the pool.

IPv6 Address/Prefix Stickiness

This feature extends lease identification criterion beyond DUID (default) for DHCPv6 leases held in the lease database for a configured period after the lease times out. DHCPv6 leases can be held in the lease database for a configurable period of time, after the lease time has expired. A large configured timeout value allows for address and prefix “stickiness”. When a subscriber requests a lease via DHCPv6 (IA_NA or PD), existing lease is looked-up and handed out. The lease identification match criterion has been extended beyond DUID to also include interface-id or interface-id and link-local address.

IPv4/v6 Linkage for Dual-Stack Hosts or Layer 3 RGs

In case of dual-stack Layer 3 RGs or dual-stack hosts behind Layer 2 CPEs, it is beneficial to have the ability to optionally link Ipv6oE host management to DHCP state for v4. This feature provides configurable support to use circuit-id in DHCPv4 option-82 to authenticate DHCPv6. Also, a SLAAC host is created based on DHCPv4 authentication if RADIUS returns IPv6 framed-prefix. IPv6oE host is deleted when the linked IPv4oE host is deleted. In addition, with v4 and v6 linkage configured, sending of unsolicited unicast RA towards the client can be configured when v4 host state is created and IPv6 is configured for the client. The linkage between IPv4 and IPv6 is based on SAP and MAC address. The sharing of circuit-id from DHCPv4 for authentication of DHCPv6 (or SLAAC) allows the 7750 SR to work around lack of support for LDRA on Access-nodes.

Host Connectivity Checks for IPv6

This feature provides support to perform SHCV checks on the global unicast address (assigned via SLAAC or DHCPv6 IA_NA) and link-local address of a L3 RG or a bridged host. SHCV uses IPv6 NS and NA messages. The configuration is similar to IPv4 support in SHCV. The **host-connectivity-check** command is extended to be configured for IPv6 or both IPv4 and IPv6.

DHCP Relay Enhancements

GRT-leaking can be used to relay DHCPv4 and DHCPv6 messages between a VRPN and the Global Routing Table (GRT) for network deployments where DHCP clients and server are in separate routing instances of which one is the Base routing instance.

In network deployments where DHCPv4 client subnets cannot be leaked in the DHCPv4 server routing instance, unicast renewals messages cannot be routed in the DHCPv4 server routing instance:

With the **relay-unicast-msg** command in the DHCPv4 relay on a regular interface or group-interface, it is possible to configure the gi-address of a DHCPv4 relayed message to any local address that is configured in the same routing instance. Unicast renewals are in this case relayed to the DHCPv4 server. In the upstream direction: update the source IP address and add the gateway IP address (gi-address) field before sending the message to the intended DHCP server (the message is not broadcasted to all configured DHCP servers). In the downstream direction: remove the gi-address and update the destination IP address to the value of the yiaddr (your IP address) field. By default, unicast DHCPv4 release messages are forwarded transparently. The optional **release-update-src-ip** flag, updates the source IP address with the value used for relayed DHCPv4 messages.

For retail subscriber interfaces, the “relay-unicast-msg” must be configured at the subscriber-interface dhcp CLI context.

```
The relay-unicast-msg function is not supported in combination with a double DHCPv4 relay
(L3 DHCPv4 relay in front of a 7750 DHCPv4 relay with relay-unicast-msg enabled).
config>service>vprn>
interface "lo0" create
                address 192.168.0.1/32
                loopback
            exit
            subscriber-interface "sub-int-1" create
                address 10.1.0.254/24
                group-interface "group-int-1-1" create
                    dhcp
                        server 172.16.1.1
                        relay-unicast-msg release-update-src-ip
                        gi-address 192.168.0.1 src-ip-addr
                        no shutdown
                     exit
                exit
            exit
```

Flexible Host Identification in LUDB Based on DHCPv4/v6 Options

Host identification plays a critical role during the assignment of the parameters to the host via LUDB. The parameters that can be assigned to the subscriber host can range from the IP addressing parameters and the subscriber identification string all the way to the parameters that define the service to which the subscriber is entitled.

LUDB access in the context of IPoE hosts is triggered by DHCP messages passing through the interface on which the LUDB access is configured. This is true regardless of the direction of the DHCP message flow (ingress/egress).

The parameters that define the characteristics of the host will be represented by an LUDB host *entry*. The parameters in the LUDB entry can be unique for each individual host, or they can be shared for a group of hosts. In the former case, the identification field for the LUDB host entry must be host specific while in the latter case the identification field for LUDB host entry could be derived from DHCP options that are common to a set of host.

The host identification in the LUDB can be based on a fixed set of predefined fields within 7x50. If this predefined set of fields is not flexible enough, a custom identification field can be constructed from the DHCP options that are processed by the Python script. Once this custom identifier is constructed, its value can be preserved for the duration of the DHCP transaction and it is used by the LUDB for the host identification.

An example of how this can be used is the following:

A Python script is installed in 7x50. This Python script will intercept incoming DHCP messages on the access side (Discover/Solicit/Request/Renew/Rebind) and it will consequently create a host identification string based on DHCP options in the packet. This string will then be cached and used for host identification in LUDB in both directions (access ingress and network ingress).

This functionality is supported for DHCPv4/DHCPv6 hosts.

DHCP Caching

Subscriber host **identification** via LUDB is performed upon the arrival of the incoming DHCP messages on both, the access and the network side, while the host **instantiation and ESM string assignment** is performed only during the processing of the DHCP ACK/Reply messages. In other words, if Python without the caching is used for subscriber host identification and classification (into proper service class by means of deriving ESM strings), the DHCP options required for host identification must be present in all DHCP messages – even the ones sent by the DHCP servers. However, DHCP servers are not required to echo DHCP options sent by the clients and relay-agents. Consequently, the missing options from the server side would cause the subscriber host instantiation to fail.

To remedy this situation and cover all deployments models (even the ones where the DHCP options are not echoed back by the DHCP servers), a **caching** mechanism is introduced whereby the results of the Python processing on ingress access are locally stored in 7x50. This will ensure that the information about the subscriber host is readily available when the DHCP packet from the DHCP server arrives. Furthermore, since we already have the cached information, no additional Python processing on the network ingress is needed.

The caching is performed in a *DHCP Transaction Cache (DTC)*, which is accessible to Python and to the EMS module. Python will write the result of its processing to it and the Enhanced Subscriber Management (EMS) module within 7x50 will be able to access those results.

The cache entries are relatively short lived, with the lifetime of a *DHCP transaction*. *DHCP transaction* is defined as a pair of DHCP messages that have the same DHCP transaction-id number (<Discover, Offer>, <Request, Ack>, <Solicit, Advertize>,<Request,Reply>, <Renew, Ack>, etc).

Flexible Creation of DHCPv4/6 Host Parameters Utilizing Python and Internal Caching

One of the facilities for flexible creation and assignment of subscriber host parameters is through Python scripting.

There are two models that allow assignment of the subscriber hosts parameters based on the Python processing, one without the utilizing the internal cache (DTC) and the other with the internal cache (DTC).

- Without utilizing the DTC, Python can process options in DHCP ACK message, derive the subscriber host parameters based on those options and consequently insert those parameters in a pre-configured DHCP option (defined in *sub-ident-policy*). The ESM module can be then instructed to extract those parameters and consequently instantiate the host with proper service levels. The drawback of this solution is that the DHCP server may not return all DHCP (v4 and v6) options that clients and relay-agents originally transmitted. Since those options are needed for subscriber parameter determination (but may be absent in the DHCP ACK/REPLY messages when the Python script is run), this solution falls short of covering all deployment cases. In addition, the range of parameters that can be assigned to a subscriber host in this fashion is smaller than the set of parameters utilizing the DTC.
- The internal cache (DTC) allows us to store the result of Python processing. The result is stored during the lifetime of the DHCP transaction. This method of string assignment does not rely on the DHCP server ability to return client's options, DHCPv4 and DHCPv6.

Parameters (ESM strings, IP addresses, etc.) present in the DTC will have priority over any other source that is providing overlapping parameters when it comes to ESM processing. In other words, if the same parameter is provided via DTC (Python), LUDB and Radius, the one provided via

DTC will be in effect. This prioritization will occur automatically without the need for any additional CLI.

For example, if the IPv4 address is provided via DTC during DHCP Discovery processing, then the mode of operation for this host will be proxy-to-dhcp (ESM will terminate DHCP, without going to the server), regardless of whether the IP address is also provided via LUDB or Radius.

This functionality is supported for DHCPv4/DHCPv6 hosts.

Python DTC Variables and API

The following are the Python variables and APIs related to DTC:

Subscriber Host Identification

alc.dtc.derivedId — A read/write (from the Python perspective) string to store the LUDB lookup key for subscriber host identification. This key is derived from the contents of the packet. This string will be used as a *match* criteria in LUDB. The derived-id can only be used when the lookup is performed in ESM. If the LUDB is attached to the local DHCP server, then the lookup based on the derived-id cannot be performed as the DHCP server has no means to derive such an ID from the DHCP message.

Caching Any Data During the Lifetime of a Transaction

alc.dtc.store(key,value) => the operator can store any data he desires in one or more entries. The key can be any arbitrary string (printable ASCII characters), up to 32 bytes in length. The value part is ‘unlimited’ (memory permitting) in size.

alc.dtc.retrieve(key) => retrieve data from the DTC. The key must be an existing key, which is a string consisting of printable ASCII characters, up to 32 bytes in length.

For example, this can be used to cache the DHCP options that the client inserts but the server does not echo back. Those options can still be retrieved in 7x50 via cache in case that their presence is needed for any reason.

The lifespan of the cached data is tied to a DHCP transaction (a pair or corresponding DHCP messages flowing in opposite direction).

ESM Related Parameters (ESM strings, routing context, etc.)

DTC provides an API to supply a subset of configuration parameters that can otherwise come from RADIUS and LUDB and are used by the ESM code to setup the subscriber host.

DTC parameters as defined below should NOT be considered as DHCP options that can be blindly returned to the DHCP client, but instead they should be considered as real configuration settings. For example, the lease-time option is used in LUDB to enforce the lease time for the client. As such, the ESM keeps state of the lease-time. The following parameters can be used to setup a subscriber host:

alc.dtc.setESM (key-from-below, value) => store data that is used by ESM. This data is write-only.

The keys will be predefined (**only** these can be used) and are shown in Table 8. These keys are read-only static variables.

The LUDB column indicates the configuration option under the **config>subscr-mgmt>loc-user-db>ipoe>host** context in LUDB.

Table 8: ESM-Related Python Variables

DTC Variable	Type	LUDB	Radius Attribute	Comment
alc.dtc.subIdent	string	identification-strings >subscriber-id	Alc-Subsc-ID-Str	
alc.dtc.subProfileString	string	identification-strings >sub-profile-string	Alc-Subsc-Prof-Str	
alc.dtc.slaProfileString	string	identification-strings >sla-profile-string	Alc-SLA-Prof-Str	
alc.dtc.ancpString	string	identification-strings >ancp-string	Alc-ANCP-Str	
alc.dtc.appProfileString	string	identification-strings >app-profile-string	Alc-App-Prof-Str	
alc.dtc.intDestId	string	identification-strings >inter-dest-id	Alc-Int-Dest-Id-Str	
alc.dtc.catMapString	string	identification-strings >category-map-name	Alc-Credit-Control-CategoryMap	
alc.dtc.ipAddress	string	address	Framed-IPAddress	
alc.dtc.dhcp4DefaultGateway	string	options>default-router	Alc-Default-Router	
alc.dtc.subnetMask	string	address	Framed-IPNetmask	
alc.dtc.ipv4LeaseTime	integer	options>lease-time	Alc-Lease-Time	
alc.dtc.ipv4PrimDns	string	options>dns-server	Alc-Primary-Dns Client-DNS-Pri	
alc.dtc.ipv4SecDns	string	NA	Alc-Secondary-Dns Client-DNS-Sec	
alc.dtc.primNbns	string	options>netbios-name-server	Alc-Primary-Nbns RB-Client-NBNSPri	
alc.dtc.secNbns	string	NA	Alc-Secondary-Nbns RB-Client-NBNSSec	
alc.dtc.msapGroupInterface	string	msap-defaults>group-interface	Alc-MSAP-Interface	

Table 8: ESM-Related Python Variables (Continued)

alc.dtc.msapPolicy	string, integer	msap-defaults>policy	Alc-MSAP-Policy	
alc.ServiceId	string, integer	msap-defaults>service	Alc-MSAP-Serv-Id	
alc.dtc.retailServiceId	string	Retail-service-id	Alc-Retail-Serv-Id	
alc.dtc.ipv6Address	string	ipv6-address	Alc-Ipv6-Address	
alc.dtc.ipv6DelegatedPrefix	string	ipv6-delegated-prefix	Delegated-IPv6-Prefix	
alc.dtc.ipv6SlaacPrefix	string	ipv6-slaac-prefix	Framed-IPv6-Prefix	
alc.dtc.ipv6WanPool	string	ipv6-slaac-prefix-pool	Framed-IPv6-Pool	
alc.dtc.ipv6PrefixPool	string	ipv6-delegated-prefix-pool	Alc-Delegated-IPv6-Pool	
alc.dtc.ipv6DelegatedPrefixLength	integer	ipv6-delegated-prefix-len	Alc-Delegated-IPv6-Prefix-Length	
alc.dtc.accountingPolicy	string	acct-policy	N/A	
alc.dtc.dhcpv4GIAddr	string	gi-address	N/A	
alc.dtc.dhcv4ServerAddress	string	server	N/A	
alc.dtc.dhcp4Pool	string	address>pool	Framed-Pool Ip-Address-Pool-Name	prim|sec (“|” – delimiter)
alc.dtc.linkAddress	string	link-address	N/A	
alc.dtc.dhcv6ServerAddr	string	server6	N/A	
alc.dtc.ipv6PrimDns	string	options6>dns-server	Alc-Ipv6-Primary-Dns	
alc.dtc.ipv6SecDns	string	NA	Alc-Ipv6-Secondary-Dns	

For example, an IP address is assigned to a DTC variable as a string:

alc.dtc.ipAddress = “192.168.0.10” — This is performed through the following ALU API: **alc.dtc.setESM(alc.dtc.ipAddress,’192.168.0.10’)**. The DTC logic then parses this variable and converts it into appropriate format for consumption by ESM code.

The values defined above are the ones that are mostly defined in the LUDB. Main use, however, is assigning ESM strings for the subscriber host instantiation phase during the processing of DHCP ACK/Reply messages. Consequently the Python script needs to be run only on DHCP Request messages (no need to run it on Discoveries for ESM string assignment, unless the LUDB derived-id is also needed).

DHCP options that are blindly returned to the DHCP client without the ESM code being aware of them cannot be configured via DTC. Such options should be configured via Radius (Alc-ToCLient-Dhcp-Options – IPv4 only) or they can be inserted directly into DHCP messages via Python (bypassing DTC).

Other possible uses for DTC variables are:

- Assigning routing context information via Python (service-id, msap, msap-policy, retail service-id, etc). For example AN can insert certain ‘hints’ in various DHCP options that would suggest to us (via Python) in which service context to place the subscriber-host.
- IP address assignment via Python (DTC). This would address the DTC-to-DHCP-Proxy case where Python script is invoked on DHCP Discovery/Solicit. For example:
  - → Discover arrives
  - → Python generates an IP address, for example based on some DHCP options
  - → The script stores the IP address by using alc.dtc.setEsm(alc.dtc.ipAddress, "10.0.1.2");
  - → After the script is finished, ESM starts processing the packet (no LUDB/RADIUS authentication configured)
  - → ESM finds the IP address already in DTC and decides to handle all DHCP and execute proxy function instead of relay
  - → ESM sends an offer with the address that python generated
  - → DHCP options should be provided as well in this case (lease-times, etc.)
  - → The same applies to the DHCP Request

DTC Debugging Facility

DTC debugging is part of the generic DHCP debugging facility that is enabled by the flowing commands:

debug router <*router-id*> **ip dhcp** --> Enable DHCP debug on Layer 3 interfaces, including subscriber-interfaces.

debug service id <*service-id*> **dhcp** --> Enable DHCP debugging on capture SAP.

If the DTC cache is populated via Python, the corresponding DTC entries will be shown as part of the matching DHCP message debug.

Virtual Subnet for DHCPv4 Hosts

The **virtual-subnet** command in the **sub-if>dhcp** context allows the system to snoop and record the default router address in DHCP ACK messages for a DHCPv4 ESM host. The system can answer or traceroute request even if the default router address is not configured on the subscriber-interface.

This feature eliminates the need to configure every default-gw address on subscriber interface.

Beside default router address, the system will also calculate host's subnet by using an assigned address and the subnet mask option in ACK. Both recorded default router address and the subnet can be displayed with the **show service** *id* **virtual-subnet** command.

Every ESM subscriber only has one set of default router address and subnet.

Proxy DHCP Server

This section describes the implementation of a proxy DHCP server capability provide a standards-based DHCP server which will front end to downstream DHCP client and DHCP relay enabled devices and interface with RADIUS to authenticate the IP host and subscriber and will obtain the IP configuration information for DHCP client devices.

The proxy DHCP server is located between an upstream DHCP server and downstream DHCP clients and relay agents when RADIUS is not used to provide client IP information.

Service providers can introduce DHCP into their networks without the need to change back-end subscriber management systems that are typically based around RADIUS (AAA). Service providers can support the use of DHCP servers and RADIUS AAA servers concurrently to provide IP information for subscriber IP devices.

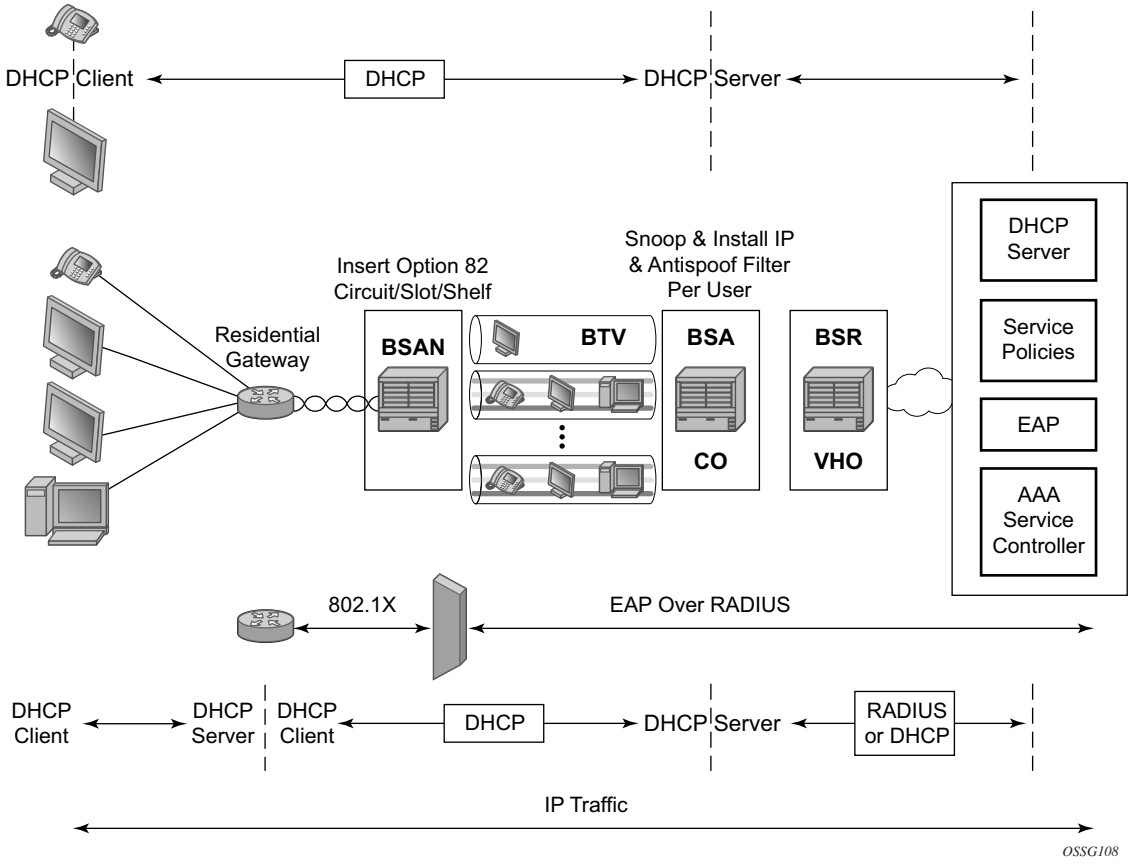


Figure 19: Typical DHCP Deployment Scenarios

DHCP is the predominant client-to-server based protocol used to request IP addressing and necessary information to allow an IP host device to connect to the network.

By implementing DHCP, the complexity of manually configuring every IP device that requires connectivity to the network is avoided. IP devices with DHCP can dynamically request the appropriate IP information to enable network access.

DHCP defines three components that are implemented in a variety of device types:

- The DHCP client allows an IP device (host) to request IP addressing information from a DHCP server to enable access to IP based networks. This is typically found in:
  - → End user notebooks, desktops and servers
  - → Residential gateways and CPE routers
  - → IP phones
  - → Set-top boxes
  - → Wireless access points
- The DHCP relay agent passes (relays) DHCP client messages to pre-configured DHCP servers where a DHCP server is not on the same subnet as the IP host. This feature optionally adds information into DHCP messages (Option 82) which is typically used for identifying attaching IP devices and their location as part of subscriber management. This is typically found in:
  - → Residential gateways and CPE routers
  - → DSLAMs
  - → Edge aggregation routers
- The DHCP server receives DHCP client messages and is responsible for inspecting the information within the messages and determining what IP information if any is to be provided to a DHCP client to allow network access. This is typically found in:
  - → Dedicated stand alone servers
  - → Residential gateways and CPE routers
  - → Edge aggregation routers
  - → Centralized management systems

DHCP is the predominant address management protocol in the enterprise community, however in the provider market PPP has traditionally been the means by which individual subscribers are identified, authenticated and provided IP addressing information.

The use of DHCP in the provider market is a growing trend for managing subscriber IP addressing, as well as supporting newer devices such as IP-enabled IP phones and set-top boxes. The majority of subscriber management systems rely heavily on RADIUS (RFC 2865, *Remote Authentication Dial In User Service (RADIUS)*) as the means for identifying and authorizing individual subscribers (and devices), deciding whether they will be allowed access to the network, and which policies should be put in place to control what the subscriber can do within network.

The proxy DHCP server capability enables the deployment of DHCP into a provider network, by acting as a proxy between the downstream DHCP devices and the upstream RADIUS based subscriber management system.

- Interact with downstream DHCP client devices and DHCP relay Agents in the path
- Interface with RADIUS to authenticate DHCP requests
- Receive all the necessary IP information to properly respond to a DHCP client
- Ability to override the allocate IP address lease time, for improved IP address management.

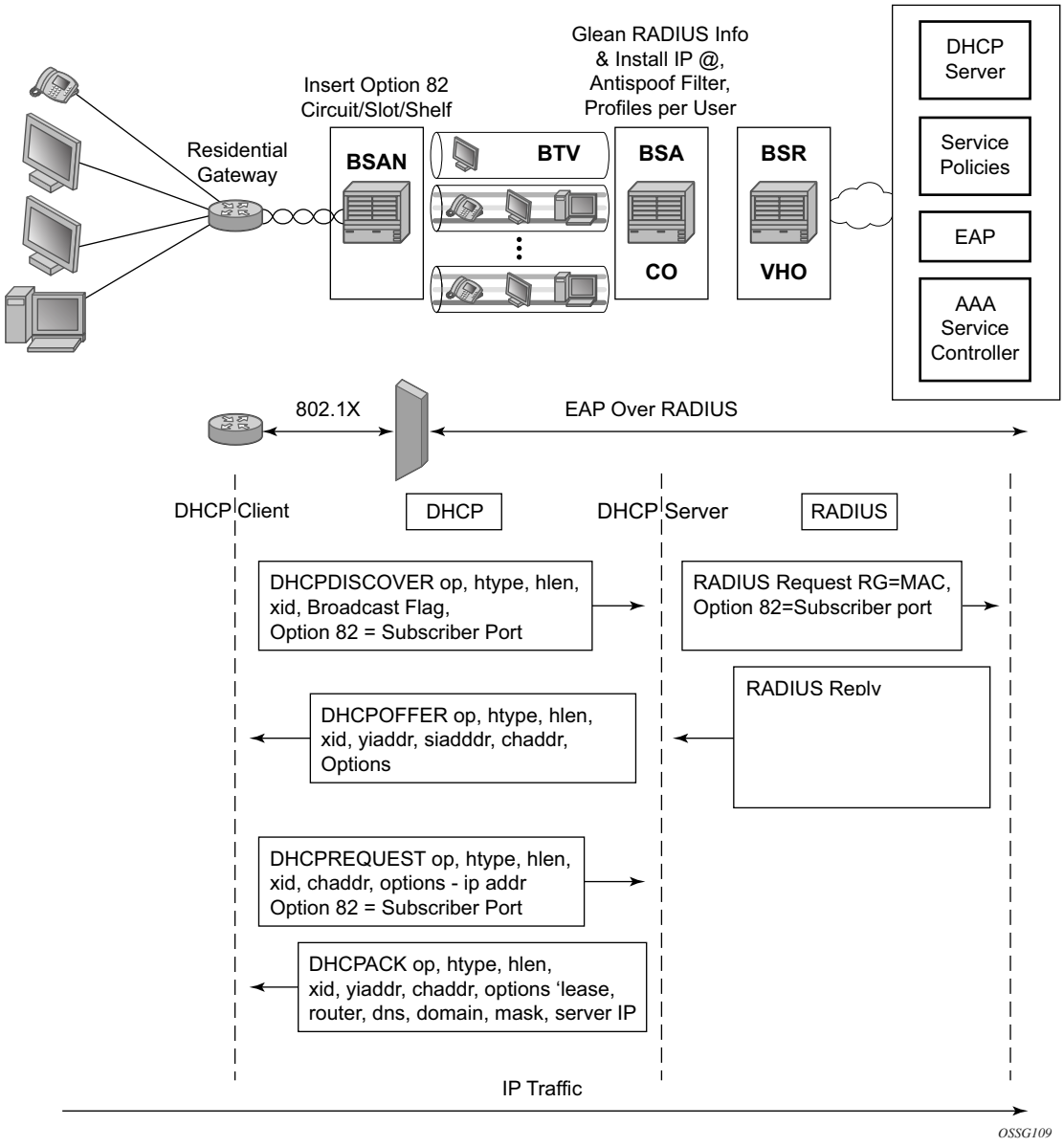


Figure 20: Example of Triple Play Aggregation Network With DHCP to RADIUS Authentication

Figure 20 displays a typical DHCP initial boot-up sequence with the addition of RADIUS authentication. The proxy DHCP server will interface with downstream DHCP client devices and then authenticate upstream using RADIUS to a providers subscriber management system.

In addition to granting the authentication of DHCP hosts, the RADIUS server can include RADIUS attributes (standard and vendor-specific attributes (VSAs)) which are then used by the edge router to:

- Provision objects related to a given DHCP host — Subscriber and SLA policy
- Provide IP addressing information to a DHCP client
- Support the features that leverage DHCP lease state
  - → Dynamic ARP population
  - → ARP reply agent
  - → Anti-spoofing filters
  - → MAC pinning
- Leverage host-connectivity-verify to determine the state of a downstream IP host

This feature offers the ability for a customer to integrate DHCP to the subscriber while maintaining their existing subscriber management system typically based around RADIUS. This provides the opportunity to control shifts to an all DHCP environment or to deploy a mixed DHCP and RADIUS subscriber management system.

In order to maximize its applicability VSAs of legacy BRAS vendors can be accepted so that a network provider is not forced to reconfigure its RADIUS databases (or at least with minimal changes).

To receive data from the RADIUS server the following are supported:

- Juniper (vendor-id 4874) attributes 4 (Primary DNS server) and 5 (Secondary DNS server)
- Redback (vendor-id 2352) attributes 1 (Primary DNS) and 2 (Secondary DNS).
- Juniper attributes 6 and 7 (Primary and Secondary NetBIOS nameserver).
- Redback attributes 99 and 100 (Primary and Secondary NetBIOS nameserver).

The following attributes can be sent to RADIUS:

- Sending authentication requests: (from the DSL Forum) (vendor-id 3561), attributes 1 (Circuit ID) and 2 (Remote ID).
- DSL Forum attributes 129 and 130 (Actual Data Rate Upstream and Downstream), 131 and 132 (Minimum Data Rate Upstream and Downstream) and 144 (Access Loop Encapsulation).

The complete list of TiMetra VSAs is available on a file included on the compact flash shipped with the image.

Local DHCP Servers

Terminology

- **Local 7x50 DHCP Server** – DHCP server instantiated on the local 7x50 node.
- **Remote 7x50 DHCP Server** – DHCP server instantiated on the remote 7x50 node (external to the local 7x50 node).
- **3rd party DHCP server** – DHCP server external to any 7x50 node and implemented outside of 7x50.
- **Intercommunication link** – the logical link between dual-homed 7x50 DHCP servers used for synchronizing DHCP lease states. Multi-chassis Synchronization (MCS) protocol runs over this link. Once this link is interrupted, synchronization of the leases between redundant DHCP servers is impaired. This link should be well protected with multiple underlying physical paths.
- **Local IP address-range/prefix** – refers to the local failover mode in which the IP address-range/prefix is configured in dual-homed DHCP environment. The local keyword does not refer to the locality (local vs remote) of the server on which the IP address-range/prefix in configured, but rather refers to the ownership of the IP address-range/prefix. The DHCP server on which the local IP address-range/prefix is configured, owns this IP address-range/prefix and consequently is allowed to delegate the IP addresses/prefixes from it at any time, regardless of the state of the intercommunication link.
- **Remote IP address-range/prefix** – refers to the remote failover mode in which the IP address-range/prefix is configured in dual-homed DHCP environment. The remote keyword does not refer to the locality of the server on which the IP address-range/prefix is configured, but rather refers to the ownership of the IP address-range/prefix. The DHCP server on which the remote IP address-range/prefix is configured, but does not own this IP address-range/prefix during normal operation and consequently is NOT allowed to delegate the IP addresses/prefixes from it. Only when the intercommunication link between the two nodes transition into particular (failed) state, the DHCP server is allowed to start delegating new IP addresses from the remote IP address-range/prefix.
- **IP address-range/prefix ownership** – 7x50 DHCP server can delegate new leases from an IP address-range/prefix that it owns. For example, an IP address-range/prefix designated as remote is not owned by the DHCP server on which it is configured unless certain conditions are met. Those conditions are governed by the state of the intercommunication link.
- **IP address-range/prefix takeover** – a 7x50 DHCP server that does not own an IP address-range/prefix can take over the ownership of this IP address-range/prefix under certain conditions. Once the ownership is taken, the new IP addresses can start being delegated from this IP address-range/prefix. Only the remote IP address-range/prefix can be taken over. Note that the takeover of an IP address-range/prefix has only local significance – in other words, the ownership is not taken away from some other 7x50

DHCP server that has the same IP address-range/prefix designated as local. It only means that IP address-range/prefix that is configured as remote is available to takeover for new IP address delegation.

- **Local PPPoX Address Pools** – this term refers to the method of accessing an IPv4/v6 address pool in 7x50 DHCP4/6 server. For PPPoX clients, the IPv4/v6 addresses are allocated from those pools without the need for an intermediate DHCP relay-agent (7x50 internal DHCP relay-agent). Although those pools are part of the local DHCP server in 7x50, the method of accessing them is substantially different than accessing local DHCP address pools for IPoE (DHCP) clients. IPoE (DHCP) and PPPoX hosts can share the same pool and yet each client type can access them in their own unique way:
  - → IPoE client via DHCP messaging
  - → PPPoE via internal API calls
- **Local PPPoX Pool Management** – IPv4 address allocation/management for PPPoX clients independent of DHCP process (DHCP lease state). An IPv4 address allocated via local PPPoX Pool Management is tied to the PPPoX session. It is without the need for an 7x50 internal DHCP relay-agent.

Overview

7x50 DHCP server multi-homing will ensure continuity of IP address/prefix assignment/renewal process in case that an entire 7x50 DHCP server fails or in case of a failure of the active link that connects clients to one of the 7x50 DHCP servers in the access part of the network. DHCP server multi-homing is an integral part of the overall subscriber management multi-chassis protection scheme.

DHCP server multi-homing can be implemented outside of the BNG, without subscriber management enabled. However, in the following text, it is assumed that the subscriber management multi-homing (SRRP/MC-LAG, subscriber synchronization) is deployed along with DHCP server multi-homing.

Although the subscriber synchronization process and the DHCP lease states synchronization process use the same synchronization infrastructure within 7x50 (Multi Chassis Redundancy protocol), they are in essence two separate processes that are not aware of each other. As such, the mechanisms that drive their switchover are different. For example, the mechanism that drives subscriber switchover from one node to the other is driven by the access protection mechanism (SRRP/MC-LAG) while the switchover (or takeover) of the IP address-range/prefixes in a DHCP pool is driven by the state of the intercommunication link over which the leases are synchronized. The failure of an entire node makes those differences irrelevant since the access-link failure coincides with the intercommunication link failure and vice versa. However, link-only failures become critical when it comes to their interpretation by the protection mechanisms (SRRP/MC-LAG/DHCP server multi-homing). Regardless of nature of the failure, overall DHCP server multi-chassis protection scheme must be devised in such fashion that the two 7x50 DHCP servers never allocate the same IP address/prefix to two different clients. Otherwise IP address/prefix duplication will ensue. Unique IP address/prefix allocation is achieved by making only one 7x50 DHCP server responsible for IP address/prefix delegation out of the shared IP address-range/prefix.

There are two basic models for DHCP server dual-homing:

- Shared IP address-range/prefix is designated as local on one 7x50 DHCP server and as remote on the other.

  In this case, the dhcp-relays must point to both DHCP servers; the one configured with the local IP address-range/prefix as well as the one with the remote IP address-range/prefix.

  Under normal circumstances, the new IP addresses/prefixes can be only allocated from the DHCP server configured with the local IP address-range/prefix.

  The DHCP server configured with the remote IP address-range/prefix will start delegating new lease from it only when it declares that the redundant peer with the local IP address-range/prefix becomes unavailable.

  Detection of the peer unavailability is triggered by the failure of the intercommunication link which can be caused either by the nodal failure or simply by the loss of connectivity between the two nodes protecting each other. Thus, the loss of intercommunication link does not necessarily mean that the peering node is truly gone. It can simply mean that the

two nodes became isolated and unable to synchronize their DHCP leases between each other. In such environment, both nodes can potentially allocate the same IP address at the same time. To prevent this, additional intercommunication link states and associated timers are introduced to give the chance the operator ample time to fix the problem.

For example, the DHCP server will take over the remote IP address-range/prefix once the MCLT period expires while the intercommunication link is in PARTNER-DOWN state. The PARTNER-DOWN state is entered after a preconfigured timer (partner-down-delay) expires. The consequence of these two additional timers (partner-down-delay and MCLT) is that the new IP address delegation from the remote (shared) IP address-range/prefix will not be possible until the preset timers expire. This is needed and justified in case that the intercommunication link is interrupted, the nodes become isolated and consequently the DHCP lease state synchronization becomes impaired. On the other hand, if the DHCP server with local IP address-range/prefix becomes truly unavailable, those additional restoration times will cause interruption in service since the new IP addresses from the remote IP address-range/prefix will not be immediately available for delegation.

Note that only new IP address delegation from the remote IP address-range/prefix is affected by this behavior. The existing IP leases can be extended on both nodes at any time irrespective of whether the configured address-range/prefix is designated as local or remote.

To ensure uninterrupted service even for new lease delegation in this model (local-remote), two approaches can be adopted:

→ Segment the IP address/prefix space so that each node has an IP address-range/prefix designated as local.
For example, instead of designating IP address-range 10.10.10.0/24 as local on DHCP server A and as remote on DHCP server B, the 10.10.10./24 IP address will be split into two: 10.10.10.0/25 and 10.10.10.128/25.
The 10.10.10.0/25 would be designated as local on the DHCP server A and as remote on DHCP server B.
The 10.10.10.128/25 would be designated as remote on the DHCP server A and as local on DHCP server B.
In this fashion, one node will always be available to assign new leases without any overlap.

→ In case that only one shared IP address-rage/prefix is deployed, the operator can bypass the timers (partner-down-delay and MCLT) that are put in place in case that DHCP server nodes become isolated. This bypass of the timers can be achieved via configuration. In this case, a safe operation is warranted only if the operator is certain that the intercommunication link failure will be caused by the nodal failure, and not the physical link failure between the two nodes.

- Shared IP address-range/prefix is designated as access-driven on both 7x50 DHCP servers.

  In this scenario, the shared IP address-range/prefix is owned by both nodes and the ownership is not driven by the state of the intercommunication link.

To avoid IP address duplication, only one DHCP server at any given time must be responsible for IP address assignment from this shared IP address-range/prefix.

This will be ensured by the access protection mechanism (SRRP/MC-LAG) that will provide a single active path from the clients to the one of the DHCP servers.

In case that clients have access to the same IP address-range/prefix on both DHCP servers at the same time, the IP address duplication may occur.

Consider the following case:

Two DHCP clients send DHCP Discovers in the following fashion:

→ DHCP client A sends DHCP Discover to the DHCP server A

→ DHCP client B sends DHCP Discover to the DHCP server B

→ DHCP server A assigns IP address 10.10.10.10 to the DHCP client A

→ DHCP server B assigns IP address 10.10.10.10 to the DHCP client B

→ This is a legitimate scenario since the DHCP lease states are not synchronized until the DHCP lease assignment is completed.

→ Just before the DHCP ACK is sent to the respective clients from both nodes, the DHCP lease sync messages are exchanged between the peers.

→ DHCP servers do not wait for the reply to the sync message before they send the DHCP Ack to the client.

→ Once the DHCP syn message is received from the peer, the DHCP server will realize that the IP lease already exist. In this case, the newer IP lease will override the older.

→ The result is that clients A and B use the same IP address and consequently the forwarding of the traffic will be impaired.

In access-driven model, the ESM subscriber host must be collocated with the DHCP server. In other words, the DHCP server must be instantiated in redundant BNGs. The dhcp-relays must point to the respective local 7x50 DHCP servers. There must be no cross-referencing of DHCP servers in this model. In addition, the IP address that the DHCP servers are associated with, must be the same on both DHCP servers. This is necessary to ensure uninterrupted service levels once the switchover in the access occurs.

For example:

→ DHCP server A on BNG A is associated with the IP address 1.1.1.1 (for example loopback interface A on BNG A)

→ DHCP server B on the peering BNG B is associated with the IP address 1.1.1.1 (configured in BNG B under loopback interface B)

→ Dhcp-relay on BNG A points to the IP address 1.1.1.1 ? DHCP server in BNG A

→ Dhcp-relay on BNG B points to the IP address 1.1.1.1 ? DHCP server in BNG B.

Consider the following when contemplating deployment of the two described models:

- Local-remote model is agnostic of the access protection mechanism. In fact, the access protection mechanism is not needed at all for safe operation.

Fast takeover of the single shared (remote) IP address-range/prefix can be provided only in cases where the operator can guarantee that the intercommunication link failure is caused by the nodal failure (entire DHCP server node becomes unavailable). Fast takeover is provided by bypassing the partner-down-timer and MCLT.

In case that multiple IP address-ranges/prefixes are deployed, bypass of the timers is not needed since the local IP address-ranges/prefixes are available on both nodes.

- Access-driven model allows a single IP address-range/prefix to be shared across the redundant DHCP server nodes. The access to the single DHCP server node from the client side is ensured by the protection mechanism deployed in the access part of the network (SRRP or MC-LAG).

DHCP Lease Synchronization

DHCP server leases are synchronized over Multi-Chassis Synchronization (MCS) protocol. A DHCP lease synchronization message is sent to the peering node just before the DHCP ACK/ Reply is sent to the client.

For example, the message flow for DHCPv4 lease establishment is the following:

DHCP Discover ; DHCP client — DHCP server

DHCP Offer ; DHCP server — DHCP client

DHCP Request ; DHCP client — DHCP server

DHCP Sync Message ; DHCP server — via MCS to the peering DHCP server

DHCP Ack ; DHCP server— DHCP client

DHCP server failover mechanism in the local-remote IP address-range/prefix model relies on the detection of the failure of the link over which DHCP states are synchronized (via MCS protocol). This link is normally disjoint from the access links towards the clients. MCS protocol normally runs over a direct link between the two redundant nodes (1) or over backbone links (2) in case that the direct link is not present.

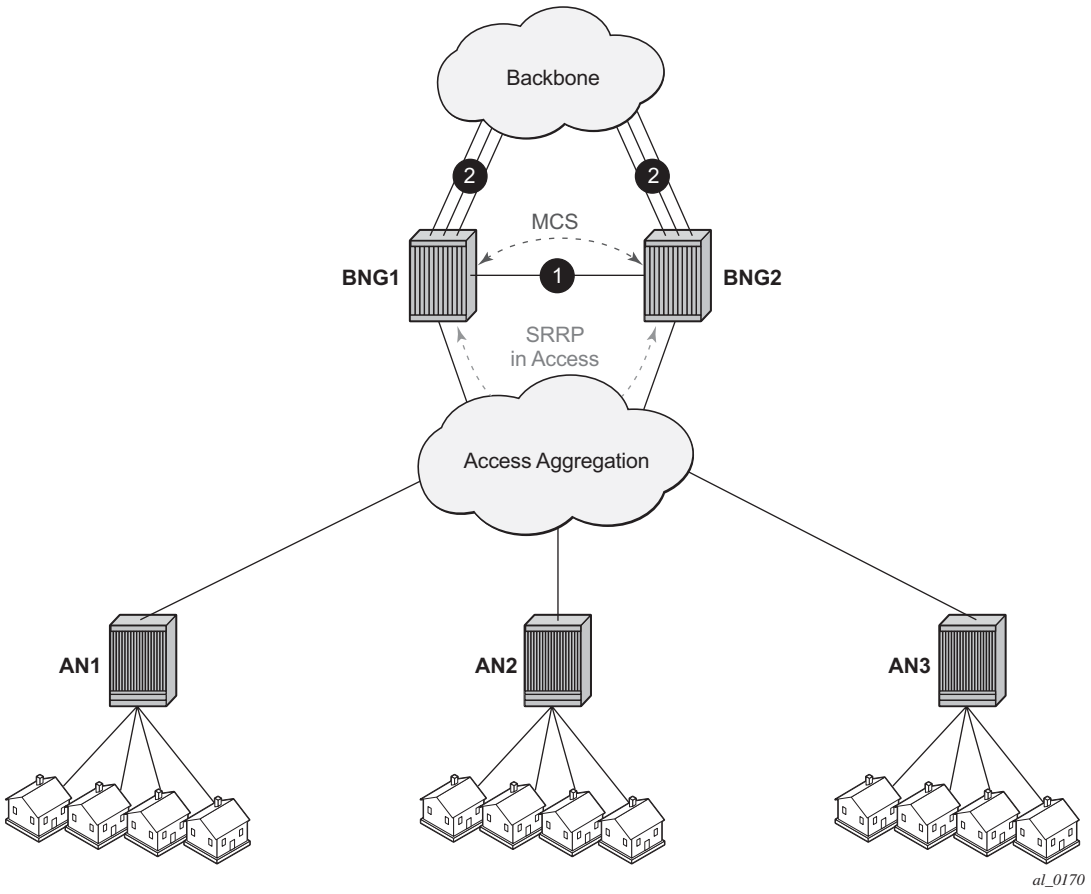


Figure 21: Redundancy Model

In the access-driven IP address-range/prefix model, the DHCP server address-ranges/prefixes are not tied to the state of the intercommunication link. Instead, the DHCP server selection for IP address assignment is only governed by the path selected by the path protection mechanism (SRRP/MC-LAG) deployed in the access part of the network.

Intercommunication Link Failure Detection

7x50 DHCP Server is a client of Multi-chassis Synchronization (MCS) application with 7x50. Once MCS transitions into out-of-sync state, the 7750 DHCP server redundancy assumes that there is a failure in the network. In essence, the DHCP server failure in dual-chassis configuration relies on the failure detection mechanism of MCS.

MCS runs over TCP, port 45067 and it is using either data traffic or keepalives to detect failure on the communication link between the two nodes. In the absence of any MCS data traffic for more than 0.5sec, MCS will send its own keepalive to the peer. If a reply is NOT received within 3sec,

MCS will declare its operational state as DOWN and the DB Sync state as out-of-sync. MCS will consequently notify its clients (DHCP Server being one of them) of this condition.

In essence, it can take up to 3 seconds before the DHCP client realizes that the interclasses communication link failed.

MCS Clients (applications) can optimally send their own proprietary keepalive messages to its partner over MCS to detect failure. DHCP Server does not utilize this method and it strictly relies on the failure notifications by MCS.

Note that the intercommunication link failure does not necessarily assume the same failed fate for the access links. In other words, it is perfectly possible (although unlikely) that both access links are operational while the inter-chassis communication link is broken.

The failure detection of the intercommunication link will lead to certain failover state transitions on the DHCP server. The DHCP lease handling in the local-remote model will depend on the particular failover state on the DHCP server and the duration of each failover state is determined by preconfigured timers.

DHCP Server Failover States

DHCP Server when paired in redundant fashion can transition through several states:

- TRANSITION
- SHUTDOWN
- INIT
- STARTUP
- NORMAL – In this state, the 7x50 DHCP Server is serving all IP leases from the local and access-driven IP addresses-ranges/prefixes (assigning new leases and extending existing ones). Remote IP addresses-ranges/prefixes are not served (new or existing ones).
- COMMUNICATION INTERUPTED – IP addresses/prefixes under the local and access-driven IP address-range/prefix are served in the same fashion as in the NORMAL state. The IP addresses/prefixes under the remote IP address-range/prefix will be renewed. However, the new address/prefix from the remote address-range/prefix will not be allocated until the partner-down timer expires, the failover state consequently transitions into PARTNER DOWN and the MCLT timer while in the PARTNER-DOWN state expires. This is necessary in case that the failure occurred only on the intercommunication link while the access link is still operational (DHCP server nodes become isolated).

  COMMUNICATION INTERUPTED state indicates that there is a failure of some kind, but it cannot be determined whether an entire node failed or only the inter-chassis link. The access layer may still be fully operational, but the new leases (including RENEWS/REBINDS) cannot be synchronized between the two peers.
- PARTNER DOWN – Once the DHCP Server reaches this state, the remote IP address-

range/prefix is taken over and after an additional time period of MCLT (Maximum Client Lead Time), the new IP addresses/prefixes from it can be delegated to clients. PARTNER-DOWN state is an indication (and assumption at the same time) that the remote node is truly down.

Otherwise, the IP address duplication may occur in case that all of the following conditions are met:

→ the DHCP server nodes become isolated

→ the failover state is PARTNER-DOWN

→ DHCP/PPPoX clients have simultaneous access to the same IP address-range/prefix on the both DHCP servers.

Lease Time Synchronization

7x50 DHCP server state synchronization is different from the lease state synchronization of the subscriber host itself.

- Each subscriber host lease state is synchronized via sub-mgmt client application. The host lease state can be seen via the output of following CLI command:

  show service id *id* **dhcp lease-state**

  The output of this command represents the state of our internal DHCP relay (client).
- On the other hand, the DHCP server lease states can be observed via the following CLI command:

  show routed *id* **dhcp local-dhcp-server** *name* **lease**

The concern is with the latter, the 7x50 DHCP server lease state synchronization. To ensure un-interrupted IP lease renewal process after a failure in the network, the DHCP server lease time that is synchronized between the 7x50 DHCP servers must always lead the currently assigned lease time for the period of the anticipated lease time in the next period.

For comparison purposes the two flow diagrams are juxtaposed in Figure 22:

- The right side does not include any lead time during synchronization
- The left side includes the lead time during synchronization

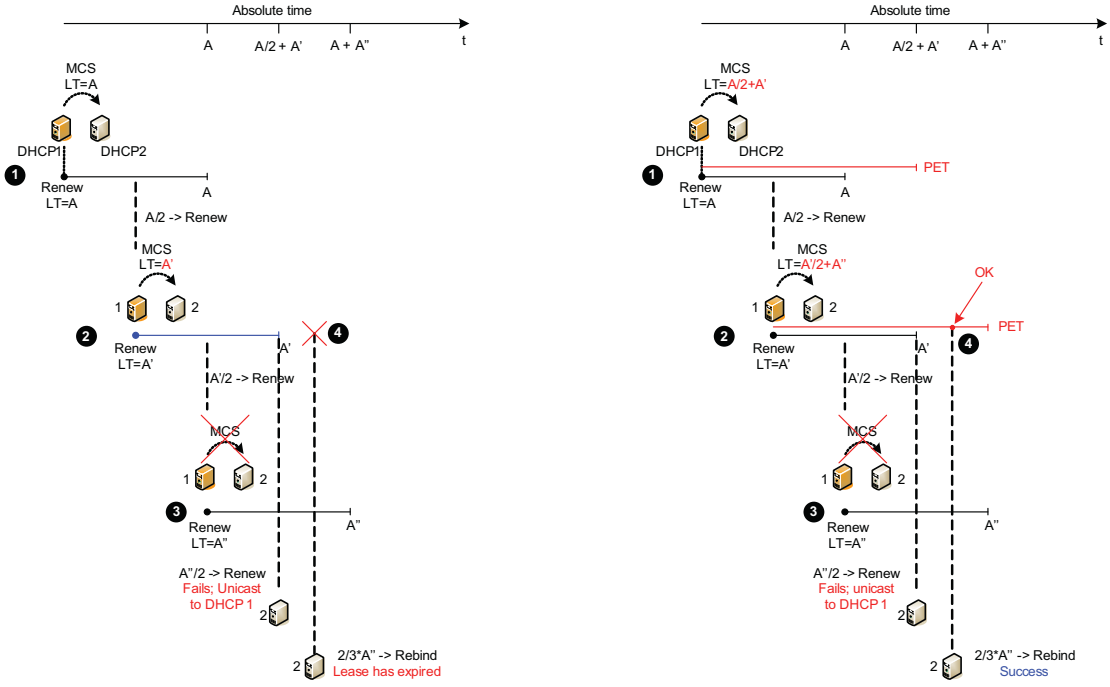


Figure 22: Potential Expiration Time

On the left side of the graph, the lease time is synchronized to the same value to which it was renewed.

In point 3, the primary DHCP server renews the lease time but fails to synchronize it due to its own failure (crash). The secondary server (2) has the old lease time A' in its database. The next time the client tries to REBIND its address/prefix, the lease in the secondary server will be expired (4). As a result, the IP address/prefix will not be renewed.

To remedy this situation, the primary server must synchronize the lease time as the current RENEW time + the next lease-time. In this fashion, as depicted in point 3, when the REBIND reaches server 2, the lease in its DB will still be active (4) and the server 2 will be able to extend the lease for the client.

Maximum Client Lead Time (MCLT)

Maximum Client Lead Time (MCLT) is the maximum time that the 7x50 DHCP Server can extend the lease time to its clients beyond the lease time currently know by the 7x50 DHCP partner node. By default this time is relatively short (10min).

The purpose of the MCLT is explained in the following scenario:

The local 7x50 DHCP server assigns a new IP lease to the client but it crashes before it sends a sync update to the partner server. Because of the local 7x50 DHCP server failure, the remote 7x50 DHCP server is not aware of the IP address/prefix that has been allocated on the local 7x50 DHCP server. This condition creates the possibility that the remote 7x50 DHCP server allocates the same address/prefix to another client. This would cause IP address/prefix duplication. MCLT is put in place to prevent this scenario.

MCLT based solution is shown in Figure 23.

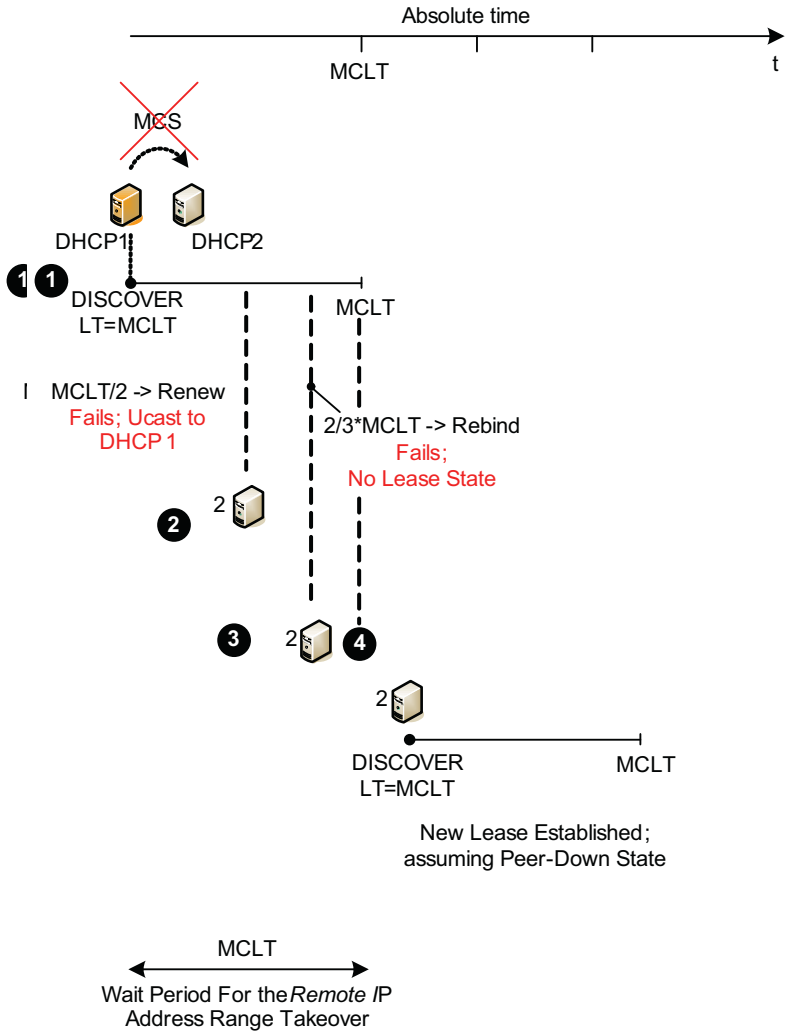


Figure 23: Address/Prefix Allocation without Synchronization

The sequence of events is the following:

1. 7x50 DHCP Server 1 is the local DHCP server (with the local address-range/prefix) that creates the IP lease state for a new client. The initial lease-time assigned to the client is MCLT which is normally shorter than the requested lease time.
   This 7x50 DHCP server fails before it gets a chance to synchronize the lease state with the 7x50 DHCP Server 2 (remote 7x50 DHCP server with the remote address-range/prefix).
2. The remote 7x50 DHCP server transitions into the PARTNER-DOWN state (assuming that the partner-down timer is 0). In this state the remote 7x50 DHCP server can extend the lease time to the existing clients but it can NOT assign a new lease for a period of MCLT. In MCLT/2 a new RENEW request is sent directly to the local 7x50 DHCP server. This server is DOWN and therefore it cannot reply.
3. The client broadcasts a REBIND request that reaches the remote 7x50 DHCP server. The remote 7x50 DHCP server has no knowledge of the requested lease and therefore it does not reply.
4. The lease for the client will expire and the client will have to reinitiate the IP address/prefix assignment process.

Since the remote 7x50 DHCP server is not aware of the lease state that was assigned by the local 7x50 DHCP server, there is a chance that the remote 7x50 DHCP server assigns to the new client the same IP address/prefix already allocated by the local 7x50 DHCP server just before it crashed. This is why the remote 7x50 DHCP server needs to wait for the MCLT time to expire so that the IP addresses/prefixes allocated (but never synchronized) by the local 7x50 DHCP server can time out.

When the communication channel between the chassis is interrupted, two scenarios are possible:

1. The entire node becomes unavailable. In this case the redundant node takes over and it starts reducing the lease time until the lease time reaches MCLT.
   - → COMMUNICATION-INTERUPTED
     The remote 7x50 DHCP server only renews the leases but does not delegate new ones (primary is DOWN).

     The local 7x50 DHCP server renews the leases (which eventually trickle down to MCLT) and delegates the new ones with the lease time of MCLT (secondary is down).
   - → PARTNER-DOWN
     The remote 7x50 DHCP server starts delegating new IP addresses/prefixes from the remote address-range/prefix after MCLT (primary is down). The lease time of the new clients is MCLT. A lease cannot be assigned for a period longer than what is agreed with the peer incremented with the MCLT. As for a “new” lease nothing is agreed yet so the sum falls back to the MCLT itself.

2. The communication channel is down but the remote 7x50 DHCP server is not (meaning that the clients have still access to both servers). The behavior in this case is following:

   → COMMUNNICATION-INTERUPTED
   The remote 7x50 DHCP server keeps renewing existing leases but it does not delegate the new leases. The chances that this will happen are low as the clients will keep sending RENEWS via unicast to the local 7x50 DHCP server which is still active. The non-synched leases in the remote 7x50 DHCP server will time out. The local 7x50 DHCP server will start trickling down the lease time to MCLT.

   The local 7x50 DHCP server will keep delegating the new leases, although with the MCLT lease time.

   → PARTNER-DOWN State
   The local 7x50 DHCP server will keep extending the existing leases but it will also start delegating new IP leases once the initial MCLT elapses.

   Note that both local and remote 7x50 DHCP server will delegate new leases in PARTNER-DOWN state (although the remote 7x50 DHCP server in PARTNER-DOWN state will have to wait an additional MCLT period before it can start delegating new leases).

Sharing IPv4 Address-Range or IPv6 Prefix Between Redundant 7x50 DHCP Servers in Access-Driven Mode

Access-driven DHCP server redundancy model will ensure uninterrupted IP address assignment service from a single IP address-range/prefix in case that an access link forwards BNG fails. To avoid duplicate address allocation, there MUST be a single active path available from the clients to only one of the 7x50 DHCP servers in redundant configuration. This single active path is ensured via a protection mechanism in dual-homed environment in the access side of the network. The supported protection mechanisms in the access in 7x50 are SRRP or MC-LAG.

In access-driven DHCP redundancy model, the DHCP relay in each 7x50 node must point only to the IP address of the local DHCP server. In other words, the DHCP messages received on one DHCP server should never be relayed to the other. Since the IP address-ranges/prefixes are shared between the DHCP servers, accessing both DHCP servers with the same DHCP request can cause DHCP lease duplication. Moreover, the IP addresses of both DHCP servers must be the same in both nodes. Otherwise the DHCP renew process would fail.

Granting new leases out of the shared IP address-ranges or prefixes that are configured as access-driven is not dependent on the state of the inter-chassis communication link (MCS). Instead, the new leases can be granted from both nodes simultaneously and it is the role of the protection mechanism in the access to ensure that a single path to either server is always active.

This model will allow the newly active node, after a SRRP/MC-LAG switchover, to be able to serve new clients immediately from the same (shared) IP range or prefix. At the same time, upon the switchover, the corresponding subscriber-interface route is re-evaluated for advertisement with

a higher routing metric to the network side via SRRP awareness. The end result is that by aligning the subscriber-interface routes or prefixes with access-driven DHCP address ranges or prefixes in DHCP server, the IP address ranges or prefixes will be advertised to the network side only from the actively serving node (SRRP Master or active MC-LAG node). This will be performed indirectly via the corresponding subscriber-interface route that is aligned (by configuration) with the DHCP address range or prefix in access-driven mode.

In case that SRRP or MC-LAG is not deployed in conjunction with the access-driven configuration option, the IP address duplication could occur.

Note that Multi-chassis redundancy relies on MCS to synchronize various client applications. (subscriber states, DHCP states, IGMP states, etc) between the two chassis. Therefore the links over which MCS peering session is established must be highly redundant. Failed MCS peering session will render dual-chassis redundancy non-operational. Considering this fact, the DHCP failover scenario with SRRP/MC-LAG and shared IP address range should be evaluated considering the following cases:

Table 9: DHCP Failover Scenarios

Access Related Failure	Inter-Chassis Link State	Number of Failures	Action
None	None	None	Only the MASTER SRRP BNG will grant IP leases. The subnet tied to the SRRP instance is advertised to the network side on the MASTER SRRP node.
None	COMM-INT	Possibly multiple	Only the MASTER SRRP BNG will grant IP leases. Communication link between the two chassis has failed and the DHCP states cannot be synchronized. Operator is required to restore the links between the chassis.
None	PARTNER-DOWN	Possibly multiple	Same as above. The premise of this deployment model in general (SRRP/MC-LAG + access-driven) is that there is only one path leading to the DHCP server active. This path is governed by SRRP. Therefore there is no change in behavior between the PARTNER-DOWN and COMM-INT states in this particular scenario.

Table 9: DHCP Failover Scenarios (Continued)

Access Related Failure	Inter-Chassis Link State	Number of Failures	Action
Access Link Towards the Master SRRP	NORMAL	Single	SRRP will switch over. The new IP lease grants will continue from new SRRP Master using the same IP address range. IP leases will be synched OK. Subnets will be advertised from new Master via SRRP awareness.
Access Link Towards the Master SRRP	COMM-INT	Multiple	SRRP will switch over. The new leases can be handed from the DHCP server on the newly SRRP Master node. However, this DHCP server may not have its lease state table up to date since the inter-chassis communication link is non-operational. Consequently, new SRRP Master node may start handing out leases that are already allocated on the node with the failed link. In this case, IP address duplication would ensue. This is why it of utmost importance that the intercommunication chassis link is well protected and the only event that causes it to go down is when the entire node goes down. Otherwise the nodes becomes isolated from each other and synchronization becomes non-operational.
Access Link Towards the Master SRRP	PARTNER-DOWN	Multiple	Same as above.
Access Link Towards the Standby SRRP	NORMAL	Single	No effect on the operation since everything is active on the Master SRRP node anyway.
Access Link Towards the Standby SRRP	COMM-INT	Multiple	Intercommunication link is broken. The Master SRRP node will continue handing out the new leases and renewing the old ones. However, they will not be synchronized to the peering node.
Access Link Towards the Standby SRRP	PARTNER-DOWN	Multiple	Same as above.

Table 9: DHCP Failover Scenarios (Continued)

Access Related Failure	Inter-Chassis Link State	Number of Failures	Action
Entire Master Node	COMM-INT	Single	SRRP will switch over. However, lease duplication may occur on the newly Master since the intercommunication link is broken and this newly SRRP Master is not aware of DHCP leases that the peer (failed node) may have allocated to the clients while the intercommunication-link was broken.
Entire Master Node	PARTNER-DOWN	Single	Same as above.
Entire Standby Node	COMM-INT	Single	Operation continues OK but multi-chassis redundancy is lost.
Entire Standby Node	PARTNER-DOWN	Single	Same as above.

A possible deployment scenario is shown in Figure 24.

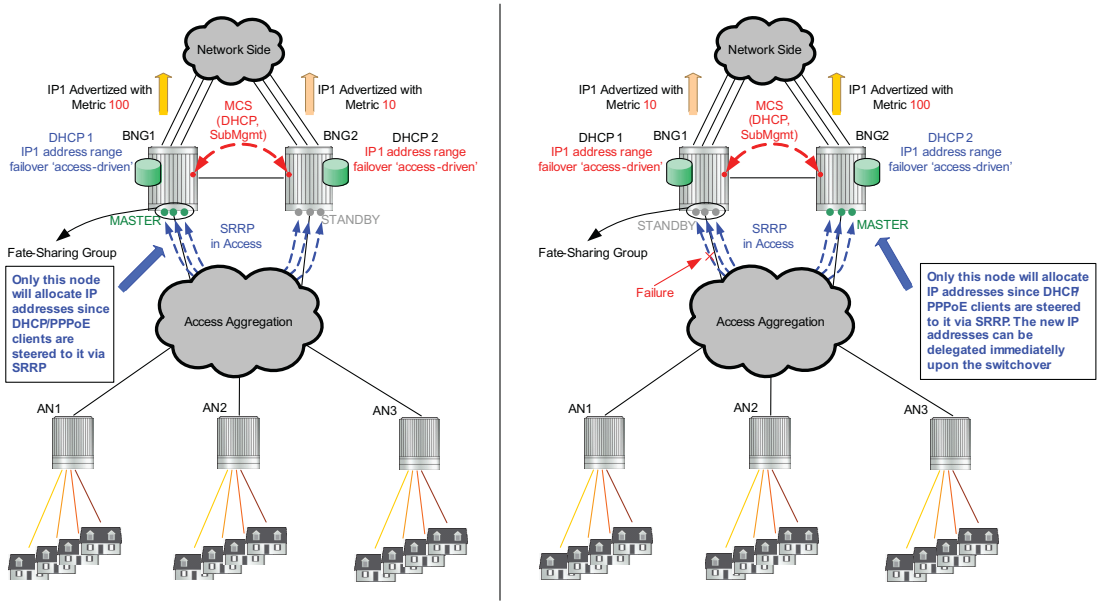


Figure 24: Failover Scenario with SRRP and DHCP in Access-Driven Mode

Fast-Switchover of IP Address/Prefix Delegation For Remote IP Address/ Prefix Range

Some deployments require that the remote IP address/prefix range starts delegating new IP addresses/prefixes upon the failure of the intercommunication link, without waiting for the intercommunication link to transition from the COMM-INT state into the PARTNER-DOWN state and the MCLT to expire while in PARTNER-DOWN state.

In other words, the takeover of the remote IP address-range/prefix should follow the failure of the intercommunication link, without any significant delays.

This can be achieved by configuring both of the following two items under the dhcp failover CLI hierarchy:

- The partner-down-delay must be set to 0. This will cause the intercommunication link to bypass the COMM-INT state upon the failure and transition straight into the PARTNER-DOWN state. The remote IP address-range/prefix can be taken over only in PARTNER-DOWN state, once the MCLT expires.
- The ignore-mclt-on-takeover flag must be enabled. With this flag enabled, remote IP address/prefix can be taken over immediately upon entering the PARTNER-DOWN state of the intercommunication link, without having to wait for the MCLT to expire. Note that by setting this flag, the lease times of the existing DHCP clients, while the intercommunication link is in the PARTNER-DOWN state, will still be reduced to the MCLT over time and all new lease times will be set to MCLT ? this behavior remain the same as originally intended for MCLT. this functionality must be exercised with caution. One needs to keep in mind that the partner-down-delay and MCLT timers were originally introduced to prevent IP address duplication in cases where DHCP redundant nodes transition out-of-sync due to the failure of intercommunication link. These timers (partner-down-delay and MCLT) would ensure that during their duration, the new IP addresses/ prefixes are delegated only from one node – the one with local IP address-range/prefix. The drawback is of course that the new IP address delegation is delayed and thus service is impacted.

But if one could ensure that the intercommunication link is always available, then the DHCP nodes would stay in sync and the two timers would not be needed. This is why it is of utmost importance that in this mode of operation, the intercommunication link is well protected by providing multiple paths between the two DHCP nodes. The only event that should cause intercommunication link to fail is the entire nodal failure. This failure is acceptable since in this case only one DHCP node is available to provide new IP addresses/prefixes.

DHCP Server Synchronization and Local PPPoX Pools

Since there is no classical DHCP lease state maintained for local PPPoX pools, the IP addresses will not be synchronized via DHCP Server. Instead they will be synchronized via PPPoX clients. Once the PPPoX subscriber is synchronized, the respective IP address lease will be updated in the respective local pool.

For example:

- A PPPoE client is created on 7x50 ‘A’.
- The IP address is assigned from the local poll on 7x50 ‘A’.
- The PPPoE client will be synchronized to the peering node 7x50 ‘B’.
- Once the client is synchronized in 7x50 ‘B’, the IP address assignment will be synchronized by our internal PPPoE process on 7x50 ‘B’ with the local pool.

One artifact of this behavior (IP address assignment in local DHCP pools is synchronized via PPPoX clients and not via DHCP server synchronization mechanism) is that during the node boot, the DHCP server must wait for the completion of PPPoX subscriber synchronization via MCS so that it learns which addresses/prefixes are already allocated on the peering node. Since the DHCP server can theoretically start assigning IP addresses before the PPPoX sync is completed, a duplicate address assignment my occur. For example an IP address lease can be granted via DHCP local pools while PPPoX sync is still in progress. Once the PPPoX sync is completed, the DHCP server may discover that the granted IP lease has already been allocated by the peering node. The most recent lease will be kept and the other will be removed from both systems. To prevent this scenario, a configurable timer can be set to an arbitrary value that will render sub-if non-operational until the timer expires. The purpose of this timer is to allow the PPPoX sync to complete before subscribers under the sub-intf can be served.

Local address assignment

Stateless Address Auto-configuration

In the stateless auto-configuration model, hosts can be assigned address statically or dynamically. For static prefix assignment, LUDB and Radius can be used. For dynamic assignment, a pool name returned from LUDB or Radius and the local DHCPv6 server is used for address management. Although, the DHCPv6 server is used there are no lease time associated with the SLAAC prefix assigned to hosts. To utilize the local pool for SLAAC prefix assignment, the command **local-address-assignment** is used under group-interface. The client-application type **ppp-slaac** and/or **ipoe-slaac** must first be specified. Afterwards, the server name of the local-address-server must also be provisioned.

Configuring DHCP with CLI

This section provides information to configure DHCP using the command line interface.

Common Configuration Tasks

Topics in this section are:

Enabling DHCP Snooping

DHCP snooping is the process of copying DHCP packets and using the contained information for internal purposes.The BSA and BSR can use the snooped DHCP information to build anti-spoofing filters, populate the ARP table, send ARP replies, etc.

For VPLS, DHCP snooping must be explicitly enabled (using the **snoop** command) on the SAP or SDP where DHCP messages ingress the VPLS instance. It is recommended to enable snooping on both the interface to the DHCP server (to snoop ACK messages) and the interface to the subscriber (to snoop RELEASE messages).

For IES and VPRN IP interfaces, lease-populate enables DHCP snooping for the subnets defined under the IP interface. The number of allowed simultaneous DHCP sessions on a SAP or interface can be limited using the lease-populate command with the parameter number-of-entries specified. Enabling lease-populate and snoop commands is effectively enabling “standard subscriber management” as described in Standard and Enhanced Subscriber Management on page 973.

The following output displays an example of a partial BSA configuration with DHCP snooping enabled in a service:

```
*A:ALA-48>config>service# info
----------------------------------------------
...
        vpls 600 customer 701 create
            sap 1/1/4:100 split-horizon-group "DSL-group2" create
                description "SAP towards subscriber"
                dhcp
                    lease-populate 1
                    option
                        action replace
                        circuit-id
                        no remote-id
                    exit
                    no shutdown
                exit
            exit
            mesh-sdp 2:800 create
                dhcp
                    snoop
                exit
            exit
            no shutdown
        exit
...
----------------------------------------------
*A:ALA-48>config>service#
```

Configuring Option 82 Handling

Option 82, or “Relay Information Option” is a field in DHCP messages used to identify the subscriber. The Option 82 field can already be filled in when a DHCP message is received at the router, or it can be empty. If the field is empty, the router should add identifying information (circuit ID, remote ID or both). If the field is not empty, the router can decide to replace it.

The following example displays an example of a partial BSA configuration with Option 82 adding on a VPLS service. Note that snooping must be enabled explicitly on a SAP.

```
A:ALA-1>config>service>vpls#
-----------------------------------------------
            no shutdown
            description "Default tls description for service id 1"
            sap 1/1/11 split-horizon-group "2dslam" create
                dhcp
                    no description
                    snoop
                    no lease-populate
                    option
                        action replace
                        circuit-id ascii-tuple
                        no remote-id
                    exit
                    no shutdown
                exit
            exit
-----------------------------------------------
A:ALA-1>config>service>vpls#
```

Enabling DHCP Relay

Note that lease populate and DHCP relay are different features in which are not both required to be enabled at the same time. DHCP relay can be performed without populating lease tables.

The following example displays DHCP relay configured on an IES interface:

```
A:ALA-48>config>service>ies>if# info
----------------------------------------------
                address 10.10.42.41/24
                local-proxy-arp
                proxy-arp
                    policy-statement "ProxyARP"
                exit
                sap 1/1/7:0 create
                    anti-spoof ip
                exit
                arp-populate
                dhcp
                    description "relay_ISP1"
                    server 10.200.10.10 10.200.10.20
                    lease-populate 1
                    no shutdown
                exit
----------------------------------------------
A:ALA-48>config>service>ies>if#
```

Configuring Local User Database Parameters

A local user data base defines a collection of hosts. There are 2 types of hosts: PPPoE and DHCP. A local user database can be used for the following:

- Perform authentication for PPPoE clients. For this only the hosts declared under PPPoE are used.
- Perform authentication and address management for the local DHCP server. For this both PPPoE and DHCP sections can be used depending on the client type indicated by a vendor-specific suboption inside Option 82 of the DHCP message.

Each host can be identified by a set of values. However, at any point in time only four of these values are taken into account for DHCP as defined by the **dhcp match-list** option and only three are considered for PPPoE as defined in the **pppoe match-list** option.

When trying to find a matching host, attempts are made to match as many items as possible. If several hosts match an incoming DHCP packet, the one with most match criteria is taken.

One host entry can map on several physical clients. For instance, when using a circuit ID, by masking when the interface-id is used, the host-entry is used for all the clients on that same interface.

DHCP host identification, called from the local DHCP server, includes:

- Circuit ID from OPTION 82. Note that for this field there is the possibility to mask the circuit ID (the **mask** command) before looking for the host.
- MAC address
- Remote ID from Option 82
- Option 60 from DHCP message, note that only first 32 bytes are looked at
- SAP ID from vendor-specific suboption of Option 82
- Service ID from vendor-specific suboption of Option 82
- String from vendor-specific suboption of Option 82
- System ID from vendor-specific suboption of Option 82

PPPOE host identification, called from the local DHCP server or from PPPoE host identification includes:

- Circuit ID
- MAC address
- Remote id
- User name, either complete user name, domain part only, or host part only

When a host cannot be inserted in the lookup database, it will be placed in an unmatched-hosts list. This can occur due to:

- Another host with the same host-identification exists. Note that only the host-identification that is specified in the match-list is taken into account for this.
- A host has no host-identification specified in the match-list.

When used for PPPOE-authentication, the fields are used as follows:

- password — Verifies the PPPoE user password. This is mandatory. If no password is required then it must be explicitly set to **ignore**.
- address:
  - → no address — No address information. The address must be obtained by other means, either radius or DHCP-server.
  - → gi-address — No meaning in this context. The address must be obtained by other means, either RADIUS or DHCP-server.
  - → use-pool-from-client — No meaning in this context, address must be obtained by other means, either RADIUS or DHCP-server.
  - → pool-name — The address must be obtained by other means, either RADIUS or a DHCP-server. When a DHCP server is used, this pool-name will be included in Option 82 vendor-specific suboption.
  - → ip-address — This ip-address will be offered to the client.
- Identification-strings — Returns the strings used for enhanced subscriber management (ESM).
- Options — Only DNS servers and NBNS server are used, others are ignored.

When used from DHCP-server following applies:

- password — not used.
- address — Defines how the address should be allocated for this host.
  - → no address — The host is not allowed. The clients mapping to this host will not get an IP address.
  - → gi-address — Finds the matching subnet and an IP address is taken from that subnet.
  - → pool-name — A free IP address is taken from that pool.
  - → ip-address — This ip-address will be offered to the client.
  - → use-pool-from-client — Use the poolname in the Option 82 vendor-specific suboption. If no poolname is provided there, falls back to the DHCP server default (none or use-gi-address).
- identification-strings — The operator can specify subscriber management strings and in which option the strings are sent back in dhcp-offer and dhcp-ack messages.
- options — The operator defines which options specific to this host should be sent back in the dhcp-offer and dhcp-ack messages. Note that the options defined here override options defined on the pool-level and subnet-level inside the local DHCP server.

The circuit ID from PPPoE or from Option 82 in DHCP messages can be masked in following ways:

- prefix-length — Drop a fixed number of bytes at the beginning of the circuit-id.
- suffix-length— Drop a fixed number of bytes at the end of the circuit-id.
- prefix-string — The matching string will be dropped from the beginning of the circuit-id. The matching string can contain wildcards (*). For example: incoming circuit-id "mybox|3|my_interface|1/1/1:22" masked with "*|*|" will leave "my_interface|1/1/1:22".
- suffix-string — The matching string will be dropped at the end of the circuit-id. For example: incoming circuit-id "mybox|3|my_interface|1/1/1:22" masked with "|*" will result in "mybox|3|my_interface".

The following is an example of a local user database used for PPPoE authentication:

```
*A:ALA-48>config>subscr-mgmt# info
----------------------------------------------
...
        local-user-db "pppoe user db"
            description "pppoe authentication data base"
            ppp
                match-list username circuit-id
                mask prefix-string "*|*|" suffix-string "|*"
                host "john" create
                    host-identification
                        username "john" no-domain
                    exit
                    password pap "23T8yPoe0w1R.BPGHB98i0qhJf7ZlZGCtXBKGnjrIrA" hash2
                    no shutdown
                exit
                host "test.com" create
                    host-identification
                        username "test.com" domain-only
                    exit
                    password ignore
                    no shutdown
                exit
                host "john@test.com" create
                    host-identification
                        username "john@test.com"
                    exit
                    password pap "23T8yPoe0w0Tlf1yCb4hskknvTYLqA2avvBB567g3eQ" hash2
                    identification-strings 122 create
                        subscriber-id "john@test.com"
                        sla-profile-string "sla prof1"
                        sub-profile-string "subscr profile 1"
                        ancp-string "ancp string"
                        inter-dest-id "inter dest"
                    exit
                    no shutdown
                exit
                host "john@test.com on interface group-if"
                    host-identification
                        circuit-id string "group-if"
                        username "john@test.com"
                    exit
                    password pap "23T8yPoe0w1R.BPGHB98i0qhJf7ZlZGCtXBKGnjrIrA" hash2
                    address 10.1.2.3
```

```
                    no shutdown
                exit
            exit
            no shutdown
        exit
...
-------------------------------------------
*A:ALA-48>config>subscr-mgmt#
```

The following are some examples when a user tries to set up PPPoE:

- john@test.com tries to setup PPPoE with circuit-id "`pe_23|3|group-if|1/1/1`": host "`john@test.com on interface group-if`" will match, the PAP password is checked and the IP address 10.1.2.3 is given to PPPoE to use for this host.
- john@test.com (on another interface): host "`john@test.com`" will match, the PAP password is checked, and identification strings are returned to PPPoE.
- alcatel@test.com: host "`test.com`" will match, no password check, the user is allowed.
- john@alcatel.com: host "`john`" will match and the password will be checked.
- anybody@anydomain: will not match and will not be allowed.

The following is an example of a local user database used for DHCP server for DHCP clients:

```
*A:ALA-50>config>subscr-mgmt# info
-------------------------------------------
...
        local-user-db "dhcp server user db"
            description "dhcp server user data base"
            dhcp
                match-list circuit-id mac
                mask prefix-string "*|*|" suffix-string "|*"
                host "mac 3 on interface" create
                    host-identification
                        circuit-id string "group-if"
                        mac 00:00:00:00:00:03
                    exit
                    address 10.0.0.1
                    no shutdown
                exit
                host "maskedCircId" create
                    host-identification
                        circuit-id string "group-if"
                    exit
                    address pool "pool 1"
                    identification-strings 122 create
                        subscriber-id "subscriber 1234"
                        sla-profile-string "sla prof 1"
                        sub-profile-string "sub prof 1"
                        ancp-string "ancpstring"
                        inter-dest-id "inter dest id 123"
                    exit
                    options
                        netbios-name-server 1.2.3.4
                        lease-time min 2
                    exit
```

```
                    no shutdown
                exit
            exit
            no shutdown
        exit
...
-------------------------------------------
*A:ALA-50>config>subscr-mgmt#
```

The following is an access example:

- MAC 00:00:00:00:00:03 on circuit-id "pe5|3|group-if|1/1/1": host "mac 3 on interface" is matched and address 10.0.0.1 is offered to the DHCP client.
- Another MAC on circuit-id "pe5|3|group-if|2/2/2": host "maskedCircId" is matched and an address is taken from "pool1" (defined in the DHCP server). The identification-strings will be copied to Option 122 in the dhcp-offer and dhcp-ack messages. The options defined here will also be copied into dhcp-offer and dhcp-ack messages.
- The circuit-id "pe5|3|other_group_if|1/1/3": no host is matched. The client will only get an IP address if on DHCP server level you defined the *use-gi-address* parameter and the gi-address matches a subnet.
-

The following is an example of a local user database used for a DHCP server, only for PPPoE clients:

If PPPoE does not get an IP address from RADIUS or the local-user-db used for authentication, the internal dhcp-client will be used to access a DHCP server which can be in the same node or in another node. These request are identified by inserting Option 82 suboption client-id in the dhcp-discover and dhcp-request messages. When the DHCP server receives this request and has a user-db connected to it, then the PPPoE section of that user-db is accessed.

```
*A:ALA-60>config>subscr-mgmt# info
-----------------------------------------------
...
        local-user-db "pppoe user db"
            description "pppoe authentication data base"
            ppp
                match-list username
                host "internet.be" create
                    host-identification
                        username "internet.com" domain-only
                    exit
                    address "pool_1"
                    no shutdown
                exit
                host "john@internet.com" create
                    host-identification
                        username "john@internet.com"
                    exit
                    identification-strings 122 create
                        subscriber-id "john@test.com"
                        sla-profile-string "sla prof1"
                        sub-profile-string "subscr profile 1"
```

```
                        ancp-string "ancp string"
                        inter-dest-id "inter dest"
                    exit
                    address use-gi
                    no shutdown
                exit
                host "malicious@internet.com"
                    host-identification
                        circuit-id string "group-if"
                        username "internet@test.com"
                    exit
                    no shutdown
                 exit
            exit
            no shutdown
        exit
...
-------------------------------------------
*A:ALA-60>config>subscr-mgmt#
```

The following is an access example:

- john@internet.com: GI is used to find a subnet and a free address will be allocated form that subnet. Identification strings are returned in Option 122.
- anybody@internet.com: pool_1 will be used to find a free IP address.
- malicious@internet.com: no address is defined. This user will not get an IP address.

The following is an example of associating a local user database to PPPoE for authentication

```
A:pe5>config>service>vprn#
-------------------------------------------
            subscriber-interface "tomylinux" create
               address 10.2.2.2/16
               group-interface "grp_pppoe3" create
                   pppoe
                       e "pppoe"
                   exit
               exit
-------------------------------------------
A:pe5>config>service>vprn#
```

The following is an example of associating a local user database to a local DHCP server.

```
A:pe7>config>router>dhcp#
-------------------------------------------
                local-dhcp-server my_server
                    description "my dhcp server"
                    user-db "data base 1"
                        ...
                exit
-------------------------------------------
A:pe7>config>router>dhcp#
```

In PPPoE access scenario's without access node or with access nodes that do not insert PPPoE vendor specific tags "Circuit-ID" and/or "Remote-ID", it may be required to configure this

information in the local user database so that they can be picked up in pre-authentication phase and used for RADIUS authentication and reporting in RADIUS accounting messages. For example:

```
>config>subscr-mgmt

        local-user-db "ludb-1" create
            ppp
                match-list username
                host "host-1" create
                    access-loop-information
                        circuit-id string "LUDB inserted circuit-id"
                        remote-id string "LUDB inserted remote-id"
                    exit
                    host-identification
                        username "cpe-1@domain1.com"
                    exit
                    auth-policy "auth-policy-1"
                    password ignore
                    no shutdown
                exit
            exit
```

Triple Play DHCP Command Reference

Configuration Commands

Global DHCP Commands

config
— **system**
— **dhcp6**
— **adv-noaddrs-global** [**esm-proxy**] [**esm-relay**] [**relay**] [**server**]
— **no adv-noaddrs-global**

Router DHCP Commands

config
— **router**
— **dhcp**
— **dhcp6**
— **local-dhcp-server** *server-name* [**create**]
— **no local-dhcp-server** *server-name*
— **description** *description-string*
— **no description**
— **failover**
— [**no**] **ignore-mclt-on-takeover**
— **maximum-client-lead-time** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
— **no maximum-client-lead-time**
— **partner-down-delay** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
— **no partner-down-delay**
— **peer** *ip-address* **tag** *sync-tag*
— **no peer**
— [**no**] **shutdown**
— [**no**] **startup-wait-time** [**min** *minutes*] [**sec** *seconds*] [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]

- [**no**] **force-renews**
- [**no**] **ignore-rapid-commit**
- [**no**] **interface-id-mapping**
- **lease-hold-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
- **no lease-hold-time**
- [**no**] **lease-hold-time-for**
  - [**no**] **internal-lease-ipsec**
  - [**no**] **solicited-release**
- **pool** *pool-name* [**create**]
- **no pool** *pool-name*
  - **delegated-prefix-length** *bits*
  - **no delegated-prefix-length**
  - **description** *description-string*
  - **no description**
  - [**no**] **exclude-prefix** *ipv6-prefix/prefix-length*
  - **failover**
    - [**no**] **ignore-mclt-on-takeover**
    - **maximum-client-lead-time** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
    - **no maximum-client-lead-time**
    - **partner-down-delay** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
    - **no partner-down-delay**
    - **peer** *ip-address* **tag** *sync-tag*
    - **no peer**
    - [**no**] **shutdown**
    - [**no**] **startup-wait-time** [**min** *minutes*] [**sec** *seconds*] [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
  - **max-lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
  - **no max-lease-time**
  - **min-lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
  - **no min-lease-time**
  - **minimum-free** *minimum-free* [**percent**] [**event-when-depleted**]
  - **no minimum-free**
  - **offer-time** [**min** *minutes*] [**sec** *seconds*]
  - **no offer-time**
  - **options**
    - **custom-option** *option-number* **address** [*ip-address*...(up to 4 max)]
    - **custom-option** *option-number* **hex** *hex-string*
    - **custom-option** *option-number* **string** *ascii-string*
    - **no custom-option** *option-number*
    - **dns-server** [*ip-address*...(up to 4 max)]
    - **domain-name** *domain-name*
    - **no domain-name**
    - **lease-rebind-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
    - **no lease-rebind-time**
    - **lease-renew-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
    - **no lease-renew-time**
    - **lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
    - **no lease-time**

- **netbios-name-server ip-address** [*ip-address*...(up to 4 max)]
- **no netbios-name-server**
- **netbios-node-type** *netbios-node-type*
- **no netbios-node-type**

- [**no**] **nak-non-matching-subnet**
- **prefix** *ipv6-addr/prefix-len* [**failover** {**local** | **remote**}] [**pd**] [**wan-host**] [**create**]
- **no prefix** *ipv6-addr/prefix-len*
  - **thresholds**
    -
- **thresholds**
  - [**no**] **minimum-free prefix-length** [1..128]
    - [**no**] **depleted-event**
    - **minimum percent** [0..100]
    - **no minimum**
- **subnet** {*ip-address*/*mask*|*ip-address netmask*} [**create**]
- **no subnet** {*ip-address*/*mask*|*ip-address netmask*}
  - [**no**] **address-range** *start-ip-address end-ip-address*
  - [**no**] **drain**
  - [**no**] **exclude-addresses** *start-ip-address* [*end-ip-address*]
  - **maximum-declined** *maximum-declined*
  - **no maximum-declined**
  - **minimum-free** *minimum-free* [**percent**] [**event-when-depleted**]
  - **no minimum-free**
  - **options**
    - **custom-option** *option-number* **address** [*ip-address*...(upto 4 max)]
    - **custom-option** *option-number* **hex** *hex-string*
    - **custom-option** *option-number* **string** *ascii-string*
    - **no custom-option** *option-number*
    - **default-router** *ip-address* [*ip-address*...(up to 4 max)]
    - **no default-router**
    - **subnet-mask** *ip-address*
    - **no subnet-mask**
  - **subnet-binding key** [**sys-id-svc-id** | **sys-id** | **string**] **unbind-delay** [**hrs** *hours*] [**min** *mins*] [**sec** *secs*]
  - **no subnet-binding key**
- **use-gi-address** [**scope** *scope*]
- **no use-gi-address**
- **use-pool-from-client delimiter** *delimiter*
- **use-pool-from-client**
- **no use-pool-from-client**
- **use-link-address** [**scope** *scope*]
- **no use-link-address**
- **user-db** *local-user-db-name*
- **no user-db**
- **user-ident** *user-ident*
- **no user-ident**

VPLS DHCP Commands

```
config
    — service
        — [no] vpls service-id [customer customer-id] [vpn vpn-id] [m-vpls]
            — sap sap-id [split-horizon-group group-name] [capture-sap]
                — dhcp
                    — description description-string
                    — no description
                    — lease-populate [nbr-of-entries]
                    — no lease-populate
                    — [no] option
                        — action {dhcp-action}
                        — no action
                        — [no] circuit-id [ascii-tuple | vlan-ascii-tuple]
                        — remote-id [mac | string string]
                        — no remote-id
                        — [no] vendor-specific-option
                            — [no] client-mac-address
                            — [no] sap-id
                            — [no] service-id
                            — string text
                            — no string
                            — [no] system-id
                    — proxy-server
                        — emulated-server
                        — lease-time
                        — [no] shutdown
                    — [no] shutdown
                    — [no] snoop
                — dhcp-user-db local-user-db-name
                — no dhcp-user-db
                — dhcp-python-policy policy-name
                — no dhcp-python-policy
                — dhcp6-user-db local-user-db-name
                — no dhcp6-user-db
                — dhcp6
                    — description description-string
                    — no description
                    — [no] option
                        — interface-id
                        — interface-id ascii-tuple
                        — interface-id vlan-ascii-tuple
                        — no interface-id
                        — remote-id
                        — remote-id mac
                        — remote-id string [32 chars max]
                        — no remote-id
                    — [no] shutdown
                    — [no] snoop
                — dhcp-python-policy policy-name
                — no dhcp-python-policy
                — dhcp6-user-db local-user-db-name
                — no dhcp6-user-db
                — ipoe-session
                    — description description-string
                    — no description
```

```
                    — ipoe-session-policy policy-name
                    — no ipoe-session-policy
                    — [no] shutdown
                    — user-db local-user-db-name
                    — no user-db
— mesh-sdp sdp-id[:vc-id] [vc-type {ether | vlan}]
        — dhcp
                    — description description-string
                    — no description
                    — [no] snoop
— ppp-user-db local-user-db-name
— no ppp-user-db
— pppoe-user-db local-user-db-name
— no pppoe-user-db
— spoke-sdp sdp-id[:vc-id] [vc-type {ether | vlan}] [split-horizon-group group-
  name]
        — dhcp
                    — description description-string
                    — no description
                    — [no] snoop
```

IES DHCP Commands

```
config
    — service
        — ies service-id [customer customer-id] [vpn vpn-id]
            — [no] interface ip-int-name
                — dhcp
                    — description description-string
                    — no description
                    — gi-address ip-address [src-ip-addr]
                    — no gi-address
                    — lease-populate nbr-of-leases
                    — no lease-populate
                    — [no] option
                        — action {replace | drop | keep}
                        — no action
                        — circuit-id [ascii-tuple | ifindex | sap-id |vlan-ascii-tuple]
                        — no circuit-id
                        — remote-id [mac | string string]
                        — no remote-id
                        — [no] vendor-specific-option
                            — [no] client-mac-address
                            — [no] pool-name
                            — [no] sap-id
                            — [no] service-id
                            — string text
                            — no string
                            — [no] system-id
                    — proxy-server
                        — emulated-server ip-address
                        — no emulated-server
                        — lease-time [days days] [hrs hours] [min minutes] [sec seconds] [override]
                        — no lease-time
                        — [no] shutdown
                    — [no] relay-plain-bootp
                    — relay-unicast-msg [release-update-src-ip]
                    — no relay-unicast-msg
                    — python-policy policy-name
                    — no python-policy
                    — server server1 [server2...(up to 8 max)]
                    — no server
                    — [no] shutdown
                    — [no] trusted
                — [no] ipv6
                    — address ipv6-address/prefix-length [eui-64]
                    — no address ipv6-address/prefix-length
                    — [no] dhcp6-relay
                        — description description-string
                        — no description
                        — lease-populate [nbr-of-leases]
                        — lease-populate [nbr-of-leases] route-populate [pd] na [ta]
                        — lease-populate [nbr-of-leases] route-populate pd [na] [ta] [exclude]
```

```
                    — lease-populate [nbr-of-leases] route-populate [pd] [na] ta
                    — no lease-populate
                    — [no] neighbor-resolution
                    — [no] option
                        — interface-id
                        — interface-id ascii-tuple
                        — interface-id ifindex
                        — interface-id sap-id
                        — no interface-id
                        — [no] remote-id
                    — server ipv6z-address [ipv6z-address...(up to 8 max)]
                    — no server [ipv6z-address...(up to 8 max)]
                    — description description-string
                    — no description
                    — source-address ipv6-address
                    — no source-address
                — [no] dhcp6-server
                    — max-nbr-of-leases max-nbr-of-leases
                    — no max-nbr-of-leases
                    — [no] prefix-delegation
                        — [no] prefix ipv6-address/prefix-length
                            — duid duid [iaid iaid]
                            — no duid
                            — preferred-lifetime seconds
                            — preferred-lifetime infinite
                            — no preferred-lifetime
                            — valid-lifetime seconds
                            — valid-lifetime infinite
                            — no valid-lifetime
                        — [no] shutdown
                — icmp6
                    — packet-too-big [number seconds]
                    — no packet-too-big
                    — param-problem [number seconds]
                    — no param-problem
                    — redirects [number seconds]
                    — no redirects
                    — time-exceeded [number seconds]
                    — no time-exceeded
                    — unreachables [number seconds]
                    — no unreachables
                — [no] local-proxy-nd
                — neighbor ipv6-address mac-address
                — no neighbor ipv6-address
                — proxy-nd-policy policy-name [policy-name..(up to 5 max)]
                — no proxy-nd-policy
    — [no] subscriber-interface ip-int-name
        — dhcp
            — gi-address ip-address [src-ip-addr]
            — no gi-address
            — relay-unicast-msg [release-update-src-ip]
            — no relay-unicast-msg
            — [no] virtual-subnet
        — [no] group-interface ip-int-name
```

- dhcp
  - client-applications {[dhcp] [pppoe]}
  - no client-applications
  - description *description-string*
  - no description
  - gi-address *ip-address* [*src-ip-addr*]
  - no gi-address
  - gi-address [*nbr-of-leases*]
  - lease-populate [*nbr-of-leases*] l2-header [mac *ieee-address*]
  - no lease-populate
  - [no] match-circuit-id
  - [no] option
    - action {replace | drop | keep}
    - no action
    - circuit-id [ascii-tuple | ifindex | sap-id | vlan-ascii-tuple]
    - no circuit-id
    - remote-id [mac | string *string*]
    - no remote-id
    - [no] vendor-specific-option
      - [no] client-mac-address
      - [no] pool-name
      - [no] sap-id
      - [no] service-id
      - string *text*
      - no string
      - [no] system-id
  - relay-unicast-msg [*release-update-src-ip*]
  - no relay-unicast-msg
  - server *server1* [*server2*...(up to 8 max)]
  - no server
  - [no] shutdown
  - [no] trusted
- [no] pppoe
  - anti-spoof *pppoe-anti-spoofing-type*
  - no anti-spoof
  - description *description-string*
  - no description
  - dhcp-client
    - [no] ccag-use-origin-sap
  - policy *ppp-policy-name*
  - no policy
  - sap-session-limit *sap-session-limit*
  - no sap-session-limit
  - session-limit *session-limit*
  - no session-limit
  - [no] shutdown
  - user-db *local-user-db-name*
  - no user-db

VPRN DHCP Commands

```
config
    — service
        — vprn
            — dhcp
            — dhcp6
                — local-dhcp-server-server server-name [create]
                — no local-dhcp-server server-name
                    — failover
                        — [no] ignore-mclt-on-takeover
                        — maximum-client-lead-time [hrs hours] [min minutes] [sec seconds]
                        — no maximum-client-lead-time
                        — partner-down-delay [hrs hours] [min minutes] [sec seconds]
                        — no partner-down-delay
                        — peer ip-address tag sync-tag
                        — no peer
                        — [no] shutdown
                        — [no] startup-wait-time [min minutes] [sec seconds] [days days] [hrs hours] [min minutes] [sec seconds]
                    — lease-hold-time [days days] [hrs hours] [min minutes] [sec seconds]
                    — no lease-hold-time
                    — [no] lease-hold-time-for
                        — [no] internal-lease-ipsec
                        — [no] solicited-release
                    — pool pool-name [create]
                    — no pool pool-name
                        — failover
                            — [no] ignore-mclt-on-takeover
                            — maximum-client-lead-time [hrs hours] [min minutes] [sec seconds]
                            — no maximum-client-lead-time
                            — partner-down-delay [hrs hours] [min minutes] [sec seconds]
                            — no partner-down-delay
                            — peer ip-address tag sync-tag
                            — no peer
                            — [no] shutdown
                            — [no] startup-wait-time [min minutes] [sec seconds] [days days] [hrs hours] [min minutes] [sec seconds]
                        — prefix ipv6-addr/prefix-len [failover {local | remote}] [pd] [wan-host] [create]
                        — no prefix ipv6-addr/prefix-len
                            — thresholds
                                — [no] minimum-free prefix-length [1..128]
                                — [no depleted-event
                                — minimum [percent [0..100]] [number [0..4294967295]]
                                — no minimum
            — [no] interface ip-int-name
                — dhcp
```

- **description** *description-string*
- **no description**
- **gi-address** *ip-address* [*src-ip-addr*]
- **no gi-address**
- **lease-populate** [*nbr-of-leases*]
- **no lease-populate**
- [**no**] **option**
    - **action** {**replace** | **drop** | **keep**}
    - **no action**
    - **circuit-id** [**ascii-tuple** | **ifindex** | **sap-id** |**vlan-ascii-tup**]
    - **no circuit-id**
    - **remote-id** [**mac** | **string** *string*]
    - **no remote-id**
    - [**no**] **vendor-specific-option**
        - [**no**] **client-mac-address**
        - [**no**] **pool-name**
        - [**no**] **sap-id**
        - [**no**] **service-id**
        - **string** ***text***
        - **no string**
        - [**no**] **system-id**
- [**no**] **nak-non-matching-subnet**
- **python-policy** *policy-name*
- **no python-policy**
- **proxy-server**
    - **emulated-server** *ip-address*
    - **no emulated-server**
    - **lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] [**override**]
    - **no lease-time**
    - [**no**] **shutdown**
- [**no**] **relay-plain-bootp**
- **relay-unicast-msg** [*release-update-src-ip*]
- **no relay-unicast-msg**
- **server** *server1* [*server2...*(up to 8 max)]
- **no server**
- [**no**] **shutdown**
- [**no**] **trusted**
- [**no**] **use-arp**
- **user-ident** *user-ident*
- **no user-ident**

VPRN DHCP Subscriber Interface Commands

```
config
    — service
        — vprn
            — subscriber-interface ip-int-name [fwd-service service-id fwd-subscriber-interface
              ip-int-name] [create]
            — no subscriber-interface ip-int-name
                — dhcp
                    — client-applications dhcp
                    — client-applications pppoe
                    — client-applications dhcp pppoe
                    — no client-applications
                    — description description-string
                    — no description
                    — gi-address ip-address [src-ip-addr]
                    — no gi-address
                    — lease-populate nbr-of-leases
                    — no lease-populate
                    — [no] option
                        — [no] vendor-specific-option
                            — [no] client-mac-address
                            — [no] sap-id
                            — [no] service-id
                            — string text
                            — no string
                            — [no] system-id
                    — proxy-server
                        — emulated-server ip-address
                        — no emulated-server
                        — lease-time [days days] [hrs hours] [min minutes] [sec
                          seconds] [override]
                        — no lease-time
                        — [no] shutdown
                    — relay-unicast-msg [release-update-src-ip]
                    — no relay-unicast-msg
                    — server server1 [server2...(up to 8 max)]
                    — no server
                    — [no] shutdown
                    — [no] virtual-subnet
                — [no] group-interface ip-int-name
                    — [no] arp-populate
                    — arp-timeout seconds
                    — no arp-timeout
                    — authentication-policy name
                    — no authentication-policy
                    — description description-string
                    — no description
                    — dhcp
                        — description description-string
                        — no description
                        — gi-address ip-address [src-ip-addr]
                        — no gi-address
                        — lease-populate [nbr-of-leases] l2-header [mac ieee-
                          address]
```

- **no lease-populate**
- [**no**] **match-circuit-id**
- [**no**] **option**
  - **action** {**replace** | **drop** | **keep**}
  - **no action**
  - **circuit-id** [**ascii-tuple**|**ifindex**|**sap-id**|**vlan-ascii-tupl**]
  - **no circuit-id**
  - **remote-id** [**mac** | **string** *string*]
  - **no remote-id**
  - [**no**] **vendor-specific-option**
    - [**no**] **client-mac-address**
    - [**no**] **sap-id**
    - [**no**] **service-id**
    - **string** *text*
    - **no string**
    - [**no**] **system-id**
- **proxy-server**
  - **emulated-server** *ip-address*
  - **no emulated-server**
  - **lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] [**override**]
  - **no lease-time**
  - [**no**] **shutdown**
- **relay-unicast-msg** [*release-update-src-ip*]
- **no relay-unicast-msg**
- **server** *server1* [*server2*...(up to 8 max)]
- **no server**
- [**no**] **shutdown**
- [**no**] **trusted**

IES/VPRN IPv6-DHCP6 Commands

```
configure
    — service
        — ies service-id/vprn service-id
            — subscriber-interface
                — group-interface
                    — ipv6
                        — [no] allow-multiple-wan-addresses
                        — dhcp6
                            — [no] option
                                — interface-id [ascii-tuple]
                                — interface-id ifindex
                                — interface-id sap-id
                                — interface-id string string
                                — no interface-id
                                — [no] remote-id
                            — [no] override-slaac
                            — [no] pd-managed-route
                            — [no] proxy-server
                                — client-applications {[dhcp] [ppp]}
                                — no client-applications
                                — preferred-lifetime [days days] [hrs hours] [min minutes] [sec seconds]
                                — preferred-lifetime infinite
                                — no preferred-lifetime
                                — rebind-timer [days days] [hrs hours] [min minutes] [sec seconds]
                                — no rebind-timer
                                — renew-timer [days days] [hrs hours] [min minutes] [sec seconds]
                                — no renew-timer
                                — server-id duid-en hex hex-string
                                — server-id duid-en string ascii-string
                                — server-id duid-ll
                                — no server-id
                                — no shutdown
                                — valid-lifetime [days days] [hrs hours] [min minutes] [sec seconds]
                                — valid-lifetime infinite
                                — no valid-lifetime
                            — python-policy name
                            — no python-policy
                            — [no] relay
                                — client-applications [dhcp] [ppp]
                                — no client-applications
                                — description description-string
                                — no description
                                — link-address ipv6-address
                                — no link-address
                                — [no] server [ipv6z-address...(upto 8 max)]
                                — no server
                                — [no] shutdown
                                — source-address ipv6-address
```

```
                — no source-address
              — user-db local-user-db-name
              — no user-db
        — [no] ipoe-bridged-mode
        — [no] qos-route-lookup
        — [no] router-advertisements
            — current-hop-limit limit
            — no current-hop-limit
            — [no] dns-options
                — [no] include-dns
                — rdnss-lifetime seconds
                — rdnss-lifetime infinite
                — no rdnss-lifetime
            — force-mcast [ip] [mac]
            — no force-mcast
            — [no] managed-configuration
            — max-advertisement seconds
            — no max-advertisement
            — min-advertisement seconds
            — no min-advertisement
            — mtu bytes
            — no mtu
            — [no] other-stateful-configuration
            — [no] prefix-options
                — [no] autonomous
                — [no] on-link
                — preferred-lifetime seconds
                — preferred-lifetime infinite
                — no preferred-lifetime
                —
            — reachable-time milli-seconds
            — no reachable-time
            — retransmit-time milli-seconds
            — no retransmit-time
            — router-lifetime seconds
            — router-lifetime no-default-router
            — no router-lifetime
            — [no] shutdown
        — router-solicit
            — inactivity-timer [days days] [hrs hours] [min
            minutes] [sec seconds]
            — inactivity-timer infinite
            — no inactivity-timer
            — min-auth-interval [days days] [hrs hours] [min
            minutes] [sec seconds]
            — no min-auth-interval
            — [no] shutdown
            — user-db local-user-db-name
            — no user-db
        — [no] urpf-check
            — mode {strict|loose|strict-no-ecmp}
```

Local User Database Commands

IPoE Commands

```
config
    — subscriber-mgmt
        — local-user-db local-user-db-name [create]
        — no local-user-db local-user-db-name
            — description description-string
            — no description
            — ipoe
                — host host-name [create]
                — no host host-name
                    — acct-policy acct-policy-name [duplicate acct-policy-name]
                    — no acct-policy
                    — address gi-address [scope scope]
                    — address ip-address
                    — address pool pool-name [secondary-pool sec-pool-name]
                      [delimiter delimiter]
                    — address use-pool-from-client [delimiter delimiter]
                    — no address
                    — auth-domain-name domain-name
                    — no auth-domain-name
                    — auth-policy policy-name
                    — no auth-policy
                    — diameter-application-policy policy-name
                    — no diameter-application-policy
                    — diameter-auth-policy name
                    — no diameter-auth-policy
                    — gi-address ip-address
                    — no gi-address
                    — host-identification
                        — circuit-id string ascii-string
                        — circuit-id hex hex-string
                        — no circuit-id
                        — derived-id derived-id-string
                        — no derived-id
                        — encap-tag-range start-tag start-tag end-tag end-tag
                        — no encap-tag-range
                        — mac ieee-address
                        — no mac
                        — option60 hex-string
                        — no option60
                        — remote-id hex hex-string
                        — remote-id string ascii-string
                        — no remote-id
                        — sap-id sap-id
                        — no sap-id
                        — service-id service-id
                        — no service-id
                        — string string
```

- — **no string**
- — **system-id** *system-id*
- — **no system-id**

— **identification-strings** *option-number* [**create**]
— **no identification-strings**

- — **ancp-string** *ancp-string*
- — **no ancp-string**
- — **app-profile-string** *app-profile-string*
- — **no app-profile-string**
- — **category-map** *category-map-name*
- — **no category-map**
- — **inter-dest-id** *intermediate-destination-id*
- — **no inter-dest-id**
- — **sla-profile-string** *sla-profile-string*
- — **no sla-profile-string**
- — **sub-profile-string***sub-profile-string*
- — **no sub-profile-string**
- — **subscriber-id** *sub-ident-string*
- — **no subscriber-id**

— **ipv6-address** *ipv6-address*
— **no ipv6-address**
— **ipv6-delegated-prefix** *ipv6-prefix/prefix-length*
— **no ipv6-delegated-prefix**
— **ipv6-delegated-prefix-length** *bits*
— **no ipv6-delegated-prefix-length**
— **ipv6-delegated-prefix-pool** *pool-name*
— **no ipv6-delegated-prefix-pool**
— [**no**] **ipv6-lease-times**

- — **preferred-lifetime** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
- — **preferred-lifetime** *infinite*
- — **no preferred-lifetime**
- — **rebind-timer** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
- — **no rebind-timer**
- — **renew-timer** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
- — **no renew-timer**
- — **valid-lifetime** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
- — **valid-lifetime infinite**
- — **no valid-lifetime**

— **ipv6-slaac-prefix** *ipv6-prefix/prefix-length*
— **no ipv6-slaac-prefix**
— **ipv6-slaac-prefix-pool** *pool*
— **no ipv6-slaac-prefix-pool**
— **ipv6-wan-address-pool** *pool-name*
— **no ipv6-wan-address-pool**
— **link-address** *ipv6-address*
— **no link-address**
— **match-radius-proxy-cache**

- — **delete-hold-time** *seconds*
- — **no delete-hold-time**
- — **fail-action** {**continue**|**drop**}
- — **no fail-action**
- — **mac-format** *mac-format*
- — **no mac-format**

- **match** {**circuit-id**|**mac**|**remote-id**}
- **match option** [1..254] [**option6** [1..65535]]
- **match option6** [1..65535]
- **no match**
- **server** [service *service-id*] **name** *server-name*
- **no server**

— **msap-defaults**

- **group-interface** *ip-int-name* [**prefix** {*port-id*}]
- **group-interface** *ip-int-name* [**suffix** {*port-id*}]
- **no group-interface**
- **policy** *msap-policy-name*
- **no policy**
- **service** *service-id*
- **no service**

— **options**

- **custom-option** *option-number* **address** [*ip-address*...(up to 4 max)]
- **custom-option** *option-number* **hex** *hex-string*
- **custom-option** *option-number* **string** *ascii-string*
- **no custom-option** *option-number*
  - **default-router** *ip-address* [*ip-address*...(up to 4 max)]
  - **no default-router**
- **dns-server address** [*ip-address*...(upto 4 max)]
- **no dns-server**
- **domain-name** *domain-name*
- **no domain-name**
- **lease-rebind-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
- **no lease-rebind-time**
- **lease-renew-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
- **no lease-renew-time**
- **lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
- **no lease-time**
- **netbios-name-server ip-address** [*ip-address*...(up to 4 max)]
- **no netbios-name-server**
- **netbios-node-type** *netbios-node-type*
- **no netbios-node-type**
- **subnet-mask** *ip-address*
- **no subnet-mask**

— **options6**

- **dns-server** *ipv6-address* [*ipv6-address*...(upto 4 max)]
- **no dns-server**

— **to-client-options**

- **dhcpv4**
  - **option** *option-number* **address** *ipv4-address* [*ipv4-address*...(upto 4 max)]
  - **option** *option-number* **hex** *hex-string*
  - **option** *option-number* **string** ascii-string
  - **no option** *option-number*
- **dhcpv6**

— **option** *option-number* **address** *ipv6-address* [*ipv6-address*...(upto 4 max)]
— **option** *option-number* **hex** *hex-string*
— **option** *option-number* **string** ascii-string
— **no option** *option-number*
— **ipv4**
— **option** *option-number* **address** [*ip-address*...(up to 4 max)]
— **option** *option-number* **hex** *hex-string*
— **option** *option-number* **string** *ascii-string*
— **no option** *option-number*
— **ipv6**
— **option** *option-number* **address** [*ip-address*...(up to 4 max)]
— **option** *option-number* **hex** *hex-string*
— **option** *option-number* **string** *ascii-string*
— **no option** *option-number*
— **retail-service-id** *service-id*
— **no retail-service-id**
— **server** *ip-address*
— **no server**
— **server6** *ipv6-address*
— **no server6**
— [**no**] **shutdown**
— **mask type** *ipoe-match-type* {[**prefix-string** *prefix-string* | **prefix-length** *prefix-length*] [**suffix-string** *suffix-string* | **suffix-length** *suffix-length*]}
— **no mask type** *ipoe-match-type*
— **match-list** *ipoe-match-type-1* [*ipoe-match-type-2*...(up to 4 max)]
— **no match-list**

PPP Commands

```
config
    — subscriber-mgmt
        — local-user-db local-user-db-name [create]
        — no local-user-db local-user-db-name
            — description description-string
            — no description
            — ppp
                — host host-name [create]
                — no host host-name
                    — [no] access-loop-encapsulation
                        — encap-offset [type type]
                        — no encap-offset
                        — rate-down rate
                        — no rate-down
                    — access-loop-information
                        — circuit-id sap-id
                        — circuit-id ASCII string
                        — no circuit-id
                        — remote-id mac
                        — remote-id ASCII string
                        — no remote-id
                    — acct-policy acct-policy-name [duplicate acct-policy-name]
                    — no acct-policy
                    — address gi-address [scope scope]
                    — address ip-address[/prefix-length]
                    — address pool pool-name [secondary-pool sec-pool-name]
                      [delimiter delimiter]
                    — address use-pool-from-client [delimiter delimiter]
                    — no address
                    — auth-policy policy-name
                    — no auth-policy
                    — diameter-application-policy policy-name
                    — no diameter-application-policy
                    — diameter-auth-policy name
                    — no diameter-auth-policy
                    — [no] force-ipv6cp
                    — host-identification
                        — circuit-id string ascii-string
                        — circuit-id hex hex-string
                        — no circuit-id
                        — encap-tag-range start-tag start-tag end-tag end-tag
                        — no encap-tag-range
                        — mac ieee-address
                        — no mac
                        — remote-id hex hex-string
                        — remote-id string ascii-string
                        — no remote-id
                        — sap-id sap-id
                        — no sap-id
                        — service-name service-name
                        — no service-name
                        — username user-name
                        — username user-name [no-domain]
```

- **username** *user-name* **domain-only**
- **no username**

- **identification-strings** *option-number* [**create**]
- **no identification-strings**
  - **ancp-string** *ancp-string*
  - **no ancp-string**
  - **app-profile-string** *app-profile-string*
  - **no app-profile-string**
  - **category-map** *category-map-name*
  - **no category-map**
  - **inter-dest-id** *intermediate-destination-id*
  - **no inter-dest-id**
  - **sla-profile-string** *sla-profile-string*
  - **no sla-profile-string**
  - **sub-profile-string** *sub-profile-string*
  - **no sub-profile-string**
  - **subscriber-id** *sub-ident-string*
  - **no subscriber-id**
- **interface** *ip-int-name* **service-id** *service-id*
- **no interface**
- **ipv6-address** *ipv6-address*
- **no ipv6-address**
- **ipv6-delegated-prefix** *ipv6-prefix/prefix-length*
- **no ipv6-delegated-prefix**
- **ipv6-delegated-prefix-length** *bits*
- **no ipv6-delegated-prefix-length**
- **ipv6-delegated-prefix-pool** *pool-name*
- **no ipv6-delegated-prefix-pool**
- [**no**] **ipv6-lease-times**
  - **preferred-lifetime** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
  - **preferred-lifetime** *infinite*
  - **no preferred-lifetime**
  - **rebind-timer** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
  - **no rebind-timer**
  - **renew-timer** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
  - **no renew-timer**
  - **valid-lifetime** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
  - **valid-lifetime infinite**
  - **no valid-lifetime**
- **ipv6-slaac-prefix** *ipv6-prefix/prefix-length*
- **no ipv6-slaac-prefix**
- **ipv6-slaac-prefix-pool** *pool*
- **no ipv6-slaac-prefix-pool**
- **ipv6-wan-address-pool** *pool-name*
- **no ipv6-wan-address-pool**
- **l2tp**
  - **group** *tunnel-group-name* [**service-id** *service-id*]
  - **no group**
- **msap-defaults**
  - **group-interface** *ip-int-name* [**prefix** {*port-id*}]
  - **group-interface** *ip-int-name* [**suffix** {*port-id*}]
  - **no group-interface**
  - **policy** *msap-policy-name*

- **no policy**
- **service** *service-id*
- **no service**

- **options**
  - **custom-option** *option-number* **address** [*ip-address*...(up to 4 max)]
  - **custom-option** *option-number* **hex** *hex-string*
  - **custom-option** *option-number* **string** *ascii-string*
  - **no custom-option** *option-number*
  - **dns-server address** [*ip-address*...(upto 4 max)]
  - **no dns-server**
  - **netbios-name-server ip-address** [*ip-address*...(up to 4 max)]
  - **no netbios-name-server**
- **options6**
  - **dns-server** *ipv6-address* [*ipv6-address*...(upto 4 max)]
  - **no dns-server**
- **pado-delay** *deci-seconds*
- **no pado-delay**
- **password ignore**
- **password** {**chap** *password* |**pap** *password*} [**hash**|**hash2**]
- **no password**
- **pre-auth-policy** *policy-name*
- **no pre-auth-policy**
- **to-client-options**
  - **ipv4**
    - **option** *option-number* **address** [*ip-address*...(up to 4 max)]
    - **option** *option-number* **hex** *hex-string*
    - **option** *option-number* **string** *ascii-string*
    - **no option** *option-number*
  - **ipv6**
    - **option** *option-number* **address** [*ip-address*...(up to 4 max)]
    - **option** *option-number* **hex** *hex-string*
    - **option** *option-number* **string** *ascii-string*
    - **no option** *option-number*
- **retail-service-id** *service-id*
- **no retail-service-id**
- [**no**] **shutdown**

Show Commands

```
show
    — router
        — dhcp
            — lease-state [sap sap-id]
            — servers
            — statistics [interface ip-int-name | ip-address]
            — summary
            — local-dhcp-server server-name
                — associations
                — declined-addresses ip-address[/mask] [detail]
                — declined-addresses pool pool-name
                — free-addresses ip-address[/mask]
                — free-addresses summary [subnet ip-address[/mask]
                — free-addresses pool pool-name
                — leases ip-address[/mask] address-from-user-db [detail]
                — leases ip-address[/mask] dhcp-host dhcp-host-name [detail]
                — leases ip-address[/mask] ppp-host ppp-host-name [detail]
                — leases ip-address[/mask] [detail]
                — pool-ext-stats [pool-name]
                — server-stats
                — subnet-ext-stats ip-address[/mask]
                — subnet-ext-stats pool pool-name
                — subnet-stats ip-address[/mask]
                — subnet-stats pool pool-name
                — summary
            — servers
    — router
        — dhcp6
            — local-dhcp-server server-name
                — associations
                — interface-id-mapping
                — leases [ipv6-address/prefix-length] [type] [state] [detail]
                — pool-ext-stats [pool-name]
                — prefix-ext-stats ipv6-address/prefix-length
                — prefix-ext-stats pool pool-name
                — pool-threshold-stats [pool-name] detail [format {exact|scientific}]
                — pool-threshold-stats [pool-name]
                — prefix-threshold-stats pool pool-name detail [format {exact|scientific}]
                — prefix-threshold-stats pool pool-name
                — prefix-threshold-stats ipv6-address/prefix-length detail [format
                  {exact|scientific}]
                — prefix-threshold-stats ipv6-address/prefix-length
                — server-stats
                — summary
            — statistics
            — summary

show
    — service
        — id service-id
            — dhcp
                — lease-state [wholesaler service-id] [sap sap-id | sdp sdp-id:vc-id | inter-
                  face interface-name | ip-address ip-address[/mask] | chaddr ieee-address
```

| **mac** *ieee-address* | {[**port** *port-id*] [**no-inter-dest-id** | **inter-dest-id** *inter-dest-id*]}] [**detail**]
— **statistics** [**sap** *sap-id*] | [**sdp** [*sdp-id*[:*vc-id*]] | **interface** *ip-int-name*]]
— **summary**
— **virtual-subnet subscriber** *sub-ident*
— **virtual-subnet** [**sap** *sap-id*]
— **dhcp6**
— **lease-state** [**detail**]
— **lease-state** [**detail**] **interface *interface-name***
— **lease-state** [**detail**] **ipv6-address** *ipv6-prefix*[/*prefix-length*]
— **lease-state** [**detail**] **mac** *ieee-address*
— **statistics** [**interface** *ip-int-name*]
— **summary**

show
— **system**
— **dhcp6**

Tools Commands

```
tools
    — subscriber-mgmt
        — remap-lease-state old-mac ieee-address mac ieee-address
        — remap-lease-state sap sap-id [mac ieee-address]
```

Clear Commands

```
clear
    — router
        — dhcp
            — lease-state [interface ip-int-name | ip-addr | ip-address ip-address | mac ieee-address]
            — local-dhcp-server server-name
                — declined-addresses ip-address[/mask]
                — declined-addresses pool pool-name
                — leases ip-address[/mask] [offered]
                — pool-ext-stats [pool-name]
                — server-stats
                — subnet-ext-stats ip-address[/mask]
                — subnet-ext-stats pool pool-name
            — statistics [ip-int-name | ip-address]
        — dhcp6
            — local-dhcp-server server-name
                — leases [ipv6-address/prefix-length] [type] [state]
                — leases all [type] [state]
                — pool-ext-stats [pool-name]
                — pool-threshold-stats [pool-name]
                — prefix-ext-stats ipv6-address/prefix-length
                — prefix-ext-stats pool pool-name
                — prefix-threshold-stats ipv6-address/prefix-length
                — prefix-threshold-stats pool pool-name
                — server-stats
            — statistics
    — service
        — id service-id
            — dhcp
                — lease-state [no-dhcp-release]
                — lease-state [port port-id] [inter-dest-id intermediate-destination-id] [no-dhcp-release]
                — lease-state [port port-id] no-inter-dest-id [no-dhcp-release]
                — lease-state ip-address ip-address [no-dhcp-release]
                — lease-state mac ieee-address no-dhcp-release
                — lease-state sap sap-id [no-dhcp-release]
                — lease-state sdp sdp-id:vc-id [no-dhcp-release]
                — statistics [sap sap-id | sdp [sdp-id[:vc-id] | interface ip-int-name | ip-address]
            — dhcp6
                — lease-state [ip-address ipv6-address/prefix-length] [mac ieee-address]
```

DHCP Debug Commands

```
debug
    — router
        — ip
            — [no] dhcp [ip-int-name]
                — detail-level {low | medium | high}
                — no detail-level
                — mode {dropped-only | ingr-and-dropped | egr-ingr-and-dropped}
                — no mode
            — dhcp6 [ip-int-name]
            — no dhcp6
        — [no] local-dhcp-server server-name [lease-address ip-address]
            — detail-level {low | medium | high}
            — no detail-level
            — mode {dropped-only | ingr-and-dropped | egr-ingr-and-dropped}
            — no mode
```

Tools Commands

```
tools
    — perform
        — subscriber-mgmt
            — edit-ppp-session sap sap-id ip ip-address [subscriber sub-ident-string] [sub-profile-string sub-profile-string] [sla-profile-string sla-profile-string] [inter-dest-id intermediate-destination-id] [ancp-string ancp-string] [app-profile-string app-profile-string] [user-name user-name]
            — eval-lease-state [svc-id service-id] [sap sap-id] [subscriber sub-ident-string] [ip ip-address]
            — local-user-db local-user-db-name
                — ppp
                    — authentication pppoe-user-name [password password]
                    — host-lookup[mac ieee-address] [remote-id remote-id] [user-name user-name] [circuit-id circuit-id | circuit-id-hex circuit-id-hex]
                — dhcp
                    — host-lookup [mac ieee-address] [remote-id remote-id] [sap-id sap-id] [service-id service-id] [string vso-string] [system-id system-id] [option60 hex-string] [circuit-id circuit-id | circuit-id-hex circuit-id-hex]
```

Triple Play DHCP Configuration Commands

Note: For the 7450 ESS configurations, the DHCP6 and IPv6 ESM commands apply only when in mixed-mode.

Global Commands

shutdown

Syntax [**no**] **shutdown**

Context config>service>ies>if>dhcp
config>service>vpls>sap>dhcp
config>service>vpls>sap>dhcp6
config>service>vpls>sap>dhcp>option>vendor
config>service>vpls>sap>ipoe-session
config>service>vprn>if>dhcp
config>service>vprn>if>dhcp>proxy-server
config>subscr-mgmt>loc-user-db
config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>dhcp>host>options
config>subscr-mgmt>loc-user-db>ppp>host
config>router>dhcp6>server>failover
config>router>dhcp>server>failover

Description This command administratively disables an entity. When disabled, an entity does not change, reset, or remove any configuration settings or statistics.

The operational state of the entity is disabled as well as the operational state of any entities contained within. Many objects must be shut down before they may be deleted.

The **no** form of this command places the entity into an administratively enabled state.

description

Syntax **description** *description-string*
no description

Context config>service>vpls>sap>dhcp
config>service>vpls>sap>dhcp6
config>service>vpls>sap>ipoe-session
config>service>ies>if>dhcp
config>service>ies>if>ipv6>dhcp6-relay
config>service>vprn>if>dhcp
config>router>dhcp>server
config>router>dhcp>server>pool
config>subscr-mgmt>loc-user-db
config>service>vprn>sub-if>ipv6>dhcp6>relay

config>service>ies>sub-if>ipv6>dhcp6>relay

Description This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the content in the configuration file.

The **no** form of this command removes the string from the configuration.

Default No description associated with the configuration context.

Parameters *description-string* — The description character string. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

System Commands

adv-noaddrs-global

Syntax **adv-noaddrs-global** [**esm-proxy**] [**esm-relay**] [**relay**] [**server**]
no adv-noaddrs-global

Context config>system>dhcp6

Description This command configures the different DHCPv6 applications to send the NoAddrsAvail Status-Code in DHCPv6 Advertise messages at the global DHCP message level.

By default, all applications send the NoAddrsAvail Status-Code in DHCPv6 Advertise messages at the IA_NA Option level.

Default no adv-noaddrs-global. All applications send the NoAddrsAvail Status-Code in DHCPv6 Advertise messages at the IA_NA Option level.

Parameters Different applications for which NoAddrsAvail Status-Code in DHCPv6 Advertise messages can be configured at the global DHCP message level.

The only valid combination in current SROS is “adv-noaddrs-global esm-relay server”.

esm-proxy — Specifies the DHCPv6 proxy server on subscriber group-interfaces. Not supported in current SR OS.

esm-relay — Specifies the DHCPv6 relay on subscriber group-interfaces. Must be enabled together with the DHCPv6 server (server) application.

relay — Specifies the DHCPv6 relay on regular IES/VPRN interfaces. Not supported in current SR OS.

server — Specifies the DHCPv6 server. Must be enabled together with the DHCPv6 relay on subscriber interfaces (esm-relay) application.

DHCP Configuration Commands

local-dhcp-server

Syntax **local-dhcp-server** *server-name* [**create**]
no local-dhcp-server *server-name*

Context config>router>dhcp
config>service>vprn>dhcp

Description This command instantiates a local DHCP server. A local DHCP server can serve multiple interfaces but is limited to the routing context it was which it was created.

Default none

Parameters *server-name* — Specifies the name of local DHCP server.

delegated-prefix-length

Syntax **delegated-prefix-length** *bits*
delegated-prefix-length variable
no delegated-prefix-length

Context configure>router>local-dhcp-server>pool

Description This command configures the subscriber-interface level setting for delegated prefix length. The delegated prefix length for a subscriber- interface can be either set to a fixed value that is explicitly configured under the subscriber-interface CLI hierarchy or a variable value that can be obtained from various sources. This command can be changed only when no IPv6 prefixes are configured under the subscriber-interface.

Default no delegated-prefix-length This means that the delegated prefix length is 64.

Parameters *bits* — The delegated prefix length in bits. This value will beapplicable to the entire subscriber-interface. In case that the delegated prefix length is also supplied via other means (LUDB, RADIUS or DHCP Server), such supplied value must match the value configured under the subscriber-interface. Otherwise the prefix instantiation in 7x50 will fail.

Values 48 — 64

variable — The delegated prefix value can be of any length between 48..64. The value itself can vary between the prefixes and it will be provided at the time of prefix instantiation. The order of priority for the source of the delegated prefix length is:

- LUDB
- RADIUS
- DHCPv6 server

failover

Syntax **failover**

Context config>router>dhcp>server
config>router>dhcp6>server

Description This command enables the context to configure failover parameters.

maximum-client-lead-time

Syntax **maximum-client-lead-time** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no maximum-client-lead-time

Context configure>router>dhcp>server>failover
configure>router>dhcp>server>pool>failover
configure>service>vprn>dhcp>server>failover
configure>service>vprn>dhcp>server>pool>failover
configure>router>dhcp6>server>failover
configure>router>dhcp6>server>pool>failover
configure>service>vprn>dhcp6>server>failover
configure>service>vprn>dhcp6>server>pool>failover

Context Maximum-client-lead-time (MCLT) is the maximum time that a DHCP server can extend client? lease time beyond the lease time currently known by the DHCP partner node. In dual-homed environment, the initial lease time for all DHCP clients is strictly restricted to MCLT. Consecutive DHCP renews are allowed to extend the lease time beyond the MCLT.

The MCLT is a safeguard against IP address/prefix duplication in cases of a lease synchronization failure.

Consider a case whereby the primary DHCP server assign a new lease to the client but it crashes before it sends a sync update to the partner (secondary DHCP server). Because of the primary DHCP server failure, the secondary server (whose partner-down-delay is set to 0) is not aware of the IP address/prefix that has been allocated on the primary server. This condition creates the possibility in which the secondary DHCP server allocates the same address/prefix to another client. This would cause IP address/prefix duplication. MCLT is put in place to prevent this scenario.

Lease synchronization failure can be caused either by a node failure, or a failure of the link over which the DHCP leases are synchronized (Multi-Chassis Synchronization (MCS link). Synchronization failure detection can take up to three seconds. Once the synchronization failure is detected, the minimum time required for a DHCP server to start delegating new addresses/prefixes from the prefix designated as remote is the sum of the maximum-client-lead-time and the partner-down-delay.

During the failed state (DHCP peer is unreachable), the DHCP lease time for the new clients will be restricted to MCLT while for the existing clients the lease time will over time (by consecutive DHCP renews) gradually be reduced to the MCLT.

Default 10 minutes

Parameters **hrs** *hours* — Specifies the maximum amount of time, in hours, that one server can extend a lease for a client's binding beyond the time known by the partner server.

Values 1 — 23

min *minutes* — Specifies the maximum amount of time, in minutes, that one server can extend a lease for a client's binding beyond the time known by the partner.

Values 1 — 59

sec *seconds* — Specifies the maximum amount of time, in seconds, that one server can extend a lease for a client's binding beyond the time known by the partner.

Values 1 — 59

partner-down-delay

Syntax **partner-down-delay** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no partner-down-delay

Context config>router>dhcp>server>failover
config>router>dhcp6>server>failover

Description Since the DHCP lease synchronization failure can be caused by the failure of the Multi-Chassis Synchronization (MCS) link (and not necessary the entire node), there is a possibility that both DHCP servers are operational during the failure. The purpose of the partner-down-delay is to allow the operator enough time to remedy the failed situation and to avoid duplication of IP addresses/prefixes during the failure. During the partner-down-delay time, the prefix designated as remote will be eligible only for renewals of the existing DHCP leases that have been synchronized by the peering node. Only after the sum of the partner-down-delay and the maximum-client-lead-time will the prefix designated as remote be eligible for assignment of the new DHCP leases.

Default 23 hours, 59minutes and 59 seconds

Parameters **hrs** *hours* — Specifies the partner-down delay time in hours.

Values 1 — 23

min *minutes* — Specifies the partner-down delay time in minutes.

Values 1 — 59

sec *seconds* — Specifies the partner-down delay time in seconds.

Values 1 — 59

peer

Syntax **peer** *ip-address* **tag** *sync-tag-name*
no peer *ip-address*

Context config>router>dhcp6>server>failover
config>router>dhcp>server>failover

Description DHCP leases are synchronized per DHCP server. The pair of synchronizing servers (peers) is identified by a tag. The synchronization information is carried over the Multi-Chassis Synchronization (MCS) link between the two peers. MCS link is a logical link (IP or MPLS).

MCS runs over TCP, port 45067 and it is using either data traffic or keepalives to detect failure on the communication link between the two nodes. In the absence of any MCS data traffic for more than

0.5sec, MCS will send its own keepalive to the peer. If a reply is NOT received within 3sec, MCS will declare its operation state as DOWN and the DB Sync state as out-of-sync. MCS will consequently notify its clients (DHCP Server being one of them) of this. It can take up to 3 seconds before the DHCP client realizes that the inter-chassis communication link has failed.

Note that the inter-chassis communication link failure does not necessarily assume the same failed fate for the access links.

Parameters *ip-address* — Specifies the IPv4 address of the peer.

sync-tag *sync-tag* **—** Specifies a synchronization tag to be used while synchronizing with the multi-chassis peer.

startup-wait-time

Syntax [**no**] **startup-wait-time** [**min** *minutes*] [**sec** *seconds*]

Context config>router>dhcp6>server>failover
config>router>dhcp>server>failover

Description This command enables startup-wait-time during which each peer waits after the initialization process before assuming the active role for the prefix designated as local. This is to avoid transient issues during the initialization process.

Default 2 minutes

Parameters **min** *minutes* **—** Specifies the time in minutes that one server attempts to contact the partner server. During this time, the server is unresponsive to DHCP client requests.

Values 1 — 10

sec *seconds* **—** Specifies the time in seconds that one server attempts to contact the partner server. During this time, the server is unresponsive to DHCP client requests.

Values 1 — 59

force-renews

Syntax [**no**] **force-renews**

Context config>router>dhcp>server

Description This command enables the sending of sending forcerenew messages.

The **no** form of the command disables the sending of forcerenew messages.

Default no force-renews

ignore-rapid-commit

Syntax [**no**] **ignore-rapid-commit**

Context config>router>dhcp6>server

Description This command enables the Rapid Commit Option.

The **no** form of the command disables the Rapid Commit Option.

interface-id-mapping

Syntax [**no**] **interface-id-mapping**

Context config>router>dhcp6>server

Description If enabled, this command enables the behavior where unique /64 prefix is allocated per interface-id, and all clients having the same interface-id get an address allocated out of this /64 prefix. This is relevant for bridged clients behind the same local-loop (and same SAP), where sharing the same prefix allows communication between bridged clients behind the same local-loop to stay local. For SLAAC based assignment, downstream neighbor-discovery is automatically enabled to resolve the assigned address.

Default no interface-id-mapping

lease-hold-time

Syntax **lease-hold-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no lease-hold-time

Context config>service>vprn>dhcp>server
config>router>dhcp>server
config>service>vprn>dhcp6>server
config>router>dhcp6>server

Description This command configures the time to remember this lease. This lease-hold-time is for unsolicited release conditions such as lease timeout and normal solicited release from DHCP client.

The no form of the command reverts to the default.

Default sec 0

Parameters [**days** *days*][**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] — Specifies the lease hold time.

Values

days:	[0..3650]
hours:	[0..23]
minutes:	[0..59]
seconds:	[0..59

lease-hold-time-for

Syntax [**no**] **lease-hold-time-for**

Context config>service>vprn>dhcp6>server
config>router>dhcp6>server
config>service>vprn>dhcp>server
config>router>dhcp>server

Description This command enables the context to configure **lease-hold-time-for** parameters which defines additional types of lease or triggers that cause system to hold up leases.

Use the **lease-hold-time** to enable or disable lease hold up on the server level.

Default lease-hold-time-for

internal-lease-ipsec

Syntax [**no**] **internal-lease-ipsec**

Context config>service>vprn>dhcp6>server>lease-hold-time-for
config>router>dhcp6>server> lease-hold-time-for
config>service>vprn>dhcp>server
config>router>dhcp>server

Description This command enables the server to hold up the lease of local IPSec clients.

The no form of the command disables the server to hold up the lease of local IPSec clients.

Default no internal-lease-ipsec

solicited-release

Syntax [**no**] **solicited-release**

Context config>service>vprn>dhcp6>server>lease-hold-time-for
config>router>dhcp6>server> lease-hold-time-for
config>service>vprn>dhcp>server
config>router>dhcp>server

Description This command enables server to hold up lease even in case of solicited release. For example, the server receives normal DHCP release message

Default no solicited-release

pool

Syntax **pool** *pool-name* [**create**]
no pool *pool-name*

Context config>router>dhcp>server

Description This command configures a DHCP address pool on the router.

Default none

Parameters *pool name* — Specifies the name of this IP address pool. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters.

exclude-prefix

Syntax [**no**] **exclude-prefix** *ipv6-prefix/prefix-length*

Context config>service>vprn>dhcp6>server>pool
config>router>dhcp6>server>pool

Description This command defines a prefix that to be excluded from available prefix in the pool. The typical use case is to exclude the interface address.

- A held lease will be deleted if it got excluded by an exclude prefix.
- An exclude range can never exclude only a part of an existing lease. If for example a /63 PD is assigned, an exclude of /64 which belongs to this /63 can NOT be configured.
- A single exclude prefix can never exclude a whole include prefix.
- When applying or removing an exclude prefix, the threshold stats are adjusted to reflect the actual address space and its usage.

Default none

Parameters *ipv6-prefix/prefix-length* — Specifies an IPv6 prefix and prefix length.

Values

ipv6-prefix	x:x:x:x:x:x:x:x	(eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d	
	x - [0..FFFF]H	
	d - [0..255]D	
prefix-length	- [0..128]	

failover

Syntax **failover**

Context config>router>dhcp>server
configure>service>vprn>dhcp>server

Description This command enables the context to configure failover paramters.

ignore-mclt-on-takeover

Syntax [**no**] **ignore-mclt-on-takeover**

Context configure>router>dhcp>server>failover
configure>router>dhcp>server>pool>failover
configure>router>dhcp6>server>failover
configure>router>dhcp6>server>pool>failover
configure>service>vprn>dhcp>server>failover
configure>service>vprn>dhcp>server>pool>failover
configure>service>vprn>dhcp6>server>failover
configure>service>vprn>dhcp6>server>pool>failover

Description With this flag enabled, the remote IP address/prefix can be taken over immediately upon entering the PARTNER-DOWN state of the intercommunication link, without having to wait for the MCLT to

expire. Note that by setting this flag, the lease times of the existing DHCP clients, while the intercommunication link is in the PARTNER-DOWN state, will still be reduced to the MCLT over time and all new lease times will be set to MCLT. This behavior remains the same as originally intended for MCLT.

Some deployments require that the remote IP address/prefix range starts delegating new IP addresses/prefixes upon the failure of the intercommunication link, without waiting for the intercommunication link to transition from the COMM-INT state into the PARTNER-DOWN state and the MCLT to expire while in PARTNER-DOWN state.

This can be achieved by enabling the **ignore-mclt-on-takeover** flag and by configuring the **partner-down-delay** to 0.

Enabling this functionality must be exercised with caution. One needs to keep in mind that the partner-down-delay and MCLT timers were originally introduced to prevent IP address duplication in cases where DHCP redundant nodes transition out-of-sync due to the failure of intercommunication link. These timers (**partner-down-delay** and MCLT) would ensure that during their duration, the new IP addresses/prefixes are delegated only from one node, the one with local IP address-range/prefix. The drawback is of course that the new IP address delegation is delayed and thus service is impacted.

But if one could ensure that the intercommunication link is always available, then the DHCP nodes would stay in sync and the two timers would not be needed. This is why it is of utmost importance that in this mode of operation, the intercommunication link is well protected by providing multiple paths between the two DHCP nodes. The only event that should cause intercommunication link to fail is the entire nodal failure. This failure is acceptable since in this case only one DHCP node is available to provide new IP addresses/prefixes.

Default no ignore-mclt-on-takeover

maximum-client-lead-time

Syntax **maximum-client-lead-time** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no maximum-client-lead-time

Context configure>router>dhcp>server>failover
configure>router>dhcp>server>pool>failover
configure>service>vprn>dhcp>server>failover
configure>service>vprn>dhcp>server>pool>failover
configure>router>dhcp6>server>failover
configure>router>dhcp6>server>pool>failover
configure>service>vprn>dhcp6>server>failover
configure>service>vprn>dhcp6>server>pool>failover

Description The **maximum-client-lead-time** (MCLT) is the maximum time that a DHCP server can extend client's lease time beyond the lease time currently known by the DHCP partner node. In dual-homed environment, the initial lease time for all DHCP clients is by default restricted to MCLT. Consecutive DHCP renews are allowed to extend the lease time beyond the MCLT.

The MCLT is a safeguard against IP address/prefix duplication in cases of a lease synchronization failure when local-remote failover model is deployed

Once the intercommunication link failure between the redundant DHCP servers is detected, the DHCP IP address range configured as remote will not be allowed to start delegating new leases until the MCLT + partner-down-delay intervals expire. This is to ensure that the new lease that was delegated from the 'local' IP address-range/prefix on one node, but was never synchronized due to

the intercommunication link failure, will expire before the same IP address/prefix is allocated from the remote IP address-range/prefix on the other node.

However, the already existing (and synchronized) lease times can be renewed from the remote IP address range at any time, regardless of the state of the intercommunication link (operational or failed).

Lease synchronization failure can be caused either by a node failure, or a failure of the link over which the DHCP leases are synchronized (intercommunication link). Synchronization failure detection can take up to 3 seconds.

During the failure, the DHCP lease time for the new clients will be restricted to MCLT while for the existing clients the lease time will over time (by consecutive DHCP renews) be gradually reduced to the MCLT.

Default 10 minutes

Parameters **hrs** *hours* — Specifies the maximum client lead time in hours.

Values 1 — 23

min *minutes* — Configure the maximum client lead time in minutes.

Values 1 — 59

sec *seconds* — Configure the maximum client lead time in seconds.

Values 1 — 59

partner-down-delay

Syntax **partner-down-delay** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no partner-down-delay

Context configure>router>dhcp>server>failover
configure>router>dhcp>server>pool>failover
configure>service>vprn>dhcp>server>failover
configure>service>vprn>dhcp>server>pool>failover
configure>router>dhcp6>server>failover
configure>router>dhcp6>server>pool>failover
configure>service>vprn>dhcp6>server>failover
configure>service>vprn>dhcp6>server>pool>failover

Description Since the DHCP lease synchronization failure can be caused by the failure of the intercommunication link (and not necessary the entire node), there is a possibility the redundant DHCP servers become isolated in the network. In other words, they can serve DHCP clients but they cannot synchronize the lease. This can lead to duplicate assignment of IP addresses, since the servers have configured overlapping IP address ranges but they are not aware of each other's leases.

The purpose of the partner-down-delay is to prevent the IP lease duplication during the intercommunication link failure by not allowing new IP addresses to be assigned from the remote IP address range. This timer is intended to provide the operator with enough time to remedy the failed situation and to avoid duplication of IP addresses/prefixes during the failure.

During the partner-down-delay time, the prefix designated as remote will be eligible only for renewals of the existing DHCP leases that have been synchronized by the peering node. Only after the sum of the partner-down-delay and the maximum-client-lead-time will the prefix designated as

remote be eligible for delegation of the new DHCP leases. When this occurs, we say that the remote IP address range has been taken over.

It is possible to expedite the takeover of a remote IP address range so that the new IP leases can start being delegated from that range shortly after the intercommunication failure is detected. This can be achieved by configuring the partner-down-delay timer to 0 seconds, along with enabling the ignore-mclt-on-takeover CLI flag. Caution must be taken before enabling this functionality. It is safe to bypass safety timers (partner-down-delay + MCLT) only in cases where the operator is certain that the intercommunication between the nodes has failed due to the entire node failure and not due to the intercommunication (MCS) link failure. Failed intercommunication due to the nodal failure would ensure that only one node is present in the network for IP address delegation (as opposed to two isolated nodes with overlapping IP address ranges where address duplication can occur). For this reason, the operator must ensure that there are redundant paths between the nodes to ensure uninterrupted synchronization of DHCP leases.

In access-driven mode of operation, partner-down-delay has no effect.

Default 23 hours, 59minutes and 59 seconds

Parameters **hrs** *hours* — Specifies the partner-down delay time in hours.

Values 1 — 23

min *minutes* — Configure the partner-down delay time in minutes.

Values 1 — 59

sec *seconds* — Configure the partner-down delay time in seconds.

Values 1 — 59

peer

Syntax **peer** *ip-address* **tag** *sync-tag*
no peer

Context configure>router>dhcp>server>failover
configure>router>dhcp>server>pool>failover
configure>service>vprn>dhcp>server>failover
configure>service>vprn>dhcp>server>pool>failover
configure>router>dhcp6>server>failover
configure>router>dhcp6>server>pool>failover
configure>service>vprn>dhcp6>server>failover
configure>service>vprn>dhcp6>server>pool>failover

Description DHCP leases can be synchronized per DHCP server of DHCP pool. The pair of synchronizing servers or pools is identified by a tag. The synchronization information is carried over the Multi-Chassis Synchronization (MCS) link between the two peers. MCS link is a logical link (IP, or MPLS).

MCS runs over TCP, port 45067 and it is using either data traffic or keepalives to detect failure on the communication link between the two nodes. In the absence of any MCS data traffic for more than 0.5sec, MCS will send its own keepalive to the peer. If a reply is NOT received within 3sec, MCS will declare its operation state as DOWN and the DB Sync state as out-of-sync. MCS will consequently notify its clients (DHCP Server being one of them) of this. It can take up to 3 seconds before the DHCP client realizes that the inter-chassis communication link has failed.

Note that the inter-chassis communication link failure does not necessarily assume the same failed fate for the access links. In other words the two redundant nodes can become isolated from each other in the network. This would occur in cases where only the intercommunication (MCS) link fails. It is of utmost importance that this MCS link be highly redundant.

Default none

Parameters *ip-address* — Specifies the IPv4 address of the peer.

tag — Specifies a tag that will identify synchronizing DHCP servers or pools.

startup-wait-time

Syntax [**no**] **startup-wait-time** [**min** *minutes*] [**sec** *seconds*]

Context configure>router>dhcp>server>failover
configure>router>dhcp>server>pool>failover
configure>service>vprn>dhcp>server>failover
configure>service>vprn>dhcp>server>pool>failover
configure>router>dhcp6>server>failover
configure>router>dhcp6>server>pool>failover
configure>service>vprn>dhcp6>server>failover
configure>service>vprn>dhcp6>server>pool>failover

Description This command enables startup-wait-time during which each peer waits after the initialization process before assuming the active role for the prefix designated as local or access-driven. This is to avoid transient issues during the initialization process.

Default 2 minutes

Parameters **min —** Specifies the the startup wait time in minutes.

Values 1 — 10

sec — Specifies the the startup wait time in seconds.

Values 1 — 59

max-lease-time

Syntax **max-lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no max-lease-time

Context config>router>dhcp>server>pool

Description This command configures the maximum lease time.

The **no** form of the command returns the value to the default.

Default 10 days

Parameters *time* — Specifies the maximum lease time.

Values		
	days :	0 — 3650
	hours	0 — 23

minutes:	0 — 59	
seconds	0 — 59	

min-lease-time

Syntax **min-lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no min-lease-time

Context config>router>dhcp>server>pool

Description This command configures the minimum lease time.

The **no** form of the command returns the value to the default.

Default 10 minutes

Parameters *time* — Specifies the minimum lease time.

Values

days :	0 — 3650	
hours	0 — 23	
minutes:	0 — 59	
seconds	0 — 59	

minimum-free

Syntax **minimum-free** *minimum-free* [**percent**] [**event-when-depleted**]
no minimum-free

Context config>router>dhcp>server>pool

Description This command specifies the desired minimum number of free addresses in this pool.

The **no** form of the command reverts to the default.

Default 1

Parameters *minimum-free* — Specifies the minimum number of free addresses.

0 — 255

percent — Specifies that the value indicates a percentage.

event-when-depleted — This parameter enables a system-generate event when all available addresses in the pool/subnet of local DHCP server are depleted.

nak-non-matching-subnet

Syntax [**no**] **nak-non-matching-subnet**

Context config>service>vprn>dhcp>server>pool
config>router>dhcp>server>pool

Description With this command, if the local DHCPv4 server receives a DHCP request with option 50 (means client try to request a previous allocated message as described in section 3.2 of RFC 2131, *Dynamic*

Host Configuration Protocol) and the address allocation algorithm ends up using a pool and the address in option50 is not in pool, then system will return a DHCP NAK, otherwise system just drop the DHCP packet.

Default no nak-non-matching-subnet

offer-time

Syntax **offer-time** [**min** *minutes*] [**sec** *seconds*]
no offer-time

Context config>router>dhcp>server>pool

Description This command configures the offer time.

The **no** form of the command returns the value to the default.

Default 1 minute

Parameters *time* — Specifies the offer time.

Values

minutes:	0 — 10
seconds	0 — 59

msap-defaults

Syntax **msap-default**

Context config>sub-mgmt>lu-db>dhcp>hos
config>sub-mgmt>lu-db>ipoe>host
config>sub-mgmt>lu-db>ppp>host

Description This command configures MSAP authentication defaults.

group-interface

Syntax **group-interface** *ip-int-name* [**prefix** {*port-id*}]
group-interface *ip-int-name* [**prefix** {*port-id*}]
group-interface *ip-int-name* [**suffix** {*port-id*}]
no group-interface

Context config>sub-mgmt>lu-db>dhcp>host
config>subscr-mgmt>loc-user-db>ipoe>host>msap-defaults
config>sub-mgmt>lu-db>ppp>host

Description This command configures the group interface.

Parameters *ip-int-name* — Specifies the IP interface name.

Values 32 chars max (must start with a letter)

Parameters **prefix** {*port-id*} — Specifies the port ID as the prefix to the specified ip-int-name.

suffix {*port-id*} **—** Specifies the port ID as the suffix to the specified ip-int-name.

policy

Syntax **policy** *msap-policy-name*
no policy

Context config>sub-mgmt>lu-db>dhcp>host
config>subscr-mgmt>loc-user-db>ipoe>host>msap-defaults
config>sub-mgmt>lu-db>ppp>host

Description This command configures the MSAP policy.

Parameters *msap-policy-name* — Specifies the policy name.

service

Syntax **service** *service-id*
no service

Context config>sub-mgmt>lu-db>dhcp>host
config>subscr-mgmt>loc-user-db>ipoe>host>msap-defaults
config>sub-mgmt>lu-db>ppp>host

Description This command sets retail-service for a given subscriber host.

Parameters *service-id* — Specifies the service ID as an interger.

Values 1-2147483648

retail-service

Syntax [**no**] **retail-service** *service-id*

Context config>sub-mgmt>lu-db>dhcp>hos
config>sub-mgmt>lu-db>ppp>host

Description This command sets default service for all subscribers created based on trigger packets received on the given capture SAP in case the corresponding VSA is not included in the RADIUS authentication response. This command is applicable to capture SAP only.

Default no retail-service

options

Syntax **options**

Context config>router>dhcp>local-dhcp-serve>pool
config>router>dhcp>local-dhcp-serve>pool>subnet

config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ppp>host

Description This command enables the context to configure pool options. The options defined here can be overruled by defining the same option in the local user database.

Default none

custom-option

Syntax **custom-option** *option-number* **address** [*ip-address*...(up to 4 max)]
custom-option *option-number* **hex** *hex-string*
custom-option *option-number* **string** *ascii-string*
no custom-option *option-number*

Context config>router>dhcp>local-dhcp-serve>pool>options
config>router>dhcp>local-dhcp-serve>pool>subnet>options
config>subscr-mgmt>loc-user-db>dhcp>host>options
config>subscr-mgmt>loc-user-db>ppp>host>options

Description This command configures specific DHCP options. The options defined here can overrule options in the local user database.

The **no** form of the removes the option from the configuration.

Default none

Parameters *option-number* — specifies the option number that the DHCP server uses to send the identification strings to the DHCP client.

Values 1 — 254

address *ip-address* **—** Specifies the IP address of this host.

hex *hex-string* **—** Specifies the hex value of this option.

Values 0x0..0xFFFFFFFF...(maximum 254 hex nibbles)

string *ascii-string* **—** Specifies the value of this option.

Values Up to 127 characters maximum.

dns-server

Syntax **dns-server address** [*ip-address*...(upto 4 max)]
no dns-server

Context config>router>dhcp>server>pool>options
config>subscr-mgmt>loc-user-db>dhcp>host>options
config>subscr-mgmt>loc-user-db>ipoe>host>options
config>subscr-mgmt>loc-user-db>ppp>host>options

Description This command configures the IP address of the DNS server.

Default none

Parameters *ipv6-address* — The IPv4 address of the DNS server. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

dns-server

Syntax **dns-server** *ipv6-address* [*ipv6-address*...(up to 4 max)]
no dns-server

Context config>subscr-mgmt>loc-user-db>ppp>host>options6
config>subscr-mgmt>loc-user-db>dhcp>host>options6

Description Configure IPv6 DNS server addresses that can be used for name resolution

Default no dns-server

Parameters *ipv6-address* — - IPv6 address of the a DNS server.

domain-name

Syntax **domain-name** *domain-name*
no domain-name

Context config>router>dhcp>server>pool>options
config>subscr-mgmt>loc-user-db>dhcp>host>options
config>subscr-mgmt>loc-user-db>ipoe>host>options

Description This command configures the default domain for a DHCP client that the router uses to complete unqualified hostnames (without a dotted-decimal domain name).

The **no** form of the command removes the name from the configuration.

Default none

Parameters *domain-name* — Specifies the domain name for the client.

Values Up to 127 characters

lease-rebind-time

Syntax **lease-rebind-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no lease-rebind-time

Context config>router>dhcp>server>pool>subnet>options
config>subscr-mgmt>loc-user-db>dhcp>host>options
config>subscr-mgmt>loc-user-db>ipoe>host>options

Description This command configures the time the client transitions to a rebinding state.

The **no** form of the command removes the time from the configuration.

Default none

Parameters

Parameters *time* — Specifies the lease rebind time.

Values		
	days:	0 — 3650
	hours:	0 — 23
	minutes:	0 — 59
	seconds	0 — 59

lease-renew-time

Syntax **lease-renew-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no lease-renew-time

Context config>router>dhcp>server>pool>options
config>subscr-mgmt>loc-user-db>dhcp>host>options
config>subscr-mgmt>loc-user-db>ipoe>host>options

Description This command configures the time the client transitions to a renew state.

The **no** form of the command removes the time from the configuration.

Default none

Parameters *time* — Specifies the lease renew time.

Values		
	days:	0 — 3650
	hours:	0 — 23
	minutes:	0 — 59
	seconds	0 — 59

lease-time

Syntax **lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no lease-time

Context config>router>dhcp>server>pool>options
config>subscr-mgmt>loc-user-db>dhcp>host>options

Description This command configures the amount of time that the DHCP server grants to the DHCP client permission to use a particular IP address.

The **no** form of the command removes the lease time parameters from the configuration.

Default none

Parameters *time* — Specifies the lease time.

Values		
	days :	0 — 3650
	hours	0 — 23
	minutes:	0 — 59
	seconds	0 — 59

netbios-name-server

Syntax **netbios-name-server ip-address** [*ip-address*...(up to 4 max)]
no netbios-name-server

Context config>router>dhcp>server>pool>options
config>subscr-mgmt>loc-user-db>dhcp>host>options
config>subscr-mgmt>loc-user-db>ppp>host>options
config>subscr-mgmt>loc-user-db>ipoe>host>options

Description This command configures up to four Network Basic Input/Output System (NetBIOS) name server IP addresses.

Default none

Parameters *ip-address* — The IP address of the NetBIOS name server. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

netbios-node-type

Syntax **netbios-node-type** *netbios-node-type*
no netbios-node-type

Context config>router>dhcp>server>pool>options
config>subscr-mgmt>loc-user-db>dhcp>host>options
config>subscr-mgmt>loc-user-db>ipoe>host>options

Description This command configures the Network Basic Input/Output System (NetBIOS) node type.

Default none

Parameters *netbios-node-type* — Specifies the netbios node type.

Values B — Broadcast node uses broadcasting to query nodes on the network for the owner of a NetBIOS name.
P — Peer-to-peer node uses directed calls to communicate with a known NetBIOS name server for the IP address of a NetBIOS machine name.
M — Mixed node uses broadcasted queries to find a node, and if that fails, queries a known P-node name server for the address.
H — Hybrid node is the opposite of the M-node action so that a directed query is executed first, and if that fails, a broadcast is attempted.

prefix

Syntax **prefix** *ipv6-addr/prefix-len* [**failover** {**local** | **remote**}] [**pd**] [**wan-host**] [**create**]
no prefix *ipv6-addr/prefix-len*

Context configure>router>dhcp6>server>pool
configure>service>vprn>dhcp6>server>pool

Description This is an existing command and we just need to add the failover option.

Default failover local

Parameters *ipv6-addr/prefix-len* —

Values ipv6-address x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x [0..FFFF]H
d [0..255]D
prefix-length [1..128]

failover {**local** | **remote**} **—** This command designates a prefix as local or remote. This is used when multi-chassis synchronization is enabled.

Values **local** — A prefix designated as local is always used to renew the existing addresses/prefixes or to assign a new one.
remote — A prefix designated as remote is used only to renew the existing DHCP leases. The new leases will be assigned from it only after the maximum-client-lead-time + partner-down-delay time elapses.

thresholds

Syntax **thresholds**

Context config>service>vprn>dhcp6>server>pool
config>router>dhcp6>server>pool

Description This command enables the context to configure pool level thresholds.

Default thresholds

thresholds

Syntax **thresholds**

Context config>service>vprn>dhcp6>server>pool>prefix
config>router>dhcp6>server>pool>prefix

Description This command enables the context to configure prefix level thresholds.

Default thresholds

minimum-free

Syntax [**no**] **minimum-free prefix-length** [1..128]

Context config>service>vprn>dhcp6>server>pool>thresholds
config>router>dhcp6>server>pool>thresholds

Description This command creates a threshold for a given prefix length on the pool level. Up to 128 thresholds could be created. For example, with **minimum-free prefix-length 64**, then the usage of /64 prefix in the pool is counted.

There are two types of thresholds could be defined on pool level:

- Depleted — The system sends out a warning when the prefix with the configured length is no long available in the pool.
- Minimum free — A percentage-based threshold which represents the minimal available percentage of prefix with the configured length in the pool. The system will send out warning if the actual percentage is lower than the configured percentage

Configuration of this command also enables the system stats collection for **configure prefix length**, which could be displayed via the **show router** <*router-id*>**dhcp6 local-dhcp-server "d6" pool-threshold-stats** command.

Default none

Parameters **1..128 —** Specifies the IPv6 prefix length.

minimum-free

Syntax [**no**] **minimum-free prefix-length** [1..128]

Context config>service>vprn>dhcp6>server>pool>prefix>thresholds
config>router>dhcp6>server>pool>>prefix>thresholds

Description This command creates a threshold for a given prefix length on the prefix level. Up to 128 thresholds could be created. For example, with **minimum-free prefix-length 64**, then the usage of /64 prefix in the prefix is counted.

There are two types of thresholds could be defined on pool level:

- Depleted — The system sends out a warning when the prefix with the configured length is no long available in the provisioned prefix.
- Minimum free — A percentage or number based threshold which represent the minimal available percentage or number of the prefix with configured length in the provisioned prefix. The system will send out warning if the actual percentage is lower than the configured percentage

Configuration of this command also enables the system stats collection for **configure prefix length**, which can be displayed with the **show router** <*router-id*>**dhcp6 local-dhcp-server "d6" prefix-threshold-stats** command.

Default none

Parameters **1..128 —** Specifies the IPv6 prefix length.

depleted-event

Syntax [**no**] **depleted-event**

Context config>service>vprn>dhcp6>server>pool>thresholds>minimum-free
config>router>dhcp6>server> pool>thresholds>minimum-free

Description This command enables the system to send out warnings when the prefix with the configured length is no long available in the pool.

Default none

depleted-event

Syntax [**no**] **depleted-event**
config>service>vprn>dhcp6>server>pool>prefix>thresholds>minimum-free
config>router>dhcp6>server> pool>prefix>thresholds>minimum-free

Description This command enables the system to send out a warning when the prefix with a configured length is no long available in the provisioned prefix.

For example:

```
prefix 2001:0:0:ffe0::/50 pd wan-host create
   thresholds
       minimum-free prefix-length 64
           depleted-event
```

With the above configuration, the system will send out a warning when there is no available /64 that can be allocated out of 2001:0:0:ffe0::/50.

Default none

minimum

Syntax **minimum percent** [0..100]
no minimum

Context config>service>vprn>dhcp6>server>pool>thresholds>minimum-free
config>router>dhcp6>server> pool>thresholds>minimum-free

Description This command specifies a percentage based threshold which represent the minimal available percentage of the prefix with configured length in the pool. The system will send out a warning if the actual percentage is lower than the configured percentage.

Default none

Parameters **percent** [0..100] — Specifies the percentage of used prefixes with the minimum free threshold length in the pool compared to the number of provisioned prefixes.

minimum

Syntax **minimum** [**percent** [0..100]] [**number** [0..4294967295]]
no minimum

Context config>service>vprn>dhcp6>server>pool>prefix>thresholds>minimum-free
config>router>dhcp6>server> pool>prefix>thresholds>minimum-free

Description This command configures a percentage-based or number-based threshold which represents the minimal available percentage or number of the prefix with a configured length in the provisioned prefix. The system will send out a warning if the actual percentage or number is lower than the configured threshold.

For example:

```
prefix 2001:0:0:ffe0::/50 pd wan-host create
   thresholds
```

```
minimum-free prefix-length 64
    minimum number 3
```

With the above configuration, the system will send a warning when the number of available /64 in prefix 2001:0:0:ffe0::/50 is less than 3.

Default none

Parameters **percent** [0..100] — Specifies the percentage of used prefixes with the minimum free threshold length in the pool compared to the number of provisioned prefixes.

number [0..4294967295] — Specifies the number of prefixes.

to-client-options

Syntax **to-client-options**

Context config>subscr-mgmt>loc-user-db>ipoe>host

Description This command configures the DHCP options to send to the client.

option

Syntax **option** *option-number* **address** [*ip-address*...(up to 4 max)]
option *option-number* **hex** *hex-string*
option *option-number* **string** *ascii-string*
no option *option-number*

Context config>router>dhcp>local-dhcp-serve>pool>options
config>router>dhcp>local-dhcp-serve>pool>subnet>options
config>subscr-mgmt>loc-user-db>dhcp>host>options
config>subscr-mgmt>loc-user-db>ppp>host>options
config>subscr-mgmt>loc-user-db>ipoe>host>to-client-options>ipv4
config>subscr-mgmt>loc-user-db>ipoe>host>to-client-options>ipv6

Description This command configures specific DHCP options. The options defined here can overrule options in the local user database.

The **no** form of the removes the option from the configuration.

Default none

Parameters *option-number* — specifies the option number that the DHCP server uses to send the identification strings to the DHCP client.

Values 1 — 254

address *ip-address* — Specifies the IP address of this host.

hex *hex-string* — Specifies the hex value of this option.

Values 0x0..0xFFFFFFFF...(maximum 254 hex nibbles)

string *ascii-string* — Specifies the value of this option.

Values Up to 127 characters maximum.

option

Syntax **option** *option-number* **address** *ipv6-address* [*ipv6-address*...(upto 4 max)]
option *option-number* **hex** *hex-string*
option *option-number* **string** *ascii-string*
no option *option-number*

Context configure>subscr-mgmt>loc-user-db>ipoe>host>to-client-options>dhcpv6
configure>subscr-mgmt>loc-user-db>ppp>host>to-client-options>dhcpv6

Description This command configures DHCPv6 options via LUDB that will be passed in all DHCP messages to the client. The options will be blindly appended to any options already present in the DHCP message. In other words, there is no intelligent merging of the options where overlapping options from different sources are further evaluated to determine whether only one option or multiple options should be returned to the client.

Multiple DHCP options can be configured at the same time although each option requires its own option statement. Those options are equivalent to RADIUS VSAs **Alc-ToCLient-Dhcp6-Options**.

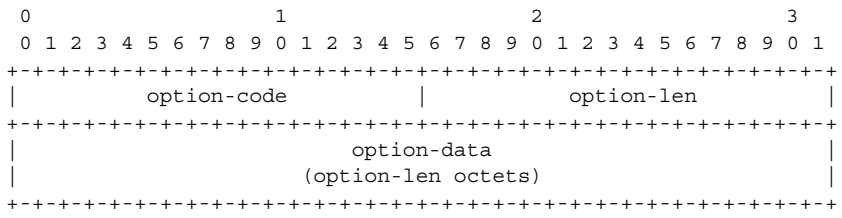
DHCPv6 options can be provided via DHCPv6 server in the relay case. In addition, DHCPv6 options provided via LUDB or RADIUS can be supplied and consequently appended to the already existing options. In case that DHCPv6 options are provided simultaneously via LUDB and RADIUS, the RADIUS as a source of DHCPv6 option will be blocked and the options supplied via LUDB will be passed to the client. This is valid for the relay and proxy case.

Any DHCP option may be encoded in the option statement. An example of the option statement for DHCPv6 DNS servers is given below:

```
option 23 2001:db8::1  2001:db8::2.
```

Options are stored serially in the options field of DHCP message header, with no padding between the options. Options are byte-aligned but are not aligned in any other way such as on 2 or 4 byte boundaries.

The format of DHCPv6 options is:

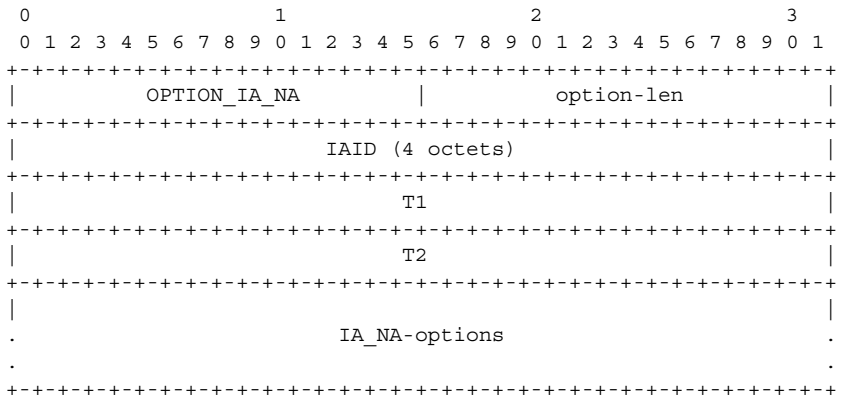


option-code — An unsigned integer identifying the specific option type carried in this option.

option-len — An unsigned integer giving the length of the option-data field in this option in octets.

option-data —The data for the option; the format of this data depends on the definition of the option.

DHCPv6 options are scoped by using encapsulation. Some options apply generally to the client, some are carried with other options, such as IA-NA:



option-code — OPTION_IA_NA (3).

option-len — 12 + length of IA_NA-options field.

IAID —The unique identifier for this IA_NA; the IAID must be unique among the identifiers for all of this client's IA_NAs. The number space for IA_NA IAIDs is separate from the number space for IA_TA IAIDs.

T1 — The time at which the client contacts the server from which the addresses in the IA_NA were obtained to extend the lifetimes of the addresses assigned to the IA_NA; T1 is a time duration relative to the current time expressed in units of seconds.

T2 — The time at which the client contacts any available server to extend the lifetimes of the addresses assigned to the IA_NA; T2 is a time duration relative to the current time expressed in units of seconds.

IA_NA-options — Options associated with this IA_NA.

Default no option

Parameters *option-number* — Specifies the number of the option. This can be a well known option (some of which are defined in RFC 3315, *Dynamic Host Configuration Protocol for IPv6 (DHCPv6)*), or an anonymous option.

address *ipv6-address* **—** Specifies IPv6 address as an option.

hex *hex-string* **—** Specifies options coded as Hex characters.

string *ascii-string* **—** Specifies options coded as string.

option

Syntax **option** *option-number* **address** *ipv4-address* [ipv4-address...(upto 4 max)]
option *option-number* **hex** *hex-string*
option *option-number* **string** *ascii-string*
no option *option-number*

Context configure>subscr-mgmt>loc-user-db>ipoe>host>to-client-options>dhcpv4
configure>subscr-mgmt>loc-user-db>ppp>host>to-client-options>dhcpv4

Description This command configures DHCPv4 options via LUDB that will be passed in all DHCP messages to the client. The options will be blindly appended to any options already present in the DHCP message.

In other words, there is no intelligent merging of the options where overlapping options from different sources are further evaluated to determine whether only one option or multiple options should be returned to the client.

Multiple DHCP options can be configured at the same time although each option requires its own option statement. Those options are equivalent to RADIUS VSAs **Alc-ToCLient-Dhcp4-Options**.

DHCPv4 options can be provided via DHCPv4 server in the relay case. In addition, DHCPv4 options provided via LUDB or RADIUS can be supplied and consequently appended to the already existing options. In case that DHCPv4 options are provided simultaneously via LUDB and RADIUS, the RADIUS as a source of DHCPv4 option will be blocked and the options supplied via LUDB will be passed to the client. This is valid for the relay and proxy case.

Any DHCP option may be encoded in the option statement. An example of the option statement for DHCPv4 default-gateway is given below:

```
option 3 192.168.1.254
```

DHCPv4 options may be fixed length or variable length. They are appended at the end of DHCPv4 messages. All options begin with a tag octet, which uniquely identifies the option. Fixed-length options without data consist of only a tag octet. Only options 0 and 255 are fixed length. All other options are variable-length.

Default no option

Parameters *option-number* — Number of the option. This can be a well known option, or a an anonymous option.

address *ipv4-address* **—** Specifies IPv4 address as an option.

hex *hex-string* **—** Specifies options coded as Hex characters.

string *ascii-string* **—** Specifies options coded as string.

subnet

Syntax **subnet** {*ip-address*/*mask*|*ip-address netmask*} [**create**]
no subnet {*ip-address*/*mask*|*ip-address netmask*}

Context config>router>dhcp>server>pool

Description This command creates a subnet of IP addresses to be served from the pool. The subnet cannot include any addresses that were assigned to subscribers without those addresses specifically excluded. When the subnet is created no IP addresses are made available until a range is defined.

Default none

Parameters *ip-address* — Specifies the base IP address of the subnet. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

mask — The subnet mask in dotted decimal notation. Allowed values are dotted decimal addresses in the range 128.0.0.0 – 255.255.255.252. Note that a mask of 255.255.255.255 is reserved for system IP addresses.

netmask — Specifies a string of 0s and 1s that mask or screen out the network part of an IP address so that only the host computer part of the address remains.

address-range

Syntax [**no**] **address-range** *start-ip-address end-ip-address* [**failover** {**local** | **remote**}]

Context config>router>dhcp>server>pool>subnet

Description This command configures a range of IP addresses to be served from the pool. All IP addresses between the start and end IP addresses will be included (other than specific excluded addresses).

Default none

Parameters *start-ip-address* — Specifies the start address of this range to include. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

end-ip-address — Specifies the end address of this range to include. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

failover local — Specifies that the DHCP server failover control type is in control under normal operation.

failover remote — Specifies that the remote DHCP server failover system is in control under normal operation.

drain

Syntax [**no**] **drain**

Context config>service>vprn>dhcp>server>pool>subnet

Description This command subnet draining which means no new leases can be assigned from this subnet and existing leases are cleaned up upon renew/rebind.

The **no** form of the command means the subnet is active and new leases can be assigned from it.

exclude-addresses

Syntax [**no**] **exclude-addresses** *start-ip-address* [*end-ip-address*]

Context config>router>dhcp>server>pool>subnet

Description This command specifies a range of IP addresses that excluded from the pool of IP addresses in this subnet.

Default none

Parameters *start-ip-address* — Specifies the start address of this range to exclude. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

end-ip-address — Specifies the end address of this range to exclude. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

maximum-declined

Syntax **maximum-declined** *maximum-declined*
no maximum-declined

Context config>router>dhcp>server>pool>subnet

Description This command configures the maximum number of declined addresses allowed.

Default 64

Parameters *maximum-declined* — Specifies the maximum number of declined addresses allowed.

Values 0 — 4294967295

minimum-free

Syntax **minimum-free** *minimum-free* [**percent**] [**event-when-depleted**]
no minimum-free

Context config>router>dhcp>server>pool>subnet

Description This command configures the minimum number of free addresses in this subnet. If the actual number of free addresses in this subnet falls below this configured minimum, a notification is generated.

Default 1

Parameters *minimum-free* — Specifies the minimum number of free addresses in this subnet.

Values 0 — 255

percent — Specifies that the value indicates a percentage.

event-when-depleted — This parameter enables a system-generate event when all available addresses in the pool/subnet of local DHCP server are depleted.

default-router

Syntax **default-router** *ip-address* [*ip-address*...(up to 4 max)]
no default-router

Context config>router>dhcp>server>pool>subnet>options
config>subscr-mgmt>loc-user-db>ipoe>host>options

Description This command configures the IP address of the default router for a DHCP client. Up to four IP addresses can be specified.

The **no** form of the command removes the address(es) from the configuration.

Default none

Parameters *ip-address* — Specifies the IP address of the default router. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

subnet-mask

Syntax **subnet-mask** *ip-address*
no subnet-mask

Context config>router>dhcp>local-dhcp-serve>pool>subnet>options
config>subscr-mgmt>loc-user-db>dhcp>host>options
config>subscr-mgmt>loc-user-db>ipoe>host>options

Description This command specifies the subnet-mask option to the client. The mask can either be defined (for supernetting) or taken from the pool address.

The **no** form of the command removes the address from the configuration.

Default none

Parameters *ip-address* — Specifies the IP address of the subnet mask. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

subnet-binding key

Syntax **subnet-binding key** [**sys-id-svc-id** | **sys-id** | **string**] **unbind-delay** [**hrs** *hours*] [**min** *mins*] [**sec** secs]
no subnet-binding key

Context config>router>dhcp>local-dhcp-server>pool
config>service>vprn>dhcp>local-dhcp-server>pool

Description The command enables the pool to bind three selectable parameters, **sys-id-svc-id**, **sys-id**, or a **string** to a subnet. These parameters are retrieved from DHCP relay Option 82 vendor specific option (VSO). The intent of this feature is to allow multiple BNG to share a DHCP pool. When a subnet is bound to a VSO, only DHCP discoveries with matching VSO are allowed to allocate additional DHCP addresses. For example, if **sys-id** is the chosen VSO, a DHCP discovery will bind the **sys-id** to a subnet. Only DHCP discoveries with matching **sys-id** are allowed to allocate additional addresses from the same subnet. If a DHCP discovery fails to match any bindings, and if a new subnet is still available, it will first bind the VSO to the new subnet and offer the subscriber an IP address.

Once all addresses are released back to the pool, the subnet is once again available for binding after the unbind-delay has expired. The unbind-delay expiration is to hold the subnet for a small period of time until the subnet has successful remove itself from the routing table. The delay is configurable to allow enough time for routing update to occur. By default, the delay is 5 minute with a minimal required value of 1 second.

Default **unbind-delay min 5**

Parameters *key* — The desire key to which the subnet to bind: **sys-id-svc-id** | **sys-id** | **string**

hours — [0 — 24] the delay for the subnet to unbind in hours.

minutes — [0 — 59] the delay for the subnet to unbind in minutes.

seconds — [0 — 59] the delay for the subnet to unbind in seconds.

use-gi-address

Syntax **use-gi-address** [**scope** *scope*]

Context config>router>dhcp>server

Description This command enables the use of gi-address matching. By default, the scope is subnet and addresses are allocated only from the subnet where the gi-address belongs, even if the pool contains multiple other subnets. When the scope is pool, addresses are allocated from any subnet in the pool that contains the subnet where the gi-address belongs.

Default no use-gi-address

Parameters **scope** *scope* — Specifies if addresses are handed out for a certain subnet where the gi-address belongs to only or for all subnets part of the pool.

Values **subnet** — Addresses are only handed out for the subnet where the gi-address is part of
pool — All subnets part of the pool which contain subnet where the gi-address is part of can hand out addresses.

use-pool-from-client

Syntax **use-pool-from-client delimiter** *delimiter*
use-pool-from-client
no use-pool-from-client

Context config>router>dhcp>server

Description This command enables the use of the pool indicated by DHCP client. When enabled, the IP address pool to be used by this server is the pool is indicated by the vendor-specific sub-option 13 of the DHCP option 82. When disabled or if there is no sub-option 13 in the DHCP message, the pool selection falls back to the "use-gi-address" configuration.

Default no use-pool-from-client

Parameters **delimiter** *delimiter* — A single ASCII character specifies the delimiter of separating primary and secondary pool names in Option82 VSO.

user-ident

Syntax **user-ident** *user-ident*
no user-ident

Context config>router>dhcp>local-dhcp-server
config>service>vprn>dhcp>server

Description This command configures the keys for identification of the DHCPv4 lease being held in the lease-database (for configured period after lease timeout). Subscriber requesting a lease via DHCPv4 that matches an existing lease based on this configured key is handed the matched prefix or address. This allows address and prefix"stickiness" for DHCPv4 assigned prefixes (IA_NA or PD).

Default duid

Parameters *user-ident* — Specifies the the user identification method

Values **duid** — Specifies the IPv4 DHCP unique identifier from DHCPv4.
interface-id — Specifies the IPv4 interface-id option.
interface-id-link-local — Specifies the interface-id and link-local address.

user-ident

Syntax **user-ident** *user-ident*
no user-ident

Context config>router>dhcp6>local-dhcp-server
config>service>vprn>dhcp6>server

Description This command configures the keys for identification of the DHCPv6 lease being held in the lease-database (for configured period after lease timeout). Subscriber requesting a lease via DHCPv6 that matches an existing lease based on this configured key is handed the matched prefix or address. This allows address and prefix"stickiness" for DHCPv6 assigned prefixes (IA_NA or PD).

Default duid

Parameters *user-ident* — Specifies the the user identification method

Values **duid** — Specifies the IPv6 DHCP unique identifier from DHCPv6.
interface-id — Specifies the IPv6 interface-id option.
interface-id-link-local — Specifies the interface-id and link-local address.

use-link-address

Syntax **use-link-address** [**scope** *scope*]
no use-link-address

Context config>router>dhcp6>local-dhcp-server

Description If configured, local pool selection for v6 address or prefix assignment will use the configured link-address under relay configuration. The selected pool will contain a prefix covering the link-address. The scope option defines the scope for the match. With scope **subnet**, the prefix or address selection is limited to the prefix in the pool that covers the link-address. With scope **pool**, all the prefixes in the selected pool are eligible for assignment.

Default scope subnet

Parameters **scope** *scope* — Specifies the scope of the IP address selection.

Values **subnet** — Specifies that the prefix or address selection is limited to the prefix in the pool that covers the link address.
pool — Specifies that all prefixes in the selected pool are eligible for assignment.

user-db

Syntax **user-db** *local-user-db-name*

no user-db

Context config>router>dhcp>server

Description This command configures a local user database for authentication.

Default not enabled

Parameters *local-user-db-name* — Specifies the name of a local user database.

Service Commands

dhcp

Syntax **dhcp**

Context config>service>vpls>sap
config>service>vpls>spoke-sdp
config>service>vpls>mesh-sdp
config>service>ies>interface
config>service>vprn
config>service>vprn>interface
config>service>vprn>sub-if
config>service>vprn>sub-if>grp-if
config>service>ies>sub-if>grp-if
config>service>ies>sub-if
config>service>ies>sub-if>grp-if

Description This command enables the context to configure DHCP parameters.

dhcp6

Syntax **dhcp6**

Context config>service>vpls>sap
config>service>vpls>spoke-sdp
config>service>vpls>mesh-sdp
config>service>ies>interface
config>system
config>service>vprn
config>service>vprn>interface
config>service>vprn>sub-if
config>service>vprn>sub-if>grp-if
config>service>ies>sub-if>group-grp-if
config>service>vprn>sub-if>grp-if>ipv6
config>service>ies>sub-if>grp-if>ipv6
config>service>ies>sub-if
config>service>ies>sub-if>grp-if

Description This command enables the context to configure DHCP6 parameters.

relay

Syntax [**no**] **relay**

Context config>service>vprn>sub-if>grp-if>ipv6>dhcp6
config>service>ies>sub-if>grp-if>ipv6>dhcp6

config>service>vprn>sub-if>ipv6>dhcp6
config>service>ies>sub-if>ipv6>dhcp6

Description This command enables the context to configure DHCPv6 relay parameters for this interface.

client-applications

Syntax **client-applications dhcp**
client-applications pppoe
client-applications dhcp pppoe
no client-applications

Context config>service>vprn>sub-if>dhcp
config>service>ies>sub-if>dhcp
config>service>vprn>sub-if>grp-if>dhcp
config>service>ies>sub-if>grp-if>dhcp
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>proxy
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>relay
config>service>ies>sub-if>grp-if>ipv6>dhcp6>proxy
config>service>ies>sub-if>grp-if>ipv6>dhcp6>relay
config>service>vprn>sub-if>ipv6>dhcp6>proxy
config>service>vprn>sub-if>ipv6>dhcp6>relay
config>service>ies>sub-if>ipv6>dhcp6>proxy
config>service>ies>sub-if>ipv6>dhcp6>relay

Description This command enables DHCP relay and proxy-server for the configured client types.

The **no** form of the command resets the default client application (dhcp).

Default client-applications dhcp

Parameters **dhcp —** Enables IPoE clients to use the DHCP relay or proxy-server

pppoe — Enables PPPoE clients to use the DHCP relay or proxy-server that PPPoE will attempt to request an IP address for a PPPoE client from the DHCP server(s)ly assigned to PPPoE node.

match-circuit-id

Syntax [**no**] **match-circuit-id**

Context config>service>ies>sub-if>grp-if>dhcp
config>service>vprn>sub-if>dhcp
config>service>vprn>sub-if>grp-if>dhcp

Description This command enables matching Option 82 circuit ID on relayed DHCP packet matching.

For Routed CO, the group interface DHCP relay process is stateful. When packets are relayed to the server the virtual router ID, transaction ID, SAP ID, and client hardware MAC address of the relayed packet are tracked. When a response is received from the server the virtual router ID, transaction ID, and client HW MAC address must be matched to determine the SAP on which to send the packet out. In some cases, the virtual router ID, transaction ID, and client HW MAC address are not guaranteed to be unique.

When the **match-circuit-id** command is enabled this part of the key is used to guarantee correctness in the lookup. This is only needed when are dealing with an IP aware DSLAM that proxies the client HW mac address.

Default no match-circuit-id

lease-populate

Syntax **lease-populate** [*nbt-of-entries*]
no lease-populate

Context config>service>vpls>if>dhcp>option
config>service>ies>if>dhcp>option

Description This command enables dynamic host lease state management for SAPs.

For VPLS, DHCP snooping must be explicitly enabled (using the **snoop** command) at all points where DHCP messages requiring snooping enter the VPLS instance (both from the DHCP server and from the subscribers). Lease state information is extracted from snooped DHCP ACK messages to populate lease state table entries for the MSAP.

The optional number-of-entries parameter is used to define the number lease state table entries allowed for an MSAP or IP interface. If number-of-entries is omitted, only a single entry is allowed. Once the maximum number of entries has been reached, subsequent lease state entries are not allowed and subsequent DHCP ACK messages are discarded.

The retained lease state information representing dynamic hosts may be used to:

- Populate an MSAP based anti-spoof filter table to provide dynamic anti-spoof filtering. If the system is unable to populate the dynamic host information in the anti-spoof filter table on the SAP, the DHCP ACK message must be discarded without adding new lease state entry or updating an existing lease state entry.
- Generate dynamic ARP replies if **arp-reply-agent** is enabled.

The **no** form of the command disables dynamic host lease state management for the MSAP.

Default no lease-populate

lease-populate

Syntax **lease-populate** [*nbr-of-leases*]
lease-populate [*nbr-of-leases*] **l2-header** [**mac** *ieee-address*]
no lease-populate

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp
config>service>vpls>sap>dhcp
config>service>ies>interface>dhcp
config>service>vprn>interface>dhcp
config>service>ies>sub-if>grp-if>dhcp
config>service>vprn>sub-if>grp-if>dhcp
config>service>vprn>sub-if>dhcp

Description This command enables and disables dynamic host DHCPv4 lease state management for SAPs.

For VPLS, DHCP snooping must be explicitly enabled (using the **snoop** command) at all points where DHCP messages requiring snooping enter the VPLS instance (both from the DHCP server and from the subscribers). Lease state information is extracted from snooped DHCP ACK messages to populate lease state table entries for the SAP.

The optional number-of-entries parameter defines the number lease state table entries allowed.

- for this SAP in case of a VPLS service
- for this interface in case of an IES or VPRN interface
- for each SAP in case of an IES or VPRN group-interface
- for this interface in case of an IES or VPRN retail subscriber-interface

If number-of-entries is omitted, only a single entry is allowed. Once the maximum number of entries has been reached, subsequent lease state entries are not allowed and subsequent DHCP ACK messages are discarded.

The retained lease state information representing dynamic hosts may be used to:

- Populate a SAP based anti-spoof filter table to provide dynamic anti-spoof filtering. If the system is unable to populate the dynamic host information in the anti-spoof filter table on the SAP, the DHCP ACK message must be discarded without adding new lease state entry or updating an existing lease state entry.
- Populate the system's ARP cache based on the arp-populate configuration. Applicable to IES and VPRN interfaces or group-interfaces.
- Populate managed entries into a VPLS forwarding database. VPLS forwarding database population is an implicit feature that automatically places the dynamic host's MAC address into the VPLS FDB. When a dynamic host's MAC address is placed in the lease state table, it will automatically be populated into the VPLS forwarding database associated with the SAP on which the host is learned. The dynamic host MAC address will override any static MAC entries using the same MAC and prevent dynamic learning of the MAC on another interface. Existing static MAC entries with the same MAC address as the dynamic host are marked as inactive but not deleted. If all entries in the lease state table associated with the MAC address are removed, the static MAC may be populated. New static MAC definitions for the VPLS instance may be created while a dynamic host exists associated with the static MAC address
- Generate dynamic ARP replies if **arp-reply-agent** is enabled. Applicable to VPLS service SAPs

Default no lease-populate

Parameters *nbr-of-leases* — Specifies the number of DHCPv4 leases allowed.

Values 1 — 32767
1 — 65535 (chassis-mode d, SF/CPM-4 or later)
1 — 262143 (chassis-mode d, SF/CPM-4 or later, retail subscriber interfaces only)

l2-header — Indicates a mode of operation where anti-spoof entry associated with the given DHCP state is created based on the MAC address from the Layer 2 header. The Layer 2 header flag is not set by default. This parameter is only applicable for group-interfaces.

mac — Specifies that the provisioned ieee-address will be used in the anti-spoofing entries for this SAP. The parameter may be changed mid-session. Existing sessions will not be re-programmed unless a tools perform command is issues for the lease. This parameter is only applicable for group-interfaces.

option

Syntax [**no**] **option**

Context config>service>vpls>sap>dhcp
config>service>vpls>sap>dhcp6
config>service>ies>interface>dhcp
config>service>vprn>interface>dhcp
config>service>vprn>sub-if>dhcp
config>service>vprn>sub-if>grp-if>dhcp
config>service>ies>sub-if>grp-if>dhcp

Description This command enables DHCP Option 82 (Relay Agent Information Option) parameters processing and enters the context for configuring Option 82 sub-options.

The **no** form of this command returns the system to the default.

Default no option

action

Syntax **action** {**replace** | **drop** | **keep**}
no action

Context config>service>vpls>sap>dhcp>option
config>service>ies>interface>dhcp>option
config>service>vprn>interface>dhcp>option
config>service>vprn>sub-if>grp-if>dhcp>option
config>service>ies>sub-if>grp-if>dhcp

Description This command configures the Relay Agent Information Option (Option 82) processing.

The **no** form of this command returns the system to the default value.

Default The default is to keep the existing information intact.

Parameters **replace —** In the upstream direction (from the user), the Option 82 field from the router is inserted in the packet (overwriting any existing Option 82 field). In the downstream direction (towards the user) the Option 82 field is stripped (in accordance with RFC 3046).

drop — The DHCP packet is dropped if an Option 82 field is present, and a counter is incremented.

keep — The existing information is kept in the packet and the router does not add any additional information. In the downstream direction the Option 82 field is not stripped and is forwarded towards the client.

In Vendor-Specific Options (VSOs) scenarios, the behavior is slightly different. Even with the action=keep, the router will insert his own vso into the Option 82 field. This will only be done when the incoming message has already an Option 82 field.

If no Option 82 field is present, the router will not create the Option 82 field - in that case, no VSO will be added to the message.

circuit-id

Syntax **circuit-id** [**ascii-tuple** | **vlan-ascii-tuple**]
no circuit-id

Context config>service>vpls>sap>dhcp>option

Description When enabled, the router sends an ASCII-encoded tuple in the **circuit-id** sub-option of the DHCP packet. This ASCII-tuple consists of the access-node-identifier, service-id, and SAP-ID, separated by "|".

In order to send a tuple in the circuit ID, the **action replace** command must be configured in the same context.

If disabled, the **circuit-id** sub-option of the DHCP packet will be left empty.

The **no** form of this command returns the system to the default.

Default circuit-id

Parameters **ascii-tuple —** Specifies that the ASCII-encoded concatenated tuple consisting of the access-node-identifier, service-id, and interface-name is used.

vlan-ascii-tuple — Specifies that the format will include VLAN-id and dot1p bits in addition to what is included in ascii-tuple already. The format is supported on dot1q and qinq ports only. Thus, when the Option 82 bits are stripped, dot1p bits will be copied to the Ethernet header of an outgoing packet.

circuit-id

Syntax **circuit-id** [**ascii-tuple** | **ifindex** | **sap-id** | **vlan-ascii-tuple**]
no circuit-id

Context config>service>ies>if>dhcp>option
config>service>ies>sub-if>grp-if>dhcp>option
config>service>vprn>if>dhcp>option
config>service>vprn>sub-if>grp-if>dhcp>option

Description When enabled, the router sends an ASCII-encoded tuple in the **circuit-id** sub-option of the DHCP packet. This ASCII-tuple consists of the access-node-identifier, service-id, and SAP-ID, separated by "|".

In order to send a tuple in the circuit ID, the **action replace** command must be configured in the same context.

If disabled, the **circuit-id** sub-option of the DHCP packet will be left empty.

The **no** form of this command returns the system to the default.

Default circuit-id

ascii-tuple — Specifies that the ASCII-encoded concatenated tuple will be used which consists of the access-node-identifier, service-id, and interface-name, separated by "|".

ifindex — Specifies that the interface index will be used. (The If Index of a router interface can be displayed using the command **show>router>interface>detail**)

sap-id — Specifies that the SAP identifier will be used.

vlan-ascii-tuple — Specifies that the format will include VLAN-id and dot1p bits in addition to what is included in ascii-tuple already. The format is supported on dot1q-encapsulated ports only. Thus, when the option 82 bits are stripped, dot1p bits will be copied to the Ethernet header of an outgoing packet.

remote-id

Syntax **remote-id** [**mac** | **string** *string*]
no remote-id

Context config>service>vpls>sap>dhcp>option
config>service>ies>if>dhcp>option
config>service>vprn>if>dhcp>option
config>service>ies>sub-if>grp-if>dhcp>option
config>service>ies>sub-if>grp-if>dhcp>option

Description This command specifies what information goes into the remote-id sub-option in the DHCP relay packet.

If disabled, the **remote-id** sub-option of the DHCP packet will be left empty.

The **no** form of this command returns the system to the default.

Default remote-id

Parameters **mac —** This keyword specifies the MAC address of the remote end is encoded in the sub-option.

string *string* **—** Specifies the remote-id.

vendor-specific-option

Syntax [**no**] **vendor-specific-option**

Context config>service>vpls>sap>dhcp>option
config>service>ies>if>dhcp>option
config>service>vprn>if>dhcp>option
config>service>ies>sub-if>grp-if>dhcp>option
config>service>vprn>sub-if>grp-if>dhcp>option

Description This command configures the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

client-mac-address

Syntax [**no**] **client-mac-address**

Context config>service> ies>if>dhcp>option>vendor
config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor
config>service>ies>sub-if>grp-if>dhcp>option>vendor

Description This command enables the sending of the MAC address in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

The **no** form of the command disables the sending of the MAC address in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

pool-name

Syntax [**no**] **pool-name**

Context config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor
config>service>ies>if>dhcp>option>vendor
config>service>ies>sub-if>grp-if>dhcp>option>vendor

Description This command sends the pool name in the Alcatel vendor specific suboption of the DHCP relay packet.

The **no** form of the command disables the sending.

sap-id

Syntax [**no**] **sap-id**

Context config>service>vpls>sap>dhcp>option>vendor
config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor
config>service>ies>sub-if>grp-if>dhcp>option>vendor

Description This command enables the sending of the SAP ID in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

The **no** form of the command disables the sending of the SAP ID in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

service-id

Syntax [**no**] **service-id**

Context config>service>vpls>sap>dhcp>option>vendor
config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor
config>service>ies>sub-if>grp-if>dhcp>option>vendor

Description This command enables the sending of the service ID in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

The **no** form of the command disables the sending of the service ID in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

string

Syntax [**no**] **string** *text*

Context config>service>vpls>sap>dhcp>option>vendor
config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor
config>service>ies>sub-if>grp-if>dhcp>option>vendor

Description This command specifies the string in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

The **no** form of the command returns the default value.

Parameters *text* — The string can be any combination of ASCII characters up to 32 characters in length. If spaces are used in the string, enclose the entire string in quotation marks (“ ”).

system-id

Syntax [**no**] **system-id**

Context config>service>vpls>sap>dhcp>option>vendor
config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor
config>service>ies>sub-if>grp-if>dhcp>option>vendor

Description This command specifies whether the system-id is encoded in the Alcatel-Lucent vendor specific sub-option of Option 82.

override-slaac

Syntax [**no**] **override-slaac**

Context config>service>vprn>sub-if>>ipv6>dhcp6
config>service>ies>sub-if>ipv6>dhcp6
config>service>vprn>sub-if>grp-if>ipv6>dhcp6
config>service>ies>sub-if>grp-if>ipv6>dhcp6

Description This command allows a DHCP IA_NA address to override and replace a host existing SLAAC address. When this feature is enabled, a subscriber SLAAC address is removed once the DHCP IA_NA address assignment is completed. If used with conjunction with the **allow-multiple-wan-address** command, the DHCP IA_NA address will also override the SLAAC address.

pd-managed-route

Syntax [**no**] **pd-managed-route**

Context config>service>vprn>sub-if>ipv6>dhcp6
config>service>ies>sub-if>ipv6>dhcp6
config>service>vprn>sub-if>grp-if>ipv6>dhcp6

config>service>ies>sub-if>grp-if>ipv6>dhcp6

Description This command enables DHCP IA-PD (delegated prefix) to be modeled as managed (framed) route instead of as a subscriber-host. Antispoof filtering for the subscriber host associated with the IA-PD route must be set to nh-mac. The subscriber specific parameters (sla-profile, sla-profile, etc) will be ignored during the authentication phase since IA-PD is not modeled as a subscriber host.

The next-hop for PD managed route must be an IPv6 sub-host (DHCP IA-NA or SLAAC) with the same mac address as the one in the DHCP lease state for the managed IA-PD. DHCP IA-NA next-hop host will always override SLAAC next-hop host if both are available. In case that the v6 next-hop is not present at the time when the framed IA-PD is instantiated, the IA-PD will be setup but the traffic destined to the IA-PD managed route will be black-holed.

The typical subscriber host information for DHCP IA-PD modeled as a route is removed from the operational show commands related to the subscriber host state (i.e. show service active-susbscribert or show service id X subscriber-host). However, DHCP IA-PD route is displayed as s managed route for the corresponding IPv6 subscriber host (DHCP IA-NA or SLAAC).

DHCP IA-PD information for managed IA-PD route is still maintained in the DHCPv6 lease state and as such it can be displayed with the appropriate show command.

Default no pd-managed-route

enable-ingress-stats

Syntax [**no**] **enable-ingress-stats**

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command enables the collection of ingress interface IP stats. This command is only appliable to IP statistics, and not to uRPF statistics.

If enabled, then the following statistics are collected:

- IPv4 offered packets
- IPv4 offered octets
- IPv6 offered packets
- IPv6 offered octets

Note that octet statistics for IPv4 and IPv6 bytes at IP interfaces include the Layer 2 frame overhead.

Default no enable-ingress-stats

duid

Syntax **duid** *duid* [**iaid** *iaid*]
no duid

Context config>service>ies>if>ipv6>dhcp6>pfx-delegate>prefix

Description This command configures the DHCP Unique Identifier (DUID) of the DHCP client.

Parameters *duid* — Specifies the ID of the requesting router. If set to a non zero value the prefix defined will only be delegated to this router. If set to zero, the prefix will be delegated to any requesting router.

iaid *iaid* **—** Specifies the identity association identification (IAID) from the requesting router that needs to match in order to delegate the prefix defined in this row.If set to 0 no match on the received IAID is done.

preferred-lifetime

Syntax **preferred-lifetime** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
preferred-lifetime infinite
no preferred-lifetime

Context config>service>ies>if>ipv6>dhcp6>pfx-delegate>prefix
config>service>vprn>if>ipv6>dhcp6>pfx-delegate>prefix
config>service>vprn>sub-if>ipv6>dhcp6>proxy
config>service>ies>sub-if>ipv6>dhcp6>proxy
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>proxy
config>service>ies>sub-if>grp-if>ipv6>dhcp6>proxy

Description This command configures the IPv6 prefix/mask preferred life time. The preferred-lifetime value cannot be bigger than the valid-lifetime value.

The **no** form of the command reverts to the default value.

Default 604800 seconds (7 days)

Parameters [**days** *days*][**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] — Specifies the preferred lifetime.

Values

days:	[0..3650]
hours:	[0..23]
minutes:	[0..59]
seconds:	[0..59

preferred-lifetime

Syntax **preferred-lifetime seconds**
preferred-lifetime infinite
no preferred-lifetime

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv>pfx-opt
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv>pfx-opt
config>service>ies>sub-if>ipv6>rtr-adv>pfx-opt
config>service>vprn>sub-if>ipv6>rtr-adv>pfx-opt

Description This command specifies the remaining time for this prefix to be preferred, thus time until deprecation.

Default 3600 seconds

Parameters *seconds* — Specifies the time for the prefix to remain preferred on this group-interface in seconds.

Values 0 — 4294967295

infinite — Specifies that the remaining time will never expire.
Note that the value **4294967295** seconds is interpreted as infinite.

valid-lifetime

Syntax **valid-lifetime** *seconds*
valid-lifetime infinite
no valid-lifetime

Context config>service>ies>if>ipv6>dhcp6>pfx-delegate>prefix
config>service>vprn>sub-if>grp-if>ipv6>dhcp6
config>service>ies>sub-if>grp-if>ipv6>dhcp6

Description This command configures the time, in seconds, that the prefix is valid. The maximum value 4294967295 is considered equal to infinity.

The **no** form of the command reverts to the default value.

Default 2592000 seconds (30 days)

Parameters *seconds* — Specifies the time, in seconds, that this prefix remains valid.

Values 1 — 4294967294

infinite — Specifies that this prefix remains valid infinitely.

valid-lifetime

Syntax **valid-lifetime** *seconds*
valid-lifetime infinite
no valid-lifetime

Context config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv

Description This command specifies the remaining time for this prefix to be valid for the purpose of on-link determination.

Default 86400

Parameters *seconds* — Specifies the time for the prefix to remain valid on this group-interface in seconds.

Values 0 — 4294967295

infinite — Specifies that the remaining time will never expire.

python-policy

Syntax **python-policy** *name*
no python-policy

Context config>service>ies>if>dhcp
config>service>vprn>if>dhcp>

Description This command specifies the python-policy to be used for DHCPv4 relay.

Parameters *name* — Specifies the name of an existing python script up to 32 characters in length.

python-policy

Syntax **python-policy** *name*
no python-policy

Context config>service>vprn>sub-if
config>service>vprn>sub-if>ipv6>dhcp6
config>service>ies>sub-if>ipv6>dhcp6
config>service>ies>if>ipv6>dhcp6-relay
config>service>vprn>if>ipv6>dhcp6-relay

Description This command specifies the python-policy to be used for DHCPv6 relay.

Parameters *name* — Specifies the name of an existing python script up to 32 characters in length.

emulated-server

Syntax **emulated-server** *ip-address*
no emulated-server

Context config>service>ies>if>dhcp>proxy-server
config>service>ies>sub-if>grp-if>dhcp>proxy-server
config>service>vpls>sap>dhcp>proxy-server
config>service>vprn>sub-if>grp-if>dhcp

Description This command configures the IP address which will be used as the DHCP server address in the context of the SAP. Typically, the configured address should be in the context of the subnet represented by the service.

The **no** form of this command reverts to the default setting. The local proxy server will not become operational without the emulated-server address being specified.

Parameters *ip-address* — Specifies the emulated server's IP address. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

emulated-server

Syntax **emulated-server** *ip-address*
no emulated-server

Context config>service>vprn>if>dhcp>proxy
config>service>vprn>sub-if>grp-if>dhcp>proxy-server

Description This command configures IP address which will be used as DHCP server address in context of the SAP. Typically, configured address should be in context of the subnet represented by VPRN. No version of these commands reverts to default setting. The local proxy server will not become operational without emulated-server address being specified.

Parameters *ip-address* — Specifies the emulated server's IP address.

lease-time

Syntax **lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] [**override**]
no lease-time

Context config>service>vpls>sap>dhcp>proxy-server
config>service>ies>if>dhcp>proxy-server
config>service>ies>sub-if>grp-if>dhcp>proxy-server
config>service>vprn>if>dhcp>proxy
config>service>vprn>sub-if>grp-if>dhcp>proxy-server

Description This command defines the length of lease-time that will be provided to DHCP clients. By default the local-proxy-server will always make use of the lease-time information provide by either a RADIUS or DHCP server.

The **no** form of this command disables the use of the lease-time command. The local-proxy-server will use the lease-time offered by either a RADIUS or DHCP server.

Default 7 days 0 hours 0 seconds

Parameters **override —** Specifies that the local-proxy-server will use the configured lease-time information to provide DHCP clients.

radius-override — Supported only in the **config>service>vpls>sap>dhcp>proxy-server** context, specifies that the local-proxy-server will use the configured lease-time information to provide DHCP clients.

days — Specifies the number of days that the given IP address is valid.

Values 0 — 3650

hours — Specifies the number of hours that the given IP address is valid.

Values 0 — 23

minutes — Specifies the number of minutes that the given IP address is valid.

Values 0 — 59

seconds — Specifies the number of seconds that the given IP address is valid.

Values 0 — 59

snoop

Syntax **snoop**
no snoop

Context config>service>vpls>sap>dhcp
config>service>vpls>sap>dhcp6
config>service>vpls>spoke-sdp>dhcp
config>service>vpls>mesh-sdp>dhcp
config>service>vprn>if>dhcp>option

Description This command enables DHCP snooping of DHCP messages on the SAP or SDP. Enabling DHCP snooping on interfaces (SAPs and SDP bindings) is required where DHCP messages important to lease state table population are received, or where Option 82 information is to be inserted. This includes interfaces that are in the path to receive messages from either DHCP servers or from subscribers.

Use the **no** form of the command to disable DHCP snooping on the specified SAP or SDP binding.

Default no snoop

dhcp6

dhcp-user-db

Syntax **dhcp-user-db** *local-user-db*
no dhcp-user-db

Context configure>service>vpls>sap

Description This command enabled access to LUDB for DHCPv4 hosts under the capture SAP. The name of this ludb must match the name of ludb configured under the **configure>service>vprn/ies>subscr-intf>group-intf>dhcp** hierarchy.

Default no dhcp-user-db

Parameters *local-user-db* — Specifies the name of the local-user-database up to 32 characters max.

dhcp-python-policy

Syntax **dhcp-python-policy** *policy-name*
no dhcp-python-policy

Context config>service>vpls>sap

Description This command specifies the name of the Python policy. The Python policy is created in the **config>python>python-policy** *name* context.

The **no** form of the command reverts to the default.

Default none

Parameters *policy-name* — Specifies a Python policy name up to 32 characters in length.

dhcp6

Syntax **dhcp6**

Context config>service>vpls>sap
config>service>ies>sub-if>grp-if>ipv6
config>service>vprn>sub-if>grp-if>ipv6

Description This command configures DHCP6 parameters for this SAP.

interface-id

Syntax **interface-id**
interface-id ascii-tuple
interface-id vlan-ascii-tuple
no interface-id

Context config>service>ies>if>ipv6>dhcp6>option
config>service>vprn>if>ipv6>dhcp6>option
config>service>vpls>sap>dhcp6>option

Description This command configure the interface-id suboption of the DHCP6 Relay packet

The **no** form of the command disables the sending of interface ID options in the DHCPv6 relay packet

Parameters **ascii-tuple —** Specifies that the ASCII-encoded concatenated tuple will be used which consists of the access-node-identifier, service-id, and interface-name, separated by "|".

vlan-ascii-tuple — Specifies that the format will include VLAN-id and dot1p bits in addition to what is included in ascii-tuple already. The format is supported on dot1q-encapsulated ports only. Thus, when the option 82 bits are stripped, dot1p bits will be copied to the Ethernet header of an outgoing packet.

mac — This keyword specifies the MAC address of the remote end is encoded in the sub-option.

remote-id

Syntax **remote-id**
remote-id mac
remote-id string [*32 chars max*]
no remote-id

Context config>service>ies>if>ipv6>dhcp6>option
config>service>vprn>if>ipv6>dhcp6>option
config>service>vpls>sap>dhcp6>option

Description This command enables the sending of remote ID option in the DHCPv6 relay packet.

The client DHCP Unique Identifier (DUID) is used as the remote ID.

The **no** form of the command disables the sending of remote ID option in the DHCPv6 relay packet.

interface-id

Syntax **interface-id**
interface-id ascii-tuple
interface-id vlan-ascii-tuple
no interface-id

Context config>service>vpls>sap>dhcp6>option

Description This command configures the interface-id suboption of the DHCP6 relay packet.

The no form of the command reverts to the default.

Default none

Parameters **ascii-tuple —** Specifies that the ASCII-encoded concatenated tuple consisting of the access-node-identifier, service-id, and interface-name is used.

vlan-ascii-tuple — Specifies that the format will include VLAN-id and dot1p bits in addition to what is included in ascii-tuple already. The format is supported on dot1q and qinq ports only. Thus, when the option 82 bits are stripped, dot1p bits will be copied to the Ethernet header of an outgoing packet.

dhcp6-user-db

Syntax **dhcp6-user-db** *local-user-db*
no dhcp6-user-db

Context configure>service>vpls>sap

Description This command enabled access to LUDB for DHCPv6 hosts under the capture SAP. The name of this ludb must match the name of ludb configured under the **configure>service>vprn/ies>subscr-intf>group-intf>dhcp** hierarchy.

Default no dhcp6-user-db

Parameters *local-user-db* — Specifies the name of the local-user-database up to 32 characters max.

ppp-user-db

Syntax **ppp-user-db** *local-user-db-name*
no ppp-user-db

Context configure>service>vpls

Description This command enabled access to LUDB for PPPoE and PPPoEoA v4and v6 hosts under the capture SAP. The name of this ludb must match the name of ludb configured under the **configure>service>vprn/ies>subscr-intf>group-intf>pppoe** hierarchy.

Default no pppoe-user-db

Parameters *local-user-db* — Specifies the name of the local-user-database up to 256 characters max.

pppoe-user-db

Syntax **pppoe-user-db** *local-user-db-name*
no pppoe-user-db

Context configure>service>vpls

Description This command enabled access to LUDB for PPPoE and PPPoEoA v4and v6 hosts under the capture SAP. The name of this ludb must match the name of ludb configured under the **configure>service>vprn/ies>subscr-intf>group-intf>pppoe** hierarchy.

Default no pppoe-user-db

Parameters *local-user-db* — Specifies the name of the local-user-database up to 256 characters max.

filter

Syntax **filter** *filter-id*
no filter

Context config>service>ies>sub-if>grp-if>dhcp

Description This command configures the DHCP filter for this interface

gi-address

Syntax **gi-address** *ip-address* [*src-ip-addr*]
no gi-address

Context config>service>ies>if>dhcp
config>service>vprn>interface>dhcp
config>service>vprn>sub-if>dhcp
config>service>ies>sub-if>grp-if>dhcp
config>service>ies>sub-if>dhcp

Description This command configures the gateway interface address for the DHCP relay. A subscriber interface can include multiple group interfaces with multiple SAPs. The GI address is needed, when the router functions as a DHCP relay, to distinguish between the different subscriber interfaces and potentially between the group interfaces defined.

By default, the GI address used in the relayed DHCP packet is the primary IP address of a normal IES interface. Specifying the GI address allows the user to choose a secondary address. For group interfaces a GI address must be specified under the group interface DHCP context or subscriber-interface DHCP context in order for DHCP to function.

Default no gi-address

Parameters *ip-address* — Specifies the host IP address to be used for DHCP relay packets.

src-ip-address — Specifies that this GI address is to be the source IP address for DHCP relay packets.

gi-address

Syntax **gi-address** *ipv4-address*
no gi-address

Context configure>subscr-mgmt>loc-user-db>ipoe>host

Description This command allows selection of gi-addresses based on the host entry in LUDB.

The gi-address must be a valid address (associated with an interface) within the routing context that received the DHCP message on the access side.

Default no gi-address

Parameters *ipv4-address* — Specifies the IPv4 gi-address.

relay-plain-bootp

Syntax [**no**] **relay-plain-bootp**

Context config>service>ies>if>dhcp

Description This command enables the relaying of plain BOOTP packets.

The **no** form of the command disables the relaying of plain BOOTP packets.

relay-unicast-msg

Syntax **relay-unicast-msg** [**release-update-src-ip**]
no relay-unicast-msg

Context config>service>ies>if>dhcp
config>service>ies>sub-if>dhcp
config>service>ies>sub-if>grp-if>dhcp
config>service>vprn>if>dhcp
config>service>vprn>sub-if>dhcp
config>service>vprn>sub-if>grp-if>dhcp

Description Relay unicast client DHCPv4 request (renew) messages. In the upstream direction: update the source-ip address and add the gateway IP address (gi-address) field before sending the message to the intended DHCP server (the message is not broadcasted to all configured DHCP servers). In the downstream direction: remove the gi-address and update the destination IP address to the value of the yiaddr (your IP addess) field.

By default, unicast DHCPv4 release messages are forwarded transparently. The optional “release-update-src-ip” flag, updates the source IP address with the value used for relayed DHCPv4 messages.

Additionally when the optional flag “relay-unicast-msg” is enabled, then the gi address and source IP address of relayed DHCPv4 messages can be configured to any local configured IP address in the same routing instance.

Default no relay-unicast-msg

Parameters **release-update-src-ip —** Updates the source IP address with the value used for relayed DHCPv4 messages.

server

Syntax **server** *ipv6z-address* [*ipv6z-address*...(up to 8 max)]

Context config>service>ies>if>ipv6>dhcp6

Description This command specifies a list of servers where DHCP6 requests will be forwarded. The list of servers can entered as either IP addresses or fully qualified domain names. There must be at least one server specified for DHCP6 relay to work. If there are multiple servers then the request is forwarded to all of the servers in the list.

There can be a maximum of 8 DHCP6 servers configured.

Default no server

Parameters *ipv6z-address* — Specifies a non-global IPv4 address including a zone index as defined by the InetAddressIPv4z textual convention. Up to 8 addresses can be specified.

Values ipv6-address: x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x: [0 — FFFF]H
d: [0 — 255]D

virtual-subnet

Syntax [**no**] **virtual-subnet**

Context config>service>ies>sub-if>dhcp
config>service>vprn>sub-if>dhcp

Description This command enables a virtual-subnet for DHCPv4 hosts under the subscriber-interface. With this command configured, the system will snoop and record the default router address in the DHCP ACK message for the DHCPv4 ESM host. The system could answer or traceroute request even if the default router address is not configured on the subscriber-interface.

Default none

server

Syntax **server** *server1* [*server2*...(up to 8 max)]

Context config>service>ies>if>dhcp
config>service>vprn>if>dhcp
config>service>ies>sub-if>grp-if>dhcp

Description This command specifies a list of servers where requests will be forwarded. The list of servers can entered as either IP addresses or fully qualified domain names. There must be at least one server

specified for DHCP relay to work. If there are multiple servers then the request is forwarded to all of the servers in the list.

There can be a maximum of 8 DHCP servers configured.

Default no server

Parameters *server* — Specify the DHCP server IP address.

relay-plain-bootp

Syntax [**no**] **relay-plain-bootp**

Context config>service>vprn>if>dhcp

Description This command enables the relaying of plain BOOTP packets.

The **no** form of the command disables the relaying of plain BOOTP packets.

use-arp

Syntax [**no**] **use-arp**

Context config>service>vprn>if>dhcp

Description This command enables the use of ARP to determine the destination heardware address.

The **no** form of the command disables the use of ARP to determine the destination heardware address

trusted

Syntax [**no**] **trusted**

Context config>service>ies>if>dhcp
config>service>vprn>if>dhcp
config>service>vprn>sub-if>grp-if>dhcp
config>service>ies>sub-if>grp-if>dhcp

Description This command enables relaying of untrusted packets.

The **no** form of this command disables the relay.

Default not enabled

host-connectivity-verify

Syntax **host-connectivity-verify** [**interval** *interval*] [**action** {**remove**|**alarm**}] [**family** *family*]

Context config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if
config>service>vprn>sub-if>grp-if>dhcp

Description This command enables enables subscriber host connectivity verification on a given SAP within a service.

This tool will periodically scan all known hosts (from dhcp-state) and perform a UC ARP request. The subscriber host connectivity verification will maintain state (connected vs. not-connected) for all hosts.

Default no host-connectivity-verify

Parameters **interval** ***interval*** **—** The interval, expressed in minutes, which specifies the time interval which all known sources should be verified. The actual rate is then dependent on number of known hosts and interval.

Values 1— 6000) Note that a zero value can be used by the SNMP agent to disable host-connectivity-verify.)

action {**remove** | **alarm**} **—** Defines the action taken on a subscriber host connectivity verification failure for a given host. The **remove** keyword raises an alarm and removes dhcp-state and releases all allocated resources (queues, table entries, etc.). DHCP-RELEASE will be signaled to corresponding DHCP server. Static hosts will never be removed. The **alarm** keyword raises an alarm indicating that the host is disconnected.

family *family* **—** The family configuration allows the host connectivity checks to be performed for IPv4 endpoint, IPv6 endpoint or both. With family IPv6 configured, host connectivity checks will be performed on the global unicast address (assigned via SLAAC or DHCPv6 IA_NA) and link-local address of a Layer 3 RG or bridged hosts. In case of SLAAC assignment, host connectivity can only be performed if the /128 is known (via downstream ND). DHCPv6 PD assigned prefixes will be removed if link-local address is determined to be unreachable via “host connectivity check”. Reachability checks for GUA and link-local address will be done simultaneously.

dhcp

Syntax **dhcp**

Context config>service>vprn>interface
config>service>vprn>
config>service>vprn>sub-if>grp-if

Description This command enables the context to configure DHCP parameters.

action

Syntax **action** {**replace** | **drop** | **keep**}
no action

Context config>service>vprn>if>dhcp>option
config>service>vprn>sub-if>grp-if>dhcp>option

Description This command configures the processing required when the SR-Series receives a DHCP request that already has a Relay Agent Information Option (Option 82) field in the packet.

The **no** form of this command returns the system to the default value.

Default Per RFC 3046, *DHCP Relay Agent Information Option* , section 2.1.1, *Reforwarded DHCP requests*, the default is to keep the existing information intact. The exception to this is if the giaddr of the received packet is the same as the ingress address on the router. In that case the packet is dropped and an error is logged.

Parameters **replace —** In the upstream direction (from the user), the existing Option 82 field is replaced with the Option 82 field from the router. In the downstream direction (towards the user) the Option 82 field is stripped (in accordance with RFC 3046).

drop — The packet is dropped, and an error is logged.

keep — The existing information is kept in the packet and the router does not add any additional information. In the downstream direction the Option 82 field is not stripped and is sent on towards the client.

The behavior is slightly different in case of Vendor Specific Options (VSOs). When the keep parameter is specified, the router will insert his own VSO into the Option 82 field. This will only be done when the incoming message has already an Option 82 field.

If no Option 82 field is present, the router will not create the Option 82 field. In this in that case, no VSO will be added to the message.

match-circuit-id

Syntax [**no**] **match-circuit-id**

Context config>service>vprn>sub-if>grp-if>dhcp

Description This command enables Option 82 circuit ID on relayed DHCP packet matching. For routed CO, the group interface DHCP relay process is stateful. When packets are relayed to the server the virtual router ID, transaction ID, SAP ID, and client hardware MAC address of the relayed packet are tracked.

When a response is received from the server the virtual router ID, transaction ID, and client hardware MAC address must be matched to determine the SAP on which to send the packet out. In some cases, the virtual router ID, transaction ID, and client hardware MAC address are not guaranteed to be unique.

When the **match-circuit-id** command is enabled this part of the key is used to guarantee correctness in our lookup. This is really only needed when dealing with an IP aware DSLAM that proxies the client hardware MAC address.

Default no match-circuit-id

option

Syntax [**no**] **option**

Context config>service>vprn>if>dhcp
config>service>vprn>sub-if>dhcp
config>service>vprn>sub-if>grp-if>dhcp

Description This command enables DHCP Option 82 (Relay Agent Information Option) parameters processing and enters the context for configuring Option 82 sub-options.

The **no** form of this command returns the system to the default.

Default no option

vendor-specific-option

Syntax [**no**] **vendor-specific-option**

Context config>service>vprn>if>dhcp>option
config>service>vprn>sub-if>grp-if>dhcp>option

Description This command configures the Alcatel-Lucent vendor specific suboption of the DHCP relay packet.

client-mac-address

Syntax [**no**] **client-mac-address**

Context config>service>vprn>if>dhcp>option
config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor

Description This command enables the sending of the MAC address in the Alcatel-Lucent vendor specific suboption of the DHCP relay packet.

The **no** form of the command disables the sending of the MAC address in the Alcatel-Lucent vendor specific suboption of the DHCP relay packet.

sap-id

Syntax [**no**] **sap-id**

Context config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor

Description This command enables the sending of the SAP ID in the Alcatel-Lucent vendor specific suboption of the DHCP relay packet.

The **no** form of the command disables the sending of the SAP ID in the Alcatel-Lucent vendor specific suboption of the DHCP relay packet.

service-id

Syntax [**no**] **service-id**

Context config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor

Description This command enables the sending of the service ID in the Alcatel-Lucent vendor specific suboption of the DHCP relay packet.

The **no** form of the command disables the sending of the service ID in the Alcatel-Lucent vendor specific suboption of the DHCP relay packet.

string

Syntax [**no**] **string** *text*

Context config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor

Description This command specifies the vendor specific suboption string of the DHCP relay packet.

The **no** form of the command returns the default value.

Parameters *text* — The string can be any combination of ASCII characters up to 32 characters in length. If spaces are used in the string, enclose the entire string in quotation marks (“ ”).

system-id

Syntax [**no**] **system-id**

Context config>service>vprn>if>dhcp>option>vendor
config>service>vprn>sub-if>grp-if>dhcp>option>vendor

Description This command specifies whether the system-id is encoded in the Alcatel-Lucent vendor specific sub-option of Option 82.

Default None

proxy-server

proxy-server

Context config>service>vpls>sap>dhcp
config>subscr-mgmt>msap-policy>vpls-only>dhcp
config>service>vprn>if>dhcp
config>service>ies>if>dhcp
config>service>vprn>sub-if>grp-if>dhcp
config>service>ies>sub-if>grp-if>dhcp
config>service>vprn>sub-if>dhcp
config>service>vprn>sub-if>grp-if>ipv6>dhcp6
config>service>ies>sub-if>grp-if>ipv6>dhcp6
config>service>vprn>sub-if>ipv6>dhcp6
config>service>ies>sub-if>ipv6>dhcp6

Description This command configures the DHCP proxy server.

emulated-server

Syntax **emulated-server** *ip-address*
no emulated-server

Context config>service>vprn>if>dhcp>proxy
config>service>vprn>sub-if>grp-if>dhcp>proxy-server

Description This command configures the IP address to be used as the DHCP server address in the context of this service. Typically, the configured address should be in the context of the subnet.

The **no** form of this command reverts to the default setting. The local proxy server will not become operational without a specified emulated server address.

Parameters *ip-address* — Specifies the emulated server address.

Default Note that for a retail interface, the default is the local interface.

lease-time

Syntax **lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] [**override**]
no lease-time

Context config>service>vprn>if>dhcp>proxy
config>service>vprn>sub-if>grp-if>dhcp>proxy-server

Description This command defines the length of lease-time that will be provided to DHCP clients. By default the local-proxy-server will always make use of the lease-time information provide by either a RADIUS or DHCP server.

The no form of this command disables the use of the lease-time command. The local-proxy-server will use the lease-time offered by either a RADIUS or DHCP server.

Default 7 days 0 hours 0 seconds

Parameters **override —** Specifies that the local-proxy-server will use the configured lease-time information to provide DHCP clients.

days — Specifies the number of days that the given IP address is valid.

Values 0 — 3650

hours — Specifies the number of hours that the given IP address is valid.

Values 0 — 23

minutes — Specifies the number of minutes that the given IP address is valid.

Values 0 — 59

seconds — Specifies the number of seconds that the given IP address is valid.

Values 0 — 59

server

Syntax **server** *server1* [*server2*...(up to 8 max)]

Context config>service>vprn>if>dhcp
config>service>vprn>sub-if>grp-if>dhcp

Description This command specifies a list of servers where requests will be forwarded. The list of servers can entered as either IP addresses or fully qualified domain names. There must be at least one server specified for DHCP relay to work. If there are multiple servers then the request is forwarded to all of the servers in the list. There can be a maximum of 8 DHCP servers configured.

The flood command is applicable only in the VPLS case. There is a scenario with VPLS where the VPLS node only wants to add Option 82 information to the DHCP request to provider per-subscriber information, but it does not do full DHCP relay. In this case, the server is set to "flood". This means the DHCP request is still a broadcast and is sent through the VPLS domain. A node running at L3 further upstream then can perform the full L3 DHCP relay function.

Default no server

Parameters *server* — Specify the DHCP server IP address.

host-connectivity-verify

Syntax **host-connectivity-verify** [**interval** *interval*] [**action** {**remove**|**alarm**}] [**family** *family*]

Context config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if
config>service>vprn>sub-if>grp-if>dhcp

Description This command enables enables subscriber host connectivity verification on a given SAP within a service.

This tool will periodically scan all known hosts (from dhcp-state) and perform a UC ARP request. The subscriber host connectivity verification will maintain state (connected vs. not-connected) for all hosts.

Default no host-connectivity-verify

Parameters **interval** ***interval*** **—** The interval, expressed in minutes, which specifies the time interval which all known sources should be verified. The actual rate is then dependent on number of known hosts and interval.

Values 1— 6000) Note that a zero value can be used by the SNMP agent to disable host-connectivity-verify.)

action {**remove** | **alarm**} **—** Defines the action taken on a subscriber host connectivity verification failure for a given host. The **remove** keyword raises an alarm and removes dhcp-state and releases all allocated resources (queues, table entries, etc.). DHCP-RELEASE will be signaled to corresponding DHCP server. Static hosts will never be removed. The **alarm** keyword raises an alarm indicating that the host is disconnected.

family *family* **—** The family configuration allows the host connectivity checks to be performed for IPv4 endpoint, IPv6 endpoint or both. With family IPv6 configured, host connectivity checks will be performed on the global unicast address (assigned via SLAAC or DHCPv6 IA_NA) and link-local address of a Layer 3 RG or bridged hosts. In case of SLAAC assignment, host

connectivity can only be performed if the /128 is known (via downstream ND). DHCPv6 PD assigned prefixes will be removed if link-local address is determined to be unreachable via “host connectivity check”. Reachability checks for GUA and link-local address will be done simultaneously.

source-address

Syntax **source-address** *ipv6-address*
no source-address

Context config>service>ies>if>ipv6>dhcp6
config>service>ies>sub-if>grp-if>ipv6>dhcp6
config>service>ies>sub-if>ipv6>dhcp6>relay
config>service>ies>sub-if>grp-if>ipv6>dhcp6>relay
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>proxy-server
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>proxy-server
config>service>vprn>if>ipv6>dhcp6>dhcp6-relay
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>relay
config>service>vprn>sub-if>ipv6>dhcp6>relay

Description This command configures the source IPv6 address of the DHCPv6 relay messages.

Parameters *ipv6-address* — Specifies the source IPv6 address of the DHCPv6 relay messages.

Values ipv6-address: x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x: [0 — FFFF]H
d: [0 — 255]D

dhcp6-server

Syntax [**no**] **dhcp6-server**

Context config>service>ies>if>ipv6

Description This command enables the context to configure DHCPv6 server parameters for the IES interface.

The **no** form of the command disables the DHCP6 server.

max-nbr-of-leases

Syntax **max-nbr-of-leases** *max-nbr-of-leases*
no max-nbr-of-leases

Context config>service>ies>if>ipv6>dhcp6-server

Description This command configures the maximum number of lease states installed by the DHCP6 server function allowed on this interface.

The **no** form of the command returns the value to the default.

Default 8000

Parameters *max-nbr-of-leases* — Specifies the maximum number of lease states installed by the DHCP6 server function allowed on this interface.

Values 0 — 8000

prefix-delegation

Syntax [**no**] **prefix-delegation**

Context config>service>ies>if>ipv6>dhcp6-server

Description This command configures prefix delegation options for delegating a long-lived prefix from a delegating router to a requesting router, where the delegating router does not require knowledge about the topology of the links in the network to which the prefixes will be assigned.

The **no** form of the command disables prefix-delegation.

prefix

Syntax [**no**] **prefix** *ipv6-address/prefix-length*

Context config>service>ies>if>ipv6>dhcp6-server>pfx-delegate

Description This command specifies the IPv6 prefix that will be delegated by this system.

Parameters *ipv6-address/prefix-length* — Specify the IPv6 address on the interface.

Values

ipv6-address/prefix: ipv6-address	x:x:x:x:x:x:x:x (eight 16-bit pieces) x:x:x:x:x:x:d.d.d.d x [0 — FFFF]H d [0 — 255]D
prefix-length	1 — 128

Interface Commands

local-proxy-arp

Syntax [**no**] **local-proxy-arp**

Context config>service>vprn>interface
config>service>vprn>sub-if>grp-if

Description This command enables local proxy ARP. When local proxy ARP is enabled on an IP interface, the system responds to all ARP requests for IP addresses belonging to the subnet with its own MAC address, and thus will become the forwarding point for all traffic between hosts in that subnet. When local-proxy-arp is enabled, ICMP redirects on the ports associated with the service are automatically blocked.

Default no local-proxy-arp

mac

Syntax [**no**] **mac** *ieee-mac-address*

Context config>service>vprn>interface
config>service>vprn>if>vrrp
config>service>vprn>sub-if>grp-if

Description This command assigns a specific MAC address to a VPRN IP interface.

The **no** form of this command returns the MAC address of the IP interface to the default value.

Default The physical MAC address associated with the Ethernet interface that the SAP is configured on.

Parameters *ieee-mac-address* — Specifies the 48-bit MAC address for the static ARP in the form *aa***:***bb***:***cc***:***dd***:***ee***:***ff* or *aa***-***bb***-***cc***-***dd***-***ee***-***ff* where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

proxy-arp-policy

Syntax [**no**] **proxy-arp** *policy-name* [*policy-name*...(up to 5 max)]

Context config>service>vprn>interface
config>service>vprn>sub-if>grp-if

Description This command enables a proxy ARP policy for the interface.

The no form of this command disables the proxy ARP capability.

Default no proxy-arp

Parameters *policy-name* — The export route policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

The specified name(s) must already be defined.

redundant-interfacer

Syntax **redundant-interface** *red-ip-int-name*
no redundant-interface

Context config>service>vprn
config>service>vprn>sub-if>grp-if

Description This command configures a redundant interface used for dual homing.

Parameters *red-ip-int-name* — Specifies the redundant IP interface name.

remote-proxy-arp

Syntax [**no**] **remote-proxy-arp**

Context config>service>vprn>interface
config>service>vprn>sub-if>grp-if

Description This command enables remote proxy ARP on the interface.

Remote proxy ARP is similar to proxy ARP. It allows the router to answer an ARP request on an interface for a subnet that is not provisioned on that interface. This allows the router to forward to the other subnet on behalf of the requester. To distinguish remote proxy ARP from local proxy ARP, local proxy ARP performs a similar function but only when the requested IP is on the receiving interface.

Default no remote-proxy-arp

Subscriber Interface Commands

subscriber-interface

Syntax [**no**] **subscriber-interface** *ip-int-name*

Context config>service>ies
config>service>vprn

Description This command allows the operator to create special subscriber-based interfaces. It is used to contain multiple group interfaces. Multiple subnets associated with the subscriber interface can be applied to any of the contained group interfaces in any combination. The subscriber interface allows subnet sharing between group interfaces.

Use the **no** form of the command to remove the subscriber interface.

Parameters *ip-int-name* — Specifies the name of the IP interface. Interface names can be from 1 to 32 alphanumeric characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

group-interface

Syntax [**no**] **group-interface** *ip-int-name*

Context config>service>ies>sub-if

Description This command enables the context to configure a group interface. A group interface is an interface that may contain one or more SAPs. This interface is used in triple-play services where multiple SAPs are part of the same subnet.

Default none

Parameters *ip-int-name* — Configures the interface group name. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

authentication-policy

Syntax **authentication-policy** *name*
no authentication-policy

Context config>service>ies>sub-if>grp-if

Description This command assigns a RADIUS authentication policy to the interface.

The **no** form of this command removes the policy name from the group interface configuration.

Default no authentication-policy

Parameters *name* — Specifies the authentication policy name. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

Local User Database Commands

local-user-db

Syntax **local-user-db** *local-user-db-name* [**create**]
no local-user-db *local-user-db-name*

Context config>subscr-mgmt

Description This command enables the context to configure a local user database.

Default not enabled

Parameters *local-user-db-name* — Specifies the name of a local user database.

user-db

Syntax **user-db** *local-user-db-name*
no user-db

Context config>service>ies>sub-if>grp-if>dhcp
config>service>ies>sub-if>grp-if>dhcp6
config>service>ies>sub-if>grp-if>ipv6>dhcp6
config>service>ies>sub-if>grp-if>ipv6>dhcp6

Description This command assigns a local user database.

Default not enabled

Parameters *local-user-db-name* — Specifies the name of a local user database.

ipoe

Syntax **ipoe**

Context config>subscr-mgmt>loc-user-db

Description This command configures IPoE host parameters.

ppp

Syntax **ppp**

Context config>subscr-mgmt>loc-user-db

Description This command configures PPP host parameters.

mask

Syntax **mask type** *dhcp-match-type* {[**prefix-string** *prefix-string* | **prefix-length** *prefix-length*] [**suffix-string** *suffix-string* | **suffix-length** *suffix-length*]}
no mask type *dhcp-match-type*

Context config>subscr-mgmt>loc-user-db>dhcp
config>subscr-mgmt>loc-user-db>ppp
config>subscr-mgmt>loc-user-db>ipoe

Description This command configures the mask.

Parameters *dhcp-match-type* — Specifies up to four matching types to identify a host.

Values DHCP: circuit-id, option60, remote-id, sap-id, string, system-id
PPP: circuit-id, remote-id, service-name, username

Values prefix-string *prefix-string*

Specifies a substring that is stripped of the start of the incoming circuit ID before it is matched against the value configured in the DHCP or PPPOE circuit ID.

This string can only contain printable ASCII characters. The "*" character is a wildcard that matches any substring. If a "\" character is masked, use the escape key so it becomes "\\".

Values 127 characters maximum , *' is wildcard.

prefix-length *prefix-length* **—** Specifies the number of characters to remove from the start of the incoming circuitId before it is matched against the value configured in the DHCP circuit ID.

Values 1— 127

suffix-string *suffix-string* **—** Specifies a substring that is stripped of the end of the incoming circuit ID before it is matched against the value configured in DHCP circuit ID.

This string can only contain printable ASCII characters. The "*" character is a wildcard that matches any substring. If a "\" character is masked, use the escape key so it becomes "\\".

Values 127 characters maximum

suffix-length *suffix-length* **—** Specifies the number of characters to remove from the end of the incoming circuit ID before it is matched against the value configured in the DHCP circuit ID.

Values 1— 127

host

Syntax **host** *host-name* [**create**]
no host *host-name*

Context config>subscr-mgmt>loc-user-db>dhcp
config>subscr-mgmt>loc-user-db>ppp

Description This command defines a DHCP or PPP subscriber.

Parameters *host-name* —

create — Keyword used to create the host name. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

access-loop-encapsulation

Syntax [**no**] **access-loop-encapsulation**

Context config>subscr-mgmt>loc-user-db>ppp>host

Description This command enables access loop information.

encap-offset

Syntax **encap-offset** [**type** *type*]
no encap-offset

Context config>subscr-mgmt>loc-user-db>ppp>host>ale

Description This command configures the egress encapsulation offset.

Parameters **type** *type* — Selects the encap type.

Values pppoa-llc, pppoa-null, pppoeoa-llc, pppoeoa-llc-fcs, pppoeoa-llc-tagged, pppoeoa-llc-tagged-fcs, pppoeoa-null, pppoeoa-null-fcs, pppoeoa-null-tagged, pppoeoa-null-tagged-fcs, ipoa-llc, ipoa-null, ipoeoa-llc, ipoeoa-llc-fcs, ipoeoa-llc-tagged, ipoeoa-llc-tagged-fcs, ipoeoa-null, ipoeoa-null-fcs, ipoeoa-null-tagged, ipoeoa-null-tagged-fcs, pppoe, pppoe-tagged, ipoe, ipoe-tagged

rate-down

Syntax **rate-down** *rate*
no rate-down

Context config>subscr-mgmt>loc-user-db>ppp>host>ale

Description This command configures the last mile link downstram rate in the access loop.

Parameters *rate* — Specifies the the last mile link downstram rate needed for proper (shaping) rate calculations and interleaving delay in the access loop.

Values 1 — 100000 kbps

access-loop-information

Syntax **access-loop-information**

Context config>subscr-mgmt>loc-user-db>ppp>host>ali

Description This command enables the context to configure access loop information in the local user database

circuit-id

Syntax **circuit-id sap-id**
circuit-id string *ASCII string*
no circuit-id

Context config>subscr-mgmt>loc-user-db>ppp>host

Description This command specifies a circuit-id for PPPoE hosts. A circuit-id received in PPPoE tags has precedence over the ludb specified circuit-id.

Default no circuit-id

Parameters **sap-id —** Specifies to use the SAP ID of the PPPoE session as the circuit ID.

string *ASCII string*

Specifies the circuit-id as a string, up to 63 characters. in length.

remote-id

Syntax **remote-id string mac**
remote-id string *ASCII string*
no remote-id

Context config>subscr-mgmt>loc-user-db>ppp>host>ali

Description This command specifies a remote-id for PPPoE hosts. A remote-id received in PPPoE tags has precedence over the ludb specified remote-id.

Default no remote-id

Parameters string *ASCII string* — specifies the circuit-id as a string, up to 63 characters. in length.

mac — specifies MAC address of the PPPoE session as the remote ID.

acct-policy

Syntax **acct-policy** *acct-policy-name* [**duplicate** *acct-policy-name*]
no acct-policy

Context config>subscr-mgmt>loc-user-db>ppp>hostconfig>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>dhcp>host

Description This command specifies the accounting policy used for sending an Accounting Stop message to report RADIUS authentication failures of PPPoE sessions. A duplicate policy can be specified if a copy of the Accounting Stop message must be sent to another destination.

Reporting RADIUS authentication failures with an Accounting Stop message must be enabled in the RADIUS authentication policy (“send-acct-stop-on-fail”)

A duplicate RADIUS accounting policy can be specified if the accounting stop resulting from a RADIUS authentication failure must also be sent to a second RADIUS destination.

Default no acct-policy

Parameters *acct-policy-name* — Specifies the name of a RADIUS accounting policy up to 32 characters in length.

address

Syntax **address gi-address** [**scope** *scope*]
address *ip-address*[*/prefix-length*]
address pool *pool-name* [**secondary-pool** *sec-pool-name*] [**delimiter** *delimiter*]
address use-pool-from-client [**delimiter** *delimiter*]
no address

Context config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures how the IP address is defined for this host.

When the user-db is used from a local-dhcp-server, then this command defines how to define the IP address the server will "offer" to the DHCP-client.

When the user-db is used for PPPoE authentication, the **gi-address** parameter cannot be used. A fixed IP address will then cause PPPoE to use this IP address. If no IP address is specified, the PPPoE will look for IP address by other means (DHCP). If a pool name is given, this pool will be sent in the DHCP request so that it can be used in by the DHCP server to determine which address to give to the host.

The **no** form of the command causes no IP address to be assigned to this host. In a user-db referred to from a local-dhcp-server, creating a host without address information will cause the matching client never to get an IP address.

Default no address

Parameters **gi-address —** When specified, the gi-address of the DHCP message is taken to look for a subnet in the local DHCP server. The first available free address of the subnet is taken and "offered" to the host. When **local-user-db** is used for PPPoE authentication, this has the same result as **no address**.

ip-address — Specifies the fixed IP address to use for this host.

pool-name/sec-pool-name — Specifies the primary (and secondary) pool (in the local DHCP server) to use to look for an available address. The first available IP address from any subnet in the pool will be used. When local-user-dbis used for PPPoE authentication, this causes the specified pool name tobe sent to the DHCP server in a vendor-specific suboption under Option 82

use-pool-from-client — Use the pool-name in the Option 82 vendor-specific sub-option.

delimiter *delimiter* **—** A single ascii character specifies the delimiter of separating primary and secondary pool names in option82 VSO.

auth-domain-name

Syntax **auth-domain-name** *domain-name*
no auth-domain-name

Context config>subscr-mgmt>loc-user-db>ipoe>host

config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures the authentication policy of this host.

auth-policy

Syntax **auth-policy** *policy-name*
no auth-policy

Context config>subscr-mgmt>loc-user-db>dhcp>host

Description This command configures the authentication policy of this host and PPPoE hosts. This authentication policy is only used if no authentication policy is defined at the interface level. For DHCP hosts, the host entry should not contain any other information needed for setup of the host (IP address, ESM strings, etc.). For PPPoE hosts, the authentication policy configured here must have its pppoe-authentication-method set to **pap-chap**, otherwise the request will be dropped.

Parameters *policy-name* — Specifies the authentication policy name.

force-ipv6cp

Syntax [**no**] **force-ipv6cp**

Context config>subscr-mgmt>loc-user-db>ppp>host

Description This command specifies if the IPv6 control protocol should be negotiated after PPP reaches the Network-Layer Protocol phase.

diameter-application-policy

Syntax **diameter-application-policy** *policy-name*
no diameter-application-policy

Context config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ipoe>host
config>subscr-mgmt>loc-user-db>ppp>host
config>service>ies>subscr-if>group-if
config>service>vprn>subscr-if>group-if

Description This command configures the Diameter application policy.

Parameters *policy-name* — Specifies the Diameter application policy name.

diameter-auth-policy

Syntax **diameter-auth-policy** *name*
no diameter-auth-policy

Context config>subscr-mgmt>loc-user-db>dhcp>host

config>subscr-mgmt>loc-user-db>ipoe>host
config>subscr-mgmt>loc-user-db>ppp>host
config>service>ies>subscr-if>group-if
config>service>vprn>subscr-if>group-if

Description This command is used to configure the Diameter NASREQ application policy to use for authentication.

Parameters *name* — Specifies the name of the Diameter NASREQ application policy to use for authentication.

auth-domain-name

Syntax **auth-domain-name** *domain-name*
no auth-domain-name

Context config>subscr-mgmt>loc-user-db>dhcp>host

Description This command sets the domain name which can be appended to user-name in RADIUS-authentication-request message for the given host.

Parameters *domain-name* — Specifies the domain name to be appended to user-name in RADIUS-authentication-request message for the given host.

host-identification

Syntax **host-identification**

Context config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ppp>host

Description This command enables the context to configure host identification parameters.

server

Syntax **server** *ip-address*
no server

Context config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ipoe>host

Description This command configures the IP address of the DHCP server in which to relay.

The **no** form of the command removes the value from the configuration.

Default no server

Parameters *ip-address* — Specifies the IP address of the DHCP host server. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

circuit-id

Syntax **circuit-id string** *ascii-string*
circuit-id hex *hex-string*
no circuit-id

Context config>subscr-mgmt>loc-user-db>dhcp>host>host-ident
config>subscr-mgmt>loc-user-db>ppp>host>host-ident

Description This command specifies the circuit-id to match.

Parameters *ascii-string* — specifies the circuit ID from the Option 82.

hex-string — Specifies the circuit ID in hexadecimal format from the Option 82.

Values 0x0..0xFFFFFFFF (maximum 254 hex nibbles)

derived-id

Syntax **derived-id** *derived-id-string*
no derived-id

Context config>subscr-mgmt>loc-user-db>dhcp>host>host-ident

Description This command configures an ASCII string that uniquely identifies a host, and is derived by a Python script from packet content available during a DHCP transaction.

Parameters *derived-id-string* — Specifies the host ID to be derived by a python script from DHCP packets during a DHCP transaction up to 255 characters in length.

encap-tag-range

Syntax **encap-tag-range start-tag** *start-tag* **end-tag** *end-tag*
no encap-tag-range

Context config>subscr-mgmt>loc-user-db>dhcp>host>host-ident
config>subscr-mgmt>loc-user-db>ppp>host>host-ident

Description This command specifies a range of encapsulation tag as the host identifications. The encapsulation tag is dot1q or qinq on Ethernet port; VPI/VCI on ATM port.

For dot1q, the start/end-tag is single number, range from 0-4094; for QinQ, the start/end-tag format is x.y, x or y could be "*", which means ignore inner or outer tag;

For ATM the start/end-tag format is vpi/vci, vpi or vci could be "*", which means ignore VPI or VCI.

Note: This command will only be used when "encap-tag-range" is configured as one of the match-list

The **no** form of the command removes the values from the configuration.

Default none

Parameters **start-tag** *start-tag* — Specifies the value of the start label in the range of SAP's allowed on this host.

Values

start-tag	dot1q	qtag1
	qinq(	qtag1.qtag2 | qtag1.* | *.qtag2)

atm (vpi/vci | vpi/* | */vci)
qtag1 [0..4094]
qtag2 [0..4094]
vpi [0..4095] (NNI)
[0..255] (UNI)
vci [1..65535]

end-tag *end-tag* **—** Specifies the value of the end label in the range of SAP's allowed on this host.

Values *end-tag*

dot1q qtag1
qinq(qtag1.qtag2 | qtag1.* | *.qtag2)
atm (vpi/vci | vpi/* | */vci)
qtag1 [0..4094]
qtag2 [0..4094]
vpi [0..4095] (NNI)
[0..255] (UNI)
vci [1..65535]

mac

Syntax **mac** *ieee-address*
no mac

Context config>subscr-mgmt>loc-user-db>dhcp>host>host-ident
config>subscr-mgmt>loc-user-db>ppp>host>host-ident

Description This command specifies the MAC address to match.

Parameters *ieee-address* — Specifies the 48-bit MAC address in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers.

options6

Syntax **options6**

Context config>subscr-mgmt>loc-user-db>ppp>host
config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ipoe>host>options

Description This command enables the context to configure IPv6 DNS server information in the local user database

option60

Syntax **option60** *hex-string*
no option60

Context config>subscr-mgmt>loc-user-db>dhcp>host>host-ident

Description This command specifies the Vendor-Identifying Vendor Option to match. Option 60 is encoded as Type-Length-Value (TLV). The *hex-string* portion of Option 60 in the received DHCP request is used

for matching. Only the first 32 bytes can be defined here. If Option 60 from the message is longer, those bytes are ignored.

Default no option60

Parameters *hex-string* — Specifies the hex value of this option.

Values 0x0..0xFFFFFFFF...(maximum 254 hex nibbles)

remote-id

Syntax **remote-id** *hex-string*
remote-id *ascii-string*
no remote-id

Context config>subscr-mgmt>loc-user-db>dhcp>host>host-ident
config>subscr-mgmt>loc-user-db>ppp>host>host-ident

Description This command specifies the remote id of this host.

The **no** form of this command returns the system to the default.

Default no remote-id

Parameters *remote-id* — Specifies the remote-id.

service-name

Syntax **service-name** *service-name*
no service-name

Context config>subscr-mgmt>loc-user-db>ppp>host>host-ident

Description This command specifies the service-name tag in PADI and/or PADR packets to match for PPPoE hosts.

Parameters *service-name* — Specifies a PPPoE service name, up to 255 characters maximum.

sap-id

Syntax **sap-id** *sap-id*
no sap-id

Context config>subscr-mgmt>loc-user-db>dhcp>host>host-ident

Description This command specifies the SAP ID from the Alcatel Vendor Specific Sub-option in Option 82 to match.

Parameters *sap-id* — Specifies a SAP ID, up to 255 characters maximum.

service-id

Syntax **service-id** *service-id*
no service-id

Context config>subscr-mgmt>loc-user-db>dhcp>host>host-ident

Description This command specifies an existing service ID from the Alcatel Vendor Specific Sub-Option in Option 82 to match.

Parameters *service-id* — Specifies an existing service ID.

Values 1 — 2147483647

string

Syntax **string** *string*
no string

Context config>subscr-mgmt>loc-user-db>dhcp>host>host-ident

Description This command specifies the string from the Alcatel Vendor Specific Sub-Option in Option 82 to match.

Parameters *string* — Specifies the string, up to 255 characters maximum.

system-id

Syntax **system-id** *system-id*
no system-id

Context config>subscr-mgmt>loc-user-db>dhcp>host>host-ident

Description This command specifies the system ID from the Alcatel Vendor Specific Sub-Option in Option 82 to match.

Parameters *system-id* — Specifies the system ID, up to 255 characters maximum.

username

Syntax **username** *user-name*
username *user-name* [**no-domain**]
username *user-name* **domain-only**
no username

Context config>subscr-mgmt>loc-user-db>ppp>host>host-ident

Description This command specifies how the username is specified.

Parameters *username* — Specifies the user name of this host.

no-domain — No username is specified.

domain-only — Only the domain part of the username is specified, for example, alcatel-lucent.com.

identification-strings

Syntax **identification-strings** *option-number* [**create**]
no identification-strings

Context config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ppp>host

Description This command specifies identification strings for the subscriber. This is useful when the server is centralized with Enhanced Subscriber Management (ESM) in a lower level in the network. These strings will be parsed by a downstream Python script or they can be used literally if the "strings-from-option" option in the **config>subscriber-mgmt>sub-ident-policy** context is set to this option number. In this case, the option number may be set to any allowed number (between 224 and 254 is suggested, as these are not dedicated to specific purposes). If the option number is not given, a default value of 254 is used. Note, for PPPoE only, if the local user database is attached to the PPPoE node under the group interface and not to a local DHCP server, the strings will be used internally so the option number is not used.

Default 254

Parameters *option-number* — Specifies identification strings for the subscriber

Values 1 — 254

ancp-string

Syntax **ancp-string** *ancp-string*
no ancp-string

Context config>subscr-mgmt>loc-user-db>dhcp>host>ident-strings
config>subscr-mgmt>loc-user-db>ppp>host>ident-strings

Description This command specifies the ANCP string which is encoded in the identification strings.

Parameters *ancp-string* — Specifies the the ANCP string, up to 63 characters, maximum.

app-profile-string

Syntax **app-profile-string** *app-profile-string*
no app-profile-string

Context config>subscr-mgmt>loc-user-db>dhcp>host>ident-strings
config>subscr-mgmt>loc-user-db>ppp>host>ident-strings

Description This command specifies the application profile string which is encoded in the identification strings.

Parameters *app-profile-string* — Specifies the the application profile string, up to 16 characters, maximum.

category-map

Syntax **category-map** *category-map-name*
no category-map *category-map-name*

Context config>subscr-mgmt>loc-user-db>dhcp>host>ident-strings
config>subscr-mgmt>loc-user-db>ppp>host>ident-strings

Description This command specifies the category map name.

Default none

Parameters *category-map-name* — Specifies an existing category map name up to 32 characters in length.

inter-dest-id

Syntax **inter-dest-id** *intermediate-destination-id*
no inter-dest-id

Context config>subscr-mgmt>loc-user-db>dhcp>host>ident-strings
config>subscr-mgmt>loc-user-db>ppp>host>ident-strings

Description This command specifies the intermediate destination identifier which is encoded in the identification strings.

Parameters *intermediate-destination-id* — Specifies the intermediate destination identifier, up to 32 characters, maximum.

sla-profile-string

Syntax **sla-profile-string** *sla-profile-string*
no sla-profile-string

Context config>subscr-mgmt>loc-user-db>dhcp>host>ident-strings
config>subscr-mgmt>loc-user-db>ppp>host>ident-strings

Description This command specifies the SLA profile string which is encoded in the identification strings.

Parameters *sla-profile-string* — Specifies the SLA profile string, up to 16 characters, maximum.

sub-profile-string

Syntax **sub-profile-string** *sub-profile-string*
no sub-profile-string

Context config>subscr-mgmt>loc-user-db>dhcp>host>ident-strings
config>subscr-mgmt>loc-user-db>ppp>host>ident-strings

Description This command specifies the subscriber profile string which is encoded in the identification strings.

Parameters *sub-profile-string* — Specifies the subscriber profile string, up to 16 characters, maximum.

subscriber-id

Syntax **subscriber-id** *sub-ident-string*
no subscriber-id

Context config>subscr-mgmt>loc-user-db>dhcp>host>ident-strings
config>subscr-mgmt>loc-user-db>ppp>host>ident-strings

Description This command specifies the subscriber ID which is encoded in the identification strings.

Parameters *sub-ident-string* — Specifies the subscriber ID string, up to 32 characters, maximum.

interface

Syntax **interface** *ip-int-name* **service-id** *service-id*
no interface

Context config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures the interface where PPP sessions are terminated.

The no form of the command reverts to the default.

Default none

Parameters *ip-int-name* — Specifies the name of the group interface where the PPP sessions are established

service-id *service-id* **—** Specifies the service ID of the service where the PPP sessions are established.

ipv6-address

Syntax **ipv6-address** *ipv6-address*
no ipv6-address

Context config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures static DHCPv6 IA-NA address for the host. This address is delegated to the client as /128 via DHCPv6 proxy function within the 7x50. This IP address must not be part of any DHCP pool within internal DHCP server.

The **no** form of the command removes the IPv6 address from the host configuration.

Parameters *ipv6-address* — Specifies the IPv6 address.

Values ipv6-address: ipv6-prefix x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x [0..FFFF]H
d [0..255]D

ipv6-delegated-prefix

Syntax **ipv6-delegated-prefix** *ipv6-prefix/prefix-length*
no ipv6-delegated-prefix

Context config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ipoe>host
config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures static DHCPv6 IA-PD prefix for the host. This prefix can be further delegated by the host itself to its clients. The prefix length is restricted to 48 to 64 bits. This prefix must not be part of any DHCP pool within internal DHCP server.

Default no ipv6-delegated-prefix

Parameters *ipv6-address* — Specifies the IPv6 address.

Values

ipv6-address:	ipv6-prefix x:x:x:x:x:x:x:x (eight 16-bit pieces) x:x:x:x:x:x:d.d.d.d x [0..FFFF]H d [0..255]D
prefix-length	[48..64]

ipv6-delegated-prefix-pool

Syntax **ipv6-delegated-prefix-pool** *pool-name*
no ipv6-delegated-prefix-pool

Context config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ipoe>host
config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures the pool name that will be used in DHCPv6 server for DHCPv6 IA-PD prefix selection.

The **no** form of the command removes the pool name from the configuration.

Parameters *pool-name* — Specifies the pool name ot be assigned to the delegated prefix pool.

ipv6-slaac-prefix

Syntax **ipv6-slaac-prefix** *ipv6-prefix/prefix-length*
no ipv6-slaac-prefix

Context config>subscr-mgmt>loc-user-db>dhcp>host
config>subscr-mgmt>loc-user-db>ppp>host
config>subscr-mgmt>loc-user-db>ipoe>host

Description This command configures static IPv6 SLAAC prefix (PIO) for the host. The host will assign an IPv6 address to itself based on this prefix. The prefix length is 64 bits.

The **no** form of the command removes the static IPv6 SLAAC prefix (PIO) for the host from the configuration.

Default no ipv6-slaac-prefix

Parameters *ipv6-prefix/prefix-length* — Specifies the IPv6 address and prefix length.

Values <ipv6-prefix/prefi*> : ipv6-prefix x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x [0..FFFF]H
d [0..255]D

prefix-length 64

ipv6-slaac-prefix-pool

Syntax **ipv6-slaac-prefix-pool** *pool*
no ipv6-slaac-prefix-pool

Context config>subscr-mgmt>loc-user-db>ipoe>host
config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures the IPv6 slaac prefix pool of this host.

ipv6-delegated-prefix-length

Syntax **ipv6-delegated-prefix-length** *bits*
no ipv6-delegated-prefix-length

Context configure>subscr-mgmt>local-user-db>dhcp>host
configure>subscr-mgmt>local-user-db>ppp>host

Description This command allows configuration of delegated prefix length via local user database.

Default no ipv6-delegated-prefix-length

Parameters *bits* — Specifies the delegated prefix length in bits.

Values 48..64

ipv6-prefix

Syntax **ipv6-prefix** *ipv6-prefix/prefix-length*
no ipv6-prefix

Context config>subscr-mgmt>loc-user-db>dhcp>host

Description This command configures the IPv6 prefix and length of this host.

The **no** form of the command removes the IPv6 prefix and length of this host from the configuration.

Parameters *ipv6-prefix/prefix-length* — Specifies the IPv6 prefix of this host.

Values ipv6-prefix/prefix: ipv6-prefix x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d

x [0..FFFF]H
d [0..255]D
prefix-length 48..64

ipv6-wan-address-pool

Syntax **ipv6-wan-address-pool** *pool-name*
no ipv6-wan-address-pool

Context config>subscr-mgmt>loc-user-db>dhcp>host

Description This command configures the pool name that will be used in DHCPv6 server for DHCPv6 IA-PA address selection.

The **no** form of the command removes the pool name from the configuration.

Default no ipv6-wan-address-pool

Parameters *pool-name* — Specifies the WAN address pool up to 32 characters in length.

link-address

Syntax **link-address** *ipv6-address*
no link-address

Context config>subscr-mgmt>loc-user-db>ipoe>host
config>service>ies>sub-if>grp-if>ipv6>dhcp6>proxy-server
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>proxy-server

Description This command allows link-address selection based on the host entry in LUDB.

The link-address is a field in DHCP6 Relay-Forward message that is used in DHCP6 server to select the IPv6 address (IA-NA) or IPv6 prefix (IA-PD) from a pool with configured prefix range covering the link-address. The selection scope is the pool or a prefix range within the pool.

Parameters *ipv6-address* — Specifies the link-address.

Values <ipv6-address> ipv6-address - x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x - [0..FFFF]H
d - [0..255]D

server

Syntax **server** *ipv6-address* [*ipv6-address*...(upto 8 max)]
no server

Context config>service>ies>subscriber-interface>ipv6>dhcp6
config>service>vprn>subscriber-interface>ipv6>dhcp6

match-radius-proxy-cache

Syntax **match-radius-proxy-cache**

Context config>subscr-mgmt>loc-user-db>ipoe>host

Description This command enables the context to configure RADIUS proxy cache match parameters.

delete-hold-time

Syntax **delete-hold-time** *seconds*
no delete-hold-time

Context config>subscr-mgmt>loc-user-db>dhcp>host>match-rdprox-cache

Description This command specifies the time for which the UE state (including ESM host) is maintained after an accounting-stop has been received for the UE from RADIUS client on the AP. This allows UE state to exist when a UE moves to a new AP and re-authenticates within the hold-time, thereby providing seamless mobility. The hold-time is canceled if re-authentication or accounting-start is received for the UE before expiry. If the hold-time expires, the UE state is deleted.

The no form of the command reverts to the default.

Default no delete-hold-time

Parameters *seconds* — Specifies the time for which the UE state will be held after an accounting-stop has been received for the UE.

Values 1 — 600

fail-action

Syntax **fail-action** {**continue**|**drop**}
no fail-action

Context config>subscr-mgmt>loc-user-db>ipoe>host>match-radprox-cache

Description This command specifies the action to take when no match is found in the cache.

The no form of the command reverts to the default.

Default drop

mac-format

Syntax **mac-format** *mac-format*
no mac-format

Context config>subscr-mgmt>loc-user-db>ipoe>host>match-radprox-cache

Description This command specifies how a MAC address is represented.

match

Syntax **match** {**circuit-id**|**mac**|**remote-id**}
match option [1..254] [**option6** [1..65535]>
match option6 [1..65535]
no match

Context config>subscr-mgmt>loc-user-db>ipoe>host>match-radprox-cache

Description This command specifies in what DHCPv6 option to retrieve the value to be used as lookup key in the RADIUS proxy cache.

Default none

server

Syntax **server** [**service** *service-id*] **name** *server-name*]
no server

Context config>subscr-mgmt>loc-user-db>ipoe>host>match-radprox-cache

Description This command specifies the RADIUS proxy server.

ipv6-lease-times

Syntax [**no**] **ipv6-lease-times**

Context config>subscr-mgmt>loc-user-db>ipoe>host
config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures the lease times for DHCPv6.

preferred-lifetime

Syntax **preferred-lifetime** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
preferred-lifetime *infinite*
no preferred-lifetime

Context config>service>vprn>sub-if>ipv6>dhcp6>proxy
config>service>ies>sub-if>ipv6>dhcp6>proxy
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>proxy
config>service>ies>sub-if>grp-if>ipv6>dhcp6>proxy

Description This command configures the preferred-lifetime for DHCPv6 leases (address/prefix) in a proxy-scenario (For example address/prefix obtained from Radius)

Preferred lifetime is the length of time that a valid address/prefix is preferred (for example, the time until deprecation).

Default **hrs 1**

Parameters *infinite* — Specifies that the valid lifetime is infinite.

Values 0xffffffff

[**days** *days*][**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] **—** Specifies the preferred lifetime.

Values		
	days:	[0..3650]
	hours:	[0..23]
	minutes:	[0..59]
	seconds:	[0..59]

rebind-timer

Syntax **rebind-timer** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
no rebind-timer

Context config>subscr-mgmt>loc-user-db>ipoe>host>ipv6-lease-times
config>subscr-mgmt>loc-user-db>ppp>host>ipv6-lease-times
config>service>ies>sub-if>grp-if>ipv6>dhcp6>proxy-server
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>proxy-server

Description This command configures the lease rebind timer (T2) via LUBD.

The T2 time is the time at which the client contacts any available addressing authority to extend the lifetimes of DHCPv6 leases. T2 is a time duration relative to the current time expressed in units of seconds.

The IP addressing authority controls the time at which the client contacts the addressing authority to extend the lifetimes on assigned addresses/prefixes through the T1 and T2 parameters assigned to an IA. At time T1 for an IA, the client initiates a Renew/Reply message exchange to extend the lifetimes on any addresses in the IA. The client includes an IA option with all addresses/prefixes currently assigned to the IA in its Renew message. Recommended values for T1 and T2 are .5 and .8 times the shortest preferred lifetime of the addresses/prefixes in the IA that the addressing authority is willing to extend, respectively.

The configured rebind timer should always be longer than or equal to the renew timer.

The T1 and T2 are carried in the IPv6 address option that is within the IA.

Default rebind-timer min 48

Parameters **days** *days*][**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] **—** Specifies the preffered lifetime.

Values		
	days:	[0..7]
	hours:	[0..23]
	minutes:	[0..59]
	seconds:	[0..59

renew-timer

Syntax **renew-timer** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
no renew-timer

Context config>subscr-mgmt>loc-user-db>ipoe>host>ipv6-lease-times
config>subscr-mgmt>loc-user-db>ppp>host>ipv6-lease-times

config>service>ies>sub-if>grp-if>ipv6>dhcp6>proxy-server
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>proxy-server

Description This command configures the lease renew time (T1) via LUDB.

The T1 is the time at which the client contacts the addressing authority to extend the lifetimes of the DHCPv6 leases (addresses/prefixes). T1 is a time duration relative to the current time expressed in units of seconds.

The IP addressing authority controls the time at which the client contacts the addressing authority to extend the lifetimes on assigned addresses through the T1 and T2 parameters assigned to an IA. At time T1 for an IA, the client initiates a Renew/Reply message exchange to extend the lifetimes on any addresses in the IA. The client includes an IA option with all addresses currently assigned to the IA in its Renew message. Recommended values for T1 and T2 are .5 and .8 times the shortest preferred lifetime of the addresses in the IA that the addressing authority is willing to extend, respectively.

The configured renew timer should always be smaller than or equal to the rebind timer.

The T1 and T2 are carried in the IPv6 address option that is within the IA.

Default renew-timer min 30

Parameters **days** *days*][**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] **—** Specifies the preffered lifetime.

Values

days:	[0..7]
hours:	[0..23]
minutes:	[0..59]
seconds:	[0..59

server-id

Syntax **server-id duid-en hex** *hex-string*
server-id duid-en string *ascii-string*
server-id duid-ll
no server-id

Context config>service>ies>sub-if>grp-if>ipv6>dhcp6
config>service>ies>sub-if>grp-if>ipv6>dhcp6>proxy-server
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>proxy-server

Description This command allows operator to customize the “server-id” attribute of a DHCPv6 message from the DHCPv6 proxy server (such as DHCPv6 advertise and reply). By default, the server-id uses DUID-ll derive from the chassis link-layer address. Operators have the option to use a unique identifier by using DUID-en (vendor based on enterprise number). There is a maximum length associated with the customizable hex-string and ascii-string.

Default server-id duid-ll

Parameters **duid-en hex** *hex-string* **—** Specifies a DUID system ID in a hex format.

Values 0x0..0xFFFFFFFF...(max 116 hex nibbles

duid-en string *ascii-string* **—** Specifies a DUID system ID in an ASCII format up to 58 characters.

duid-ll — Specifies that the DUID system ID is derived from the system link layer address.

valid-lifetime

Syntax **valid-lifetime** [**days** *days*] [**hrs** *hrs*] [**min** *min*] [**sec** *sec*]
valid-lifetime *infinite*
no valid-lifetime

Context config>subscr-mgmt>loc-user-db>ipoe>host>ipv6-lease-times
config>subscr-mgmt>loc-user-db>ppp>host>ipv6-lease-times
config>service>ies>sub-if>grp-if>ipv6>dhcp6>proxy-server
config>service>vprn>sub-if>grp-if>ipv6>dhcp6>proxy-server

Description This command configured valid-lifetime for DHCPv6 lease (address/prefix).

Valid lifetime is the the length of time an address/prefix remains in the valid state (i.e., the time until invalidation). The valid lifetime must be greater than or equal to the preferred lifetime. When the valid lifetime expires, the address/prefix becomes invalid and must not be used in communications. RFC 2461, sec 6.2.1 recommends default value of 30 days.

Each address/prefix assigned to the client has associated preferred and valid lifetimes specified by the address assignment authority (DHCP Server, Radius, ESM). To request an extension of the lifetimes assigned to an address, the client sends a Renew message to the addressing authority. The addressing authority sends a Reply message to the client with the new lifetimes, allowing the client to continue to use the address/prefix without interruption.

The lifetimes are transmitted from the addressing authority to the client in the IA option on the top level (not the address or prefix level).

Default valid-lifetime days 1

Parameters *infinite* — Specifies that the valid lifetime is infinite.

Values 0xffffffff

days *days*][**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] — Specifies the preffered lifetime.

Values		
	days:	[0..3650]
	hours:	[0..23]
	minutes:	[0..59]
	seconds:	[0..59

l2tp

Syntax **l2tp**

Context config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures L2TP for the host.

group

Syntax **group** *tunnel-group-name* [**service-id** *service-id*]
no group

Context config>subscr-mgmt>loc-user-db>ppp>host>l2tp

Description This command configures the L2TP tunnel group. The tunnel-group-name is configured in the **config>router>l2tp** context. Refer to the 7750 SR OS Router Configuration Guide.

Parameters *tunnel-group-name* — Specifies an existing tunnel L2TP group up to 63 characters in length.

service-id *service-id* — [Specifies an existing service ID or service name.

Values service-id: 1 — 214748364
svc-name: A string up to 64 characters in length.

authentication-policy

Syntax **authentication-policy** *policy-name*
no authentication-policy

Context config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures the authentication policy for the host. A host name with name "default" will be matched when all other hosts do not match.

pado-delay

Syntax **pado-delay** *deci-seconds*
no pado-delay

Context config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures the delay timeout before sending a PPPoE Active Discovery Offer. (PADO)

Parameters *deci-seconds* — Specifies the delay timeout before sending a PADO.

Values 1 — 30

mask

Syntax **mask type** *ppp-match-type* {[**prefix-string** *prefix-string* **| prefix-length** *prefix-length*] [**suffix-string** *suffix-string* **| suffix-length** *suffix-length*]}
no mask type *ppp-match-type*

Context config>subscr-mgmt>loc-user-db>ppp
Syntax **mask type** *dhcp-match-type* {[**prefix-string** *prefix-string* **| prefix-length** *prefix-length*] [**suffix-string** *suffix-string* **| suffix-length** *suffix-length*]}
no mask type *dhcp-match-type*

Context config>subscr-mgmt>loc-user-db>dhcp

Description This command configures the mask.

Parameters *ppp-match-type* — Specifies the sub-option inserted by the PPPoE intermediate agent.

Values circuit-id, remote-id, service-name, username

dhcp-match-type — The data type represents the type of matching done to identify a DHCP host.

Values circuit-id , option60 , remote-id , sap-id , string , system-id

prefix-string *prefix-string* **—** Specifies a substring that is stripped of the start of the incoming circuit ID before it is matched against the value configured in the DHCP or PPPOE circuit ID.

This string can only contain printable ASCII characters. The "*" character is a wildcard that matches any substring. If a "\" character is masked, use the escape key so it becomes "\\".

Values 127 characters maximum , *' is wildcard.

prefix-length *prefix-length* **—** Specifies the number of characters to remove from the start of the incoming circuitId before it is matched against the value configured in the circuit ID.

Values 1— 127

suffix-string *suffix-string* **—** Specifies a substring that is stripped of the end of the incoming circuit ID before it is matched against the value configured in circuit ID.

This string can only contain printable ASCII characters. The "*" character is a wildcard that matches any substring. If a "\" character is masked, use the escape key so it becomes "\\".

Values 127 characters maximum

suffix-length *suffix-length* **—** Specifies the number of characters to remove from the end of the incoming circuit ID before it is matched against the value configured in the circuit ID.

Values 1— 127

match-list

Syntax **match-list** *match-type-1* [*match-type-2*...(up to 4 max)]
no match-list

Context config>subscr-mgmt>loc-user-db>dhcp
config>subscr-mgmt>loc-user-db>ppp
config>subscr-mgmt>loc-user-db>ipoe

Description This command specifies the type of matching done to identify a host. There are different match-types for PPPoE or IPoE hosts of which a maximum of 4 can be specified.

Default no match-list

Parameters *match-type-x* — Specifies up to four matching types to identify a host.

Values circuit-id, derived-id, dual-stack-remote-id, encap-tag-range, mac, option60, remote-id, sap-id, service-id, string, system-id

circuit-id — Specifies the DHCP4 option (82,1) or DHCP6 option 18.
mac — Specifies the MAC address of the client. Chaddr in DHCP4 and DUID in IPv6.
option60 — Specifies the DHCP4 option 60.
remote-id — Specifies the DHCP4 option (82,2) or DHCP6 option 37
(Note that the format of remote-id in IPv6 is different that the format of remote-id in IPv6; IPv6 remote-id contains enterprise-id filed that is also honored in matching.)
dual-stack-remote-id — Specifies the enterprise-id in v6 Remote-id will be stripped off before LUDB matching is performed. Processing of IPv4 Remote-id remains unchanged. This will allow a single host entry in LUDB for dual-stack host where host identification is performed

based on the Remote-id field.
sap-id — Specifies the SAP ID on which DHCPv4 packet are received. The sap-id is inserted as ALU VSO (82,9,4) by the DHCPv4 relay in 7x50. This is enabled via configuration under the vendor-specific-option CLI hierarchy of the DHCPv4 relay. Since the dhcp-relay configuration is enabled under the group-interface CLI hierarchy, the group-interface and the service-id must be known before the sap-id can be used for LUDB match.
encap-tag-range — Specifies the VLAN tags.
service-id — Specifies the service-id of the ingress SAP for DHCPv4 packets. The service-id is inserted as ALU VSO (82,9,3) by the DHCPv4 relay in 7x50. This is enabled via configuration under the vendor-specific-option CLI hierarchy of the DHCPv4 relay.
string — Specifies the custom string configured under the vendor-specific-option CLI hierarchy of the DHCPv4 relay. The string is inserted as ALU VSO (82,9,5) by the DHCPv4 relay in 7x50. Since the dhcp-relay configuration is enabled under the group-interface CLI hierarchy, the group-interface and the service-id must be known before the string can be used for LUDB match.
system-id — Specifies thesystem-id of the node name configured under the system>name CLI hierarchy. The system-id is inserted as ALU VSO (82,9,1) by the DHCPv4 relay in 7x50. This is enabled via configuration under the vendor-specific-option CLI hierarchy of the DHCPv4 relay. Since the dhcp-relay configuration is enabled under the group-interface CLI hierarchy, the group-interface and the service-id must be known before the system-id can be used for LUDB match.

derived-id — Specifies the value extracted by Pyton script during processing of DHCP Discover/Solicit/Request/Renew/Rebind Messages (client to server bound messages). The value is stored in the DHCP Transaction Cache (DTC) in a variable named alc.dtc.derivedId. This value has a lifespan of a DHCP transaction (a single pair of messages exchanged between the client and the server; for example DHCP Discover and DHCP Offer).

password

Syntax **password** {**ignore** | **chap** *string* |**pap** *string*} [**hash**|**hash2**]
no password

Context config>subscr-mgmt>loc-user-db>ppp>host

Description This command specifies a password type or configures password string for **pap** or **chap**. The pap and chap passwords are stored in a hashed format in the config files. The **hash**|**hash2** optional keywords are used for config execution.

This command will only be interpreted if the local user database is connected directly to the PPPoE node under the VPRN/IES group interface. It is not used if the local user database is accessed by a local DHCP server.

Parameters **ignore —** Specifies that the password will be ignored, in which case authentication will always succeed, independent of the password used by the PPPoE client. The client must still perform authentication.

chap *string* **—** Specifies that the password for Challenge-Handshake Authentication Protocol) (CHAP) is used. Only a password received with the CHAP protocol will be accepted.

pap *string* **—** Specifies that the Password Authentication Protocol (PAP) is used. Only a password received with the PAP protocol will be accepted, even though the CHAP protocol will be proposed to the client first because it is unknown at the time of the offer which password type will be allowed to the client.

hash|**hash2 —** Specifies hashing scheme.

pre-auth-policy

Syntax **pre-auth-policy** *policy-name*
no pre-auth-policy

Context config>subscr-mgmt>loc-user-db>ppp>host

Description This command configures the pre-authentication policy of this host.

retail-service-id

Syntax **retail-service-id** *service-id*
no retail-service-id

Context config>subscr-mgmt>loc-user-db>ipoe>host
config>subscr-mgmt>loc-user-db>ppp>host

Description This command indicates the service ID of the retailer VPRN service to which this session belongs. If the value of this object is non-zero, the session belongs to a retailer VPRN.

The **no** form of the command removes the service ID from the configuration.

Default no retail-service-id

Parameters *service-id* — Specifies the the retailer service ID.

Values

service-id:	1 — 2147483647
service-name:	Service name up to 64 characters in length.

server6

Syntax **server6** *ipv6-address*
no server6

Context config>subscr-mgmt>loc-user-db>ipoe>host

Description This command allows DHCP6 server selection based on the host entry in LUDB.

The configured DHCP6 message must reference one if the v6 addressees configured under the **configure>service>vprn>sub-if>grp-if>ipv6>dhcpv6>relay** or **configure>service>ies>sub-if>grp-if>ipv6>dhcpv6>relay** context.

Default no server6

Parameters *ipv6-address* — Specifies the the retailer service ID.

Values

service-id:	1 — 2147483647
service-name:	Service name up to 64 characters in length.

MLPPP on LNS Commands

accept-mrru

Syntax [**no**] **accept-mrru**

Context configure>subscr-mgt>ppp-policy>mlppp

Description This command is applicable only to LAC. MRRU option is an indication that the session is of MLPPPoX type. The 7750 LAC will never initiate MRRU option in LCP negotiation process. However, it will respond to MRRU negotiation request by the client.

This command provides an option to specifically enable or disable negotiation of MLPPPoX on a capture SAP level or on a group-interface level.

Default no accept-mrru — The MRRU option in LCP will not be negotiated by LAC.

admin-state

Syntax **admin-state** {**up** | **down**}
no admin-state

Context configure>router>l2tp>group>tunnel>mlppp
configure>service>vprn>l2tp>group>tunnel>mlppp

Description This command is applicable only to LNS.

The tunnel can be explicitly activated (assuming that the parent group is in a no shutdown state) or deactivated by the **up** and **down** keywords.

If case that there is no admin-state configured, the tunnel will inherit its administrative state from its parent (group).

Default no admin-state — Tunnel administrative state is inherited from the group.

up — Tunnel is in administratively up.

down — Tunnel is administratively down.

encap-offset

Syntax **encap-offset** [**type** *encap-type*]
no encap-offset

Context configure>subscriber-mgmt>local-user-db>ppp>host>access-loop

Description This command is applicable within the LAC/LNS context. It provides the last mile link encapsulation information that is needed for proper (shaping) rate calculations and interleaving delay in the last mile.

The encapsulation value will be taken from the following sources in the order of priority:

- Statically provisioned value in local user database (LUDB).
- RADIUS
- PPPoE tags on LAC or ICRQ message (RFC 5515) on LNS

In case that the encapsulation information is not provided by any of the existing means (LUDB, RADIUS, AVP signaling, PPPoE Tags), then by default pppoea-null encapsulation will be in effect.

The following values are supported encapsulation values on LNS in the 7750.

encap-type:

pppoa-llc	LLC (NLPID) PPPoA encapsulation.
pppoa-null	VC-MUX PPPoA encapsulation.
pppoeoa-llc	LLC/SNAP based bridged Ethernet PPPoEoA encapsulation without FCS.
pppoeoa-llc-fcs	LLC/SNAP based bridged Ethernet PPPoEoA encapsulation with FCS.
pppoeoa-null	VC-MUX PPPoEoA encapsulation without FCS.
pppoeoa-null-fcs	VC-MUX PPPoEoA encapsulation with FCS.
pppoe	PPPoE encapsulation.
pppoe-tagged	Tagged PPPoE Encapsulation.

The values are not supported encapsulation values on LNS in the 7750.

pppoeoa-llc-tagged
pppoeoa-llc-tagged-fcs
pppoeoa-null-tagged
pppoeoa-null-tagged-fcs
ipoa-llc
ipoa-null
ipoeeoa-llc
ipoeoa-llc-fcs
ipoeoa-llc-tagged
ipoeoa-llc-tagged-fcs
ipoeoa-null
ipoeoa-null-fcs
ipoeoa-null-tagged
ipoeoa-null-tagged-fcs
ipoe
ipoe-tagged

Default no encap-offset No offset is configured.

endpoint

Syntax **endpoint ip** *ip-address*
endpoint mac *ieee-address*
endpoint system-ip
endpoint system-mac
no endpoint

Context configure>router>l2tp>group>mlppp
configure>router>l2tp>group>tunnel>mlppp
configure>service>vprn>l2tp>group>mlppp
configure>service>vprn>l2tp>group>tunnel>mlppp
configure>subscr-mgt>ppp-policy>mlppp

Description When configured under the l2tp hierarchy, this command is applicable to LNS.

Within the ppp-policy, this command is applicable only to LAC.

The endpoint, according to RFC 1990, represents the system transmitting the packet. It is used during MLPPPoX negotiation phase to distinguish this peer from all others.

In the case that the client rejects the endpoint option during LCP negotiation, the LAC and the LNS must be able to negotiate the LCP session without the endpoint option.

The **no** form of this command disables sending endpoint option in LCP negotiation.

Default no endpoint

Parameters **ip** *ip-address* — Specifies the IPv4 address (class 2)

system-ip — Specifies to use the system IPv4 address (class 2)

mac *ieee-address* — Specifies the MAC address of the interface (class 3).

system-mac — Specifies to use the MAC address of the system (class 3)

interleave

Syntax [**no**] **interleave**

Context configure>router>l2tp>group>mlppp
configure>service>vprn>l2tp>group>mlppp

Description This command is applicable only to LNS. Interleaving is supported only on MLPPPoX bundles that contain a single member link. If more than one link is present in the MLPPPoX bundle, interleaving will be automatically disabled and a TRAP/log (tmnxMlpppBundleIndicatorsChange) will be generated.

The minimum supported rate of the link on which interleaving is performed is 1kbps.

If configured at this level, interleaving will be enabled on all tunnels within the group, unless it is explicitly disable per tunnel.

Default no interleave — Interleaving per group is disabled.

interleave

Syntax **interleave** {**always** | **never**}
no interleave

Context configure>router>l2tp>group>tunnel>mlppp
configure>service>vprn>l2tp>group>tunnel>mlppp

Description This command is applicable only to LNS. Interleaving is supported only on MLPPPoX bundles that contain a single member link. If more than one link is present in the MLPPPoX bundle, interleaving will be automatically disabled and a TRAP/log (tmnxMlpppBundleIndicatorsChange) will be generated.

The minimum supported rate of the link on which interleaving is performed is 1kbps.

Interleaving configured on this level will overwrite the configuration option under the group hierarchy. If the no form of the command is configured for interleaving at this level, the interleaving configuration will inherit the configuration option configured under the l2tp group.

Default no interleave — Interleaving configuration is inherited from the group.

Parameters **always —** Always perform interleaving on single linked MLPPPoX sessions within this tunnel, regardless of the configuration option for interleaving under the group level.

never — Never perform interleaving on single linked MLPPPoX sessions within this tunnel, regardless of the configuration option for interleaving under the group level.

load-balance-method

Syntax **load-balance-method** {**session** | **tunnel**}
no load-balance-method

Context configure>router>l2tp>group
configure>router>l2tp>group>tunnel
configure>service>vprn>l2tp>group
configure>service>vprn>l2tp>group>tunnel

Description This command is applicable only to LNS. By default traffic load balancing between the BB-ISAs is based on sessions. Each session is individually assigned to an BB-ISA during session establishment phase.

By introducing MLPPPoX, all sessions of a bundle must be terminated on the same LNS BB-ISA. This is necessary for two reasons:

- QoS in the carrier IOM has a uniform view of the subscriber
- a single BB-ISA is responsible for MLPPPoX encapsulation/fragmentation for a given bundle.

Therefore, if fragmentation is enabled, load-balancing per tunnel must be configured. In the per tunnel load-balancing mode, all sessions within the same tunnel are terminated on the same LNS BB-ISA.

In the case that we have MLPPPoX sessions with a single member link, both load-balancing methods are valid.

The **no** form of this command set the per session load balancing.

Default session — Per session load balancing is enabled by default.

Parameters **session —** Traffic load balancing between the LNS BB-ISAs is based on individual PPPoE sessions.

tunnel — Traffic load balancing between the LNS BB-ISAs is based on tunnels.

max-fragment-delay

Syntax **max-fragment-delay** *mili-seconds*
no max-fragment-delay

Context configure>router>l2tp>group>mlppp
configure>router>l2tp>group>tunnel>mlppp
configure>service>vprn>l2tp>group>mlppp
configure>service>vprn>l2tp>group>tunnel>mlppp

Description This command is applicable only to LNS. It determines the maximum fragment delay caused by the transmission that will be imposed on a link.

Fragmentation can be used to interleave high priority packet in-between low priority fragments on a MLPPPoX session with a single link or on a MLPPPoX session with multiple links to better load balance traffic over multiple member links.

Default no max-fragment-delay — Fragmentation is disabled.

Parameters *mili-seconds* — Specfies the interval in mili-seconds.

Values 5-1000ms

max-link

Syntaxs **max-links** *max-links*
no max-links

Context configure>router>l2tp>group>mlppp
configure>router>l2tp>group>tunnel>mlppp
configure>service>vprn>l2tp>group>mlppp
configure>service>vprn>l2tp>group>tunnel>mlppp

Description This command is applicable only to LNS. It determines the maximum number of links that can be put in a bundle.

Any attempt of a session to join a bundle that is above the max-link limit will be rejected.

If interleaving is configured, it is recommended that max-links be set to 1 or a ?o?version of the command is used (no max-links). Both have the same effect.

The configuration under the tunnel hierarchy will override the configuration under the group hierarchy.

The **no** form of this command limits the number of links in the bundle to 1.

Default no max-links — A single link per bundle is allowed.

Parameters *max-links* — Specifies the maximum number of links in a bundle.

Values 1 — 8

reassembly-timeout

Syntax **reassembly-timeout** {{**100** | **1000**} **milliseconds**}
no reassembly-timeout

Context configure>router>l2tp>group>mlppp
configure>router>l2tp>group>tunnel>mlppp
configure>service>vprn>l2tp>group>mlppp

configure>service>vprn>l2tp>group>tunnel>mlppp

Description This command is applicable only to LNS. It determines the time during which the LNS keeps fragments of the same packet in the buffer before it discards them. The assumption is that if the fragments do not arrive within certain time, the chance is that they were lost somewhere in the network. In this case the partial packet cannot be reassembled and all fragments that has arrived up to this point and are stored in the buffer will be discarded in order to free up the buffer. Otherwise, a condition will arise in which partial packets will be held in the buffer until the buffer is exhausted.

The configuration under the tunnel hierarchy will override the configuration under the group hierarchy.

The **no** form of this command also sets the time-out to 1000ms.

Default 1000

Parameters {{**100** | **1000**} **milliseconds**} — Specifies the reassembly timeout value.

rate-down

Syntax **rate-down** *rate*
no rate-down

Context configure>subscriber-mgmt>local-user-db>ppp>host>access-loop

Description This command is applicable to LAC and LNS. It provides the last mile link rate in the downstream direction that is needed for proper shaping and calculating the interleaving delay.

The rate information in the last mile will be taken from the following sources in the order of priority:

- Statically provisioned value in local user database (LUDB).
- RADIUS.
- PPPoE tags on LAC or ICRQ message (RFC 5515) /ICCN message (TX Connect Seed) on LNS.

Default no rate-down

Parameters *rate* — Specifies last mile link downstream rate in the access loop

Values 1 — 100000 kbps

short-sequence-numbers

Syntax [**no**] **short-sequence-numbers**

Context configure>subscr-mgt>ppp-policy>mlppp

Description This command enables a peer request to send short sequence numbers. This command is applicable to LAC and LNS. By default, MLPPPoX will negotiate 24bit long sequence numbers. This command allows this to be changed to shorter, 12-bit sequence numbers.

Default short-sequence-numbers

Show Commands

id

Syntax **id** *service-id*

Context show>service

Description This command displays information for a particular service-id.

Parameters *service-id* — The unique service identification number that identifies the service in the service domain.

all — Display detailed information about the service.

base — Display basic service information.

fdb — Display FDB entries.

labels — Display labels being used by this service.

sap — Display SAPs associated to the service.

sdp — Display SDPs associated with the service.

split-horizon-group — Display split horizon group information.

stp — Display STP information.

dhcp

Syntax **dhcp**

Context show>router
show>service>id

Description This command enables the context to show DHCP statistics.

dhcp6

Syntax **dhcp6**

Context show>router
show>service>id

Description This command enables the context to show DHCP6 statistics.

dhcp6

Syntax **dhcp6**

Context show>system

Description This command displays system-wide DHCPv6 configuration information.

Sample Output

```
A:PE-1# show system dhcp6
===============================================================================
DHCP6 system
===============================================================================
Global NoAddrsAvail status  : esm-relay server
===============================================================================
```

lease-state

Syntax **lease-state** [**detail**]
lease-state [**detail**] **interface** *interface-name*
lease-state [**detail**] **ipv6-address** *ipv6-prefix*[/*prefix-length*]
lease-state [**detail**] **mac** *ieee-address*

Context show>service>id>dhcp6

Description This command displays DHCP6 lease state related information.

Sample Output

```
*A:Dut-C# show service id  202 dhcp6 lease-state
===============================================================================
DHCP lease state table, service 202
===============================================================================
IP Address      Mac Address       Sap/Sdp Id          Remaining  Lease    MC
                                                      LifeTime   Origin   Stdby
-------------------------------------------------------------------------------
1::/120
                                  1/1/6               30d33h12m  DHCP
-------------------------------------------------------------------------------
Number of lease states : 1
===============================================================================
*A:Dut-C#


*A:Dut-C# show service id  202 dhcp6 lease-state  detail
===============================================================================
DHCP lease states for service 202
===============================================================================
Service ID           : 202
IP Address           : 1::/120
Mac Address          :
Interface            : ip-11.3.202.3
SAP                  : 1/1/6
Remaining Lifetime   : 30d33h12m
Persistence Key      : N/A
```

```
Sub-Ident            : ""
Sub-Profile-String   : ""
SLA-Profile-String   : ""
Lease ANCP-String    : ""
Dhcp6 ClientId (DUID): 0101
Dhcp6 IAID           : 1
Dhcp6 IAID Type      : prefix
Dhcp6 Client Ip      : FE80::200:FF:FE00:202

ServerLeaseStart     : 09/01/2002 04:27:00
ServerLastRenew      : 09/01/2002 04:27:00
ServerLeaseEnd       : 10/01/2002 04:27:00
-------------------------------------------------------------------------------
Number of lease states : 1
===============================================================================
*A:Dut-C#
```

statistics

Syntax **statistics** [**sap** *sap-id*] | [**sdp** [*sdp-id*[:*vc-id*]] | **interface** *ip-int-name*]]

Context show>service>id>dhcp
show>router>dhcp

Description This command displays statistics for DHCP relay and DHCP snooping.

If no IP address or interface name is specified, then all configured interfaces are displayed.

If an IP address or interface name is specified, then only data regarding the specified interface is displayed.

Parameters ***sap-id* —** Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp-id — The SDP ID to be shown.

Values 1— 17407

vc-id — The virtual circuit ID on the ID to be shown.

Values 1 — 4294967295

ip-int-name | *ip-address* — Displays statistics for the specified IP interface.

Output **Show DHCP Statistics Output —** The following table describes the output fields for DHCP statistics.

Label	Description
Received Packets	The number of packets received from the DHCP clients.
Transmitted Packets	The number of packets transmitted to the DHCP clients.
Received Malformed Packets	The number of malformed packets received from the DHCP clients.

Label	Description (Continued)
Received Untrusted Packets	The number of untrusted packets received from the DHCP clients.
Client Packets Discarded	The number of packets received from the DHCP clients that were discarded.
Client Packets Relayed	The number of packets received from the DHCP clients that were forwarded.
Client Packets Snooped	The number of packets received from the DHCP clients that were snooped.
Server Packets Discarded	The number of packets received from the DHCP server that were discarded.
Server Packets Relayed	The number of packets received from the DHCP server that were forwarded.
Server Packets Snooped	The number of packets received from the DHCP server that were snooped.

Sample Output

```
A:ALA-A# show router 1000 dhcp statistics
===============================================================
DHCP Global Statistics (Service: 1000)
===============================================================
Rx Packets                          : 16000
Tx Packets                          : 15041
Rx Malformed Packets                : 0
Rx Untrusted Packets                : 0
Client Packets Discarded            : 423
Client Packets Relayed              : 0
Client Packets Snooped              : 0
Client Packets Proxied (RADIUS)     : 0
Client Packets Proxied (Lease-Split) : 0
Server Packets Discarded            : 0
Server Packets Relayed              : 0
Server Packets Snooped              : 0
DHCP RELEASEs Spoofed               : 0
DHCP FORCERENEWs Spoofed            : 0
===============================================================
A:ALA-A#
```

summary

Syntax **summary**

Context show>router>dhcp
show>service>id>dhcp

Description Display the status of the DHCP Relay and DHCP Snooping functions on each interface.

OutputOutput **Show DHCP Summary Output —** The following table describes the output fields for DHCP summary.

Label	Description
Interface Name	Name of the router interface.
ARP Populate	Indicates whether ARP populate is enabled.
Used/Provided	Indicates the number of used and provided DHCP leases.
Info Option	Indicates whether Option 82 processing is enabled on the interface.
Admin State	Indicates the administrative state.

Sample Output

```
A:ALA-48>show>router>dhcp# summary
===============================================================================
===============================================================================
Interface Name                   Arp      Used/     Info    Admin
                                 Populate Provided  Option  State
-------------------------------------------------------------------------------
ccaiesif                         No       0/0       Keep    Down
ccanet6                          No       0/0       Keep    Down
iesBundle                        No       0/0       Keep    Up
spokeSDP-test                    No       0/0       Keep    Down
test                             No       0/0       Keep    Up
test1                            No       0/0       Keep    Up
test2                            No       0/0       Keep    Up
testA                            No       0/0       Keep    Up
testB                            No       0/0       Keep    Up
testIES                          No       0/0       Keep    Up
to-web                           No       0/0       Keep    Up
-------------------------------------------------------------------------------
Interfaces: 11
===============================================================================
A:ALA-48>show>router>dhcp#
```

virtual-subnet

Syntax **virtual-subnet subscriber** *sub-ident*
virtual-subnet [**sap** *sap-id*]

Context show>service>id

Description This command displays currently recorded default gateway and submets for all virtual subnets enabled for DHCPv4 hosts in the specified service.

Parameters **subscriber** *sub-ident* — Displays information relating to the specified subscriber ID.

sap *sap-id* — Displays information relating to the specified SAP ID.

Sample Output

```
show service id 500 virtual-subnet
```

```
===============================================================================
Virtual subnets in service 500
===============================================================================
Subscriber                  : 00:20:fc:1e:cd:52|1/1/9:200
-------------------------------------------------------------------------------
Default router              : 192.168.100.254
Subnet                      : 192.168.100.0/24
SAP                         : 1/1/9:200
-------------------------------------------------------------------------------
No. of subnets: 1
===============================================================================
```

statistics

Syntax **statistics** [**interface** *ip-int-name*]

Context show>router>dhcp6
show>service>id>dhcp6

Description This command displays statistics for DHCP relay and DHCP snooping.

Sample Output

```
A:ALA-A# show router 1000 dhcp statistics
===============================================================
DHCP Global Statistics (Service: 1000)
===============================================================
Rx Packets                          : 16000
Tx Packets                          : 15041
Rx Malformed Packets                : 0
Rx Untrusted Packets                : 0
Client Packets Discarded            : 423
Client Packets Relayed              : 0
Client Packets Snooped              : 0
Client Packets Proxied (RADIUS)     : 0
Client Packets Proxied (Lease-Split) : 0
Server Packets Discarded            : 0
Server Packets Relayed              : 0
Server Packets Snooped              : 0
DHCP RELEASEs Spoofed               : 0
DHCP FORCERENEWs Spoofed            : 0
===============================================================
A:ALA-A#
```

summary

Syntax **summary**

Context show>router>dhcp6
show>service>id>dhcp6

Description Display the status of the DHCP6 relay and DHCP snooping functions on each interface.

Output **Show DHC6P Summary Output —** The following table describes the output fields for DHCP6 summary.

Label	Description
Interface Name	Name of the router interface.
Nbr. Resol.	Indicates whether or not neighbor resolution is enabled.
Used/Provided	Indicates the number of used and provided DHCP leases.
Admin State	Indicates the administrative state.
Oper State	Indicates the operational state.

Sample Output

```
*A:Dut-C# show router dhcp6 summary
===============================================================================
DHCP6 Summary (Router: Base)
===============================================================================
Interface Name                  Nbr      Used/Max Relay     Admin  Oper Relay
  SapId                         Resol.   Used/Max Server    Admin  Oper Server
-------------------------------------------------------------------------------
ip-1.1.1.10                     No          0/0             Down   Down
  sap:1/1/5                                 0/8000          Down   Down
ip-11.3.202.3                   No          0/0             Down   Down
  sap:1/1/6                                 1/8000          Up     Up
-------------------------------------------------------------------------------
Interfaces: 2
===============================================================================
*A:Dut-C#
```

local-dhcp-server

Syntax **local-dhcp-server** *server-name*

Context show>router>dhcp

Description This command displays local DHCP server information.

Parameters *server-name* — Specifies information about the local DHCP server.

Sample Output

```
*A:ALA-48>show>router>dhcp>local-dhcp-server# declined-addresses pool test
===============================================================================
Declined addresses for server test Base
===============================================================================
 Pool                             Subnet              IP Address
PPPoe User Name/                 Time                MAC Address       Type
Option 82 Circuit ID
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
No Matching Entries
===============================================================================
```

```
*A:ALA-48>show>router>dhcp>local-dhcp-server#
```

associations

Syntax **associations**

Context show>router>dhcp>local-dhcp-server
show>router>dhcp

Description This command displays the interfaces associated with this DHCP or DHCP6 server.

Sample Output

```
*A:SUB-Dut-A# show router dhcp local-dhcp-server dhcpS1 associations
===============================================================================
DHCP server s1  router 3
===============================================================================
Associations                    Admin
-------------------------------------------------------------------------------
tosim5                          Up
===============================================================================
*A:SUB-Dut-A#
```

declined-addresses

Syntax **declined-addresses** *ip-address*[/*mask*] [**detail**]
declined-addresses pool *pool-name*

Context show>router>dhcp>local-dhcp-server

Description This command display information about declined addresses.

Parameters **pool** *pool-name* **—** Specifies a DHCP pool name on the router.

ip-address — Specifies the IP address of the DNS server. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

detail — Displays detailed information.

Sample Output

```
*A:ALA-48>show>router>dhcp>local-dhcp-server# declined-addresses pool test
===============================================================================
Declined addresses for server test Base
===============================================================================
 Pool                             Subnet              IP Address
PPPoe User Name/                 Time                MAC Address       Type
Option 82 Circuit ID
-------------------------------------------------------------------------------
No Matching Entries
===============================================================================
*A:ALA-48>show>router>dhcp>local-dhcp-server#
```

free-addresses

Syntax **free-addresses** *ip-address*[/*mask*]
free-addresses summary [**subnet** *ip-address*[/*mask*]
free-addresses pool *pool-name*

Context show>router>dhcp>local-dhcp-server

Description This command displays the free addresses in a subnet.

Parameters **pool** *pool-name* — Specifies a DHCP pool name on the router.

subnet *subnet* — Specifies a subnet of IP addresses that are served from the pool.

summary — Displays summary output of the free addresses.

Sample Output

```
*A:ALA-48>show>router>dhcp>local-dhcp-server# free-addresses pool test subnet
1.0.0.0/24
===============================================================================
Free addresses in subnet 1.0.0.0/24
===============================================================================
IP Address
-------------------------------------------------------------------------------
No. of free addresses: 0
===============================================================================
*A:ALA-48>show>router>dhcp>local-dhcp-server#
```

interface-id-mapping

Syntax **interface-id-mapping**

Context show>router>dhcp6>local-dhcp-server

Description This command displays the DHCP6 interface-id mappings.

Sample Output

```
show router 600 dhcp6 local-dhcp-server "d6" interface-id-mapping
===============================================================================
Interface-ID Mappings for DHCPv6 server d6
===============================================================================
Mapped Prefix      : 2001:AAAA::/64
Relay Interface ID : 1/1/10
LDRA Interface ID  : (Not Specified)
Active Leases      : 2001:AAAA::1 (stable)
===============================================================================
1 prefix found
===============================================================================
```

leases

Syntax **leases**
leases *ip-address*[/*mask*] **address-from-user-db** [**detail**]
leases *ip-address*[/*mask*] **dhcp-host** *dhcp-host-name* [**detail**]
leases *ip-address*[/*mask*] **ppp-host** *ppp-host-name* [**detail**]
leases *ip-address*[/*mask*] [**detail**]

Context show>router>dhcp>local-dhcp-server

Description This command displays the DHCP leases.

Parameters *ip-address* — Specifies the base IP address of the subnet. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

mask — The subnet mask in dotted decimal notation.

Values 0 — 32

address-from-user-db [**detail**] **—** Displays only leases that have ip-addresses from the local-user-db.

dhcp-host *dhcp-host-name* [**detail**] **—** Shows all leases that match a certain DHCP host from the local-user-db.

ppp-host *ppp-host-name* [**detail**] **—** Displays all leases that match a certain PPPoE host from the local-user-db.

detail — Displays detailed information of all leases that fall into the indicated subnet.

The command with no parameters will show all leases from the local-user-db.

Sample Output

```
*A:ALA-48>show>router>dhcp>local-dhcp-server# leases ip-address 1.0.0.4
===============================================================================
Leases for DHCP server test router Base
===============================================================================
IP Address      Lease State       Mac Address       Remaining Clnt
  PPPoE user name/Opt82 Circuit Id                  LifeTime  Type
-------------------------------------------------------------------------------
No leases found
*A:ALA-48>show>router>dhcp>local-dhcp-server#
```

leases

Syntax **leases** [*ipv6-address/prefix-length*] [*type*] [*state*] [**detail**]

Context show>router>dhcp6>local-dhcp-server

Description This command displays the DHCP6 leases.

Parameters *ipv6-address* — Specifies the base IP address of the subnet. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

mask — The subnet mask in dotted decimal notation.

Values 0 — 32

type — Displays the lease type.

Values pd, wan-host

state — Displays the state of the lease.

Values advertised, remove-pending, held

detail — Displays detailed information of all leases that fall into the indicated subnet.

The command with no parameters will show all leases from the local-user-db.

Sample Output

```
show router 600 dhcp6 local-dhcp-server "d6" leases
===============================================================================
Leases for DHCPv6 server d6
===============================================================================
IP Address/Prefix                          Lease State       Remaining   Fail
  Link-local Address                                         LifeTime    Ctrl
-------------------------------------------------------------------------------
2001:AAAA::1/128
  FE80::220:FCFF:FE1E:CD52                 stable            23h58m52s   local
-------------------------------------------------------------------------------
1 leases found
===============================================================================
```

pool-ext-stats

Syntax **pool-ext-stats** [*pool-name*]

Context show>router>dhcp>server

Description This command displays extended statistics per DHCPv4 pool in local DHCPv4 server.

The following statistics are included in output:

- The number of stable leases in the pool
- The number of provisioned address in the pool
- The number of used address in the pool
- The number of free address in the pool
- The percentage of used address
- The percentage of free address

For each statistic (except for Provisioned Addresses), there is current value and peak value, peak value is the highest value since pool creation or last reset via the **clear router** *rt-id* **dhcp local-dhcp-server** *svr-name* **pool-ext-stats** command.

Parameters *pool-name* — Specify the name of DHCPv4 local server pool.

Sample Output

```
show router 500 dhcp local-dhcp-server "d4" pool-ext-stats "pool-1"
===============================================================================
Extended pool statistics for server "d4"
===============================================================================
                          Current         Peak            TimeStamp
-------------------------------------------------------------------------------
Pool                      pool-1
Local:
  Stable Leases           0               0               01/07/2013 19:07:11
  Provisioned Addresses   101
  Used Addresses          0               0               01/07/2013 19:07:11
  Free Addresses          101             101             01/07/2013 19:07:11
  Used Pct                0               0               01/07/2013 19:07:11
  Free Pct                100             100             01/07/2013 19:07:11
Last Reset Time                                           01/07/2013 19:07:11
-------------------------------------------------------------------------------
Number of entries         1
===============================================================================
```

pool-ext-stats

Syntax **pool-ext-stats** [*pool-name*]

Context show>router>dhcp6>server

Description This command displays extended statistics per DHCPv6 pool in local DHCPv6 server.

The following statistics are included in output:

- The number of stable leases in the pool
- The number of provisioned /64 address block in the pool
- The number of used /64 address block in the pool
- The number of free /64 address block in the pool
- The percentage of used address (with /64 address block)
- The percentage of free address (with /64 address block)

For each statistic (except for Provisioned Addresses), there is current value and peak value, peak value is the highest value since pool creation or last reset via command “clear router <rt-id> dhcp6 local-dhcp-server <svr-name> pool-ext-stats”.

Parameters *pool-name* — Specify the name of DHCPv6 local server pool.

Sample Output

```
show router 500 dhcp6 local-dhcp-server "d6" pool-ext-stats "pool-v6"
===============================================================================
Extended pool statistics for server "d6"
===============================================================================
                          Current         Peak            TimeStamp
-------------------------------------------------------------------------------
Pool                      pool-v6
Local:
  Stable Leases           0               0               01/07/2013 19:54:52
  Provisioned Blks        4
  Used Blks               0               0               01/07/2013 19:54:52
```

```
  Free Blks                4               4               01/07/2013 19:54:52
  Used Pct                 0               0               01/07/2013 19:54:52
  Free Pct                 100             100             01/07/2013 19:54:52
Last Reset Time                                            01/07/2013 19:54:52
-------------------------------------------------------------------------------
Number of entries          1
===============================================================================
```

prefix-ext-stats

Syntax **prefix-ext-stats** *ipv6-address/prefix-length*
prefix-ext-stats pool *pool-name*

Context show>router>dhcp6>server

Description This command displays extended statistics per DHCPv6 prefix in local DHCPv6 server.

The following statistics are included in output:

- The number of stable leases in the prefix
- The number of provisioned /64 address block in the prefix
- The number of used /64 address block in the prefix
- The number of free /64 address block in the prefix
- The percentage of used address (with /64 address block)
- The percentage of free address (with /64 address block)

For each statistic (except for “Provisioned Addresses”), there is current value and peak value, peak value is the highest value since prefix creation or last reset via command “clear router <rt-id> dhcp6 local-dhcp-server <svr-name> prefix-ext-stats”.

When parameter “pool” is used, the statistics of each prefix in the pool will be displayed.

Parameters *ipv6-address/prefix-length* — Specifies the IPv6 prefix

pool-name — The name of DHCPv6 local server pool

Sample Output

```
show router 500 dhcp6 local-dhcp-server "d6" prefix-ext-stats 2001:ABCD::/62
===============================================================================
Extended statistics for prefix 2001:ABCD::/62
===============================================================================
                           Current         Peak            TimeStamp
-------------------------------------------------------------------------------
Local:
  Failover Oper State      Active
  Stable Leases            0               0               01/07/2013 19:54:52
  Provisioned Blks         4
  Used Blks                0               0               01/07/2013 19:54:52
  Free Blks                4               4               01/07/2013 19:54:52
  Used Pct                 0               0               01/07/2013 19:54:52
  Free Pct                 100             100             01/07/2013 19:54:52
Last Reset Time                                            01/07/2013 19:54:52
-------------------------------------------------------------------------------
Number of entries          1
```

```
===============================================================================
```

pool-threshold-stats

Syntax **pool-threshold-stats** [*pool-name*] **detail** [**format** {**exact**|**scientific**}]
pool-threshold-stats [*pool-name*]

Context show>router>dhcp6>server

Description This commands displays pool level threshold stats of local DHCPv6 server. A minimum-free threshold needs to be configured before system collects threshold stats for the prefix.

The stats for each threshold are calculated based on the configured minimum-free prefix length.

For example, a /59 prefix is provision in the local DHCPv6 server, and the server allocated two PD leases, one /62 and one /63. And there is a /63 minimum threshold configured. So the threshold stats are calculated based on /63 as the base unit(block). So the value of "current used block" would be 3 because there is one /62 lease and one /63 lease, so it equals to total three /63.

Parameters *pool-name* — Specifies the name of the pool in local DHCPv6 server.

detail — Displays detailed output.

format — Specifies the format in the display to be either **exact** or **scientific.**

Sample Output

```
show router 500 dhcp6 local-dhcp-server "d6" pool-threshold-stats "1"
===============================================================================
Server "d6"
===============================================================================
  Operational state         : inService
-------------------------------------------------------------------------------
Pool                        : 1
-------------------------------------------------------------------------------
  Stable leases             : 2
  Advertised leases         : 0
  -----------------------------------------------------------------------------
  Threshold   Used   Peak   Too low   Depleted   Peak timestamp
  -----------------------------------------------------------------------------
  /62         25%    25%    N         N          01/21/2015 21:52:12
  /63         19%    19%    N         N          01/21/2015 21:52:12
```

The command shown above displays an overview of pool level thresholds in the specified pool:

- The **Peak** field indicates the peak value of used
- The **Too low** field indicate if the configured minimum-free threshold is exceed
- The **Depleted** field indicate if there is no available prefix with the length in the provisioned prefix
- The **Peak timestamp** field indicates the time of peak used value

```
show router 500 dhcp6 local-dhcp-server "d6" pool-threshold-stats "1" detail
===============================================================================
Server "d6"
```

```
===============================================================================
  Operational state         : inService
-------------------------------------------------------------------------------
Pool                        : 1
-------------------------------------------------------------------------------
  Stable leases             : 2
  Advertised leases         : 0
  -----------------------------------------------------------------------------
  Threshold                 : /62
  -----------------------------------------------------------------------------
  Current Provisioned Blks  : 8.000000x10^0
  Current Used Blks         : 2.000000x10^0
  Current Free Blks         : 6.000000x10^0
  Current Used Percent      : 25%
  Current Used Peak Blks    : 2.000000x10^0
  Current Used Peak Percent : 25%
  Current Used Peak Time    : 01/21/2015 21:52:12
  Current Free Percent      : 75%
  Current Free Too Low      : N
  Current Free Depleted     : N
  Local Provisioned Blks    : 8.000000x10^0
  Local Used Blks           : 2.000000x10^0
  Local Free Blks           : 6.000000x10^0
  Local Used Peak Blks      : 2.000000x10^0
  Local Used Peak Percent   : 25%
  Local Used Peak Time      : 01/21/2015 21:52:12
  Remote Provisioned Blks   : 0.000000x10^0
  Remote Used Blks          : 0.000000x10^0
  Remote Free Blks          : 0.000000x10^0
  Remote Used Peak Blks     : 0.000000x10^0
  Remote Used Peak Percent  : 0%
  Remote Used Peak Time     : 01/21/2015 21:47:39
  Peak Reset Time           : 01/21/2015 21:47:39
  Valid Data                : Y
  -----------------------------------------------------------------------------
  Threshold                 : /63
  -----------------------------------------------------------------------------
  Current Provisioned Blks  : 1.600000x10^1
  Current Used Blks         : 3.000000x10^0
  Current Free Blks         : 1.300000x10^1
  Current Used Percent      : 19%
  Current Used Peak Blks    : 3.000000x10^0
  Current Used Peak Percent : 19%
  Current Used Peak Time    : 01/21/2015 21:52:12
  Current Free Percent      : 81%
  Current Free Too Low      : N
  Current Free Depleted     : N
  Local Provisioned Blks    : 1.600000x10^1
  Local Used Blks           : 3.000000x10^0
  Local Free Blks           : 1.300000x10^1
  Local Used Peak Blks      : 3.000000x10^0
  Local Used Peak Percent   : 19%
  Local Used Peak Time      : 01/21/2015 21:52:12
  Remote Provisioned Blks   : 0.000000x10^0
  Remote Used Blks          : 0.000000x10^0
  Remote Free Blks          : 0.000000x10^0
  Remote Used Peak Blks     : 0.000000x10^0
  Remote Used Peak Percent  : 0%
  Remote Used Peak Time     : 01/21/2015 21:47:39
  Peak Reset Time           : 01/21/2015 21:47:39
  Valid Data                : Y
```

The above command displays detailed statistics of all pool level thresholds in the specified pool:

- **Blks** in the output means the minimum free prefix length.
- **Valid Data** output indicates whether the data you see is valid or not. The data is invalid when a background stats update is scheduled or busy.

prefix-threshold-stats

Syntax **prefix-threshold-stats pool** *pool-name* **detail** [**format** {**exact**|**scientific**}]
prefix-threshold-stats pool *pool-name*
prefix-threshold-stats *ipv6-address*/*prefix-length* **detail** [**format** {**exact**|**scientific**}]
prefix-threshold-stats *ipv6-address*/*prefix-length*

Context show>router>dhcp6>server

Description This commands displays prefix level threshold stats of local DHCPv6 server prefix. A minimum-free threshold needs to be configured before system collects threshold stats for the prefix.

The stats for each threshold are calculated based on the configured minimum-free prefix length.

For example, a /59 prefix is provision in the local DHCPv6 server, and the server allocated two PD leases, one /62 and one /63. And there is a /63 minimum threshold configured. So the threshold stats are calculated based on /63 as the base unit(block). So the value of "current used block" would be 3 because there is one /62 lease and one /63 lease, so it equals to total three /63.

Parameters **pool** *pool-name* **—** Specifies the name of the pool in local DHCPv6 server up to 32 characters in length.

detail — Displays detailed output statistics.

format — Specifies that the number format in the display will be either **exact** or **scientific**

ipv6-address/prefix-length — Specifies the IPv6 prefix with prefix length

Values ipv6-address x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x [0..FFFF]H
d [0..255]D
prefix-length [1..128]

Sample Output

```
show router 500 dhcp6 local-dhcp-server "d6" leases
===============================================================================
Leases for DHCPv6 server d6
===============================================================================
IP Address/Prefix                          Lease State       Remaining   Fail
  Link-local Address                                         LifeTime    Ctrl
-------------------------------------------------------------------------------
8888:0:0:ffe0::/62
  fe80::3:ffff:fe00:111                    stable            18h19m2s    local
8888:0:0:ffe4::/63
  fe80::3:ffff:fe00:211                    stable            19h49m37s   local
-------------------------------------------------------------------------------
2 leases found
===============================================================================
show router 500 dhcp6 local-dhcp-server "d6" prefix-threshold-stats pool "1"
```

```
===============================================================================
Server "d6"
===============================================================================
  Operational state         : inService
-------------------------------------------------------------------------------
Pool                        : 1
-------------------------------------------------------------------------------
  Stable leases             : 2
  Advertised leases         : 0
-------------------------------------------------------------------------------
Prefix                      : 8888:0:0:ffe0::/59
-------------------------------------------------------------------------------
  Stable leases             : 2
  Advertised leases         : 0
  Draining                  : N
  -----------------------------------------------------------------------------
  Threshold   Used   Peak   Too low   Depleted   Peak timestamp
  -----------------------------------------------------------------------------
  /62         25%    25%    Y         N          01/20/2015 23:51:36
  /63         19%    19%    N         N          01/21/2015 05:00:53
===============================================================================
```

The command shown above displays an overview of prefix level thresholds in the specified pool:

- The **Peak** field indicates the peak value of used.
- The **Too low** field indicate if the configured minimum-free threshold is exceed.
- The **Depleted** field indicate if there is no available prefix with the length in the provisioned prefix.
- The **Peak** timestamp field indicates the time of peak used value.

```
show router 500 dhcp6 local-dhcp-server "d6" prefix-threshold-stats pool "1" detail
===============================================================================
Server "d6"
===============================================================================
  Operational state         : inService
-------------------------------------------------------------------------------
Pool                        : 1
-------------------------------------------------------------------------------
  Stable leases             : 2
  Advertised leases         : 0
-------------------------------------------------------------------------------
Prefix                      : 8888:0:0:ffe0::/59
-------------------------------------------------------------------------------
  Stable leases             : 2
  Advertised leases         : 0
  Draining                  : N
  -----------------------------------------------------------------------------
  Threshold                 : /62
  -----------------------------------------------------------------------------
  Current Provisioned Blks  : 8.000000x10^0
  Current Used Blks         : 2.000000x10^0
  Current Free Blks         : 6.000000x10^0
  Current Used Percent      : 25%
  Current Used Peak Blks    : 2.000000x10^0
  Current Used Peak Percent : 25%
  Current Used Peak Time    : 01/21/2015 21:59:02
  Current Free Percent      : 75%
  Current Free Too Low      : N
  Current Free Depleted     : N
  Local Provisioned Blks    : 8.000000x10^0
  Local Used Blks           : 2.000000x10^0
```

```
  Local Free Blks           : 6.000000x10^0
  Local Used Peak Blks      : 2.000000x10^0
  Local Used Peak Percent   : 25%
  Local Used Peak Time      : 01/21/2015 21:59:02
  Remote Provisioned Blks   : 0.000000x10^0
  Remote Used Blks          : 0.000000x10^0
  Remote Free Blks          : 0.000000x10^0
  Remote Used Peak Blks     : 0.000000x10^0
  Remote Used Peak Percent  : 0%
  Remote Used Peak Time     : 01/21/2015 21:59:02
  Peak Reset Time           : 01/21/2015 21:59:02
  Valid Data                : Y
  -------------------------------------------------------------------------------
  Threshold                 : /63
  -------------------------------------------------------------------------------
  Current Provisioned Blks  : 1.600000x10^1
  Current Used Blks         : 3.000000x10^0
  Current Free Blks         : 1.300000x10^1
  Current Used Percent      : 19%
  Current Used Peak Blks    : 3.000000x10^0
  Current Used Peak Percent : 19%
  Current Used Peak Time    : 01/21/2015 21:59:13
  Current Free Percent      : 81%
  Current Free Too Low      : N
  Current Free Depleted     : N
  Local Provisioned Blks    : 1.600000x10^1
  Local Used Blks           : 3.000000x10^0
  Local Free Blks           : 1.300000x10^1
  Local Used Peak Blks      : 3.000000x10^0
  Local Used Peak Percent   : 19%
  Local Used Peak Time      : 01/21/2015 21:59:13
  Remote Provisioned Blks   : 0.000000x10^0
  Remote Used Blks          : 0.000000x10^0
  Remote Free Blks          : 0.000000x10^0
  Remote Used Peak Blks     : 0.000000x10^0
  Remote Used Peak Percent  : 0%
  Remote Used Peak Time     : 01/21/2015 21:59:13
  Peak Reset Time           : 01/21/2015 21:59:13
  Valid Data                : Y
```

The command shown above displays detailed statistics of all prefix level thresholds in the specified pool:

- **Blks** means the minimum free prefix length.
- **Valid Data** output indicates whether the data is or is not valid.The data is invalid when a background stats update is scheduled or busy.

```
show router 500 dhcp6 local-dhcp-server "d6" prefix-threshold-stats 8888:0:0:ffe0::/
59
===============================================================================
Server "d6"
===============================================================================
  Operational state         : inService
-------------------------------------------------------------------------------
Pool                        : 1
-------------------------------------------------------------------------------
  Stable leases             : 2
  Advertised leases         : 0
-------------------------------------------------------------------------------
Prefix                      : 8888:0:0:ffe0::/59
-------------------------------------------------------------------------------
```

```
  Stable leases             : 2
  Advertised leases         : 0
  Draining                  : N
  -------------------------------------------------------------------------------
  Threshold   Used   Peak   Too low   Depleted   Peak timestamp
  -------------------------------------------------------------------------------
  /62         25%    25%    N         N          01/21/2015 21:59:02
  /63         19%    19%    N         N          01/21/2015 21:59:13
```

The command shown above displays an overview of prefix level thresholds in the specified provision prefix.

```
show router 500 dhcp6 local-dhcp-server "d6" prefix-threshold-stats 8888:0:0:ffe0::/
59 detail
===============================================================================
Server "d6"
===============================================================================
  Operational state         : inService
-------------------------------------------------------------------------------
Pool                        : 1
-------------------------------------------------------------------------------
  Stable leases             : 2
  Advertised leases         : 0
-------------------------------------------------------------------------------
Prefix                      : 8888:0:0:ffe0::/59
-------------------------------------------------------------------------------
  Stable leases             : 2
  Advertised leases         : 0
  Draining                  : N
  -------------------------------------------------------------------------------
  Threshold                 : /62
  -------------------------------------------------------------------------------
  Current Provisioned Blks  : 8.000000x10^0
  Current Used Blks         : 2.000000x10^0
  Current Free Blks         : 6.000000x10^0
  Current Used Percent      : 25%
  Current Used Peak Blks    : 2.000000x10^0
  Current Used Peak Percent : 25%
  Current Used Peak Time    : 01/21/2015 21:59:02
  Current Free Percent      : 75%
  Current Free Too Low      : N
  Current Free Depleted     : N
  Local Provisioned Blks    : 8.000000x10^0
  Local Used Blks           : 2.000000x10^0
  Local Free Blks           : 6.000000x10^0
  Local Used Peak Blks      : 2.000000x10^0
  Local Used Peak Percent   : 25%
  Local Used Peak Time      : 01/21/2015 21:59:02
  Remote Provisioned Blks   : 0.000000x10^0
  Remote Used Blks          : 0.000000x10^0
  Remote Free Blks          : 0.000000x10^0
  Remote Used Peak Blks     : 0.000000x10^0
  Remote Used Peak Percent  : 0%
  Remote Used Peak Time     : 01/21/2015 21:59:02
  Peak Reset Time           : 01/21/2015 21:59:02
  Valid Data                : Y
  -------------------------------------------------------------------------------
  Threshold                 : /63
  -------------------------------------------------------------------------------
  Current Provisioned Blks  : 1.600000x10^1
  Current Used Blks         : 3.000000x10^0
  Current Free Blks         : 1.300000x10^1
```

```
Current Used Percent      : 19%
Current Used Peak Blks    : 3.000000x10^0
Current Used Peak Percent : 19%
Current Used Peak Time    : 01/21/2015 21:59:13
Current Free Percent      : 81%
Current Free Too Low      : N
Current Free Depleted     : N
Local Provisioned Blks    : 1.600000x10^1
Local Used Blks           : 3.000000x10^0
Local Free Blks           : 1.300000x10^1
Local Used Peak Blks      : 3.000000x10^0
Local Used Peak Percent   : 19%
Local Used Peak Time      : 01/21/2015 21:59:13
Remote Provisioned Blks   : 0.000000x10^0
Remote Used Blks          : 0.000000x10^0
Remote Free Blks          : 0.000000x10^0
Remote Used Peak Blks     : 0.000000x10^0
Remote Used Peak Percent  : 0%
Remote Used Peak Time     : 01/21/2015 21:59:13
Peak Reset Time           : 01/21/2015 21:59:13
Valid Data                : Y
```

The command displayed above displays detailed statistics of prefix level thresholds in the specified provision prefix.

subnet-ext-stats

Syntax **subnet-ext-stats** *ip-address*[/*mask*]
subnet-ext-stats pool *pool-name*

Context show>router>dhcp>server

Description This command displays extended statistics per DHCPv4 subnet in local DHCPv4 server.

The following statistics are included in output:

- The number of stable leases in the subnet
- The number of provisioned address in the subnet
- The number of used address in the subnet
- The number of free address in the subnet
- The percentage of used address
- The percentage of free address

For each statistic (except for Provisioned Addresses), there is current value and peak value, peak value is the highest value since subnet creation or last reset via the **clear router** *rt-id* **dhcp local-dhcp-server** *svr-name* **subnet-ext-stats** command.

When parameter pool is used, the statistics of each subnet in the pool will be displayed.

Parameters *ip-address[/mask]* — Specifies the subnet

pool-name — The name of local DHCPv4 server pool

Sample Output

```
show router 500 dhcp local-dhcp-server "d4" subnet-ext-stats 220.10.10.0/24
===============================================================================
Extended statistics for subnet 220.10.10.0/24
===============================================================================
                           Current         Peak            TimeStamp
-------------------------------------------------------------------------------
Local:
  Stable Leases            1               1               01/07/2013 19:38:36
  Provisioned Addresses    101
  Used Addresses           1               1               01/07/2013 19:38:36
  Free Addresses           100             100             01/07/2013 19:38:36
  Used Pct                 1               1               01/07/2013 19:38:36
  Free Pct                 99              99              01/07/2013 19:38:36
Last Reset Time                                            01/07/2013 19:07:11
-------------------------------------------------------------------------------
Number of entries          1
===============================================================================
```

server-stats

Syntax **server-stats**

Context show>router>dhcp>server

Description This command displays server statistics.

Sample Output

```
*A:SUB-Dut-A# show router dhcp local-dhcp-server dhcpS1 server-stats
===============================================================================
Statistics for DHCP Server dhcpS1 router Base
===============================================================================
Rx Discover Packets           : 0
Rx Request Packets            : 0
Rx Release Packets            : 0
Rx Decline Packets            : 0
Rx Inform Packets             : 0

Tx Offer Packets              : 0
Tx Ack Packets                : 0
Tx Nak Packets                : 0
Tx Forcerenew Packets         : 0

Client Ignored Offers         : 0
Leases Timed Out              : 0

Dropped Bad Packet            : 0
Dropped Invalid Type          : 0
Dropped No User Database      : 0
Dropped Unknown Host          : 0
Dropped User Not Allowed      : 0
Dropped Lease Not Ready       : 0
Dropped Lease Not Found       : 0
Dropped Not Serving Pool      : 0
Dropped Invalid User          : 0
Dropped Overload              : 0
Dropped Persistence Overload  : 0
Dropped Generic Error         : 0
Dropped Destined To Other     : 0
```

```
Dropped Address Unavailable   : 0
Dropped Max Leases Reached    : 0
Dropped Server Shutdown       : 0
Dropped No Subnet For Fixed IP: 0

===============================================================================
*A:SUB-Dut-A#
```

subnet-stats

Syntax **subnet-stats** *ip-address*[/*mask*]
subnet-stats pool *pool-name*

Context show>router>dhcp>server

Description This command displays subnet statistics.

Sample Output

```
*A:SUB-Dut-A# show router dhcp local-dhcp-server dhcpS2 subnet-stats pool POOL2
===============================================================================
Statistics for pool POOL2
===============================================================================
Subnet              Free          Offered      Stable
                      FRPending     RemPending   Declined
-------------------------------------------------------------------------------
2.0.0.0/8           16384         0            0
                      0             0            0
-------------------------------------------------------------------------------
No. of entries: 1
===============================================================================
*A:SUB-Dut-A#
```

summary

Syntax **summary**

Context show>router>dhcp>server

Description This command displays DHCP summary information.

Sample Output

```
*A:SUB-Dut-A# show router dhcp local-dhcp-server dhcpS2 summary
===============================================================================
DHCP server dhcpS2  router Base
===============================================================================
dhcpS2-POOL2
Admin State            : inService
Persistency State      : ok
User Data Base         : N/A
Use gateway IP address : disabled
Send force-renewals    : disabled
```

```
-------------------------------------------------------------------------------
Pool name : POOL2
-------------------------------------------------------------------------------
Subnet              Free       Stable     Declined   Offered    Remove-pending
-------------------------------------------------------------------------------
2.0.0.0/8           16384      0          0          0          0

Totals for pool     16384      0          0          0          0
-------------------------------------------------------------------------------
Totals for server   16384      0          0          0          0
-------------------------------------------------------------------------------
Associations                      Admin
-------------------------------------------------------------------------------
No associations found
===============================================================================
*A:SUB-Dut-A#
```

servers

Syntax **servers**

Context show>router>dhcp

Description This command lists the local DHCP servers.

Sample Output

```
*A:ALA-49>show>router>dhcp# servers
===================================================================
Overview of DHCP Servers
===================================================================
Active Leases:      0
Maximum Leases:     159744

Router              Server                            Admin State
-------------------------------------------------------------------
Router: Base        base_router_dhcp_server           outOfService
Service: 3          s1                                inService
===================================================================
*A:ALA-49>show>router>dhcp#
```

servers

Syntax **servers**

Context show>router>dhcp>local-dhcp-server>statistics

Description This command displays server statistics.

Sample Output

```
*A:ALA-48>show>router>dhcp>local-dhcp-server>statistics# servers
===============================================================================
Statistics for DHCP Server test router Base
===============================================================================
```

```
Rx Discover Packets     : 0
Rx Request Packets      : 0
Rx Release Packets      : 0
Rx Decline Packets      : 0
Rx Inform Packets       : 0

Tx Offer Packets        : 0
Tx Ack Packets          : 0
Tx Nack Packets         : 0
Tx Forcerenew Packets   : 0

Client ignored offers   : 0

Dropped Bad Packet      : 0
Dropped Invalid Type    : 0
Dropped Unknown Host    : 0
Dropped User Not Allowed: 0
Dropped Lease Not Ready : 0
Dropped Lease Not Found : 0
Dropped Not Serving Pool: 0
Dropped Invalid User    : 0
Dropped Generic Error   : 0
===============================================================================
*A:ALA-48>show>router>dhcp>local-dhcp-server>statistics#
```

subnet

Syntax **subnet pool** *pool-name* [**subnet** *subnet*]

Context show>router>dhcp>local-dhcp-server>statistics

Description This command displays subnet statistics.

Parameters **pool** *pool-name* — Specifies the pool name on the router.

subnet *subnet* — Specifies a subnet of IP addresses that are served from the pool.

Sample Output

```
*A:ALA-48>show>router>dhcp>local-dhcp-server>statistics# subnet pool test
===============================================================================
Statistics for pool test
===============================================================================
Subnet              Free          Offered      Stable
                      FRPending     RemPending   Declined
-------------------------------------------------------------------------------
1.0.0.0/24          0             0            0
                      0             0              0
-------------------------------------------------------------------------------
No. of entries: 1
===============================================================================
*A:ALA-48>show>router>dhcp>local-dhcp-server>statistics#
```

lease-state

Syntax **lease-state** [[**sap** *sap-id*] | [**sdp** *dp-id:vc-id*] | [**interface** *interface-name*] | [**ip-address** *ip-address*[*/mask*]>] | [**mac** *ieee-address*]] [**detail**]

Context show>service>id>dhcp

Description This command displays DHCP lease state related information.

Parameters ***sap-id*** **—** Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp-id — The SDP ID to be shown.

Values 1 — 17407

vc-id — The virtual circuit ID on the SDP ID to be shown.

Values 1 — 4294967295

servers

Syntax **servers**

Context show>router>dhcp

Description This command lists the local DHCP servers.

Sample Output

```
*A:SUB-Dut-A# show router dhcp servers
===============================================================
Overview of DHCP Servers
===============================================================
Active Leases:      0
Maximum Leases:     159744

Router              Server                              Admin State
---------------------------------------------------------------
Router: Base        dhcpS1                              inService
Router: Base        dhcpS10                             inService
Router: Base        dhcpS100                            inService
Router: Base        dhcpS101                            inService
Router: Base        dhcpS102                            inService
Router: Base        dhcpS103                            inService
Router: Base        dhcpS104                            inService
Router: Base        dhcpS105                            inService
Router: Base        dhcpS106                            inService
Router: Base        dhcpS107                            inService
Router: Base        dhcpS108                            inService
Router: Base        dhcpS109                            inService
Router: Base        dhcpS11                             inService
Router: Base        dhcpS110                            inService
Router: Base        dhcpS111                            inService
Router: Base        dhcpS112                            inService
Router: Base        dhcpS113                            inService
Router: Base        dhcpS114                            inService
Router: Base        dhcpS115                            inService
```

```
Router: Base        dhcpS116                        inService
Router: Base        dhcpS117                        inService
Router: Base        dhcpS118                        inService
Router: Base        dhcpS119                        inService
...
Service: 1022       dhcpS1022                       inService
Service: 1023       dhcpS1023                       inService
Service: 1024       dhcpS1024                       inService
===============================================================
*A:SUB-Dut-A#


*A:SUB-Dut-A#
===============================================================
Overview of DHCP Servers
===============================================================
Active Leases: 0
Maximum Leases: 159744

Router Server Admin State
---------------------------------------------------------------
Router: Base base_router_dhcp_server outOfService
Service: 3 s1 inService
===============================================================
```

statistics

Syntax **statistics** [**interface** *ip-int-name*]

Context show>router>dhcp6
show>service>id>dhcp6

Description This command displays statistics for DHCP relay and DHCP snooping.

Sample Output

```
*A:Dut-C# show service id  202 dhcp6 statistics
===============================================================
DHCP Statistics, service 202, all interfaces
===============================================================
Packets received                    : 1
Packets transmitted                 : 1
Packets dropped                     : 0
===============================================================
*A:Dut-C#
```

summary

Syntax **summary**

Context show>router>dhcp6
show>service>id>dhcp6

Description This command displays the status of the DHCP6 relay and DHCP snooping functions on each interface.

OutputOutput **Show DHC6P Summary Output —** The following table describes the output fields for DHCP6 summary.

Label	Description
Interface Name	Name of the router interface.
ARP Populate	Indicates whether ARP populate is enabled.
Used/Provided	Indicates the number of used and provided DHCP leases.
Info Option	Indicates whether Option 82 processing is enabled on the interface.
Admin State	Indicates the administrative state.

Sample Output

```
*A:Dut-C# show router dhcp6 summary
===============================================================================
DHCP6 Summary (Router: Base)
===============================================================================
Interface Name                  Nbr      Used/Max Relay     Admin  Oper Relay
  SapId                         Resol.   Used/Max Server    Admin  Oper Server
-------------------------------------------------------------------------------
ip-1.1.1.10                     No          0/0             Down   Down
  sap:1/1/5                                 0/8000          Down   Down
ip-11.3.202.3                   No          0/0             Down   Down
  sap:1/1/6                                 1/8000          Up     Up
-------------------------------------------------------------------------------
Interfaces: 2
===============================================================================
*A:Dut-C#
```

remap-lease-state

Syntax **remap-lease-state old-mac** *ieee-address* **mac** *ieee-address*
remap-lease-state sap *sap-id* [**mac** *ieee-address*]

Context tools>perform>subscr-mgmt

Description This command allows the remapping of all existing hosts if network card on CMTS/WAC side is changed is required.

When this command is executed, the following restrictions apply

- When **sap** is taken, all leases associated with the SAP are re-written.
  - → For a SAP with a configured MAC in lease-populate command, this MAC will be taken.
  - → For a SAP without a configured MAC the MAC from tools command will be taken.
  - → For a SAP without a configured MAC and no MAC in tools command no action will be perform.
- When using the **old-mac** option, providing a new MAC *ieee-address* is mandatory.

This command is applicable only when dealing with DHCP lease states which were instantiated using l2header mode of DHCP operation.

Parameters **old-mac** *ieee-address*

old-mac *ieee-address* — specifies the old MAC address to remap.

mac *ieee-address* — Specifies that the provisioned MAC address will be used in the anti-spoofing entries for this SAP when l2-header is enabled. The parameter may be changed mid-session. Existing sessions will not be re-programmed unless a **tools perform** command is issued for the lease.

sap *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

When configured, the SAP parameter will remap all MAC addresses of DHCP lease states on the specified SAP. When no optional MAC parameter is specified, the **sap** *sap-id* command remaps all MAC addresses of lease states towards the MAC address specified in the l2-header configuration.

Clear Commands

dhcp

Syntax **dhcp**

Context clear>router

Description This command enables the context to clear and reset DHCP entities.

dhcp6

Syntax **dhcp6**

Context clear>router

Description This command enables the context to clear and reset DHCP6 entities.

lease-state

Syntax **lease-state** [**no-dhcp-release**]
lease-state [**port** *port-id*] [**inter-dest-id** *intermediate-destination-id*] [**no-dhcp-release**]
lease-state [**port** *port-id*] **no-inter-dest-id** [**no-dhcp-release**]
lease-state ip-address *ip-address* [**no-dhcp-release**]
lease-state mac *ieee-address* **no-dhcp-release**
lease-state sap *sap-id* [**no-dhcp-release**]
lease-state sdp *sdp-id:vc-id* [**no-dhcp-release**]

Context clear>service>id>dhcp

Description This command clears DHCP lease state information.

Parameters **no-dhcp-release** — Clears the state without sending the DHCP release message.

ip-address *ip-address* — Clears the DHCP IP address lease state information. The *ip-address* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

mac *ieee-address* — Clears DHCP MAC address lease state information. The 48-bit MAC address for the static ARP in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

sap *sap-id* — clears DHCP SAP lease state information. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp-id — Clears DHCP SDP lease state information.

Values 1 — 17407

port-id — Clears DHCP port lease state information. Common Service Commands on page 2168

intermediate-destination-id — Specifies the intermediate destination identifier which is encoded in the identification strings.

vc-id — Clears virtual circuit ID information on the specified SDP.

Values 1 — 4294967295

local-dhcp-server

Syntax **local-dhcp-server** *server-name*

Context clear>router>dhcp

Description This command clears DHCP server data.

Parameters *server-name* — Clears data for the specified local DHCP server.

declined-addresses

Syntax **declined-addresses** *ip-address[/mask]*
declined-addresses pool *pool-name*

Context clear>router>dhcp>local-dhcp-server

Description This command clears declined DHCP addresses.

Parameters *pool-name* — Specifies the declined pool name.

ip-address[/mask] — Specifies the declined IP address and mask.

leases

Syntax **leases** *ip-address[/mask]* [**offered**]

Context clear>router>dhcp>local-dhcp-server

Description This command clears DHCP leases.

Parameters *ip-address*[/*mask*] — Clears the specified IP address and mask.

offered — Clears leases in offered state only.

pool-ext-stats

Syntax **pool-ext-stats** [*pool-name*]

Context clear>router>dhcp>local-dhcp-server

Description This command clears extended pool statistics.

Parameters *pool-name* — Specifies the pool name.

server-stats

Syntax **server-stats**

Context clear>router>dhcp>local-dhcp-server

Description This command clears all server statistics.

subnet-ext-stats

Syntax **subnet-ext-stats** *ip-address*[/*mask*]
subnet-ext-stats pool *pool-name*

Context clear>router>dhcp>local-dhcp-server

Description This command clears extended subnet statistics.

lease-state

Syntax **lease-state** [**ip-address** *ipv6-address/prefix-length*] [**mac** *ieee-address*]

Context clear>service>id>dhcp6

Description This command clears DHCP6 lease state information.

Parameters **ip-address** *ipv6-address* — Clears the DHCP6 IP address lease state information. The *ipv6-address* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IPv6 addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

mac *ieee-address* — Clears DHCP6 MAC address lease state information. The 48-bit MAC address for the static ARP in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

statistics

Syntax **statistics** [**sap** *sap-id* | **sdp** [*sdp-id*[:*vc-id*] | **interface** *ip-int-name* | *ip-address*]

Context clear>router>dhcp

Description This command clears DHCP statistics.

Parameters **sap** *sap-id* **—** clears DHCP statistics. See Common Service Commands on page 2168 for *sap-id* command syntax.

sdp-id — Clears DHCP SDP statistics.

Values 1 — 17407

vc-id — Clears DHCP the SDP VC ID statistics.

Values 1 — 4294967295

ip-int-name — Clears DHCP statistics for the specified interface name.

ip-address — Clears DHCP statistics for the specified IP address.

local-dhcp-server

Syntax **local-dhcp-server** *server-name*

Context clear>router>dhcp6

Description This command enables the context to clear local DHCP server data.

leases

Syntax **leases** [*ipv6-address/prefix-length*] [*type*] [*state*]
leases all [*type*] [*state*]

Context clear>router>dhcp6>server

Description This command removes the specified leases in the specified local DHCPv6 server.

Parameters *ipv6-address/prefix-length* — The prefix of the leases to be removed.

type — The type of the lease to be remove.

Values pd, wan-host

state — The state of the lease to be removed.

Values advertised, remove-pending, held

all — Remove all leases of specified type and(or) state.

pool-ext-stats

Syntax **pool-ext-stats** [*pool-name*]

Context clear>router>dhcp6>server

Description This command reset the begin time of peak values in output of the **show router** *rt-id* **dhcp6 local-dhcp-server** *svr-name* pool-ext-stats command.

Parameters *pool-name* — The name of the local DHCPv6 server pool.

— **pool-threshold-stats** [*pool-name*]

pool-threshold-stats

Syntax **pool-threshold-stats** [*pool-name*]

Context clear>router>dhcp6>server

Description This commands resets the peak stats in the pool level threshold stats in the specified pool. If the pool name is not specified, then the peak stats in all pools in the server will be reset.

pool-name — The name of the local DHCPv6 server pool

prefix-ext-stats

Syntax **prefix-ext-stats** *ipv6-address/prefix-length*
prefix-ext-stats pool *pool-name*

Context clear>router>dhcp6>server

Description This command reset the begin time of peak values in output of the **show router** *rt-id* **dhcp6 local-dhcp-server** *svr-name* **prefix-ext-stats** command/

Parameters *ipv6-address/prefix-length* — Specify the IPv6 prefix.

pool-name — The name of the local DHCPv6 server pool

prefix-threshold-stats

Syntax **prefix-threshold-stats** *ipv6-address/prefix-length*
prefix-threshold-stats pool *pool-name*

Context clear>router>dhcp6>server

Description This commands resets the peak stats in the prefix level threshold stats in the specified provision prefix or pool.

Parameters *pool-name* — Specifies the name of the pool in local DHCPv6 server.

ipv6-address/prefix-length — Specifies the name of theIPv6 prefix with prefix length.

server-stats

Syntax **server-stats**

Context clear>router>dhcp6>server

Description This command reset all stats of the specified local DHCPv6 server.

statistics

Syntax **statistics**

Context clear>router>dhcp6

Description This command clears DHCP6 statistics.

Debug Commands

dhcp

Syntax [**no**] **dhcp** [*ip-int-name*]

Context debug>router>ip

Description This command enables DHCP debugging.
The **no** form of the command disables debugging.

Parameters *ip-int-name* — Specifies the name of the IP interface. Interface names can be from 1 to 32 alphanumeric characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

dhcp6

Syntax **dhcp6** [*ip-int-name*]
no dhcp6

Context debug>router>ip

Description This command enables DHCP debugging

The **no** form of the command disables debugging

Parameters *ip-int-name* — Specifies the name of the IP interface. Interface names can be from 1 to 32 alphanumeric characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

detail-level

Syntax **detail-level** {**low** | **medium** | **high**}
no detail-level

Context debug>router>ip>dhcp
debug>router>local-dhcp-server
debug>router>ip>dhcp6

Description This command debugs the DHCP tracing detail level.

local-dhcp-server

Syntax [**no**] **local-dhcp-server** *server-name* [**lease-address** *ip-address*]
[**no**] **local-dhcp-server** *server-name* [**mac** *ieee-address*]

Context debug>router

Description This command enables, disables or configures debugging for a local DHCP server.

Parameters *server-name* — [32 chars max]

ip-address — a.b.c.d

ieee-address — xx:xx:xx:xx:xx:xx or xx-xx-xx-xx-xx-xx (cannot be all zeroes)

mode

Syntax **mode** {**dropped-only** | **ingr-and-dropped** | **egr-ingr-and-dropped**}
no mode

Context debug>router>ip>dhcp
debug>router>local-dhcp-server
debug>router>ip>dhcp6

Description This command debugs the DHCP tracing detail level.

wpp

Syntax [**no**] **wpp**

Context debug>router

Description This command enables the context to configure debugging for the Web Portal Protocol.

packet

Syntax [**no**] **packet**

Context debug>router>wpp

Description This command configures WPP packet debugging.

detail-level

Syntax **detail-level** *detail-level*

Default debug>router>wpp>packet

Description This command specifies the detail level of the WPP packet debug output.

Parameters *detail-level* — Specifies the detail level for WPP packet debugging.

Values high, low

portal

Syntax [**no**] **portal** *wpp-portal-name*

Context debug>router>wpp

Description This command enables WPP debugging for the specified portal.

Parameters *portal-name* — Specifies the name of this WPP portal.

packet

Syntax [**no**] **packet**

Context debug>router>wpp>portal

Description This command configures the WPP portal packet debugging.

detail-level

Syntax **detail-level** *detail-level*

Context debug>router>wpp>portal>packet

Description This command configures the detail level for WPP portal packet debugging.

Parameters *detail-level* — Specifies the detail level for WPP portal packet debugging.

Values high, low

Tools Commands

tools

Syntax **tools**

Context <root>

Description This command enables the context to enable useful tools for debugging purposes.

Default none

Parameters **dump —** Enables dump tools for the various protocols.

perform — Enables tools to perform specific tasks.

perform

Syntax **perform**

Context tools

Description This command enables the context to enable tools to perform specific tasks.

Default none

subscriber-mgmt

Syntax **subscriber-mgmt**

Context tools>perform

Description This command enables tools to control subscriber management.

edit-ppp-session

Syntax **edit-ppp-session sap** *sap-id* **ip** *ip-address* [**subscriber** *sub-ident-string*] [**sub-profile-string** *sub-profile-string*] [**sla-profile-string** *sla-profile-string*] [**inter-dest-id** *intermediate-destination-id*] [**ancp-string** *ancp-string*] [**app-profile-string** *app-profile-string*]

edit-ppp-session svc-id *service-id* **ip** *ip-address* [**subscriber** *sub-ident-string*] [**sub-profile-string** *sub-profile-string*] [**sla-profile-string** *sla-profile-string*] [**app-profile-string** *app-profile-string*] [**inter-dest-id** *intermediate-destination-id*] [**ancp-string** *ancp-string*]

Context tools>perform>subscriber-mgmt

Description This command modifies PPP session information.

Parameters ***sap-id* —** Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

ip-address — Specifies the IP address.

sub-ident-string — Specifies a subscriber identification profile.

sub-profile-string — Specifies the subscriber profile string, up to 16 characters, maximum.

service-id — The service identification number that identifies the service in the domain.

intermediate-destination-id — Specifies the intermediate destination identifier which is encoded in the identification strings.

ancp-string *ancp-string* **—** Specifies the ASCII string of the DSLAM circuit ID name.

app-profile-string — Specifies an application profile string.

eval-lease-state

Syntax **eval-lease-state** [**svc-id** *service-id*] [**sap** *sap-id*] [**subscriber** *sub-ident-string*] [**ip** *ip-address*]

Context tools>perform>subscriber-mgmt

Description This command evaluates lease state.

Parameters ***sap-id* —** Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

ip-address — Specifies the a server's IP address. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

sub-ident-string — Specifies the subscriber ID string, up to 32 characters, maximum.

service-id — Specifies an existing service ID.

Values 1 — 2147483647

local-user-db

Syntax **local-user-db** *local-user-db-name*

Context tools>perform>subscriber-mgmt

Description This command enables tools for controlling the local user database.

Parameters *local-user-db-name* — Specifies the name of a local user database.

dhcp

Syntax **dhcp**

Context tools>perform>subscriber-mgmt>local-user-db

Description This command contains the tools used for controlling DHCP entries in the local user database.

host-lookup

Syntax **host-lookup** [**mac** *ieee-address*] [**remote-id** *remote-id*] [**sap-id** *sap-id*] [**service-id** *service-id*] [**string** *vso-string*] [**system-id** *system-id*] [**option60** *hex-string*] [**circuit-id** *circuit-id* **| circuit-id-hex** *circuit-id-hex*]

Context tools>perform>subscriber-mgmt>local-user-db>dhcp

Description This command performs a lookup in the local user database. This command looks up the host with the match-list configured in the local user database.

Parameters **mac** *ieee-address* — Specifies the 48-bit MAC address for the static ARP in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

remote-id — specifies what information goes into the remote-id sub-option in the DHCP relay packet.

Values Up to 255 characters maximum

sap-id — Specifies a SAP identifier to be used. See Common Service Commands on page 2168 for *sap-id* command syntax.

service-id — Specifies an existing subscriber service ID.

Values 1 — 2147483647

vso-string — Specifies a Vendor Specific Option (VSO) string.

system-id — Specifies the system ID.

Values up to 255 characters maximum.

option60 *hex-string* — Specifies the content of option 60 for this lookup.

Values 0x0..0xFFFFFFFF (maximum 64 hex nibbles)

circuit-id *circuit-id* — specifies the circuit ID from the Option 82.

circuit-id-hex *circuit-id-hex* — Specifies the circuit ID in hexadecimal format from the Option 82.

Values 0x0..0xFFFFFFFF (maximum 254 hex nibbles)

ppp

Syntax **ppp**

Context tools>perform>subscriber-mgmt>local-user-db

Description This command contains the tools used to control PPP entries in the local user database.

authentication

Syntax **authentication password** *password* [**mac** *ieee-address*] [**remote-id** *remote-id*] [**circuit-id** *circuit-id*] **user-name** *user-name* [**service-name** *service-name*]

authentication password *password* [**mac** *ieee-address*] [**remote-id** *remote-id*] [**circuit-id-hex** *circuit-id-hex*] **user-name** *user-name* [**service-name** *service-name*]

Context tools>perform>subscriber-mgmt>local-user-db>ppp

Description This command authenticates PPP user name. As local user database PAP/CHAP authentication can only be used when the local user database is connected to the PPP node under the group interface, the user lookup will be performed with match-list username.

Parameters **password** *password* **—** specifies the password of this host up to 32 characters in length.

mac ***ieee-address*** **—** Specifies information about the MAC address of the PPP session.

remote-id — specifies what information goes into the remote-id sub-option in the DHCP relay packet.

Values Up to 255 characters maximum

circuit-id *circuit-id* — specifies the circuit ID from the Option 82.

circuit-id-hex *circuit-id-hex* **—** Specifies the circuit ID in hexadecimal format from the Option 82.

Values 0x0..0xFFFFFFFF (maximum 254 hex nibbles)

user-name *user-name* **—** Specifies the PPP user name.

service-name *service-name* **—**

host-lookup

Syntax **host-lookup** [**mac** *ieee-address*] [**remote-id** *remote-id*] [**user-name** *user-name*] [**service-name** *service-name*] [**circuit-id** *circuit-id* | **circuit-id-hex** *circuit-id-hex*]

Context tools>perform>subscr-mgmt>loc-user-db>ppp

Description This command performs a lookup in the local user database.

mac *ieee-address* **—** Specifies the 48-bit MAC address for the static ARP in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

remote-id *remote-id* **—** specifies what information goes into the remote-id sub-option in the DHCP relay packet.

Values Up to 255 characters maximum

user-name *user-name* **—** Specifies a user name up to 128 characters in length.

service-name *service-name* **—** Specifies a PPP service name, up to 255 characters maximum.

circuit-id *circuit-id* — specifies the circuit ID from the Option 82.

circuit-id-hex *circuit-id-hex* — Specifies the circuit ID in hexadecimal format from the Option 82.

Values 0x0..0xFFFFFFFF (maximum 254 hex nibbles)

Point-to-Point Protocol over Ethernet (PPPoE) Management

In This Chapter

This chapter provides information about using PPPoE, including theory, supported features and configuration process overview.

Topics in this chapter include:

PPPoE

A Broadband Remote Access Server (BRAS) is a device that terminates PPPoE sessions. PPPoE sessions are supported on Alcatel-Lucent Broadband Services Router (BSR) on IOM2. The Point-to-Point Protocol (PPP) is used for communications between a client and a server. Point-to-Point Protocol over Ethernet (PPPoE) is a network protocol used to encapsulate PPP frames inside Ethernet frames.

Ethernet networks are packet-based, unaware of connections or circuits. Using PPPoE, Alcatel-Lucent users can dial from one router to another over an Ethernet network, then establish a point-to-point connection and transport data packets over the connection. In this application subscriber hosts can connect to the router using a PPPoE tunnel. There are two command available under PPPoE to limit the number of PPPoE hosts, one to set a limit that is applied on each SAP of the group-interface and one to set the limit per group-interface.

PPPoE is commonly used in subscriber DSL networks to provide point-to-point connectivity to subscriber clients running the PPP protocol encapsulated in Ethernet. IP packets are tunneled over PPP using Ethernet ports to provide the client's software or RG the ability to dial into the provider network. Most DSL networks were built with the use of PPPoE clients as a natural upgrade path from using PPP over dial-up connections. Because the PPP packets were used, many of the client software was reusable while enhancements were made such that the client could use an Ethernet port in a similar manner as it did a serial port. The protocol is defined by RFC 2516, *A Method for Transmitting PPP Over Ethernet (PPPoE)*.

PPPoE has two phases, the discovery phase and the session phase.

- Discovery: The client identifies the available servers. To complete the phase the client and server must communicate a session-id. During the discovery phase all packets are delivered to the PPPoE control plane (CPM or MDA). The IOM identifies these packets by their ethertype (0x8863).
  - → PPPoE Active Discovery Initiation (PADI). This broadcast packet is used by the client to search for an active server (Access Concentrator) providing access to a service.
  - → PPPoE Active Discovery Offer (PADO): If the access server can provide the service it should respond with a unicast PADO to signal the client it may request connectivity. Multiple servers may respond and the client may choose a server to connect to.
  - → PPPoE Active Discovery Request (PADR): After the client receives a PADO it will use this unicast packet to connect to a server and request service.
  - → PPPoE Active Discovery Session-confirmation (PADS) A server may respond to the client with this unicast packet to establish the session and provide the session-id. Once the PADS was provided the PPP phase begins.
- Session: Once the session ID is established connectivity is available for the duration of the session, using ethertype 0x8864. Either client or server can terminate a session.

  During the life of the session the packets may be uniquely identified by the client's MAC address and session-id. The session can terminate either by PADT sent by the client or server or by an LCP Terminate-Request packet.

During session creation, the following occurs:

- PADI (control packet upstream): This packet is delivered to the control plane. The control plane checks the service tag for service name. In the case multiple nodes are in the same broadcast domain the service tag can be used to decide whether to respond to the client. A relay tag can also be present.
- PADO (control packet downstream): The packet is generated by the control plane as response to the PADI message. The packet is forwarded to the client using the unicast packet directed at the client's MAC address. The node populates the AC-name tag and service tag. The packet sources the forwarding Ethernet MAC address of the node. In the case SRRP is used on the interface, it uses the gateway address as the source MAC. When in a backup state, the packet is not generated.
- PADR (control packet upstream): This packet is delivered to the control plane. The packet is destined to the node's MAC address. The control plane then generates the PADS to create the session for this request.
- PADS: (control packet downstream): The control plane prepares for the session creation and sends it to the client using the client's MAC address. The session-id (16-bit value) is unique per client. The session-id is populated in the response. Once a session-id is generated, the client uses it in all packets. In cases that the server does not agree with the client's populated service tags, the PADS can be used to send a service error tag with a zero session-id to indicate the failure.
- PADT (control packet upstream/downstream): The packet is used to terminate a session. It can be generated by either the control plane or the client. The session-id must be populated. The packet is a unicast packet.
- PPP session creation supports the LCP authentication phase.

During a session, the following forwarding actions occur:

- Upstream, in the PPPoE before PPP phase, there is no anti-spoofing. All packets are sent to the CPM. During anti-spoof lookup with IP and MAC addressing, regular filtering, QoS and routing in context continue. All unicast packets are destined to the node's MAC address. Only control packets (broadcast) are sent to the control plane. Keep-alive packets are handled by the CPM.
- Downstream, packets are matched in the subscriber lookup table. The subscriber information provides queue and filter resources. The subscriber information also provides PPPoE information, such as the dest-mac-address and session-id, to build the packet sent to the client

PPPoE-capable interfaces can be created in a subscriber interface in both IES and VPRN services. Each SAP can support one or more PPPoE sessions depending on the configuration. A SAP can simultaneously have static hosts, DHCP leases and PPPoE sessions. The number of PPPoE sessions is limited per SAP, SLA profile or subscriber profile.

RADIUS can be used for authentication. IP addresses can be provided by both RADIUS and the local IP pool, with the possibility of choosing the IP pool through RADIUS.

DHCP clients and PPPoE clients are allowed on a single SAP or group interface. If DHCP clients are not allowed, the operator should not enable lease-populate and similarly if PPPoE clients are not allowed, the operator should not enable the PPPoE node. Note that the DHCP node can be enabled when only PPPoE clients are allowed since the DHCP relay function can be used for IP retrieval. The DHCP lease-populate is for DHCP leases only. A similar command host-limit is made available under PPPoE for limits on the number of PPPoE hosts. The existing per sla-profile instance host limit is for combined DHCP and PPPoE hosts for that instance.

- For authentication, local and RADIUS are supported.
  - → RADIUS is supported through an existing policy. A username attribute has been added.
  - → For PAP/CHAP, a local user database is supported and must be referenced from the interface configuration.
- The host configuration can come directly from the local user database or from the RADIUS or DHCP server. A local host configuration is allowed through a local DHCP server with a local user database.
- IP information can be obtained from the local user database, RADIUS, a DHCP server, or a local DHCP server.

If IP information is returned from a DHCP server. PPPoE options such as the DNS name are retrieved from the DHCP ACK and provided to the PPPoE client. An open authentication option is maintained for compatibility with existing DHCP-based infrastructure.

The DHCP server can be configured to run on a loopback address with a relay defined in the subscriber or group interfaces. The DHCP proxy functionality that is provided by the DHCP relay (getting information from RADIUS, lease-split, option 82 rewriting) cannot be used for requests for PPPoE clients.

PPPoE Authentication and Authorization

General Flow

When a new PPPoE session is setup, the authentication policy assigned to the group interface is examined to determine how the session should be authenticated.

If no authentication policy is assigned to the group interface or the **pppoe-access-method** is set to **none**, the local user database assigned to the PPPoE node under the group interface is queried either during the PADI phase or during the LCP authentication phase, depending on whether the match-list of the local user database contains the requirement to match on username. If the match-list does not contain the username option, PADI authentication will be performed and it is possible to specify an authentication policy in the local user database host for an extra RADIUS PAP-CHAP authentication point.

If an authentication policy is assigned and the pppoe-access-method is set to PADI, the RADIUS server will be queried for authenticating the session based on the information available when the PADI packet is received (any PPP user name and password are not known here). When it is set to PAP-CHAP, the RADIUS server will be queried during the LCP authentication phase and the PPP user name and password will be used for authentication instead of the user name and password configured in the authentication policy.

If this authentication is successful, the data returned by RADIUS or the local user database is examined. If no IP address was returned, the DHCP server is now queried for an IP address and possibly other information, such as other DHCP options and ESM strings.

The final step consists of complementing the available information with configured default values (ESM data), after which the host is created if sufficient information is available to instantiate it in subscriber management (at least subscriber ID, subscriber profile, SLA profile, and IP address).

The information that needs to be gathered is divided in three groups, subscriber ID, ESM strings, and IP data. Once one of the data sources has offered data for one of these groups, the other sources are no longer allowed to overwrite this data (except for the default ESM data). For example, if RADIUS provides an SLA profile but no subscriber ID and IP address, the data coming from the DHCP server (either through Python or directly from the DHCP option) can no longer overwrite any ESM string, only the subscriber ID and IP data. However, after the DHCP data is processed, a configured default subscriber profile will be added to the data before instantiating the host.

RADIUS

The following attributes are sent to the RADIUS server for PPPoE authentication (optional attributes can be configured under the **config>subscr-mgmt>auth-plcy>include-radius-attribute** context):

- WT-101 access loop options, DSL-Forum VSAs (optional):
  - → Actual data rate Upstream (129)
  - → Actual data rate Downstream (130)
  - → Minimum data rate Upstream (131)
  - → Minimum data rate Downstream (132)
  - → Access loop encapsulation (144)
- Circuit-ID, DSL-Forum VSA 1 (optional)
- Remote-ID, DSL-Forum VSA 2 (optional)
- MAC address, Alcatel-Lucent VSA 27 (optional)
- PPPoE-Service-Name, Alcatel-Lucent VSA 35 (optional)
- Port identification attributes (optional)
  - → NAS-Port-Id (87) — This attribute can optionally be prefixed by a fixed string and/or suffixed by the circuit-ID or remote-ID given in the PPPoE requests. If either the circuit-ID or remote-ID suffix are given, but the corresponding information is not available, the value 0/0/0/0/0/0 will be suffixed.
  - → NAS-Port-Type (61). Values: 32 (null encap), 33 (dot1q), 34 (qinq), 15 (DHCP hosts), specified value (0 — 255)
- NAS identifier, attribute 32 (optional)
- User-Name, attribute 1
- User-Password, attribute 2
- Service-Type, attribute 6
- Framed-Protocol, attribute 7

In the reply from the RADIUS server, the following authorization attributes are accepted back for PPPoE hosts:

- Calling-station-id (optional)
- Framed-IP-Address, attribute 8
- Session-Timeout, attribute 27
- PADO-delay, Alcatel-Lucent VSA 34
- Framed-Pool, attribute 88 — If a DHCP request is done, this pool will be sent to the DHCP server in a vendor-specific sub-option under Option82 to indicate the pool from which the address from the client should be taken.

- Primary DNS, Alcatel-Lucent VSA 9
- Secondary DNS, Alcatel-Lucent VSA 10
- Primary NBNS, Alcatel-Lucent VSA 29
- Secondary NBNS, Alcatel-Lucent VSA 30
- Subscriber ID string, Alcatel-Lucent VSA 11
- Subscriber profile string, Alcatel-Lucent VSA 12
- SLA profile string, Alcatel-Lucent VSA 13
- ANCP string, Alcatel-Lucent VSA 16
- Intermediate Destination ID, Alcatel-Lucent VSA 28
- Application-profile string, Alcatel-Lucent VSA 45
- Service-Type, attribute 6 (must be correct if returned)
- Framed-Protocol, attribute 7 (must be correct if returned)
- PPPoE-Service-Name, Alcatel-Lucent VSA 35
- Reply-message, attribute 18
- Acct-Interim-Interval, attribute 85

For more information about Vendor-Specific Attributes and the Alcatel-Lucent dictionary, refer to the SR-OS RADIUS Attributes Reference Guide.

Local User Database Directly Assigned to PPPoE Node

The following are relevant settings for a local user database directly assigned to PPPoE node:

- Host identification parameters (user name only)
- Username
- Password
- Address
- DNS servers (under DHCP options)
- NBNS servers (under DHCP options)
- Identification (ESM) strings

Incoming PPPoE connections are always authenticated through the PPPoE tree in the local user database.

The matchlist for a local user database that is assigned directly to the PPPoE node under the group interface is always **user-name**, independent of the matchlist setting in the database.

For user-name matching, the incoming user name (user[@domain]) is always first converted to a user and a domain entity by splitting it on the first @-sign. If the no-domain parameter to the user name is given, the user component should be equal to the given user name, if the domain-only portion of the user name is given, the domain entity should be equal to the given user name and if no extra parameters are given, the user and domain components are concatenated again and compared to the given user name.

The option number for the identification strings is not used if the local user database is assigned directly to the PPPoE node (it is only necessary if it is connected to a local DHCP server). Any valid value may be chosen in this case (if omitted, the default value chosen will be 254).

If a pool name is given for the address, this pool name will be sent to the DHCP server in a vendor-specific sub-option of Option 82 to indicate from which pool the server should take the address. If the gi-address option is given for the address, this will be interpreted as if no address was given.

Subscriber per PPPoE Session Index

The system will keep track of the number of PPPoE sessions active on a given SAP and assign a per SAP session index to each such that always the lowest free index is assigned to the next active PPPoE session. When PAP/CHAP RADIUS authentication is used, the PPPoE SAP session index can be sent to, and received from, the RADIUS server using the following VSA:

```
ATTRIBUTE Alc-SAP-Session-Index            180      integer
```

This is supported for all PPPoE sessions, including those using LAC and LNS, but is not supported in a dual-homing topology. It should only be used in a subscriber per VLAN model as the session index is per SAP.

The intended use of the SAP session index is to provide the ability for PPPoE sessions to have their own set of queues (for QoS and accounting purposes) when using the same SLA profile name received from a RADIUS server. An example of this with multiple levels of HQoS egress scheduling is shown in Figure 25.

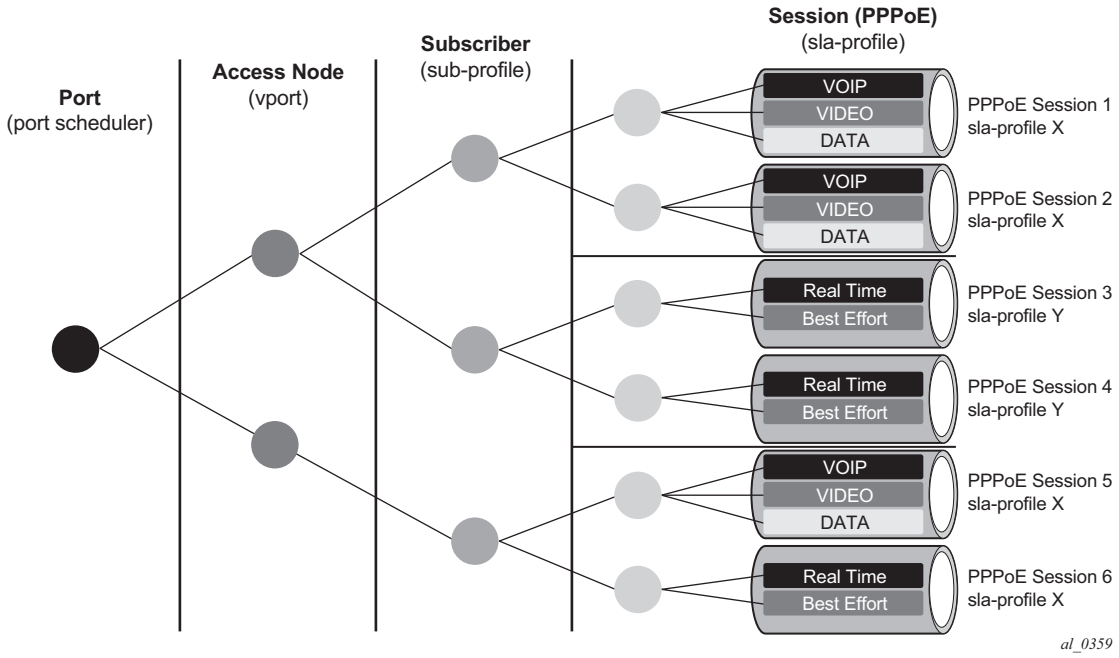


Figure 25: Egress QoS per PPPoE Session

This requires a set of identical SLA profiles to be configured which only differ by an index being, for example, appended to their name. The SAP session index must be sent to RADIUS in the Access-Request message, which is achieved by configuring the RADIUS authentication policy to include it as follows:

```
configure subscriber-mgmt authentication-policy name
            include-radius-attribute
                  [no] sap-session-index
```

The RADIUS server must then reflect the SAP session index back to the system in the RADIUS Access-Accept message together with the SLA profile name.

A Python script processes the RADIUS Access-Accept message to append the SAP session index to the SLA profile name to create the unique SLA profile name, in this example with the format:

sla-profile *sla-profile-name*.**suffix**

The exact format (for example, the separator used) is not fixed and just needs to match the pre-provisioned SLA profiles, while not exceeding 16 characters. This ensures that each PPPoE session is given its own SLA profile and consequently its own set of queues.

This processing is shown in Figure 26.

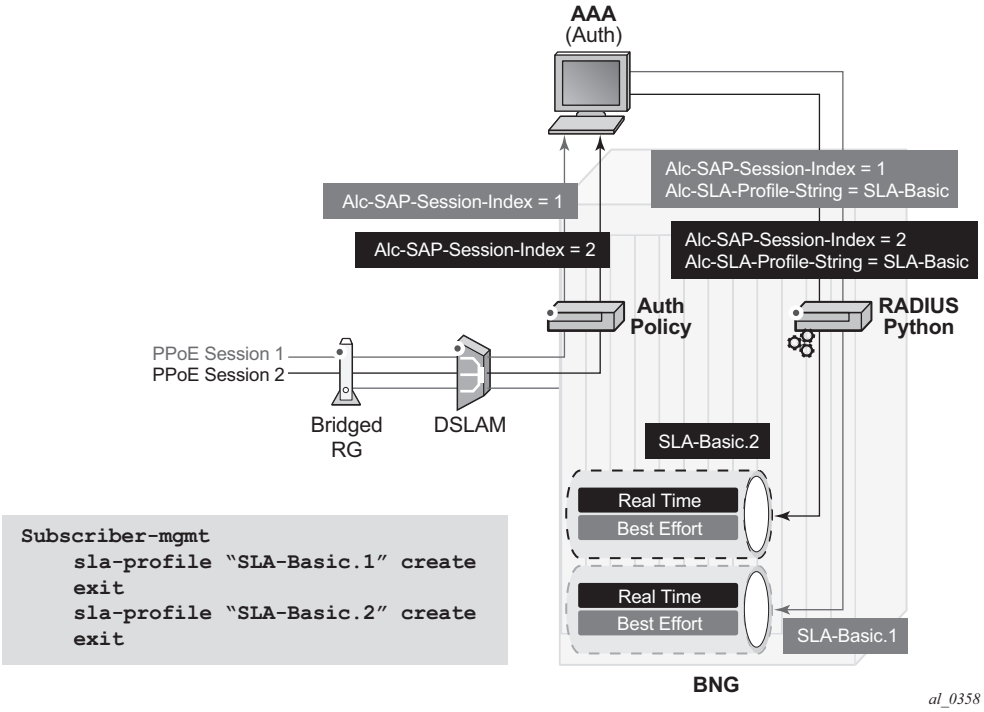


Figure 26: Per PPPoE Session SLA Profile Selection

Below is an example Python script for this purpose:

```
import alc
import struct
from alc import radius
from alc import sub_svc

PROXY_STATE = 33
ALU = 6527
SLA_PROF_STR = 13
SAP_SESSION_INDEX = 180


#################################
## QoS for Multiple PPPoE Sessions
#   This script checks if a sap-session-index (sid) is included in the authentication
#   accept. If present, the sla-profile-string (sla) is adapted to "sla.sid"

if alc.radius.attributes.isVSASet(ALU,SLA_PROF_STR):
    sla = alc.radius.attributes.getVSA(ALU,SLA_PROF_STR)
    if alc.radius.attributes.isVSASet(ALU,SAP_SESSION_INDEX):
        ssi = alc.radius.attributes.getVSA(ALU,SAP_SESSION_INDEX)
        suffix = "" .join(["%x" % ord(x) for x in ssi])
        alc.radius.attributes.setVSA(ALU,SLA_PROF_STR,sla + '.' + "%d" % int(suffix,16))
```

In order to use a COA to change the SLA profile used, the new SLA profile name must be constructed with the same suffix (in this example) as that used for the current SLA profile. This is necessary in order to ensure unique use of a given provisioned SLA profile. This mandates that the SAP session index is included in the COA information. Two options are proposed to achieve this:

- The COA can specify a new SLA profile name and include the SAP session index. A Python script would then process the COA and construct the new SLA profile name to be used by appending the suffix in the same way as was done with the RADIUS Access-Accept.
- The COA could be using a RADIUS proxy which might make the first option unattractive. An alternative solution would be to use a Python script to append the suffix to the acct-session-id in all messages sent so that the suffix can be identified when a COA is received that uses the acct-session-id(+suffix) for session identification. This would need to be performed for all messages sent that include the acct-session-id. COAs would reference the session using the acct-session-id+suffix. A Python script would be required to remove the suffix and append it to the new SLA profile name. All messages received with the acct-session-id+suffix would be processed by the Python script to remove the suffix before sending the acct-session-id to the system.

  In order to ensure that the acct-session-id sent in RADIUS accounting messages is updated with the suffix, the user must configure include-radius-attribute sla-profile in the RADIUS accounting policy to be applied. The Python script needs to remove the suffix from the SLA profile and add it to the acct-session-id for all messages sent. Clearly the acct-session-id used by any external server would then be different to that seen on the system.

Local DHCP Server with Local User Database

If a DHCP server is queried for IP or ESM information, the following information is sent in the DHCP request:

- Option 82 sub-options 1 and 2 (Circuit-ID and Remote-ID): These options contain the Circuit-ID and Remote-ID that were inserted as tags in the PPPoE packets).
- Option 82 sub-option 9 vendor-id 6527 VSO 6 (client type): this value is set to 1 to indicate that this information is requested for a PPPoE client. The local DHCP server uses this information to match a host in the list of PPPoE users and not in the DHCP list.
- Option 82 sub-option 6 (Subscriber-ID): This option contains the user name that was used if PAP/CHAP authentication was performed on the PPPoE connection.
- Option 82 sub-option 13 (DHCP pool): This option indicates to the DHCP server that the address from the client should be taken from the specified pool. The local DHCP server will only honor this request if the **use-pool-from-client** option is given in the server configuration.
- Option 82 sub-option 14 (PPPoE Service-Name): This option contains the service name that was used in the PADI packet during PPPoE setup.

- Option 60 (Vendor class ID): This option contains the string “ALU7XXXSBM” to identify the DHCP client vendor.
- The WT-101 access loop options are not sent for PPPoE clients

Local user database settings relevant to PPPoE hosts when their information is retrieved from the local DHCP server using this database:

- Host identification parameters (including user name)
- Address
- DNS servers (under DHCP options)
- NBNS servers (under DHCP options)
- Identification (ESM) strings

For user name matching, the incoming user name (user[@domain]) is always first converted to a user and a domain entity by splitting it on the first @-sign. If the no-domain parameter to the user name is given, the user component should be equal to the given user name, if the domain-only portion of the user name is given, the domain entity should be equal to the given user name and if no extra parameters are given, the user and domain components are concatenated again and compared to the given user name.

To prevent load problems, if DHCP lease times of less than 10 minutes are returned, these will not be accepted by the PPPoE server.

Multiple Sessions Per MAC Address

To support MAC-concentrating network equipment, which translates the original MAC address of a number of subscribers to a single MAC address towards the PPPoE service, the 77x0 supports at most 1023 PPPoE sessions per MAC address. Each of these sessions will be identified by a unique combination of MAC address and PPPoE session ID.

To set up multiple sessions per MAC, the following limits should be set sufficiently high:

- Maximum sessions per MAC in the PPPoE policy
- The PPPoE interface session limit in the PPPoE node of the group interface
- The PPPoE SAP session limit in the PPPoE node of the group interface
- The multiple-subscriber-sap limit in the subscriber management node of the SAP

If host information is retrieved from a local DHCP server, care must be taken that, although a host can be identified by MAC address, circuit ID, remote ID or user name, a lease in this server is only indexed by MAC address and circuit ID. For example, multiple sessions per MAC address are only supported in this scenario if every host with the same MAC address has a unique Circuit-ID value.

Private Retail Subnets

PPPoE is commonly used in residential networks and has expanded into business applications. PPPoE session management allows PPPoE to be used for business VPRN access.

PPPoE provides the following:

- Control over the session
- De-muxing based on the session ID provides the ability for the SAP and the Layer 2 network to be common to all VPRNs.

The PPPoE subscriber host will terminate in a retail VPRN and provide a routed path to the customer site. The customer site may be connected to more than one 7750 SR for dual homing purposes. In such a network routing between the two BNGs is required and can be performed with either a direct spoke SDP between the two nodes or by MPBGP route learning.

Since the PPPoE session will terminate in the retail VPRN the node must learn which VPRN service ID will carry it. Both PADI and PAP/CHAP authentication are supported. If the local user database is used, the host configuration provides a reference to the VPRN service ID that will be used. If RADIUS is used, it returns the service ID VSA. The retail interface is determined by the connection between the wholesale and retail subscriber interfaces.

The PPPoE session is negotiated with the parameters defined by the retail VPRN interface. Because the IP address space of the sub-mgmt host may overlap between VPRN services the node must anti-spoof the packets at access ingress with the session-id.

When the **config>service>vprn>sub-if>private-retail-subnets** command is enabled on the subscriber interface, the node will not push the defined subnets in the retail context to the wholesale context. This allows IP overlap between PPPoE sessions. If an operator requires both residential and business services, two VPRNs connected to the same wholesaler can be created and use the flag in only one of them.

IPCP Subnet Negotiation

This feature enables negotiation between Broadband Network Gateway (BNG) and customer premises equipment (CPE) so that CPE is allocated both ip-address and associated subnet.

Some CPEs use the network up-link in PPPoE mode and perform dhcp-server function for all ports on the LAN side. Instead of wasting one subnet for P2P uplink, CPEs use allocated subnet for LAN portion as shown in Figure 27.

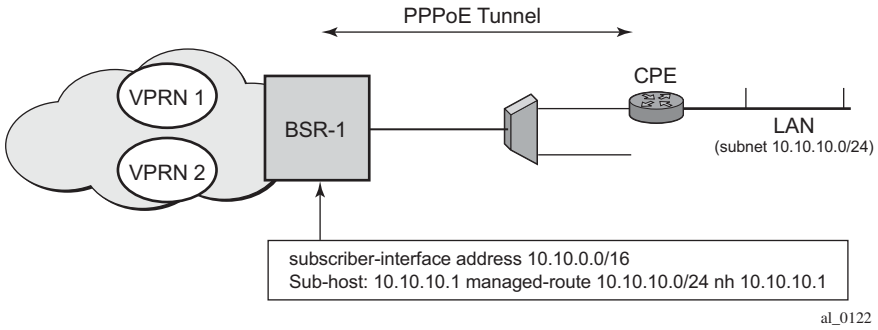


Figure 27: CPEs Network Up-link Mode

From a BNG perspective, the given PPPoE host is allocated a subnet (instead of /32) by RADIUS, external dhcp-server, or local-user-db. And locally, the host is associated with managed-route. This managed-route will be subset of the subscriber-interface subnet, and also, subscriber-host ip-address will be from managed-route range. The negotiation between BNG and CPE allows CPE to be allocated both ip-address and associated subnet.

Numbered WAN Support for Layer 3 RGs

Numbered WAN interfaces on RGs is useful to manage v6-capable RGs. Dual-stack RGs can be managed via IPv4. However, with v6-only RGs or with dual-stack RGs with private only v4 address, RGs require a globally routable v6 WAN prefix (or address) for management. This feature provides support to assign WAN prefix to PPP based Layer 3 RG using SLAAC. The feature also adds a new RADIUS VSA (Alc-PPP-Force-IPv6CP, Boolean) to control triggering of IPv6CP on completion of PPP LCP. RA messages are sent as soon as IPv6CP goes into open state, and the restriction to hold off on sending RAs till DHCP6-PD is complete in case of dual-stack PPP is no longer applicable.

IES as Retail Service for PPPoE Host

In this application, the PPPoE subscriber host terminates in a retail IES, the IES service ID can be obtained by either of following:

- Alc-Retail-Serv-Id attribute in radius access-accept packet.
- or retail-service-id config in local-user-db pppoe host if local user DB is used.

If MSAP is used then the SAP will be created in the wholesale VPRN.

The PPPoE session will be negotiated with the parameters defined by the wholesale VPRN group interface. The connectivity to the retailer will be done using the linkage between the two interfaces.

Due to the nature of IES service, there will be no IP address overlapping between different IES retails services, so the private-retail-subnets flag is not needed in this case.

Unnumbered PPPoX

Note: Unnumbered subscriber-interfaces are supported only for PPPoE, PPPoA and PPPoEoA (v4 and v6) hosts.

Unlike regular IP routes which are mainly concerned with next-hop information, subscriber-hosts are associated with an extensive set of parameters related to filtering, qos, statefull state (PPPoE/DHCP), antispoofing etc. Forwarding Information Base (fib) is not suitable to maintain all this information. Instead, each subscriber host record is maintained in separate set of subscriber-host tables.

By pre-provisioning the IP prefix (IPv4 and IPv6) under the subscriber-interface and subscriber-interface>ipv6 CLI hierarchy, only a single prefix aggregating the subscriber host entries is installed in the fib. This fib entry points to the corresponding subscriber-host tables that contain subscriber-host records.

In case that IPv4/IPv6 prefix is not pre-provisioned, or the subscriber-hosts falls out of pre-provisioned prefix, each subscriber-host will be installed in the fib. The result of the subscriber-host fib lookup will point to the corresponding subscriber-host record in the subscriber-host table. This scenario is referred to as “unnumbered subscriber-interfaces’”

Unnumbered does not mean that the subscriber hosts do not have an IP address or prefix assigned. It only means that the IP address range out of which the address or prefix is assigned to the host does not have to be known in advance via configuration under the **subscriber-interface** or **subscriber-interface>ipv6** node.

An IPv6 example would be:

```
configure
     router/service
          subscriber-interface <name>
               ipv6
                    [no] allow-unmatching-prefixes
                    delegated-prefix-length <bits>
                    subscriber-prefixes
```

This CLI indicates the following:

- There is no need for any indication of anticipated IPv6 prefixes in CLI.
- However, the **delegated-prefix-length** (DPL) command is required. The DPL (or the length of the prefix assigned to each Residential Gateway) must be known in advance. All Residential Gateways (or subscribers) under the same **subscriber-interface** share this pre-configured DPL.
- The DPL range is 48 — 64.
- If the prefix length in the received PD (via DHCP server, RADIUS or LUDB) and the DPL do not match, the host creation will fail.

- In case that the assigned IP prefix/address (DHCPServer, RADIUS, LUDB) for the host falls outside of the CLI defined prefixes AND the **allow-unmatching-prefixes** command is configured, then the new address/prefix will be automatically installed in the FIB.

MLPPPoE, MLPPP(oE)oA with LFI on LNS

MLPPPoX is generally used to address bandwidth constraints in the last mile. The following are other uses for MLPPPoX:

- To increase bandwidth in the access network by bundling multiple links/VCs together. For example it is less expensive for a customer with an E1 access to add another E1 link in order to increase the access b/w, rather than to upgrade to the next circuit speed (E3).
- LFI on a single link to prioritize small packet size traffic over traffic with large size packets. This is needed in the upstream and downstream direction.

PPPoE and PPPoEoA/PPPoA v4/v6 host types are supported.

Terminology

The term MLPPPoX is used to reference MLPPP sessions over ATM transport (oA), Ethernet over ATM transport (oEoA) or Ethernet transport (oE). Although MLPPP in subscriber management context is not supported natively over PPP/HDLC links, the terms MLPPP and MLPPPoX terms can be used interchangeably. The reason for this is that link bundling, MLPPP encapsulation, fragmentation and interleaving can be in a broader scope observed independently of the transport in the first mile. However, MLPPPoX terminology will be prevailing in this document in an effort to distinguish MLPPP functionality on ASAP MDA (outside of ESM) and MLPPPoX in LNS (inside of ESM).

Terms speed and rate are interchangeably used throughout this section. Usually speed refers to the speed of the link in general context (high or low) while rate usually quantitatively describes the link speed and associates it with the specific value in bps.

LNS MLPPPoX

This functionality is supported through LNS on BB-ISA. LNS MLPPPoX can be used then as a workaround for PTA deployments, whereby LAC and LNS can be run back-to-back in the same system (connected via an external loop or a VSM2 module), and thus locally terminate PPP sessions.

MLPPPoX can:

- Increase bandwidth in the last mile by bundling multiple links together.
- LFI/reassembly over a single MLPPPoX capable link (plain PPP does not support LFI).

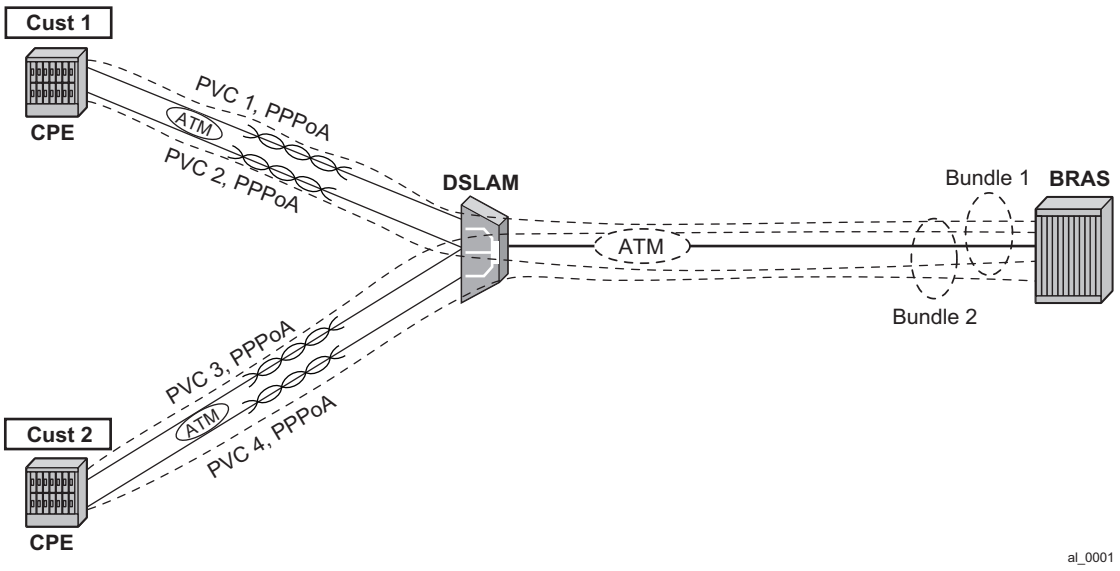


Figure 28: Typical MLPPPoA Deployment

MLPPP Encapsulation

Once the MLPPP bundle is created in the 7750 SR, traffic can be transmitted by using MLPPP encapsulation. However, MLPPP encapsulation is not mandatory over an MLPPP bundle.

MLPPP header is primarily required for sequencing the fragments. But in case that a packet is not fragmented, it can be transmitted over the MLPPP bundle using either plain PPP encapsulation or MLPPP encapsulation. MLPPP encapsulation for fragmented traffic is shown in Figure 29.

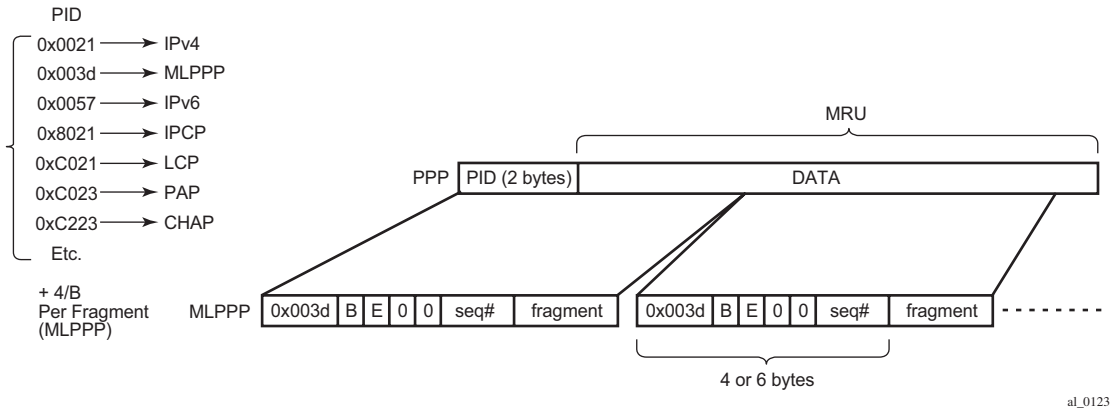


Figure 29: MLPPP Encapsulation

MLPPPoX Negotiation

MLPPPoX is negotiated during the LCP session negotiation phase by the presence of the Max-Received-Reconstructed Unit (MRRU) field in the LCP ConfReq. MRRU option is a mandatory field required in MLPPPoX negotiation. It represents the maximum number of octets in the Information field (Data part in Figure 29) of a reassembled packet. The MRRU value negotiated in the LCP phase must be the same on all member links and it can be greater or lesser than the PPP negotiated MRU value of each member link. This means that the reassembled payload of the PPP packet can be greater than the transmission size limit imposed by individual member links within the MLPPPoX bundle. Packets will always be fragmented so that the fragments are within the MRU size of each member link.

Another field that could be optionally present in an MLPPPoX LCP Conf Req is an Endpoint Discriminator (ED). Along with the authentication information, this field can be used to associate the link with the bundle.

The last MLPPPoX negotiated option is the Short Sequence Number Header Format Option which allows the sequence numbers in MLPPPoX encapsulated frames/fragments to be 12-bit long (instead 24-bit long, by default).

Once the multilink capability is successfully negotiated via LCP, PPP sessions can be bundled together over MLPPPoX capable links.

The basic operational principles are:

- LCP session is negotiated on each physical link with MLPPPoX capabilities between the two nodes.
- Based on the ED and/or the authentication outcome, a bundle is created. A subsequent IPCP negotiation is conveyed over this bundle. User traffic is sent over the bundle.
- If a new link tries to join the bundle by sending a new MLPPPoX LCP Conf Request, the LCP session will be negotiated, authentication performed and the link will be placed under the bundle containing the links with the same ED and/or authentication outcome.
- IPCP/IPv6CP will be in the whole process negotiated only once over the bundle. This negotiation will occur at the beginning, when the first link is established and MLPPPoX bundle created. IPCP and IPc6CP messages are transmitted from the 7750 LNS without MLPPPoX encapsulation, while they can be received as MLPPPoX encapsulated or non-MLPPPoX encapsulated.

Enabling MLPPPoX

The lowest granularity at which MLPPPoX can be enabled is an L2TP tunnel. An MLPPPoX enabled tunnel is not limited to carrying only MLPPPoX sessions but can carry normal PPP(oE) sessions as well.

In addition to enabling MLPPPoX on the session terminating node ?LNS, MLPPPoX can also be enabled on the LAC via PPP policy. The purpose of enabling MLPPPoX on the LAC is to negotiate MLPPPoX LCP parameters with the client. Once the LAC receives the MRRU option from the client in the initial LCP ConfReq, it will change its tunnel selection algorithm so that all sessions of an MLPPPoX bundle are mapped into the same tunnel.

The LAC will negotiate MLPPPoX LCP parameters regardless of the transport technology connected to it (ATM or Ethernet). LCP negotiated parameters are passed by the LAC to the LNS via Proxy LCP in ICCN message. In this fashion the LNS has an option to accept the LCP parameters negotiated by the LAC or to reject them and restart the negotiation directly with the client.

The LAC will transparently pass session traffic handed to it by the LNS in the downstream direction and the MLPPPoX client in the upstream direction. The LNS and the MLPPPoX client will perform all data processing functions related to MLPPPoX such as fragmentation and interleaving.

Once the LCP negotiation is completed and the LCP transition into an open state (configuration ACKs are sent and received), the Authentication phase on the LAC will begin. During the Authentication phase the L2TP parameters will become known (l2tp group, tunnel, etc), and the session will be extended by the LAC to the LNS via L2TP. In case that the Authentication phase does not return L2TP parameters, the session will be terminated because the 7750 does not support directly terminated MLPPPoX sessions.

In the case that MLPPPoX is not enabled on the LAC, the LAC will negotiate plain PPP session with the client. In case that the client accepts plain PPP instead of MLPPPoX as offered by the LAC, when the session is extended to the LNS, the LNS will re-negotiate MLPPPoX LCP with the client on a MLPPPoX enabled tunnel. The LNS will learn about the MLPPPoX capability of the client via Proxy LCP message in ICCN (first Conf Req received from the client is also send in Proxy LCP). If the there is no indication of the MLPPPoX capability of the client, the LNS will establish a plain PPP(oE) session with the client.

Note that there is no dependency between ATM autosensing on LAC and MLPPPoX since autosensing operates on a lower layer than PPP (LCP).

Link Fragmentation and Interleaving (LFI)

The purpose of LFI is to ensure that short high priority packets are not delayed by the transmission delay of large low priority packets on slow links.

For example it takes ~150ms to transmit a 5000B packet over a 256Kbps link, while the same packet is transmitted in only 40us over a 1G link (~4000 times faster transmission). To avoid the delay of a high priority packet by waiting in the queue while the large packet is being transmitted, the large packet can be segmented into smaller chunks. The high priority packet can be then interleaved with the smaller fragments. This approach can significantly reduce the delay of high priority packets.

The interleaving functionality is only supported on MLPPPoX bundles with a single link. If more than one link is added into a interleaving capable MLPPPoX bundle, then interleaving will be internally disabled and the tmnxMlpppBundleIndicatorsChange trap will be generated.

With interleaving enabled on an MLPPPoX enabled tunnel, the following session types are supported:

- Multiple LCP sessions tied into a single MLPPPoX bundle. This scenario assumes multiple physical links on the client side. Theoretically it would be possible to have multiple sessions running over the same physical link in the last mile. For example, two PPPoE sessions going over the same Ethernet link in the last mile, or two ATM VCs o2q1231qa23n the same last mile link. Whichever the case might be, the LAC/LNS is unaware of the physical topology in the last mile (single or multiple physical links). Interleaving functionality will be internally disabled on such MLPPPoX bundle.
- A single LCP session (including dual stack) over the MLPPPoX bundle. This scenario assumes a single physical link on the client side. Interleaving will be supported on such single session MLPPPoX bundle as long as the conditions for interleaving are met. Those conditions are governed by max-fragment-delay parameter and calculation of the fragment size as described in subsequent sections.
- An LCP session (including dual stack) over a plain PPP/PPPoE session. This type of session is a regular PPP(oE) session outside of any MLPPPoX bundle and therefore its traffic is not MLPPPoX encapsulated.

Packets on an MLPPPoX bundle are MLPPPoX encapsulated unless they are classified as high priority packets when interleaving is enabled.

MLPPPoX Fragmentation, MRRU and MRU Considerations

MLPPPoX in 7750 is concerned with two MTUs:

- **bundle-mtu** determines the maximum length of the original IP packet that can be transmitted over the entire bundle (collection of links) before any MLPPPoX processing takes place on the transmitting side. This is also the maximum size of the IP packet that the receiving node can accept once it de-encapsulates and assembles received MLPPPoX fragments of the same packet. Bundle-mtu is relevant in the context of the collection of links.
- **link-mtu** determines the maximum length of the payload before it is PPP encapsulated and transmitted over an individual link within the bundle. Link-mtu is relevant in the context of the single link within the bundle.

Assuming that the CPE advertized MRRU and MRU values are smaller than any configurable mtu on MLPPPoX processing modules in 7750 (carrier IOM and BB-ISA), the bundle-mtu and the link-mtu will be based on the received MRRU and MRU values, respectively. For example, the bundle-mtu will be set to the received MRRU value while link-bundle will be set to the MRU value minus the MLPPPoX encapsulation overhead (4 or 6 bytes).

In addition to mtu values, fragmentation requires a fragment length value for each MLPPP bundle on LNS. This fragment length value is internally calculated according to the following parameters;

- Minimum desired transmission delay in the last mile.
- Fragment “payload to encapsulation overhead” efficiency ratio.
- Various MTU sizes in 7750 dictated mainly by received MRU, received MRRU and configured PPP MTU under the following hierarchy:
  - → configure subscriber-mgmt ppp-policy ppp-mtu (ignored on LNS)
  - → configure service vprn l2tp group ppp mtu
  - → configure service vprn l2tp group tunnel ppp mtu
  - → configure router l2tp group ppp mtu
  - → configure router l2tp group tunnel ppp mtu

The decision whether to fragment and encapsulate a packet in MLPPPoX will depend on the mode of operation, the packet length and the packet priority as follows:

LFI Case — When Interleave is enabled in a bundle, low priority packets will always be MLPPPoX encapsulated. If a low-priority packet’s length exceeds the internally calculated Fragment Length, the packet will be MLPPPoX fragmented and encapsulated. High priority packets whose length is smaller than the link-mtu will be PPP encapsulated and transmitted without MLPPP encapsulation.

Non-LFI Case — When Interleave is disabled in a bundle, all packets will be MLPPPoX encapsulated. If a packet’s length exceeds the internally calculated fragment length, the packet will be MLPPPoX fragmented and encapsulated.

A packet of the size greater than the link-mtu cannot be natively transmitted over an MLPPPoX bundle. Such packet will be MLPPPoX encapsulated and consequently fragmented. This is irrespective of the priority of the packet in interleaving case or whether the fragmentation is enabled or disabled.

In cases where MLPPPoX fragmentation is disabled with the no max-fragment-delay command, it is expected that packets are not MLPPPoX fragmented but rather only MLPPPoX encapsulated in order to be load balanced over multiple physical links in the last mile. However, even if MLPPPoX fragmentation is disabled, it is possible that fragmentation occurs under certain circumstances. This behavior is related to the calculation of the MTU values on an MLPPPoX bundle.

Consider an example where received MRRU value sent by CPE is 1500B while received MRU is 1492B. In this case, our bundle-mtu will be set to 1500B and our link-mtu will be set to 1488B (or 1486B) to allow for the additional 4/6B of MLPPPoX encapsulation overhead. Consequently, IP payload of 1500B can be transmitted over the bundle but only 1488B can be transmitted over any individual link. In case that an IP packet with the size between 1489B and 1500B needs to be transmitted from 7750 towards the CPE, this packet would be MLPPPoX fragmented in 7750 as dictated by the link-mtu. This is irrespective of whether MLPPPoX fragmentation is enabled or disabled (as set by no max-fragment-delay flag).

To entirely avoid MLPPPoX fragmentation in this case, the received MRRU sent by CPE should be lower than the received MRU for the length of the MLPPPoX header (4 or 6 bytes). In this case, for IP packets larger than 1488B, IP fragmentation would occur (assuming that DF flag in the IP header allows it) and MLPPPoX fragmentation would be avoided.

On the 7750 side, it is not possible to set different advertized MRRU and MRU values with the ppp-mtu command. Both MRRU and MRU advertized values adhere to the same configured ppp mtu value.

LFI Functionality Implemented in LNS

As mentioned in the previous section, LFI on LNS is implemented only on MLPPPoX bundles with a single LCP session.

There are two major tasks associated with LFI[1] on the LNS:

- Executing subscriber QoS in the carrier IOM based on the last mile conditions. The subscriber QoS rates are the last mile on-the-wire rates. Once traffic is QoS conditioned, it is sent to the BB-ISA for further processing.
- Fragmentation and artificial delay (queuing) of the fragments so that high priority packets can be injected in-between low priority fragments (interleaved). This operation is performed by the BB-ISA.

Examine an example to further clarify functionality of LFI. The parameters, conditions and requirements that will be used in our example to describe the desired behavior are the following:

- High priority packets must NOT be delayed for more than 50ms in the last mile due to the transmission delay of the large low priority packets. Considering that tolerated end-to-end VoIP delay must be under 150ms, limiting the transmission delay to 50ms on the last mile link is a reasonable choosing.
- The link between the LNS and LAC is 1Gbps Ethernet.
- The last mile link rate is 256kbps.
- Three packets arrive back-to-back on the network side of the LNS (in the downstream direction). The large 5000B low priority packet P1 arrives first, followed by two smaller high priority packets P2 and P3, each 100B in length. Note that packets P1, P2 and P3 can be originated by independent sources (PCs, servers, etc.) and therefore can theoretically arrive in the LNS from the network side back-to-back at the full network link rate (10Gbps or 100Gbps).
- The transmission time on the internal 10G link between the BB-ISA and the carrier IOM for the large packet (5000B) is 4us while the transmission time for the small packet (100B) is 80ns.
- The transmission time on the 1G link (LNS->LAC) for the large packet (5000B) is 40us while the transmission time for the small packet (100B) is 0.8us.
- The transmission time in the last mile (256kbps) for the large packet is ~150ms while the transmission time for the small packet on the same link is ~3ms.
- Last mile transport is ATM.

To satisfy the delay requirement for the high priority packets, the large packets will be fragmented into three smaller fragments. The fragments will be carefully sized so that their individual

1. Most of this is also applicable to non-lfi case. The only difference between lfi and non-lfi is that there is no artificial delay performed in non-lfi case.

transmission time in the last mile does not exceed 50ms. After the first 50ms interval, there will be window of opportunity to interleave the two smaller high priority packets.

This entire process is further clarified by the five points (1-5) in the packet route from the LNS to the Residential Gateway (RG) as depicted in Figure 30.

The five points are:

1. Last Mile QoS Awareness in the LNS on page 608
2. BB-ISA Processing on page 610
3. LNS-LAC Link on page 611
4. AN-RG Link on page 611
5. Home Link on page 611

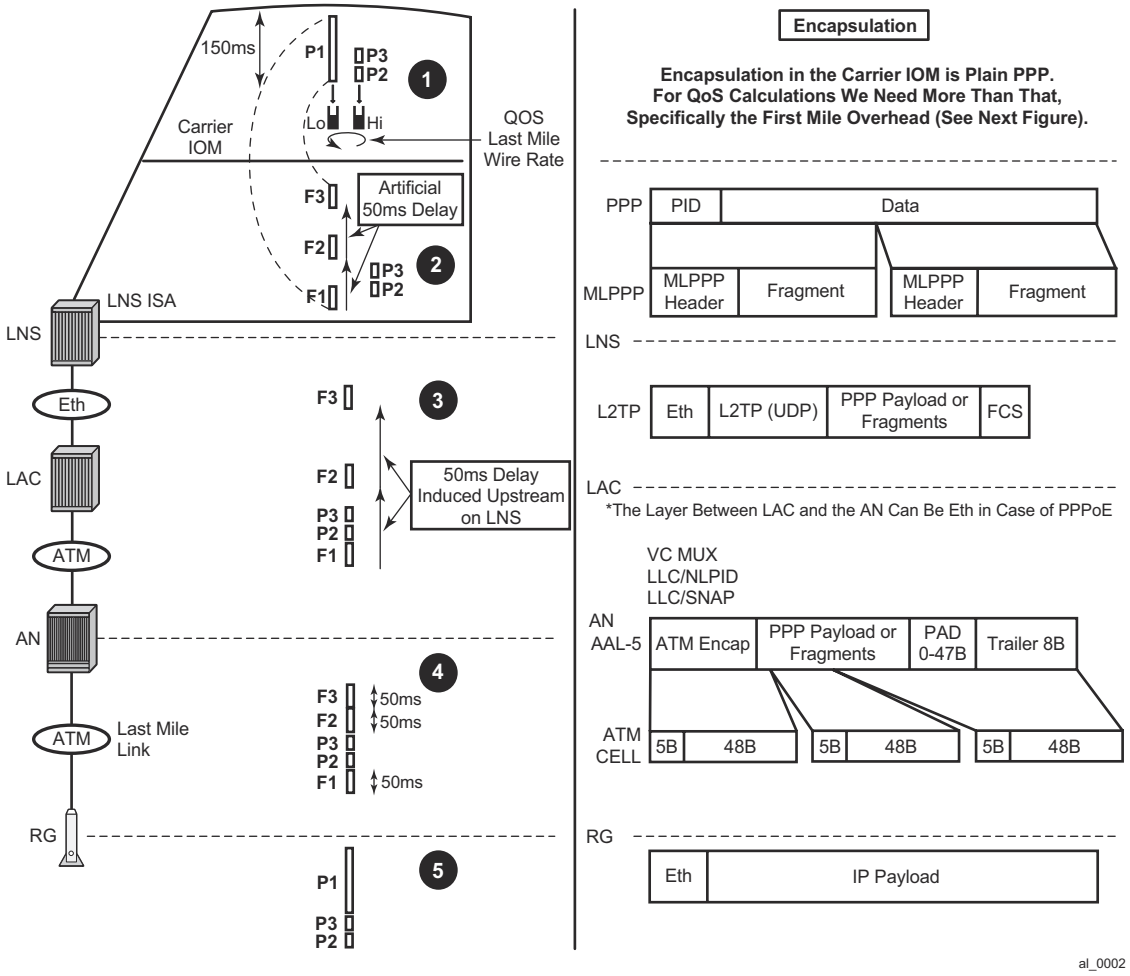


Figure 30: Packet Route from the LNS to the RG

Last Mile QoS Awareness in the LNS

By implementing MLPPPoX in LNS, we are effectively transferring the traffic treatment functions (QoS/LFI) of the last mile to the node (LNS) that is multiple hops away.

The success of this operation depends on the accuracy at which we can simulate the last mile conditions in the LNS. The assumption is that the LNS is aware of the two most important parameters of the last mile:

- The last mile encapsulation — This is needed for the accurate calculation of the overhead associated of the transport medium in the last mile for traffic shaping and interleaving.
- The last mile link rate — This is crucial for the creation of artificial congestion and packet delay in the LNS.

The subscriber QoS in the LNS is implemented in the carrier IOM and is performed on a per packets basis before the packet is handed over to the BB-ISA. Per packet, rather than per fragment QoS processing will ensure a more efficient utilization of network resources in the downstream direction. Discarding fragments in the LNS would have detrimental effects in the RG as the RG would be unable to reconstruct a packet without all of its fragments.

High priority traffic within the bundle is classified into the high priority queue. This type of traffic is not MLPPPoX encapsulated unless its packet size exceeds the link MTU as described in **MLPPPoX Fragmentation, MRRU and MRU Considerations on page 604.** Low priority traffic is classified into a low priority queue and is always MLPPPoX encapsulated. In case that the high priority traffic becomes MLPPPoX encapsulated/fragmented, the MLPPPoX processing module (BB-ISA) will consider it as low-priority. The assumption is that the high priority traffic is small in size and consequently MLPPPoX encapsulation/fragmentation an degradation in priority can be avoided. The aggregate rate of the MLPPPoX bundle is on-the-wire rate of the last mile as shown in Figure 3.

ATM on-the-wire overhead for non-MLPPPoX encapsulated high priority traffic will include:

- ATM encapsulation (VC-MUX, LLC/NLPID, LLC/SNAP).
- AAL5 trailer (8B).
- AAL5 padding to 48B cell boundary (this makes the overhead dependent on the packet size).
- Multiplication by 53/48 to account for the ATM cell headers.

For low priority traffic which is always MLPPPoX encapsulated, an additional overhead related to MLPPPoX encapsulation and possibly fragmentation must be added (blue arrow in Figure 3). In other words, each fragment carries ATM+MLPPPoX overhead.

Note that we can avoid the 48B boundary padding for all fragments except the last one. This can be done by choosing the fragment length so that it is aligned on the 48B boundary (rounded down if based on max-fragment-delay or rounded up if based on the encapsulation/utilization.

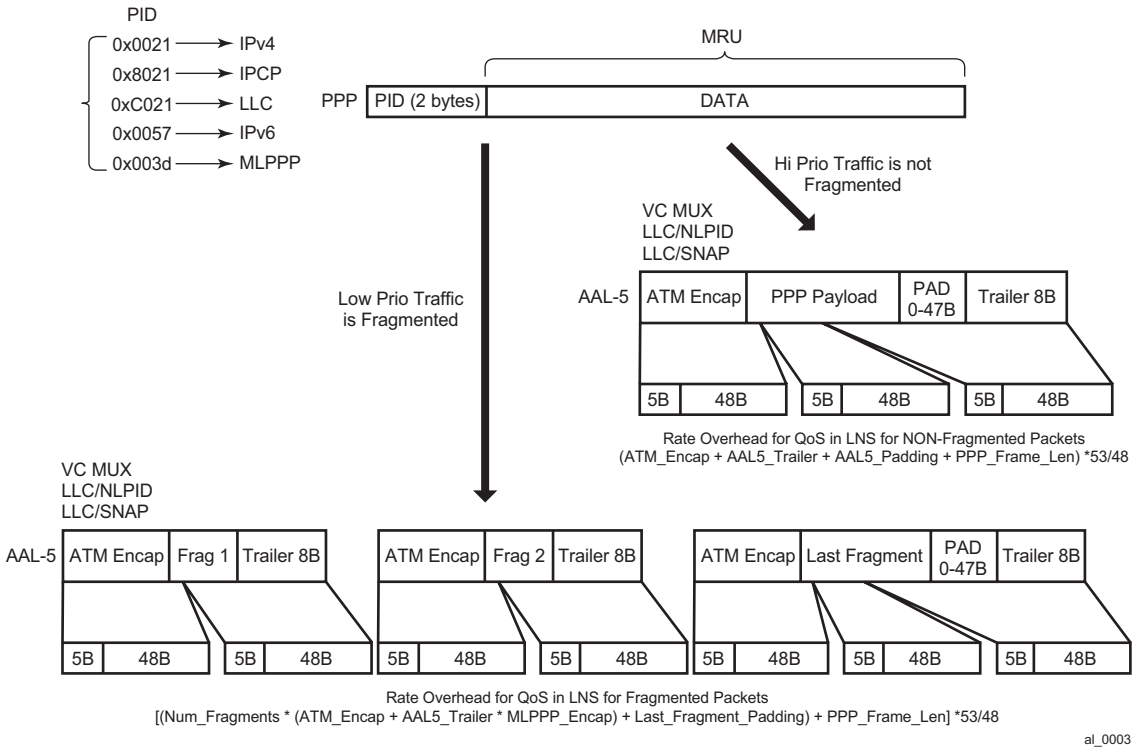


Figure 31: Last Mile Encapsulation

For Ethernet in the last mile, our implementation always assures that the fragment size plus the encapsulation overhead is always larger or equal to the minimum Ethernet packet length (64B).

BB-ISA Processing

MLPPPoX encapsulation, fragmentation and interleaving are performed by the LNS in BB-ISA. If we refer to our example, a large low priority packet (P1) is received by the BB-ISA, immediately followed by the two small high priority packets (P2 and P3). Since our requirement stipulates that there is no more than 50ms of transmission delay in the last mile (including on-the-wire overhead), the large packet must be fragmented into three smaller fragments each of which will not cause more than 50ms of transmission delay.

The BB-ISA would normally send packets/fragments to the carrier IOM at the rate of 10Gbps. In other words, by default the three fragments of the low priority packet would be sent out of the BB-ISA back-to-back at the very high rate before the high priority packets even arrive in the BB-ISA. In order to interleave, the BB-ISA must simulate the last mile conditions by delaying the transmission of the fragments. The fragments will be paced out of the BB-ISA (and out of the box) at the rate of the last mile. High priority packets will get the opportunity to be injected in front of the fragments while the fragments are being delayed.

In Figure 30 (point 2) the first fragment F1 is sent out immediately (transmission delay at 10G is in the 1us range). The transmission of the next fragment F2 is delayed by 50ms. While the transmission of the second fragment F2 is being delayed, the two high priority packets (P1 and P2 in red) are received by the BB-ISA and are immediately transmitted ahead of fragments F2 and F3. This approach relies on the imperfection of the IOM shaper which is releasing traffic in bursts (P2 and P3 right after P1). The burst size is dependent on the depth of the rate token bucket associated with the IOM shaper.

Note that by the time the second fragment F2 is transmitted, the first fragment F1 has traveled a long way (50ms) on high rate links towards the Access Node (assuming that there is no queuing delay along the way), and its transmission on the last mile link has already begun (if not already completed).

This is not applicable for this discussion, but nonetheless worth noticing is that the LNS BB-ISA also adds the L2TP encapsulation to each packet/fragment. The L2TP encapsulation is removed in the LAC before the packet/fragment is transmitted towards the AN.

LNS-LAC Link

This is the high rate link (1Gbps) on which the first fragment F1 and the two consecutive high priority packets, P2 and P3, are sent back-to-back by the BB-ISA

(BB-ISA->carrier IOM->egress IOM-> out-of-the-LNS).

The remaining fragments (F2 and F3) are still waiting in the BB-ISA to be transmitted. They are artificially delayed by 50ms each.

Additional QoS based on the L2TP header can be performed on the egress port in the LNS towards the LAC. This QoS is based on the classification fields inside of the packet/fragment headers (DSCP, dot1.p, EXP).

Note that the LAC-AN link is not really relevant for the operation of LFI on the LNS. This link can be either Ethernet (in case of PPPoE) or ATM (PPPoE or PPP). The rate of the link between the LAC and the AN is still considered a high speed link compared to the slow last mile link.

AN-RG Link

Finally, this is the slow link of the last mile, the reason why LFI is performed in the first place. Assuming that LFI played its role in the network as designed, by the time the transmission of one fragment on this link is completed, the next fragment arrives just in time for unblocked transmission. In between the two fragments, we can have one or more small high priority packets waiting in the queue for the transmission to complete.

Note on the AN-RG link in Figure 30 that packets P2 and P3 are ahead of fragments F2 and F3. Therefore the delay incurred on this link by the low priority packets is never greater than the transmission delay of the first fragment (50ms). The remaining two fragments, F2 and F3, can be queued and further delayed by the transmission time of packets P2 and P3 (which is normally small, in our example 3ms for each).

Note that if many low priority packets are waiting in the queue, then they would have caused delay and would have further delayed the fragments that are in transit from the LNS to the LAC. This condition is normally caused by bursts and it should clear itself out over time.

Home Link

High priority packets P2 and P3 are transmitted by the RG into the home network ahead of the packet P1 although the fragment F1 has arrived in the RG first. The reason for this is that the RG must wait for the fragments F2 and F3 before it can re-assemble packet P1.

Optimum Fragment Size Calculation by LNS

Fragmentation in LFI is based on the optimal fragment size. LNS implementation calculates the two optimal fragment sizes, based on two different criteria:

- Optimal fragment size based on the payload efficiency of the fragment given the fragmentation/transportation header overhead associated with the fragment ?encapsulation based fragment size.
- Optimal fragment size based on the maximum transmission delay of the fragment set by configuration ?delay based fragment size.

At the end only one optimal fragment size will be is selected. The actual fragments length will be of the optimal fragment size.

- The parameters required to calculate the optimal fragment sizes are known to the LNS either via configuration or via signaling. These, in-advance known parameters are:
- Last mile maximum transmission delay (max-fragment-delay obtained via CLI)
- Last mile ATM Encapsulation (in our example the last mile is ATM but in general it can be Ethernet for MLPPPoE)
- MLPPP encapsulation length (depending on the fragment sequence number format)
- The last mile on-the-wire rate for the MLPPPoX bundle

Examine closer each of the two optimal fragment sizes.

Encapsulation Based Fragment Size

One needs to be mindful of the fact that fragmentation may cause low link utilization. In other words, during fragmentation a node may end up transporting mainly overhead bytes in the fragment as opposed to payload bytes. This would only intensify the problem that fragmentation is intended to solve, especially on an ATM access link that tend to carry larger encapsulation overhead.

To reduce the overhead associated with fragmentation, the following is enforced in the 7750:

The minimum fragment payload size will be at least 10times greater than the overhead (MLPPP header, ATM Encapsulation and AAL5 trailer) associated with the fragment.

The optimal fragment length (including the MLPPP header, the ATM Encapsulation and the AAL5 trailer) is a multiple of 48B. Otherwise, the AAL5 layer would add an additional 48B boundary padding to each fragment which would unnecessary expand the overhead associated with fragmentation. By aligning all-but-last fragments to a 48B boundary, only the last fragment will potentially contain the AAL5 48B boundary padding which is no different from a non-fragmented packet. For future reference we will refer to all fragments except for the last fragment as non-

padded fragments. The last fragment will obviously be padded if it is not already natively aligned to a 48B boundary.

As an example, calculate the optimal fragment size based on the encapsulation criteria with the maximum fragment overhead of 22B. To achieve >10x transmission efficiency the fragment payload size must be 220B (10*22B). To avoid the AAL5 padding, the entire fragment (overhead + payload) will be rounded UP on a 48B boundary. The final fragment size will be 288B [22B + 22B*10 + 48B_allignment].

In conclusion, an optimal fragment size was selected that will carry the payload with at least 90% efficiency. The last fragment of the packet cannot be artificially aligned on a 48B boundary (it is a natural reminder), so it will be padded by the AAL5 layer. Therefore the efficiency of the last fragment will probably be less than 90% in our example. In the extreme case, the efficiency of this last fragment may be only 2%.

Note that the fragment size chosen in this manner is purely chosen based on the overhead length. The maximum transmission delay did not play any role in the calculations.

For Ethernet based last mile, the CPM always makes sure that the fragment size plus encapsulation overhead is larger or equal to the minimum Ethernet packet length of 64B.

Fragment Size Based on the Max Transmission Delay

The first criterion in selecting the optimal fragment size based on the maximum transmission delay mandates that the transmission time for the fragment, including all overheads (MLPPP header, ATM encapsulation header, AAL5 overhead and ATM cell overhead) must be less than the configured max-fragment-delay time.

The second criterion mandates that each fragment, including the MLPPP header, the ATM Encapsulation header, the AAL5 trailer and the ATM cellification overhead be a multiple of 48B. The fragment size is rounded down to the nearest 48B boundary during the calculations in order to minimize the transmission delay. Aligning the fragment on the 48B boundary eliminates the AAL5 padding and therefore reduces the overhead associated with the fragment. The overhead reduction will not only improve the transmission time but it will also increase the efficiency of the fragment.

Given these two criteria along with the configuration parameters (ATM Encapsulation, MLPPP header length, max-fragment-delay time, rate in the last mile), the implementation calculates the optimal non-padded fragment length as well as the transmission time for this optimal fragment length.

Selection of the Optimum Fragment Length

So far the implementation has calculated the two optimum fragment lengths, one based on the length of the MLPPP/transport encapsulation overhead of the fragment, the other one based on the maximum transmission delay of the fragment. Both of them are aligned on a 48B boundary. The larger of the two is chosen and the BB-ISA will perform LFI based on this selected optimal fragment length.

Upstream Traffic Considerations

Fragmentation and interleaving is implemented on the originating end of the traffic. In other words, in the upstream direction the CPE (or RG) is fragmenting and interleaving traffic. There is no interleaving or fragmentation processing in the upstream direction in the 7750. The 7750 will be on the receiving end and is only concerned with the reassembly of the fragments arriving from the CPE. Fragments will be buffered until the packet can be reconstructed. If all fragments of a packet are not received within a preconfigured timeframe, the received fragments of the partial packet will be discarded (a packet cannot be reconstructed without all of its fragments). This time-out and discard is necessary in order to prevent buffer starvation in the BB-ISA. Two values for the time-out can be configured: 100ms and 1s.

Multiple Links MLPPPoX With No Interleaving

Interleaving over MLPPPoX bundles with multiple links will not be supported. However, fragmentation is supported.

In order to preserve packet order, all packets on an MLPPPoX bundle with multiple links will be MLPPPoX encapsulated (monotonically increased sequence numbers).

We will not support multiclass MLPPP (RFC 2686, *The Multi-Class Extension to Multi-Link PPP*). Multiclass MLPPP would require another level of intelligent queuing in the BB-ISA which we do not have.

MLPPPoX Session Support

The following session types in the last mile will be supported:

- MLPPPoE — Single physical link or multilink. The last mile encapsulation is Ethernet over copper (This could be Ethernet over VDSL or HSDSL). The access rates (especially upstream) are still limited by the xDSL distance limitation and as such interleaving is required on a slow speed single link in the last mile. It is possible that the last mile encapsulation is Ethernet over fiber (FTTH) but in this case, users would not be concerned with the link speed to the point where interleaving and link aggregation is required.

Finally, this is the slow link of the last mile, the reason why LFI is performed in the first place. Assuming that LFI played its role in the network as designed, by the time the transmission of one fragment on this link is completed, the next fragment arrives just in time for unblocked transmission. In between the two fragments, we can have one or more small high priority packets waiting in the queue for the transmission to complete.

We can see on the AN-RG link in Figure 2 that packets P2 and P3 are ahead of fragments F2 and F3. Therefore the delay incurred on this link by the low priority packets is never greater than the

transmission delay of the first fragment (50ms). The remaining two fragments, F2 and F3, can be queued and further delayed by the transmission time of packets P2 and P3 (which is normally small, in our example 3ms for each).

Note that if many low priority packets were waiting in the queue, then they would have caused delay for each other and would have further delayed the fragments in transit from the LNS to the LAC. This condition is normally caused by bursts and it should clear itself out over time.

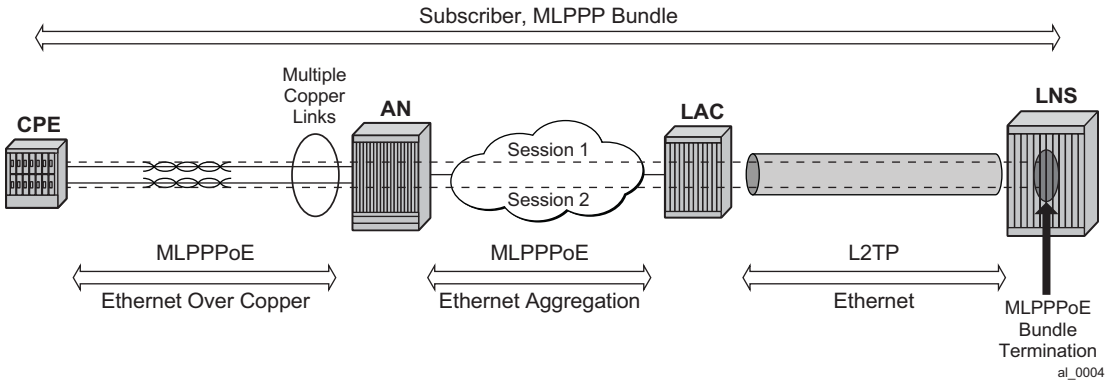


Figure 32: MLPPPoE — Multiple Physical Links

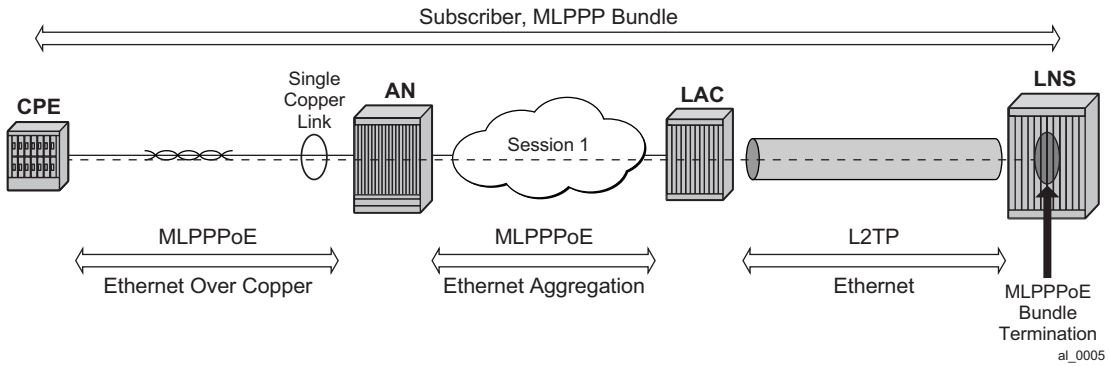


Figure 33: MLPPPoE — Single Physical Link

- MLPPP(oEo)A — A single physical link or multilink. The last mile encapsulation is ATM over xDSL.

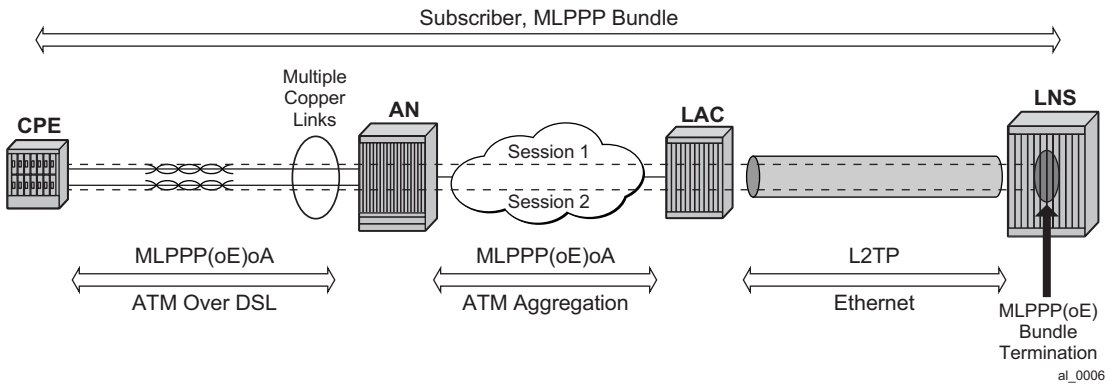


Figure 34: MLPPP(oE)oA — Multiple Physical Links

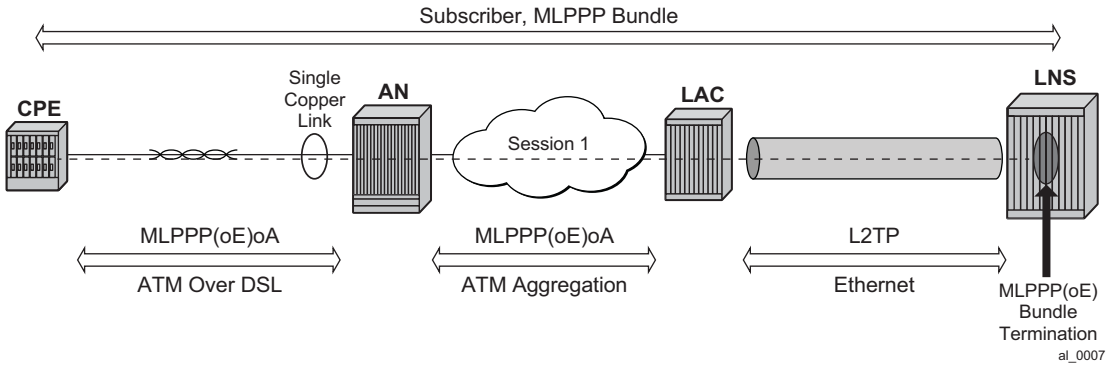


Figure 35: MLPPP(oE)oA — Single Physical Link

Some other combinations are also possible (ATM in the LAST mile, Ethernet in the aggregation) but they all come down to one of the above models that are characterized by:

- Ethernet or ATM in the last mile.
- Ethernet or ATM access on the LAC.
- LPPP/PPPoE termination on the LNS

Session Load Balancing Across Multiple BB-ISAs

PPP/PPPoE sessions are by default load balanced across multiple BB-ISAs (max 6) in the same group. The load balancing algorithm considers the number of active session on each BB-ISA in the same group[2].

With MLPPPoX, it is important that multiple sessions per bundle be terminated on the same LNS BB-ISA. This can be achieved by per tunnel load balancing mode where all sessions of a tunnel are terminated in the same BB-ISA. Per tunnel load balancing mode is mandatory on LNS BB-ISAs that are in the group that supports MLPPPoX.

On the LAC side, all sessions in an MLPPPoX bundle are automatically assigned to the same tunnel. In other words an MLPPPoX bundle is assigned to the tunnel. There can be multiple tunnels created between the same pair of LAC/LNS nodes.

2. The load balancing algorithm does not take into account the number of queues consumed on the carrier IOM. Therefore a session can be refused if queues are depleted on the carrier IOM even though the BB-ISA may be lightly loaded in terms of the number of sessions that is hosting.

BB-ISA Hashing Considerations

All downstream traffic on an MLPPPoX bundle with multiple links is always MLPPPoX encapsulated. Some traffic is fragmented and served in a octet oriented round robin fashion over multiple member links. However, fragments are never delayed in case that the bundle contains multiple links.

In a per fragment/packet load sharing algorithm, there is always the possibility that there is uneven load utilization between the member links. A single link overload will most likely go unnoticed in the network all the way to the Access Node. The access node is the only node in the network that actually has multiple physical links connected to it. All other session-aware nodes[3] (LAC and LNS) only see MLPPPoX as a bundle with multiple sessions without any mechanism to shape traffic per physical link.

If one of the member sessions is perpetually overloaded by the LNS, traffic will be dropped in the last mile since the corresponding physical link cannot absorb traffic beyond its physical capabilities. This would have detrimental effects on the whole operation of the MLPPPoX bundle. To prevent this perpetual overloading of the member links that can be caused by per packet/ fragment load balancing scheme, the load balancing scheme that takes into account the number of octets transmitted over each member link. The octet counter of a new link will be initialized to the lowest value of any existing link counter. Otherwise the load balancing mechanism would show significant bias towards the new link until the byte counter catches up with the rest of the links.

Last Mile Rate and Encapsulation Parameters

The last mile rate information along with the encapsulation information is used for fragmentation (to determine the maximum fragment length) and interleaving (delaying fragments in the BB-ISA). In addition, the aggregate subscriber rate (aggregate-rate-limit) on the LNS is automatically adjusted based on the last mile link rate and the number of links in the MLPPPoX bundle.

Downstream Data Rate in the Last Mile

The subscriber aggregate rates (agg-rate-limit) used in (H)QoS on the carrier IOM and in the BB-ISA (for interleaving) must be wire based in the last mile. This rule applies equally to both, the LAC and LNS.

The last mile on-the-wire rates of the subscriber can be submitted to the LAC and the LNS via various means. Here is the break down on how the last mile wire rates will be passed to each entity:

LAC

3. Other nodes in this case being 7750s. Other vendors may have the ability to condition (shape) traffic per session.

The last mile link rate is taken via the following methods in the order of listed priority:

- LUDB — rate-down command under the host hierarchy in LUDB.
- RADIUS Alc-Access-Loop-Rate-Down VSA. Although this VSA is stored in the state of plain PPP(oE) sessions (MLPPPoX bundled or not), it is applicable only to MLPPPoX bundles.
- PPPoE tags — Vendor Specific Tags (RFC 2516, *A Method for Transmitting PPP Over Ethernet (PPPoE)*; tag type 0x0105; tag value is Enterprise Number 3561 followed by the TLV sub-options as specified in TR-101 -> Actual Data Rate Downstream 0x82)

As long as the link rate information is available in the LAC, it will always be passed to the LNS in the ICRQ message using the standard L2TP encoding. This cannot be disabled.

In addition, an option is available to control the source of the rate information can be conveyed to the LNS via TX Connect Speed AVP in the ICCN message. This can be used for compatibility reasons with other vendors that can only use TX Connect Speed to pass the link rate information to the LNS. By default, the maximum port speed (or the sum of the maximum speeds of all member ports in the LAG) will be reported in TX Connect Speed. Unlike the rate conveyed in ICRQ message, The TX Connect Speed content is configurable via the following command:

```
config>subscriber-management>
     sla-profile <name>
          egress
               report-rate agg-rate-limit | scheduler <scheduler-name> | pppoe-actual-rate
| rfc5515-actual-rate
```

The report-rate configuration option will dictate which rate will be reported in the TX Connect Speed as follows:

- agg-rate-limit => statically configured agg-rate-limit value or RADIUS QoS override will be reported
- scheduler <scheduler-name> => virtual schedulers are not supported in MLPPPoX
- pppoe-actual-rate => rate taken from PPPoE Tags will be reported. Note that rate reported via RFC5515 can still be different if the source for both methods is not the same.
- rfc5515-actual-speed => the rate is taken from RFC5515.

The RFC 5515 relies on the same encoding as PPPoE tags (vendor id is ADSL Forum and the type for Actual Data Rate Downstream is 0x82). Note that the two methods of passing the line rate to the LNS are using different message types (ICRQ and ICCN).

The LAC on the 7750 is not aware of MLPPPoX bundles. As such, the aggregate subscriber bandwidth on the LAC is configured statically via usual means (sub-profile, scheduler-policy) or dynamically modified via RADIUS. The aggregate subscriber (or MLPPPoX bundle) bandwidth on the LAC is not automatically adjusted according to the rates of the individual links in the bundle and the number of the links in the bundle. As such, an operator must ensure that the statically provided rate value for aggregate-rate-limit is the sum of the bandwidth of each member link in the MLPPPoX bundle. The number of member links and their bandwidth must be therefore

known in advance. The alternative is to have the aggregate rate of the MLPPPoX bundle set to a high value and rely on the QoS treatment performed on the LNS.

LNS

The sources of information for the last mile link rate on the LNS will be taken in the following order:

- LUDB (during user authentication phase, same as in LAC)
- RADIUS (same as in LAC)
- ICRQ message — Actual Data Downstream Rate (RFC 5515)
- ICCN message — TX Connect Speed

There will be no configuration option to determine the priority of the source of information for the last mile link rate. TX Connect Speed in ICCN message will only be taken into consideration as a last resort in absence of any other source of last mile rate information.

Once the last mile rate information is obtained, the subscriber aggregate rate (aggregate-rate-limit will be automatically adjusted to the minimum value of:

- The smallest link speed in the MLPPPoX bundle multiplied by the number of links in the bundle.
- Statically configured aggregate-rate-limit

The link speed of each link in the bundle must be the same, i.e. different link speeds within the bundle are not supported. In the case that we receive different link speed values for last mile links within the bundle, we will adopt the minimum received speed and apply it to all links.

In case that the obtained rate information from the last mile for a session within the MLPPP bundle is out of bounds (1Kbps to 100Mbs), the session within the bundle will be terminated.

Encapsulation

Wire-rates are dependent on the encapsulation of the link to which they apply. The last mile encapsulation information can be extracted via various means.

LAC

- Static configuration via LUDB.
- RADIUS — Alc-Access_Loop-Encap-Offset VSA.
- PPPoE tags — Vendor Specific Tags (RFC 2516; tag type 0x0105; tag value is Enterprise Number 3561 followed by the TLV sub-options as specified in TR-101 -> Actual Data Rate Downstream 0x82).

The LAC will pass the line encapsulation information to the LNS via ICRQ message using the encoding defined in the RFC 5515.

LNS

The LNS will extract the encapsulation information in the following order:

- Static configuration via LUDB.
- RADIUS — Alc-Access-Loop-Encap-Offset VSA.
- ICRQ message (RFC 5515)

In case that the encapsulation information is not provided by any of the existing means (LUDB, RADIUS, AVP signaling, PPPoE Tags), then by default pppoa-null encapsulation will be in effect. This applies to LAC and LNS.

Link Failure Detection

The link failure in the last mile is detected via the expiration of session keepalives (LCP). The LNS will tear down the session over the failed link and notify the LAC via a CDN message.

CoA Support

CoA request for the subscriber aggregate-rate-limit change is honored on the LAC and the LNS.

CoA for the rate change of an individual link within the bundle is supported through the same VSA that can be used to initially assign the rate parameter to each member link. This is supported only on LNS. The rate override via CoA is applied to all active link members within the bundle.

Change of the access link parameters via CoA is be supported in the following fashion:

- Change of access loop encap: refused (NAK)
- Change of access loop rate down:
- On L2TP LAC session: refused (NAK). On LAC the access loop rate down is not locally used for any rate limiting function but instead it is just passed to the LNS at the beginning when the session is first established. Mid-session changes on LAC via CoA are not propagated to the LNS.
- On L2TP LNS session:
  - → Plain session: ignored. The rate is stored in the MIB table but no rate limiting action is taken. In other words, this parameter is internally excluded from rate calculations and advertisements. However, it is shown in the output of the relevant show commands.
- Bundle session: applied on all link sessions. The aggregate rate limit of the bundle is set to the minimum of the:
- CoA obtained local loop down rate multiplied by the number of links in the bundle

- The aggregate rate limit configured statically or obtained via CoA.
- Fragment length will be affected by this change. In case that interleaving is enabled on a single link bundle, the interleave interval will be affected.
- Non-L2TP: ignored. The rate is stored in the MIB table but no rate limiting action is taken. In other words, this parameter is internally excluded from rate calculations and advertisements. However, it will be shown in the output of the relevant show commands.

Similar behavior is exhibited if at mid session, the parameters are changed via LUDB with the exception of the rate-down parameter in LAC. If this parameter is changed on the LAC, all sessions are disconnected.

Accounting

Accounting counters on the LNS include all packet overhead (wire overhead from the last mile). There is only one accounting session per bundle.

On the LAC, there is one accounting session per pppoe session (link).

In tunnel-accounting mode there is one accounting session per link.

On LNS only the stop-link of the last link of the bundle will carry all accounting data for the bundle.

Filters and Mirroring

Filters and mirrors (LI) are not supported on an MLPPPoX bundle on LAC. However, filters and ip-only mirror type are supported on the LNS.

PTA Considerations

Locally terminated MLPPPoX (PTA) solution is offered based on the LAC and the LNS hosted in the same system. An external loop (or VSM2) is used to connect the LAC to the LNS within the same box. The subscribers will be terminated on the LNS.

QoS Considerations

Dual-Pass

HQoS and LFI are performed in two stages that involve double traversal (dual-pass) of traffic through the carrier IOM and the BB-ISA. The following are the functions performed in each pass:

- In the first pass through the carrier IOM, traffic is marked (dot1p bits) as high or low priority. This will play crucial role in the execution of LFI in the BB-ISA.
- In the first pass through the BB-ISA this prioritization from the 1st step, will be an indication (along with the internally calculated fragment size) of whether the traffic will be interleaved (non MLPPP encapsulated) or not (MLPPP encapsulated). Consequently the BB-ISA will add the necessary padding related to last mile wire overhead to each packet. This padding will be used in the second pass on the carrier IOM to perform last mile wire based QoS functions.
- In the second pass through the carrier IOM, the last mile wire based HQoS will be performed based on the padding added in the first pass through the BB-ISA.
- In the second pass through the BB-ISA, previously added overhead will be stripped off and LFI/MLPPP encapsulation functions will be performed.

Traffic Prioritization in LFI

The delivery of high priority traffic within predefined delay bounds on a slow speed last mile link is ensured by proper QoS classification and prioritization. High priority traffic will be interleaved with low priority fragments on a single link MLPPPoX bundle with LFI enabled. The classification of traffic into proper (high or low priority) forwarding class is performed on the downstream ingress interface. However, traffic can be re-classified (re-mapped into another forwarding class) on the egress access interface of the carrier IOM, just before packets are transmitted to the BB-ISA for MLPPPoX processing. This can be achieved via QoS sap-egress policy referenced in the LNS sla-profile.

The priority of the forwarding class in regular QoS (on IOM) is determined by the properties[4] of the queue to which the forwarding class is mapped. In contracts, traffic prioritization in LFI domain (in BB-ISA) is determined by the outer dot1p bits that are set by the carrier IOM while

transmitting packets towards the BB-ISA. The outer dot1p bits are marked based on the forwarding class information determined by classification/re-classification on ingress/carrier IOM. This marking of outer dot1p bits in the Ethernet header between the carrier IOM and the BB-ISA is fixed and defined in the default sap-egress LNS ESM policy 65537. The marking definition is as follows:

```
FC be -> dot1p 0
FC l2 -> dot1p 1
FC af -> dot1p 2
FC l1 -> dot1p 3
FC h2 -> dot1p 4
FC ef -> dot1p 5
FC h1 -> dot1p 6
FC nc -> dot1p 7
```

In LFI (on BB-ISA), dot1p bits [0,1,2 and 3] are considered low priority while dot1p bits (4,5,6 and 7) are considered high priority. Consequently, forwarding classes BE, L2, AF and L1 are considered low priority while forwarding classes H2, EF, H1 and NC are considered high priority. High priority traffic[5] will be interleaved with low priority traffic.

The following describes the reference points in traffic prioritization for the purpose of LFI in the 7750:

- Classification on downstream ingress interface (entrance point into the 7750) - packets can be classified into one of the following eight forwarding classes: be, l2, af, l1, h2, ef, h1 and nc. Depending on the type of the ingress interface (access or network), traffic can be classified based on dot1p, exp, DSCP, TOS bits or ip-match criteria (dscp, dst-ip, dst-port, fragment, src-ip, src-port and protocol-id).
- Re-classification on downstream access egress interface between the carrier IOM and the BB-ISA - in the carrier IOM, downstream traffic can be re-classified into another forwarding class, just before it is forwarded to the BB-ISA. Re-classification on access egress is based on the same fields as on ingress except for the dot1p and exp bits since Ethernet or MPLS headers from ingress are not carried from ingress to egress.
- Marking on downstream access egress interface between the carrier IOM and the BB-ISA - once the forwarding class is available on the carrier IOM in the egress direction (towards BB-ISA), it will be used to mark outer dot1p bits in the new Ethernet header that will be used to transport the frame from the carrier IOM to the BB-ISA. The marking of the dot1p bits on the egress SAP between the carrier IOM and the BB-ISA cannot be changed for MLPPPoX even if the no qos-marking-from-sap command is configured under the sla-profile on egress.

4. Expedited, non-expedited queue type, CIR and PIR rates.
5. Assuming that the packet size does not exceed maximum fragment size.

Shaping Based on the Last Mile Wire Rates

Accurate QoS, amongst other things, require that the subscriber rates in the first mile on an MLPPPoX bundle be properly represented in the LNS. In other words, the rate limiting functions in the LNS must account for the last mile on-the-wire encapsulation overhead. The last mile encapsulation can be Ethernet or ATM.

For ATM in the last mile, the LNS will account for the following per fragment overhead:

- PID
- MLPPP encapsulation header
- ATM Fixed overhead (ATM encap + fixed AAL5 trailer)
- 48B boundary padding as part of AAL5 trailer
- 5B per each 48B of data in ATM cell.

In case of Ethernet encapsulation in the last mile, the overhead will be:

- PID
- MLPPP header per fragment
- Ethernet Header + FCS per fragment
- Preamble + IPG overhead per fragment

The encap-offset command under the sub-profile egress CLI node will be ignored in case of MLPPPoX. MLPPPoX rate calculation will be by default always based on the last mile wire overhead.

The HQoS rates (port-scheduler, aggregate-rate-limit and scheduler) on LNS are based on the wire overhead of the entity to which the HQoS is applied. For example, if the port-scheduler is managing bandwidth on the link between the BB-ISA and the carrier IOM, then the rate of such scheduler will account for the q-in-q Ethernet encapsulation on that link along with the preamble and inter packet gap (20B).

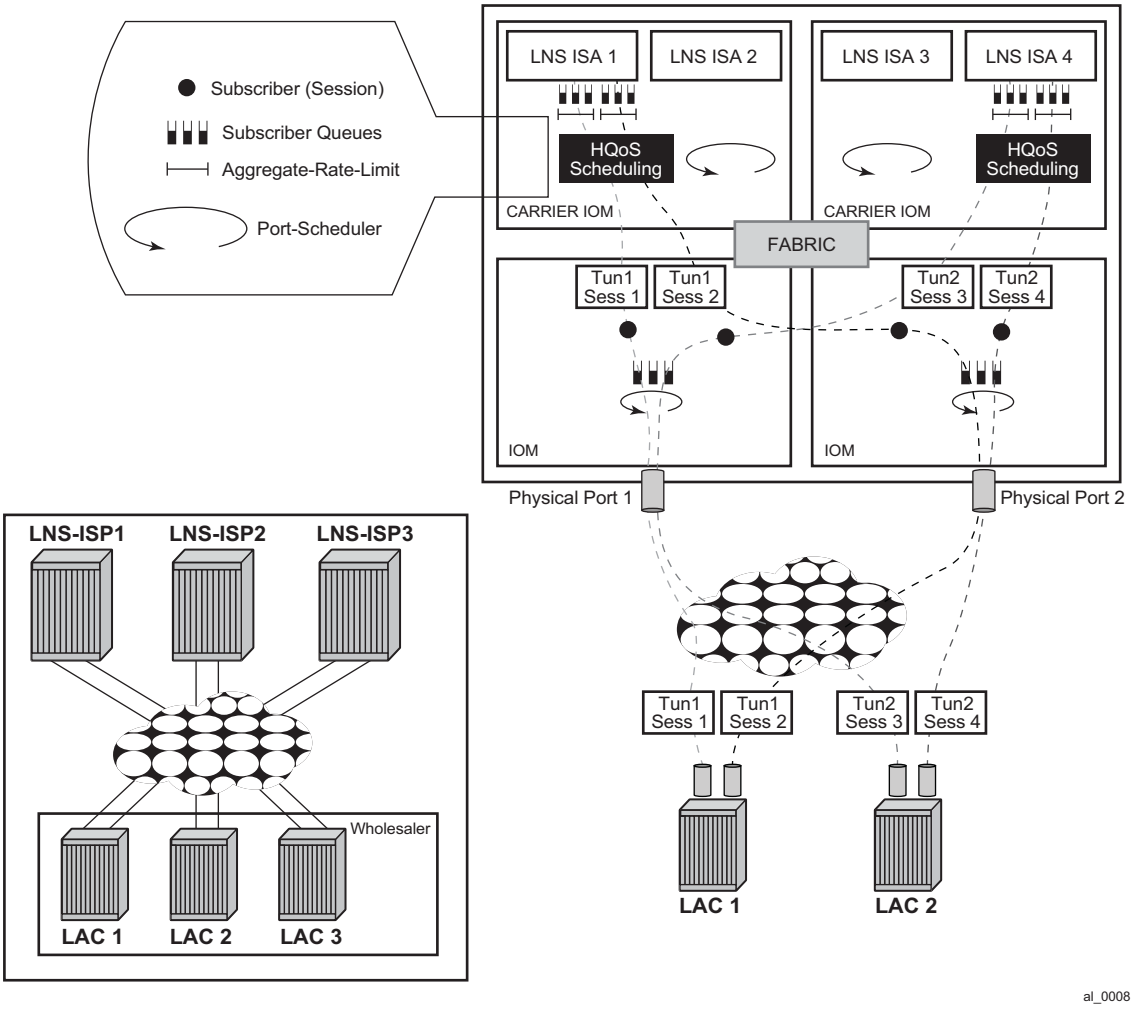


Figure 36: QoS Enforcement Points in the LNS

While virtual schedulers (attached via sub-profile) are supported on LNS for plain PPPoX sessions, they are not supported for MLPPPoX bundles. Only aggregate- rate-limit along with the port-scheduler can be used in MLPPPoX deployments.

Downstream Bandwidth Management on Egress Port

Bandwidth management on the egress physical ports (Physical Port 1 and Physical Port 2 in Figure 8) is performed at the egress port itself on the egress IOM instead on the carrier IOM. By default, the forwarding class (FC) information is preserved from network ingress to network egress. However, this can be changed via QoS configuration applied to the egress SAP of the carrier IOM towards the BB-ISA.

L2TP traffic originated locally in LNS can be marked via the router/service vprn->sgt-qos hierarchy.

Sub/Sla-Profile Considerations

Sub-profile

In the MLPPPoX case on LNS, multiple sessions are tied into the same subscriber aggregate-rate-limit via a sub-profile. The consequence is that the aggregate rate of the subscriber can be adjusted dynamically depending on the advertized link speed in the last mile and the number of links in the bundle. Note that shaping in the LNS is performed per the entire MLPPPoX bundle (subscriber) rather than per individual member links within the bundle. The exception is obviously a MLPPPoX bundle with the single member link (interleaving case) where the relationship between the session and the MLPPPoX bundle is 1:1.

In the LAC, the subscriber aggregate rate cannot be dynamically changed based on the number of links in the bundle and their rate. The LAC has no notion of MLPPPoX bundles. However, multiple sessions that in reality belong to an MLPPPoX bundle under the subscriber are shaped as an aggregate (agg-rate-limit under the sub-profile). This in essence yields the same shaping behavior as on LNS.

Sla-profile

Sessions within the MLPPPoX bundle in LNS share a single sla-profile instances (queues).

In the LAC, as long as the sessions within the subscriber6 are on the same SAP, they can also share the same sla-profile. This will be the case in MLPPPoX.

The manner in which sub/sla-profile are applied to MLPPPoX bundles and the individual sessions within results in aggregate shaping per MLPPPoX bundle as well as allocation of unique set of queues per MLPPPoX bundle. This is valid irrespective of the location where shaping is executed (LAC or LNS). Other vendors may have implemented shaping per session within the bundle and this is something that needs to be taken into consideration during the migration process.

Example of MLPPPoX Session Setup Flow

LAC behavior

- A new PPP(oEoA) session request will arrive to the LAC (PADI or LCP Conf Req).
- The LAC will negotiate PADx session if applicable.
- The LAC may negotiate MLPPPoX LCP phase with its own endpoint discriminator, or it may reject MLPPPoX specific options in LCP if MLPPPoX on the LAC is disabled (i.e. no accept-mrru in the LAC's ppp-policy). If MLPPPoX options (seq num header format, ED, MRRU) are rejected, the assumption is that the client will renegotiate plain PPP(oEoA) session with the LAC.
- Once LCP (MLPPPoX capable or not) is negotiated, the session will be authenticated (PAP/CHAP).
- Upon successful authentication, an L2TP tunnel will be identified to which the session belongs.
- If the session is a non-L2TP session (PTA MLPPPoX capable session for which the tunnel cannot be determined), the session will be terminated.
- Otherwise, the QoS constructs will be created for the subscriber hosts: the session will be assigned to a sub/sla-profiles.
- The session LCP parameters will be sent to the LNS via call management messages.
- Note that if another LCP session is requested on the same bundle, the LAC will create a new LCP session and join this session to the existing subscriber as another host. In other words, the LAC is bundle agnostic and the two sessions will appear as two hosts under the same subscriber.

The following assumes that MLPPPoX is configured on the LNS under the L2TP group or the tunnel hierarchy.

LNS behavior

- The LNS have the option to accept the LCP parameters or to reject them and start renegotiating LCP parameters directly with the client.
- If the LNS choose to renegotiate LCP parameters with the client directly, this renegotiation will be completely transparent to the LAC by the means of a T-bit (control vs. data) in the L2TP header. LCP will be renegotiated on the LNS with all the options necessary to support MLPPPoX. Note that Endpoint Discriminator is not mandatory in the MLPPPoX negotiation. If the client rejects it, the LNS must still be able to negotiate MLPPPoX capable session (same is valid for the LAC). If the client's endpoint discriminator is invalid (bad format, invalid class, etc.), the 7750 will not negotiate MLPPPoX and instead a plain PPP session will be created.
- If the LNS is configured to accept the LCP Proxy parameters, the LNS will determine the capability of the client.

If there is no indication of MLPPPoX capability in the Proxy LCP (not even in the original ConfReq), the LNS may accept plain (non MLPPPoX capable) LCP session or renegotiate from scratch the non MLPPPoX capable session.

If there is an indication of MLPPPoX capability in the Proxy LCP (either completely negotiated on the LAC or at least attempted from the client), the LNS will try to either accept the MLPPPoX negotiated session by the LAC or renegotiate the MLPPPoX capable session directly with the client.

If the LCP Proxy parameters with MLPPPoX capability are accepted by the LNS then the endpoint as negotiated on the LAC will also be accepted.

- Once the MLPPPoX capable LCP session is negotiated or accepted, authentication can be performed on the LNS. Authentication on the LNS can be restarted (CHAP challenge/response with the client), or accepted (chap challenge/response accepted and verified by the LNS via RADIUS). **Note: chap-challenge length** is configurable in LNS.
- If the authentication is successful, depending on the evaluation of the parameters negotiated up to this point a new MLPPPoX bundle will be created or an existing MLPPPoX bundle will be joined. In case that a new bundle is established, the QoS constructs for the subscriber(-host) will be created (sub/sla-profile). Session negotiation will advance to IPCP phase.
- The decision whether a new session should join an existing MLPPPoX bundle, or trigger creation of a new one is governed by RFC 1990, *The PPP Multilink Protocol (MP)*, section 5.1.3, page 16, cases 1,2,3, and 4.
- Note that interleaving is supported only on MLPPPoX bundles with single session in them.

Other Considerations

- IPv6 is supported.
- AA is supported at LNS where full IP packets can be redirected va AA policies.
- Intra-chassis redundancy is supported:
  - → CPM statefull failover
  - → BB-ISA — non-stateful failover

Configuration Notes

MLPPP in subscriber management context is supported only over ATM, Ethernet over ATM or plain Ethernet transport (MLPPPoX). Native MLPPP over PPP/HDLC links is supported outside of the subscriber management context on the ASAP MDA.

MLPPPoX is supported only on LNS.

Interleaving is supported only on MLPPPoX bundles with a single member link. If more than one link is present in an MLPPPoX bundle, the interleaving will be automatically disabled and a SNMP trap will be generated. The MIB for this even is defined as tmnxMlpppBundleIndicatorsChange.

If MLPPPoX is enabled on LNS, the load balancing mode between the BB-ISAs within the group should be set to per tunnel. This will ensure that all sessions of the same MLPPPoX bundle are terminated on the same BB-ISA. On the LAC, sessions of the same bundle are setup in the same tunnel.

Virtual schedulers are not supported on MLPPPoX tunnels on LNS. However, aggregate-rate-limit is supported.

The aggregate-rate-limit on LNS will be automatically adjusted to the minimum value of:

- configured aggregate-rate-limit
- minimum last mile rate (obtained via LUDB, RADIUS or PPPoE tags) multiplied by the number of links in the bundle.

The aggregate-rate-limit on the LAC is not adjusted automatically. Therefore, if configured it should be set to a high value and thus the traffic treatment should rely on QoS performed on the LNS.

The rate (rate-down information) of the member links within the bundle must be the same. Otherwise the lowest rate is selected and applied to all member links.

A single CoA for a rate change (Alc-Access-Loop-Rate-Down) of an individual link in an MLPPPoX bundle will modify rates of all links in the bundle. This is applicable on LNS only.

The range of supported last mile rate (rate-down information) for the member links on an MLPPPoX session is 1kbps — 100mbps. On the LNS the last mile rate can be obtained:

- From the LAC via Tx-Connect-Speed AVP or by standard L2TP encoding as described in the RFC 5515, *Layer 2 Tunneling Protocol (L2TP) Access Line Information Attribute Value Pair (AVP) Extensions.*
- From the LAC via LUDB or RADIUS
- Directly on the LNS via LUDB or RADIUS.

The session will fail to come up if the obtained rate-down information is outside of the allowable range (1kbps — 100mbps).

A session within the MLPPPoX bundle will be terminated if the rate-down information for the session is out of bounds (1Kbps — 100Mbps).

If a member link in the last mile fails, traffic will be blackholed until the LNS is notified of this failure. The failure detection in the LNS relies on PPP keepalives.

Shaping is performed per MLPPPoX bundle and not individually per member links.

If encapsulation overhead associated with fragmentation is too large in comparison to payload, the fragments will be sized based on the encapsulation overhead (to increase link efficiency) rather than on maximum transmission delay.

There can be only a single MLPPPoX bundle per subscriber.

MLPPPoX bundles and non-MLPPPoX (plain L2TP PPPoE) sessions cannot coexist under the same subscriber.

Filters and mirrors (LI) are not supported on MLPPPoX bundles on LAC.

ip-only type mirrors are supported on MLPPPoX bundles.

In MLPPP scenario, downstream traffic is traversing Carrier IOM and BB-ISA twice. This is referred to as dual-pass and effectively cuts the throughput for MLPPP in half (for example, 5Gbps of MLPPP traffic on a 10Gbps capable BB-ISA).

PPP Command Reference

Configuration Commands

PPPoE Policy Configuration Commands

```
config
    — subscriber-mgmt
        — ppp-policy ppp-policy-name [create]
        — no ppp-policy ppp-policy-name
            — default-pap-password password [hash|hash2]
            — no default-pap-password
            — default-user-name ppp-username
            — no default-user-name
            — description description-string
            — no description
            — [no] disable-cookies
            — [no] force-ppp-mtu-gt-1492
            — [no] ipcp-subnet-negotiation
            — keepalive seconds [hold-up-multiplier multiplier]
            — no keepalive
            — [no] lcp-ignore-magic-numbers
            — max-sessions-per-mac sessions [allow-same-circuit-id-for-dhcp]
            — no max-sessions-per-mac
            — pado-ac-name name
            — no pado-ac-name
            — pado-delay deci-seconds
            — no pado-delay
            — ppp-authentication {pap | chap | pref-chap | pref-pap}
            — no ppp-authentication
            — ppp-chap-challenge-length min minimum-length max maximum-length
            — no ppp-chap-challenge-length
            — [no] ppp-initial-delay
            — ppp-mtu mtu-bytes
            — no ppp-mtu
            — ppp-options
                — custom-option protocol option-number address ip-address
                — custom-option protocol option-number hex hex-string
                — custom-option protocol option-number string ascii-string
                — no custom-option protocol option-number
            — re-establish-session padr
```

— **no re-establish-session**
— [**no**] **reject-disabled-ncp**
— [**no**] **reply-on-padt**
— **session-timeout** *timeout*
— **no session-timeout**
— **unique-sid-per-sap** [**per-msap**]
— **no unique-sid-per-sap**

```
config
    — service
        — ies service-id [customer customer-id] [vpn vpn-id] [create]
        — no ies service-id
            — [no] subscriber-interface ip-int-name
                — [no] group-interface ip-int-name
                    — dhcp
                        — client-applications {[dhcp] [ppp]}
                        — no client-applications
                        — description description-string
                        — no description
                        — lease-populate [nbt-of-entries]
                        — no lease-populate
                        — [no] option
                        — [no] vendor-specific-option
                            — [no] client-mac-address
                            — [no] sap-id
                            — [no] service-id
                            — [no] string
                            — [no] system-id
                    — proxy-server
                        — emulated-server ip-address
                        — no emulated-server
                        — lease-time [days days] [hrs hours] [min minutes] [sec
                          seconds] [override]
                        — no lease-time
                        — [no] shutdown
                    — [no] option
                        —
                    — [no] pppoe
                        — description description-string
                        — no description
                        — dhcp-client
                            — [no] ccag-use-origin-sap
                            — include-option string text
                            — no include-option
                        — sap-session-limit sap-session-limit
                        — no sap-session-limit
                        — session-limit session-limit
                        — no session-limit
                        — [no] shutdown
config
    — service
        — vprn service-id [customer customer-id]  [create]
        — no vprn service-id
            — subscriber-interface ip-int-name [fwd-service service-id fwd-subscriber-interface
              ip-int-name] [create]
            — no subscriber-interface ip-int-name
                — [no] group-interface ip-int-name
                    — dhcp
                        — client-applications dhcp
                        — client-applications pppoe
                        — client-applications dhcp pppoe
                        — no client-applications
                    — [no] pppoe
```

— **description** *description-string*
— **no description**
— **dhcp-client**
  — [**no**] **ccag-use-origin-sap**
— **sap-session-limit** *sap-session-limit*
— **no sap-session-limit**
— **session-limit** *session-limit*
— **no session-limit**
— [**no**] **shutdown**

PPPoE Local User Database Commands

```
config
    — subscriber-mgmt
        — local-user-db local-user-db-name [create]
        — no local-user-db local-user-db-name
            — ppp
                — mask {[prefix-string prefix-string | prefix-length prefix-length] [suffix-string suffix-string | suffix-length suffix-length]}
                — no mask
                — host host-name [create]
                — no host host-name
                    — acct-policy acct-policy-name [duplicate acct-policy-name]
                    — no acct-policy
                    — address gi-address
                    — address ip-address
                    — address pool pool-name
                    — no address
                    — authentication-policy policy-name
                    — no authentication-policy
                    — host-identification
                        — circuit-id string ascii-string
                        — circuit-id hex hex-string
                        — no circuit-id
                        — mac ieee-address
                        — no mac
                        — remote-id remote-id
                        — no remote-id
                        — service-name service-name
                        — no service-name
                        — username user-name [no-domain]
                        — username user-name domain-only
                        — no username
                    — identification-strings option-number [create]
                    — no identification-strings
                        — ancp-string ancp-string
                        — no ancp-string
                        — app-profile-string app-profile-string
                        — no app-profile-string
                        — inter-dest-id intermediate-destination-id
                        — no inter-dest-id
                        — sla-profile-string sla-profile-string
                        — no sla-profile-string
                        — sub-profile-string sub-profile-string
                        — no sub-profile-string
                        — subscriber-id sub-ident-string
                        — no subscriber-id
                    — l2tp
                        — group tunnel-group-name
                        — no group
                    — options
                        — custom-option option-number address [ip-address...(up to 4 max)]
                        — custom-option option-number hex hex-string
                        — custom-option option-number string ascii-string
                        — no custom-option option-number
                        — dns-server [ip-address...(up to 4 max)]
```

— **no dns-server**
— **netbios-name-server ip-address** [*ip-address*...(up to 4 max)]
— **no netbios-name-server**
— **pado-delay** *deci-seconds*
— **no pado-delay**
— **password** {**ignore** | **chap** *string* | **pap** *string*}
— **no password**
— **retail-service-id** *service-id*
— **no retail-service-id**
— [**no**] **shutdown**
— **mask type** *pppoe-match-type* {[**prefix-string** *prefix-string* | **prefix-length** *prefix-length*] [**suffix-string** *suffix-string* | **suffix-length** *suffix-length*]}
— **no mask type** *pppoe-match-type*
— **match-list** *pppoe-match-type-1* [*pppoe-match-type-2*...(up to 3 max)]
— **no match-list**
— [**no**] **shutdown**

MLPPP on LNS Commands

Refer to the OS Multi-Service Integrated Services Adapter Guide for MLPPP configuration and command information.

```
config
    — subscriber-mgmt
        — ppp-policy ppp-policy-name [create]
        — no ppp-policy ppp-policy-name
            — mlppp
                — [no] accept-mrru
                — [no] short-sequence-numbers
        — local-user-db local-user-db-name [create]
        — no local-user-db local-user-db-name
            — ppp
                — host host-name [create]
                — no host host-name
                    — [no] access-loop
                        — encap-offset [type encap-type]
                        — no encap-offset
                        — rate-down rate
                        — no rate-down
config
    — router
        — l2tp
            — group tunnel-group-name [create]
            — no group tunnel-group-name
                — load-balance-method {session | tunnel}
                — no load-balance-method
                — mlppp
                    — endpoint ip ip-address
                    — endpoint mac ieee-address
                    — endpoint system-ip
                    — endpoint system-mac
                    — no endpoint
                    — [no] interleave
                    — max-fragment-delay mili-seconds
                    — no max-fragment-delay
                    — max-link max-links
                    — no max-link
                    — reassembly-timeout {{100 | 1000} milliseconds}
                    — no reassembly-timeout
                — tunnel tunnel-name [create]
                — no tunnel tunnel-name
                    — load-balance-method {session | tunnel}
                    — no load-balance-method
                    — mlppp
                        — admin-state {up | down}
                        — no admin-state
                        — endpoint ip ip-address
                        — endpoint mac ieee-address
                        — endpoint system-ip
                        — endpoint system-mac
                        — no endpoint
                        — interleave {always|never}
                        — no interleave
```

```
                                                    — max-fragment-delay mili-seconds
                                                    — no max-fragment-delay
                                                    — max-link max-links
                                                    — no max-link
                                                    — reassembly-timeout {{100 | 1000} milliseconds}
                                                    — no reassembly-timeout
config
    — service
        — vprn
            — l2tp
                — group
                    — load-balance-method {session | tunnel}
                    — no load-balance-method
                    — mlppp
                        — admin-state {up | down}
                        — no admin-state
                        — endpoint ip ip-address
                        — endpoint mac ieee-address
                        — endpoint system-ip
                        — endpoint system-mac
                        — no endpoint
                        — interleave {always|never}
                        — no interleave
                        — max-fragment-delay mili-seconds
                        — no max-fragment-delay
                        — max-link max-links
                        — no max-link
                        — reassembly-timeout {{100 | 1000} milliseconds}
                        — no reassembly-timeout
                    — tunnel
                        — load-balance-method {session | tunnel}
                        — no load-balance-method
                        — mlppp
                            — admin-state {up | down}
                            — no admin-state
                            — endpoint ip ip-address
                            — endpoint mac ieee-address
                            — endpoint system-ip
                            — endpoint system-mac
                            — no endpoint
                            — interleave {always|never}
                            — no interleave
                            — load-balance-method {session | tunnel}
                            — no load-balance-method
                            — max-fragment-delay mili-seconds
                            — no max-fragment-delay
                            — max-link max-links
                            — no max-link
                            — reassembly-timeout {{100 | 1000} milliseconds}
                            — no reassembly-timeout
```

Show Commands

show
— **router**
— **l2tp**
— **peer** *ip-address* [**udp-port** *port*]
— **peer** *ip-address* statistics [**udp-port** *port*]
— **peer** [**draining**] [**blacklisted**|**selectable**|**unreachable**]

PPP Configuration Commands

Global Commands

description

Syntax **description** *description-string*
no description

Context config>subscr-mgmt>pppoe-policy
config>service>ies>sub-if>grp-if>pppoe
config>service>vprn>sub-if>grp-if>pppoe

Description This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the content in the configuration file.

The **no** form of this command removes the string from the configuration.

Default No description associated with the configuration context.

Parameters *description-string* — The description character string. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

shutdown

Syntax [**no**] **shutdown**

Context config>service>ies>sub-if>grp-if>pppoe
config>service>vprn>sub-if>grp-if>pppoe

Description This command administratively disables an entity. When disabled, an entity does not change, reset, or remove any configuration settings or statistics.

The operational state of the entity is disabled as well as the operational state of any entities contained within. Many objects must be shut down before they may be deleted.

The **no** form of this command places the entity into an administratively enabled state.

ppp-policy

Syntax **ppp-policy** *ppp-policy-name* [**create**]
no ppp-policy *ppp-policy-name*

Context config>subscr-mgmt

Description This command configures a PPP policy. These policies are referenced from interfaces configured for PPP. Multiple PPP policies may be configured.

This default policy cannot be modified nor deleted.

Default default

Parameters *ppp-policy-name* — Specifies the PPP policy name up to 32 characters in length.

create — Keyword used to create the entity. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

default-pap-password

Syntax **default-pap-password** *password* [**hash**|**hash2**]
no default-pap-password

Context config>subscr-mgmt>ppp-policy

Description This command configures the default PAP password for RADIUS authentication when the Password-Length=0 in the PAP Authenticate-Request.

RADIUS authentication cannot be initiated when the Password-Length=0 in the PAP Authenticate-Request and no default-pap-password is configured. The PPP session terminates in this case.

Default no default-pap-password

Parameters *password* — Specifies a default PAP password , maximum 64 characters

hash — Specifies the key is entered in an encrypted form. If the hash or hash2 parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the hash or hash2 parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form that involves more variables then the key value alone, this means that hash2 encrypted variable can't be copied and pasted. If the hash or hash2 parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the hash or hash2 parameter specified.

default-user-name

Syntax **default-user-name** *ppp-username*
no default-user-name

Context config>subscr-mgmt>ppp-policy

Description This command configures the default username for authentication when not provided in PAP/CHAP authentication (no Name field in CHAP Response message or Peer-Id-Length=0 in PAP Authenticate-Request).

The PPP session terminates when no username is provided in PAP/CHAP authentication and no default-user-name is configured.

Default no default-user-name

Parameters *ppp-username* — Specifies a default usernameup to 253 characters.

disable-cookies

Syntax [**no**] **disable-cookies**

Context config>subscr-mgmt>ppp-policy

Description This command disables the use of cookies.

The **no** form of the command enables cookies.

Default no disable-cookies

force-ppp-mtu-gt-1492

Syntax [**no**] **force-ppp-mtu-gt-1492**

Context config>subscr-mgmt>ppp-policy

Description This command enables PPPoE Maximum-Receive-Unit (MRU) negotiations greater than 1492 bytes without the need to receive a "PPP-Max-Payload" tag in PADI/PADR from the client as defined in RFC 4638, *Accommodating a Maximum Transit Unit/Maximum Receive Unit (MTU/MRU) Greater Than 1492 in the Point-to-Point Protocol over Ethernet (PPPoE)*.

The MRU send in the initial LCP Config Request is determined by the **port mtu** and **ppp-policy ppp-mtu** parameters.

Default no force-ppp-mtu-gt-1492

keepalive

Syntax **keepalive** *seconds* [**hold-up-multiplier** *multiplier*]
no keepalive

Context config>subscr-mgmt>ppp-policy

Description This command defines the keepalive interval and the number of keepalives that can be missed before the session is declared down for this PPP policy.

The **no** form of the command reverts to the default value.

Default 30 seconds

3 multiplier

Parameters *seconds* — Specifies the keepalive interval in seconds.

Values 10 — 300

hold-up-multiplier *multiplier* **—** Specifies the number of keepalives that can be missed.

Values 1 — 5

ipcp-subnet-negotiation

Syntax [**no**] **ipcp-subnet-negotiation**

Context config>subscr-mgmt>ppp-policy

Description This command enables subnet negotiation using PPP IPCP Subnet-Mask option (0x90) if requested by the client. The subnet can be obtained from RADIUS (Framed-IP-Netmask attribute) or local user database. The subnet is installed as a managed route of the PPP session. This requires the anti-spoof type on the SAP to be configured to nh-mac.

By default, an IPCP Config Request with IPCP Subnet-Mask option (0x90) is rejected.

Default no ipcp-subnet-negotiation

lcp-ignore-magic-numbers

Syntax [**no**] **lcp-ignore-magic-numbers**

Context config>subscr-mgmt>ppp-policy

Description This command enables the PPP session to stay established when an LCP peer magic number mismatch is detected.

By default, the PPP session is terminated when an LCP peer magic number mismatch is detected.

Default no lcp-ignore-magic-numbers

max-sessions-per-mac

Syntax **max-sessions-per-mac** *sessions* [**allow-same-circuit-id-for-dhcp**]
no max-sessions-per-mac

Context config>subscr-mgmt>ppp-policy

Description This command sets the maximum PPP sessions that can be opened for a given MAC address.

To enable IPv4 address allocation using the internal dhcpv4 client for multiple PPPoE sessions on a single SAP and having the same MAC address and circuit-ID, the optional cli flag “allow-same-circuit-id-for-dhcp” should be added. The SROS local-dhcp-server will detect the additional vendor-specific options inserted by the internal dhcpv4 client and use an extended unique key for lease allocation.

The **no** form of the command reverts to the default value.

Default 1

sessions — Specifies the maximum PPP sessions that can be opened for the given MAC address.

Values 1 — 8191

allow-same-circuit-id-for-dhcp — (optional) Enables support for IPv4 address allocation using the internal dhcpv4 client for multiple PPPoE sessions on a single SAP that have the same MAC address and circuit-ID.

pado-ac-name

Syntax **pado-ac-name** *name*
no pado-ac-name

Context config>subscr-mgmt>ppp-policy

Description This command configures the Access Concentrator name that is used in the PPPoE PADO message.

By default, the system name or if not configured, the chassis Serial Number is used.

Default no pado-ac-name

Parameters *name* — Specifies the string up to 128 characters to be used as AC name in the PPPoE PADO message.

pado-delay

Syntax **pado-delay** *deci-seconds*
no pado-delay

Context config>subscr-mgmt>ppp-policy

Description This command configures the delay timeout before sending a PPP Active Discovery Offer (PADO) packet.

Default no delay

Parameters *deci-seconds* — Specifies the delay timeout before sending a PADO.

Values 1 — 30

ppp-authentication

Syntax **ppp-authentication** {**pap** | **chap** | **pref-chap | pref-pap**}
no ppp-authentication

Context config>subscr-mgmt>ppp-policy

Description This command configures the PPP protocol used to authenticate the PPP session.

Parameters **pap —** Specifies to always use PAP to authenticate the sessions.

chap — Specifies to always use CHAP to authenticate the sessions.

pref-chap — Specifies to attempt to use CHAP and if it fails, use PAP.

pref-pap — Specifies to attempt to use PAP and if it fails, use CHAP.

ppp-chap-challenge-length

Syntax **ppp-chap-challenge-length min** *minimum-length* **max** *maximum-length*

no ppp-chap-challenge-length

Context config>subscr-mgmt>ppp-policy

Description This command configures the minimum and maximum length of a PPP Chap Challenge.

When the Chap Challenge is exactly 16 bytes, it is send in the [60] CHAP-Challenge RADIUS attribute and also copied in the RADIUS Authenticator field from the RADIUS Access Request.

Default ppp-chap-challenge-length min 32 max 64

Parameters **min** *minimum-length* **—** Specifies the minimum PPP CHAP challenge length.

Values 8— 64

max *maximum-length* **—** Specifies the maximum PPP CHAP challenge length.

Values 8 — 64

ppp-initial-delay

Syntax **[no] ppp-initial-delay**

Context config>subscr-mgmt>ppp-policy

Description This command delays the sending of an LCP-configure request after the discovery phase by 40 – 60 milliseconds.

Default no ppp-initial-delay

ppp-mtu

Syntax **ppp-mtu** *mtu-bytes*
no ppp-mtu

Context config>subscr-mgmt>ppp-policy

Description This command configures the the maximum PPP MTU size.

Default no ppp-mtu

Parameters *mtu-bytes* — Specifies the the maximum PPP MTU size.

Values 512 — 9212

ppp-options

Syntax **ppp-options**

Context config>subscr-mgmt>pppoe-policy

Description This command enables the context to configure PPP options.

custom-option

Syntax **custom-option** *protocol option-number* **address** *ip-address*
custom-option p*rotocol option-number* **hex** *hex-string*
custom-option *protocol option-number* **string** *ascii-string*
no custom-option *protocol option-number*

Context config>subscr-mgmt>pppoe-policy>ppp-options

Description This command provides the ability to configure custom PPP options. Note that standard options such as the DNS name will be returned from DHCP or RADIUS and be converted to PPP automatically. Compression is not supported.

The no form of the command removes the custom options from the configuration.

Parameters *protocol* — Specifies a protocol for the custom option.

Values lcp, ipcp

option-number — Assigns an identifying number for the custom option.

Values 0 — 255

ip-address —

ascii-string — Specifies an ASCII format string for the custom option up to 127 characters long.

hex-string — Specifies a hex value for the custom option.

Values [0x0..0xFFFFFF...(max 254 hex nibbles)]

re-establish-session

Syntax **re-establish-session** *padr*
no re-establish-session

Context config>subscr-mgmt>pppoe-policy

Description This command enables/disables host to reconnect and override existing session.

If disabled and a subscriber abruptly terminates a PPP sessions without sending a PADT to the BNG, the BNG will deny any reconnect attempts until the stale PPP session has expired. With this, enabled re-establish-session will eliminate the waiting period by allowing immediate PPP reconnection attempts

Default no re-establish-session

reject-disabled-ncp

Syntax [**no**] **reject-disabled-ncp**

Context config>subscr-mgmt>pppoe-policy

Description This command forces an LCP Protocol Reject when receiving an IPv6CP Configure Request message while IPv6 is not configured.

By default, an IPv6CP Configure Request message is silently ignored when IPv6 is not configured.

Default no reject-disabled-ncp

reply-on-padt

Syntax [**no**] **reply-on-padt**

Context config>subscr-mgmt>pppoe-policy

Description Some of the PPPoE clients expect reply on PPPoE Active Discovery Terminate (PADT) message before the context of the session is cleared up. To support such client, a command enabling reply to PADT is provided.

Default no reply-on-padt

session-timeout

Syntax **session-timeout** *timeout*
no session-timeout

Context config>subscr-mgmt>ppp-policy

Description This command defines the time in seconds between 1 and 360 days before the PPP session will be terminated. The default value is unlimited session timeout.

A RADIUS specified session-timeout (attribute [27] Session-Timeout) overrides the CLI configured value.

Default no session-timeout

Parameters *timeout* — Specifies the session timeout in seconds.

Values 1 — 31104000

unique-sid-per-sap

Syntax **unique-sid-per-sap** [**per-msap**]
no unique-sid-per-sap

Context config>subscr-mgmt>ppp-policy

Description This command assigns a unique session ID to each PPPoE session with different MAC addresses that are active on a single SAP.

On a capture-sap, a unique session ID is assigned per MSAP. Multiple sessions with different MAC addresses that are active on the same MSAP have the same session ID.

With the optional parameter per-msap, a unique session id is assigned for each session with different MAC address that is active on the same MSAP.

The maximum session ID range is 1 — .8191.

By default, all PPPoE sessions with different MAC address on a given SAP or MSAP have session-id 1.

Default no unique-sid-per-sap

Parameters **per-msap** — Assigns a unique session id for each session with different MAC address that is active on the same MSAP. This parameter has no effect on regular SAPs.

PPP/PPPoE Service Commands

ppp

Syntax **[no] ppp**

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command configures PPP parameters.

The **no** form of the command reverts all PPP parameters from the PPP context to their defaults.

pppoe

Syntax **[no] pppoe**

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description TThis command configures PPPoE parameters.

The **no** form of the command reverts all PPPoE parameters from the PPPoE context to their defaults.

anti-spoof

Syntax **anti-spoof** *pppoe-anti-spoofing-type*
no anti-spoof

Context config>service>ies>sub-if>grp-if>pppoe
config>service>vprn>sub-if>grp-if>pppoe

Description This command specifies the type of PPPoE anti-spoof filtering to use.

Default mac-sid

pppoe-anti-spoofing-type — Specifies the PPPoE anti-spoof filtering.

Values mac-sid, mac-sid-ip

dhcp-client

Syntax **dhcp-client**

Context config>service>vprn>sub-if>grp-if>pppoe
config>service>ies>sub-if>grp-if>pppoe

Description This command enables the context to configure the PPPoE-to-DHCP options.

ccag-use-origin-sap

Syntax [**no**] **ccag-use-origin-sap**

Context config>service>vprn>sub-if>grp-if>pppoe>dhcp-client
config>service>ies>sub-if>grp-if>pppoe>dhcp-client

Description This command enables the original VPLS SAP to be included in the circuit-id option to send to the DHCP server (in case this interface is connected to a VPLS by a CCA MDA).

The **no** form of the command disables the feature.

Default no ccag-use-origin-sap

policy

Syntax **policy** *ppp-policy-name*
no policy

Context config>service>vprn>sub-if>grp-if>pppoe
config>service>ies>sub-if>grp-if>pppoe

Description This command specifies the PPPoE policy on this interface.

Parameters *ppp-policy-name* — Specifies the PPP policy name up to 32 characters in length.

include-option

Syntax **include-option string** *text*
no include-option

Context config>service>vprn>sub-if>grp-if>pppoe>dhcp-client
config>service>ies>sub-if>grp-if>pppoe>dhcp-client

Description This command allows the configuration of a vendor-specific sub-option string in a DHCP message.

Parameters **string** *text* — Specifies a vendor-specific string inside-option 82, sub-option 9, sub-option5.

sap-session-limit

Syntax **sap-session-limit** *sap-session-limit*
no sap-session-limit

Context config>service>ies>sub-if>grp-if>pppoe
config>service>vprn>sub-if>grp-if>pppoe

Description This command specifies the number of PPPoE hosts per SAP allowed for this group-interface.

Default 1

Parameters *sap-session-limit* — Specifies the number of PPPoE hosts per SAP allowed.

Values 1 — 20000

session-limit

Syntax **session-limit** *session-limit*
no session-limit

Context config>service>ies>sub-if>grp-if>pppoe
config>service>vprn>sub-if>grp-if>pppoe

Description This command specifies the number of PPPoE hosts allowed for this group interface.

Default 1

Parameters *session-limit* — Specifies the number of PPPoE hosts allowed.

Values 1 — 20000

user-db

Syntax **user-db** *local-user-db-name*
no user-db

Context config>service>ies>sub-if>grp-if>pppoe
config>service>vprn>sub-if>grp-if>pppoe

Description This command configures the local user database to use for PPP PAP/CHAP authentication

Parameters *local-user-db-name* — Specifies the local user database name up to 32 characters in length.

RADIUS Attribute Commands

acct-authentic

Syntax [**no**] **acct-authentic**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the acct-authentic RADIUS attribute.

acct-delay-time

Syntax [**no**] **acct-delay-time**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the acct-delay-time RADIUS attribute.

called-station-id

Syntax [**no**] **called-station-id**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command includes called station id attributes.

The **no** form of the command excludes called station id attributes.

calling-station-id

Syntax **calling-station-id**
calling-station-id {**mac** | **remote-id** | **sap-id** | **sap-string**}
no calling-station-id

Context config>service>ies>if>sap
config>service>ies>sub-if>grp-if>sap
config>service>vpls>sap
config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if>sap
config>subscr-mgmt>auth-plcy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include>include-radius-attribute

Description This command enables the inclusion of the calling-station-id attribute in RADIUS authentication requests and RADIUS accounting messages. The value inserted is set at the SAP level. If no **calling-station-id** value is set at the SAP level, the **calling-station-id** attribute will not be sent.

Default no calling-station-id

Parameters **mac —** Specifies that the mac-address will be sent.

remote-id — Specifies that the remote-id will be sent.

sap-id — Specifies that the sap-id will be sent.

sap-string — Specifies that the value is the inserted value set at the SAP level. If no **calling-station-id** value is set at the SAP level, the **calling-station-id** attribute will not be sent.

circuit-id

Syntax [**no**] **circuit-id**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the agent-circuit-id for RADIUS.

delegated-ipv6-prefix

Syntax [**no**] **delegated-ipv6-prefix**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the delegated-ipv6-prefix RADIUS attribute.

Default no delegated-ipv6-prefix

framed-interface-id

Syntax [**no**] **framed-interface-id**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the framed-interface-id RADIUS attribute.

framed-ip-addr

Syntax [**no**] **framed-ip-addr**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the inclusion of the framed-ip-addr attribute.

framed-ip-netmask

Syntax [**no**] **framed-ip-netmask**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the inclusion of the framed-ip-netmask attribute.

framed-ipv6-prefix

Syntax [**no**] **framed-ipv6-prefix**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the framed-ipv6-prefix RADIUS attribute.

ipv6-address

Syntax [**no**] **framed-ipv6-address**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the ipv6-address RADIUS attribute.

mac-address

Syntax [**no**] **mac-address**
config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the client MAC address RADIUS attribute.

nas-identifier

Syntax [**no**] **nas-identifier**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-identifier RADIUS attribute.

nas-port

Syntax [**no**] **nas-port** *bit-specification binary-spec*

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-port RADIUS attribute. You enter decimal representation of a 32-bit string that indicates your port information. This 32-bit string can be compiled based on different information from the port (data types). By using syntax number-of-bits data-type you indicate how many bits from the 32 bits are used for the specific data type. These data types can be combined up to 32 bits in total. In between the different data types 0's and/or 1's as bits can be added.

The **no** form of this command disables your nas-port configuration.

Parameters *bit-specification binary-spec* — Specifies the NAS-Port attribute

Values

binary-spec	<bit-specification> <binary-spec>
bit-specification	0 | 1 | <bit-origin>
bit-origin	*<number-of-bits><origin>
number-of-bits	1 — 32
origin	o | i | s | m | p
	outer VLAN ID
	i inner VLAN ID
	s slot number
	m MDA number
	p port number or lag-id

Sample

```
*12o*12i00*2s*2m*2p => oooo oooo oooo iiii iiii iiii 00ss mmpp
If outer vlan = 0 & inner vlan = 1 & slot = 3 & mda = 1 & port = 1
=>  0000 0000 0000 0000 0000 0001 0011 0101 => nas-port = 309
```

nas-port-id

Syntax [**no**] **nas-port-id** [**prefix-string** *string*] [**suffix** *suffix-option*]

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-port-id RADIUS attribute. Optionally, the value of this attribute (the SAP-id) can be prefixed by a fixed string and suffixed by the circuit-id or the remote-id of the client connection. If a suffix is configured, but no corresponding data is available, the suffix used will be 0/0/0/0/0/0.

Parameters **prefix-string** *string* — Specifies that a user configurable string will be added to the RADIUS NAS port attribute, up to 8 characters in length.

suffix *suffix-option* — Specifies the suffix type to be added to the RADIUS NAS oort attribute.

Values circuit-id, remote-id

nas-port-type

Syntax **nas-port-type**
nas-port-type [0..255]
no nas-port-type

Context config>subscr-mgmt>auth-plcy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-port-type RADIUS attribute. If set to **nas-port-type**, the following will be sent: values: 32 (null-encap), 33 (dot1q), 34 (qinq), 15 (DHCP hosts). The **nas-port-type** can also be set as a specified value, with an integer from 0 to 255.

The **no** form of the command reverts to the default.

Default no nas-port-type

Parameters **0 — 255 —** Specifies an enumerated integer that specifies the value that will be put in the RADIUS nas-port-type attribute.

nat-port-range

Syntax [**no**] **nat-port-range**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the of nat-port-range attribute.

Default no nat-port-range

remote-id

Syntax [**no**] **remote-id**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the agent-remote-id for RADIUS.

sap-session-index

Syntax **[no] sap-session-index**

Context config>subscr-mgmt>auth-policy>include-radius-attribute

Description This command includes sap-session-index attributes.

The **no** form of the command excludes sap-session-index attributes.

sla-profile

Syntax [**no**] **sla-profile**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command specifies that SLA profile attributes should be included into RADIUS accounting messages.

sub-profile

Syntax [**no**] **sub-profile**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command specifies that subscriber profile attributes should be included into RADIUS accounting messages.

subscriber-id

Syntax [**no**] **subscriber-id**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command specifies that subscriber ID attributes should be included into RADIUS accounting messages.

radius-accounting-server

Syntax **radius-accounting-server**

Context config>app-assure>rad-acct-plcy
config>aaa>l2tp-tunnel-acct-plcy

Description This command creates the context for defining RADIUS accounting server attributes under a given session authentication policy.

access-algorithm

Syntax **access-algorithm** {**direct** | **round-robin**}
no access-algorithm

Context config>app-assure>rad-acct-plcy>server

Description This command configures the algorithm used to access the list of configured RADIUS servers.

Default direct

Parameters **direct —** Specifies that the first server will be used as primary server for all requests, the second as secondary and so on.

round-robin — Specifies that the first server will be used as primary server for the first request, the second server as primary for the second request, and so on. If the router gets to the end of the list, it starts again with the first server.

retry

Syntax **retry** *count*

Context config>app-assure>rad-acct-plcy>server

Description This command configures the number of times the router attempts to contact the RADIUS server for authentication. Note that the retry count includes the first attempt.

The **no** form of the command reverts to the default value.

Default 3 (the initial attempt as well as two retried attempts)

Parameters *count* — Specifies the retry count.

Values 1 — 10

router

Syntax **router** *router-instance*
router service-name *service-name*
no router

Context config>app-assure>rad-acct-plcy>server

Description This command specifies the number of times the router attempts to contact the RADIUS server for authentication, if not successful the first time.

The **no** form of the command reverts to the default value.

server

Syntax **server** *server-index* **address** *ip-address* **secret** *key* [**hash** | **hash2**] [**port** *port*] [**create**]
no server *server-index*

Context config>app-assure>rad-acct-plcy>server

Description This command adds a RADIUS server and configures the RADIUS server IP address, index, and key values.

Up to five RADIUS servers can be configured at any one time. RADIUS servers are accessed in order from lowest to highest index for authentication requests until a response from a server is received. A higher indexed server is only queried if no response is received from a lower indexed server (which

implies that the server is not available). If a response from a server is received, no other RADIUS servers are queried.

The **no** form of the command removes the server from the configuration.

Default none

Parameters *server-index* — The index for the RADIUS server. The index determines the sequence in which the servers are queried for authentication requests. Servers are queried in order from lowest to highest index.

Values 1 — 16 (a maximum of 5 accounting servers)

address ip-address — The IP address of the RADIUS server. Two RADIUS servers cannot have the same IP address. An error message is generated if the server address is a duplicate.

secret *key* **— Values** The secret key to access the RADIUS server. This secret key must match the password on the RADIUS server.
secret-key — A string up to 20 characters in length.
hash-key — A string up to 33 characters in length.
hash2-key — A string up to 55 characters in length.

hash — Specifies the key is entered in an encrypted form. If the hash parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the hash parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form. If the hash2 parameter is not used, the less encrypted hash form is assumed.

port — Specifies the UDP port number on which to contact the RADIUS server for authentication.

Values 1 — 65535

source-address-range

Syntax **source-address-range** *start-ip-address end-ip-address*
no source-address

Context config>app-assure>rad-acct-plcy>server

Description This command configures the source address range of the RADIUS messages.

The **no** form of the command reverts to the default value.

Default systemIP address

Parameters *start-ip-address* — Specifies the start of the the range of source addresses to be used for NAT RADIUS accounting.

end-ip-address — Specifies the end of the the range of source addresses to be used for NAT RADIUS accounting.

timeout

Syntax **timeout** *seconds*

Context config>app-assure>rad-acct-plcy>server

Description This command configures the number of seconds the router waits for a response from a RADIUS server.

The **no** form of the command reverts to the default value.

Default 5

Parameters *seconds* — Specifies the time the router waits for a response from a RADIUS server.

Values 1 — 90

Show Commands

ppp-policy

Syntax **ppp-policy** [*ppp-policy-name* [**association**]]

Context show>subscr-mgmt

Description This command displays PPP policy information.

Parameters *ppp-policy-name* — Specifies an existing PPP policy

association — Displays the object the PPP policy is associated.

Sample Output

```
*A:ALA-49>show>subscr-mgmt# pppoe-policy policy1
===============================================================================
PPPoE Policy "policy1"
===============================================================================
Last Mgmt Change     : 11/16/2003 20:06:39     PPP-mtu              : N/A
Keepalive Interval   : 10s                     Keepalive Multiplier : 1
Disable AC-Cookies   : No                      PADO Delay           : 0msec
Max Sessions-Per-Mac : 63                      Reply-On-PADT        : No

-------------------------------------------------------------------------------
PPP Custom Options
-------------------------------------------------------------------------------
Protocol Number Value
-------------------------------------------------------------------------------
No options configured.
===============================================================================


*A:ALA-49>show>subscr-mgmt# pppoe-policy policy1 association
===============================================================================
PPPoE Policy "policy1"
===============================================================================
-------------------------------------------------------------------------------
Interface Associations
-------------------------------------------------------------------------------
Service-Id : 20 (IES)
 - grp_pppoe1
 - grp_pppoe2
 - grp_pppoe3
===============================================================================
*A:ALA-49>show>subscr-mgmt#
```

pppoe

Syntax **pppoe**

Context show>service>id

Description This command enables the context to display PPPoE information.

session

Syntax **session** [**interface** *ip-int-name* | *ip-address* | **sap** *sap-id*] [**session-id** *session-id*] [**mac** *ieee-address*] [**ip-address** *ip-address*[*/mask*]] [**port** *port-id*] [**no-inter-dest-id** | **inter-dest-id** *intermediate-destination-id*] [**detail** | **statistics**]
session *l2tp-connection-id connection-id* [**detail**|**statistics**]

Context show>service>id>pppoe

Description This command displays PPPoE session information.

Parameters **interface** *ip-int-name* **—**

ip-address — Displays information about the IP address of the PPPoE session.

sap *sap-id* — Displays information about the specified SAP ID.

session-id *session-id* — Displays information about the ID of the PPPoE session.

mac *ieee-address* — Displays information about the MAC address of the PPPoE session.

port *port-id* — Displays information about about the specified port ID.

no-inter-dest-id —

inter-dest-id *intermediate-destination-id* — Displays information about the specified intermediate destination ID.

detail — Displays detailed information.

statistics — Displays statistics about the PPPoE session.s

Sample Output

```
*A:ALA-49#show service id 20 pppoe session
===============================================================================
PPPoE sessions for svc-id 20
===============================================================================
Sap Id              Mac Address       Sid Up Time        IP Address
-------------------------------------------------------------------------------
1/1/3:200           00:00:00:00:00:03 1   1d 00:48:39    20.0.0.101
1/1/3:300           00:00:00:00:00:05 1   0d 00:01:08    30.0.0.119
-------------------------------------------------------------------------------
Number of sessions : 2
===============================================================================
*A:ALA-49#


*A:ALA-49# show service id 20 pppoe session ip-address 20.0.0.101 detail
```

```
===============================================================================
PPPoE sessions for svc-id 20
===============================================================================
Sap Id              Mac Address       Sid Up Time        IP Address
-------------------------------------------------------------------------------
1/1/3:200           00:00:00:00:00:03 1   1d 00:49:46    20.0.0.101

LCP State            : Opened
IPCP State           : Opened
PPP MTU              : 1492
PPP Auth-Protocol    : PAP
PPP User-Name        : user4@domain1

Subscriber-interface : sub_pppoe
Group-interface      : grp_pppoe2

Subscriber Origin    : RADIUS
Strings Origin       : RADIUS
IPCP Info Origin     : DHCP

Subscriber           : "radius_papchap4"
Sub-Profile-String   : "sub1"
SLA-Profile-String   : "sla1"
ANCP-String          : ""
Int-Dest-Id          : ""
App-Profile-String   : ""

Primary DNS          : N/A
Secondary DNS        : N/A
Primary NBNS         : N/A
Secondary NBNS       : N/A

Circuit-Id           : 2
Remote-Id            :

Session-Timeout      : N/A
-------------------------------------------------------------------------------
Number of sessions : 1
===============================================================================
*A:ALA-49#


*A:ALA-49# show service id 20 pppoe session ip-address 20.0.0.101 statistics
===============================================================================
PPPoE sessions for svc-id 20
===============================================================================
Sap Id              Mac Address       Sid Up Time        IP Address
-------------------------------------------------------------------------------
1/1/3:200           00:00:00:00:00:03 1   1d 00:50:39    20.0.0.101

Packet Type               Received        Transmitted
-------------------------------------------------------------------------------
LCP Configure-Request     1               2
LCP Configure-Ack         1               1
LCP Configure-Nak         1               0
LCP Configure-Reject      0               0
LCP Terminate-Request     0               0
LCP Terminate-Ack         0               0
LCP Code-Reject           0               0
LCP Echo-Request          8927            866
LCP Echo-Reply            866             8927
```

```
LCP Protocol-Reject       0               0
LCP Discard-Request       0               0
-------------------------------------------------------------------------------
PAP Authenticate-Request  1               -
PAP Authenticate-Ack      -               1
PAP Authenticate-Nak      -               0
-------------------------------------------------------------------------------
CHAP Challenge            -               0
CHAP Response             0               -
CHAP Success              -               0
CHAP Failure              -               0
-------------------------------------------------------------------------------
IPCP Configure-Request    2               1
IPCP Configure-Ack        1               1
IPCP Configure-Nak        0               1
IPCP Configure-Reject     0               0
IPCP Terminate-Request    0               0
IPCP Terminate-Ack        0               0
IPCP Code-Reject          0               0
-------------------------------------------------------------------------------
Unknown Protocol          0               -
-------------------------------------------------------------------------------
Number of sessions : 1
===============================================================================
*A:ALA-49#


*A:Dut-C# show service id 2000 pppoe session detail
===============================================================================
PPPoE sessions for svc-id 2000
===============================================================================
Sap Id              Mac Address       Sid    Up Time               Type
    IP/L2TP-Id/Interface-Id
-------------------------------------------------------------------------------
2/1/5:2000          00:01:00:00:04:15 1      0d 00:05:07           Local
    200.1.5.22

LCP State            : Opened
IPCP State           : Opened
IPv6CP State         : Initial
PPP MTU              : 1492
PPP Auth-Protocol    : None
PPP User-Name        : (Not Specified)

Subscriber-interface : ies-2000-200.1.1.1
Group-interface      : grp-Vprn-2/1/5

Subscriber Origin    : RADIUS
Strings Origin       : RADIUS
IPCP Info Origin     : RADIUS
IPv6CP Info Origin   : None

Subscriber           : "hpolSub43"
Sub-Profile-String   : "hpolSubProf2"
SLA-Profile-String   : "hpolSlaProf1"
ANCP-String          : ""
Int-Dest-Id          : "2000"
App-Profile-String   : ""
Category-Map-Name    : ""

Primary DNS          : N/A
```

```
Secondary DNS        : N/A
Primary NBNS         : N/A
Secondary NBNS       : N/A
Address-Pool         : N/A

IPv6 Prefix          : N/A
IPv6 Del.Pfx.        : N/A
Primary IPv6 DNS     : N/A
Secondary IPv6 DNS   : N/A

Circuit-Id           : circuit 0
Remote-Id            : remote 00-00-00-00-00-00-eth0-2
Service-Name         :

Session-Timeout      : N/A
RADIUS Class         :
RADIUS User-Name     : 00:01:00:00:04:15
Data link            : aal5
Encaps 1             : notAvailable
Encaps 2             : pppoaLlc
-------------------------------------------------------------------------------
Overrides
-------------------------------------------------------------------------------
Direction Type           Key        PIR        CIR        CBS        MBS
-------------------------------------------------------------------------------
Egress    Agg-Rate-Limit N/A        24125940   N/A        N/A        N/A
-------------------------------------------------------------------------------
No. of Overrides: 1
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Number of sessions   : 1
===============================================================================
*A:Dut-C#
```

statistics

Syntax **statistics** [{**sap** *sap-id* | **interface** *ip-int-name* | *ip-address*}]

Context show>service>id>pppoe

Description This command displays PPPoE statistics.

Parameters **sap** *sap-id* — Displays information for the specified SAP. See Common Service Commands on page 2168 for *sap-id* command syntax.

interface *ip-int-name* — Displays information about the specified interface.

ip-address — Displays information about the specified IP address.

Sample Output

```
*A:ALA-49# show service id 20 pppoe statistics
===============================================================================
PPPoE statistics for IES service 20
===============================================================================
Packet Type         Received        Transmitted
-------------------------------------------------------------------------------
```

```
PADI                2               -
PADO                -               2
PADR                2               -
PADS                -               2
PADT                0               0
session             9838            9839
-------------------------------------------------------------------------------
Drop Counters
-------------------------------------------------------------------------------
Rx Invalid Version   : 0
Rx Invalid Type      : 0
Rx Invalid Code      : 0
Rx Invalid Session   : 0
Rx Invalid Length    : 0
Rx Invalid Tags      : 0
Rx Invalid AC-Cookie : 0
Rx Dropped           : 0
===============================================================================
*A:ALA-49#
```

summary

Syntax **summary**

Context show>service>id>pppoe

Description This command displays PPPoE summary information

Clear Commands

pppoe

Syntax **pppoe**

Context clear>service>id

Description This command enables the context to clear PPPoE-related data for the specified service.

session

Syntax **session all** [**no-padt**]
session {**interface** *ip-int-name* | *ip-address* | **sap** *sap-id*} [**mac** *ieee-address*] [**session-id** *session-id*] [**ip-address** *ip-address*[/*mask*]] [**port** *port-id*] [**no-inter-dest-id** | **inter-dest-id** *intermediate-destination-id*] [**no-padt**]

Context clear>service>id>ppoe

Description This command clears PPPoE sessions.

statistics

Syntax **statistics** [{**sap** *sap-id* | **interface** *ip-int-name* | *ip-address*}]

Context clear>service>id>ppoe

Description This command clears PPPoE statistics.

Debug Commands

ppp

Syntax [**no**] **ppp**

Context debug>service>id

Description This command enables and configures PPP debugging.

event

Syntax [**no**] **event**

Context debug>service>id>ppp

Description This command enables debugging for specific PPPoE events.

dhcp-client

Syntax **dhcp-client** [**terminate-only**]
no dhcp-client

Context debug>service>id>ppp>event

Description This command enables debugging for specific DHCP client events.

ppp

Syntax **ppp** [**terminate-only**]
no ppp

Context debug>service>id>ppp>event

Description This command enables debugging for specific PPP events.

mac

Syntax [**no**] **mac** *ieee-address*

Context debug>service>id>ppp

Description This command shows PPP packets for a particular MAC address.

packet

Syntax [**no**] **packet**

Context debug>service>id>ppp

Description This command enables debugging for specific PPPoE packets.

detail-level

Syntax **detail-level** {**low** | **medium** | **high**}
no detail-level

Context debug>service>id>ppp>packet

Description This command configures the PPP packet tracing detail level.

dhcp-client

Syntax [**no**] **dhcp-client**

Context debug>service>id>ppp>packet

Description This command enables debugging for specific DHCP client packets.

discovery

Syntax **discovery** [**padi**] [**pado**] [**padr**] [**pads**] [**padt**]
no discovery

Context debug>service>id>ppp>packet

Description This command enables debugging for specific PPP discovery packets.

mode

Syntax **mode** {**dropped-only** | **ingr-and-dropped** |**egr-ingr-and-dropped**}
no mode

Context debug>service>id>ppp>packet

Description This command configures the PPP packet tracing mode.

ppp

Syntax **ppp** [**lcp**] [**pap**] [**chap**] [**ipcp**]
no ppp

Context debug>service>id>ppp>packet

Description This command enables debugging for specific PPP packets

sap

Syntax [**no**] **sap** *sap-id*

Context debug>service>id>ppp

Description This command displays PPP packets for a particular SAP.

Tools Commands

tools

Syntax **tools**

Context <root>

Description The context to enable useful tools for debugging purposes.

Default none

Parameters **dump —** Enables dump tools for the various protocols.

perform — Enables tools to perform specific tasks.

perform

Syntax **perform**

Context tools

Description This command enables the context to enable tools to perform specific tasks.

Default none

subscriber-mgmt

Syntax **subscriber-mgmt**

Context tools>perform

Description This command enables tools to control subscriber management.

local-user-db

Syntax **local-user-db** *local-user-db-name*

Context tools>perform>subscriber-mgmt

Description This command enables tools for controlling the local user database.

Parameters *local-user-db-name* — [32 chars max]

dhcp

Syntax **dhcp**

Context tools>perform>subscriber-mgmt>local-user-db

Description This command contains the tools used for controlling DHCP entries in the local user database.

host-lookup

Syntax **host-lookup** [**mac** *ieee-address*] [**remote-id** *remote-id*] [**sap-id** *sap-id*] [**service-id** *service-id*] [**string** *vso-string*] [**system-id** *system-id*] [**option60** *hex-string*] [**circuit-id** *circuit-id* **| circuit-id-hex** *circuit-id-hex*]

Context tools>perform>subscriber-mgmt>local-user-db>dhcp

Description This command performs a lookup in the local user database.

Parameters **mac** *ieee-address* **—** Specifies the 48-bit MAC address for the static ARP in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

remote-id — Specifies what information goes into the remote-id sub-option in the DHCP relay packet.

Values Up to 255 characters maximum

sap-id — Specifies a SAP identifier to be used.

service-id — Specifies an existing subscriber service ID.

Values 1 — 2147483647

vso-string — Specifies a vendor-specific option string.

Values Up to 255 characters maximum

system-id — Specifies the system ID.

Values Up to 255 characters maximum

hex-string — [0x0..0xFFFFFFFF.. (max 64 hex nibbles)]

circuit-id — Specifies the circuit-id string.

Values Up to 127 characters maximum

circuit-id-hex — [0x0..0xFFFFFFFF.. (max 254 hex nibbles)]

ppp

Syntax **ppp**

Context tools>perform>subscriber-mgmt>local-user-db

Description This command contains the tools used to control PPP entries in the local user database.

authentication

Syntax **authentication** *ppp-user-name* [**password** *password*]

Context tools>perform>subscriber-mgmt>local-user-db>ppp

Description This command authenticates PPP user name. As local user database PAP/CHAP authentication can only be used when the local user database is connected to the PPPoE/PPP node under the group interface, the user lookup will be performed with match-list username.

Parameters *ppp-user-name* — Specifies the PPP username.

password — Specifies the password of this host up to 32 characters in length.

host-lookup

Syntax **host-lookup** [**mac** *ieee-address*] [**remote-id** *remote-id*] [**user-name** *user-name*] [**circuit-id** *circuit-id* **| circuit-id-hex** *circuit-id-hex*]

Context tools>perform>subscriber-mgmt>local-user-db>ppp

Description This command performs a lookup in the local user database.

Parameters *ieee-address* — xx:xx:xx:xx:xx:xx or xx-xx-xx-xx-xx-xx

remote-id — [255 chars max]

user-name — Specifies the PPPoE username.

circuit-id — [127 chars max]

circuit-id-hex — [0x0..0xFFFFFFFF.. (max 254 hex nibbles)]

edit-ppp-session

Syntax **edit-ppp-session sap** *sap-id* **ip** *ip-address* [**subscriber** *sub-ident-string*] [**sub-profile-string** *sub-profile-string*] [**sla-profile-string** *sla-profile-string*] [**inter-dest-id** *intermediate-destination-id*] [**ancp-string** *ancp-string*] [**app-profile-string** *app-profile-string*] [**user-name** *user-name*]
edit-ppp-session svc-id *service-id* **ip** *ip-address* [**subscriber** *sub-ident-string*] [**sub-profile-string** *sub-profile-string*] [**sla-profile-string** *sla-profile-string*] [**app-profile-string** *app-profile-string*] [**inter-dest-id** *intermediate-destination-id*] [**ancp-string** *ancp-string*][**user-name** *user-name*]

Context tools>perform>subscriber-mgmt

Description This command modifies PPP session information.

Parameters *sap-id*: null [*port-id* | *bundle-id* | *bpgrp-id* | *lag-id* | *aps-id*]

dot1q	[*port-id* | *bundle-id* | *bpgrp-id* | *lag-id* | *aps-id*]:*qtag1*
qinq	[*port-id* | *bundle-id* | *bpgrp-id* | *lag-id*]:*qtag1.qtag2*
atm	[*port-id* | *aps-id*][:*vpi/vci*|*vpi*| *vpi1.vpi2*]
frame	[*port-id* | *aps-id*]:*dlci*
cisco-hdlc	*slot/mda/port.channel*
cem	*slot/mda/port.channel*
ima-grp	[*bundle-id*[:vpi/vci|vpi|*vpi1.vpi2*]
port-id	*slot/mda/port*[.*channel*]
bundle-id	bundle-*type-slot/mda.bundle-num*
	bundle keyword
	type ima, ppp
	*bundle-num*1 — 256
bpgrp-id	bpgrp-*type-bpgrp-num*
	bpgrp keyword
	type ima, ppp
	*bpgrp-num*1 — 1280
aps-id	aps-*group-id*[.*channel*]
	aps keyword
	group-id 1 — 64
ccag-id	ccag-*id.path-id*[*cc-type*]:*cc-id*
	ccag keyword
	id 1 — 8
	path-id a, b
	cc-type .sap-net, .net-sap
	cc-id 0 — 4094
lag-*id*	lag-*id*
	lag keyword
	id 1 — 800
qtag1	0 — 4094
qtag2	*, 0 — 4094
vpi	NNI: 0 — 4095
	UNI: 0 — 255
vci	1, 2, 5 — 65535
dlci	16 — 1022

ip-address — Displays information for the specified IP address.

sub-ident-string — Displays information for the specified subscriber identification profile.

sub-profile-string — Displays information for the specified subscriber profile.

service-id — Specifies the ID that uniquely identifies a service.

Values 1 — 2147483647

intermediate-destination-id — Specifies the intermediate destination identifier, up to 32 characters in length.

ancp-string *ancp-string* **—** Specifies the ASCII string of the DSLAM circuit ID name.

app-profile-string — Displays information about the specified application profile.

eval-lease-state

Syntax **eval-lease-state** [**svc-id** *service-id*] [**sap** *sap-id*] [**subscriber** *sub-ident-string*] [**ip** *ip-address*]

Context tools>perform>subscriber-mgmt

Description This command evaluates lease state.

Parameters

sap-id: null [*port-id* | *bundle-id* | *bpgrp-id* | *lag-id* | *aps-id*]

dot1q	[*port-id* | *bundle-id* | *bpgrp-id* | *lag-id* | *aps-id*]:*qtag1*
qinq	[*port-id* | *bundle-id* | *bpgrp-id* | *lag-id*]:*qtag1.qtag2*
atm	[*port-id* | *aps-id*][:*vpi/vci*|*vpi*| *vpi1.vpi2*]
frame	[*port-id* | *aps-id*]:*dlci*
cisco-hdlc	*slot/mda/port.channel*
cem	*slot/mda/port.channel*
ima-grp	[*bundle-id*[:vpi/vci|vpi|*vpi1.vpi2*]
port-id	*slot/mda/port*[*.channel*]
bundle-id	bundle-*type-slot/mda.bundle-num*
	bundle keyword
	type ima, ppp
	*bundle-num*1 — 256
bpgrp-id	bpgrp-*type-bpgrp-num*
	bpgrp keyword
	type ima, ppp
	*bpgrp-num*1 — 1280
aps-id	aps-*group-id*[*.channel*]
	aps keyword
	group-id 1 — 64
ccag-id	ccag-*id.path-id*[*cc-type*]:*cc-id*
	ccag keyword
	id 1 — 8
	path-id a, b
	cc-type .sap-net, .net-sap
	cc-id 0 — 4094
lag-*id*	lag-*id*
	lag keyword
	id 1 — 800
qtag1	0 — 4094
qtag2	*, 0 — 4094
vpi	NNI: 0 — 4095
	UNI: 0 — 255
vci	1, 2, 5 — 65535
dlci	16 — 1022

ip-address — a.b.c.d

sub-ident-string — [32 chars max]

service-id — [1..2147483647]

L2TP

In This Chapter

This chapter provides information about using L2TP, including theory, supported features and configuration process overview.

Topics in this chapter include:

L2TP

Terminology

- Tunnel spec — Describes the requirements for a tunnel and is defined as a set of parameters that will be used in tunnel setup/selection process. The tunnel-spec is defined in the CLI or can be supplied through RADIUS.
- Tunnel (instance) — A run-time object with a unique id terminating at a specific peer. Any change in the tunnel spec once the tunnel has been created has no bearings on the tunnel itself. The list of tunnels can be obtained using the **show router l2tp tunnel** command.
- Peer — A run-time object that is defined by a *ip-address/port* combination. Multiple tunnels can be terminated on the same peer. The list of peers can be obtained using the **show router l2tp peer** command.

LAC DF Bit

The LAC DF bit is configurable, but by default, it sends all L2TP packets with the DF bit set to 1. Clearing the DF bit will allow downstream routers to fragment the L2TP packets. The LAC itself will not fragment L2TP packets. L2TP packets that have a larger MTU size than what the LAC egress ports allows are dropped. The DF bit can also be configured via RADIUS attribute **Alc-Tunnel-DF-bit**.

Handling L2TP Tunnel/Session Initialization Failures

L2TP Tunnel/Session Initialization Failover Mechanisms on LAC

In deployment scenarios with multiple LNS nodes, a list of those LNS nodes can be presented to the LAC during the L2TP session instantiation process (either through CLI or RADIUS). An example of this would be a RADIUS Accept message with a list of tunnel peers:

```
tunnel.com Auth-Type := Local, Password == "tunnel1"
Tunnel-Type:1 += L2TP,
       Tunnel-Medium-Type:1 += IP,
       Tunnel-Client-Auth-Id:1 += lns_tun,
       Tunnel-Assignment-Id:1 += 1,
     Tunnel-Client-Endpoint:1 += 10.0.0.1,
     Tunnel-Server-Endpoint:1 += 10.0.0.2,
       Tunnel-Password:1 += TUNNELPASS,

          Tunnel-Type:2 += L2TP,
     Tunnel-Medium-Type:2 += IP,
          Tunnel-Client-Auth-Id:2 += lns_tun,
     Tunnel-Assignment-Id:2 += 2,
       Tunnel-Client-Endpoint:2 += 10.0.0.1,
       Tunnel-Server-Endpoint:2 += 10.0.0.3,
       Tunnel-Password:2 += TUNNELPASS,

              Tunnel-Type:3 += L2TP,
       Tunnel-Medium-Type:3 += IP,
       Tunnel-Client-Auth-Id:3 += lns_tun,
       Tunnel-Assignment-Id:3 += 3,
       Tunnel-Client-Endpoint:3 += 10.0.0.1,
       Tunnel-Server-Endpoint:3 += 10.0.0.4,
       Tunnel-Password:3 += TUNNELPASS,
              Tunnel-Type:4 += L2TP,

       Tunnel-Medium-Type:4 += IP,
       Tunnel-Client-Auth-Id:4 += lns_tun,
       Tunnel-Assignment-Id:4 += 4,
       Tunnel-Client-Endpoint:4 += 10.0.0.1,
       Tunnel-Server-Endpoint:4 += 10.0.0.5,
       Tunnel-Password:4 += TUNNELPASS
```

In case that the tunnel or the session establishment attempt fails for any reason, a search for additional operational facilities (tunnels or peers) will be made in order to complete the establishment of the tunnel/session that failed in the previous attempt. Moreover, sometimes it is required to go beyond this automatic search for the new facilities and place the tunnel/peer in question into a blacklist. A tunnel timeout will always force the corresponding peer and the tunnel into the blacklist. In addition, a tunnel can be forced into the blacklist by certain explicit error codes (CDN, and Stop-CCN) during the tunnel/session initialization phase. A peer is never forced on a blacklist as a consequence of explicit Result-Code sent by LNS.

Blacklisted peers and tunnels are not eligible to serve new incoming L2TP session until they are removed from the blacklist. The exception case is when all tunnel specs evaluate into a blacklisted item. In this case a blacklisted item (tunnel) will be tried.

Peer Blacklist

A peer is always placed into the blacklist if:

- An attempt to establish a new tunnel fails due to a time out (SCCRQ and SCCN timeouts)
- The timeout occurs on any control packet within an already established tunnel. All sessions on such tunnel are terminated (PADT is sent toward the clients, StopCCN is sent toward the LNS). Other tunnels that are terminated on the same peer will timeout on their own (if the peer is indeed non-operational), for example, 7x50 will not explicitly tear them down based on the timeout of a single tunnel. The timeout of an existing tunnel is caused by lack of acknowledgments to transmitted control packets (ICRQ, ICCN, CDN, Hello).

A tunnel timeout will occur if an acknowledgement is not received after max-retries-established (on an established tunnel) or max-retries-not-established (for the tunnel in the process of being established) retries.

Although there is no configuration option that would control whether a peer can or cannot be blacklisted (it is always blacklisted on tunnel timeout), the amount of time that a peer remains in the blacklist is configurable within the **tunnel-selection-blacklist** CLI node.

Tunnel Blacklists

A tunnel spec (that evaluates into a tunnel) is temporary unusable in case that corresponding peer or the tunnel is blacklisted. The following events will trigger placement of the tunnel into the blacklist:

1. Explicit termination of the L2TP session that is in the process of being established within this tunnel. The following CDN Result Codes will place a tunnel to a blacklist (text in red are CLI keywords that will enable specific Result Codes as triggers and [rx,tx] is direction of the messages from the LAC perspective):
   - 02 DisconnectedSeeErrorCode, rx (cdn-err-code)
   - 04 TempMissingFacilities, rx (cdn-tmp-no-facilities)

     Transmit CDN when no session can be allocated

     Audit not yet complete
   - 05 PermanentMissingFacilities, rx (cdn-perm-no-facilities)

     No result code available
   - 06 InvalidDestination, rx(cdn-inv-dest)

     Tunnel is not usable (for example lns-group is not configure on LNS)
   - 10 NotEstablishedInAllotedTime, tx (tx-cdn-not-established-in-time)
2. Explicit termination of the L2TP tunnel in the process of establishment via Stop-CCN Result-Codes:
   - → (1) General request to clear control connection, rx (stop-ccn-other)
   - → (2) General error, rx (stop-ccn-err-code)
   - → (4) Requestor is not authorized to establish a control channel, rx, tx (stop-ccn-other)
   - → (5) Protocol version not supported, rx, tx(stop-ccn-other)
   - → (6) Requestor is being shutdown, rx (stop-ccn-other)

Error messages identified by the received Result-Codes can be interpreted as the inability of the LNS to accept additional L2TP sessions within the tunnel (for example due to resource depletion) or to accept additional new tunnels.

The following statements further describe behavior related to the placement of tunnels into the blacklist:

- New L2TP session establishment attempt will not be triggered on the tunnel that is in the blacklist. Instead, another tunnel will be searched according to the configured preference model.
- The tunnel/session initialization failure will always trigger the selection mechanism for another tunnel. However, it is possible to control via configuration whether to blacklist or

not the tunnel for which the L2TP initialization process failed due to certain Result Codes in CDN and/or Stop CCN messages.

- Once the L2TP tunnel/session is established, no events other than the timeout can force the tunnel (and the peer) into the blacklist. In other words, a tunnel Stop or Call disconnect message for a stable tunnel/session will not force the tunnel into the blacklist.
- Existing sessions within the L2TP tunnel will not be purposefully terminated in case that the tunnel is forced into the blacklist due to an explicit reply from LNS indicating the tunnel/session initialization failure. In other words, although the L2TP tunnel might be blacklisted and therefore prevented from serving new L2TP sessions, the existing L2TP session over this tunnel will not be affected.
- A peer will NOT be forced into the blacklist in case of the explicit failure response from that particular peer. Only tunnels will be blacklisted in that case, assuming that the configuration trigger is enabled. Peers are blacklisted only based on timeouts and not explicit responses.

In case that the end-point is not in the routing table (unreachable via routing), the end-point is marked as permanently unavailable (removed from the L2TP process). Such end-point will never be blacklisted.

Tunnel Timeout Due to the Peer IP Address Change

In case that the peer address is changed mid-session (for example, from configured IP@ 1.1.1.1 to the new IP@ 2.2.2.2), and then subsequently the tunnel times-out, the new peer 2.2.2.2 would be placed in the blacklist by default. The tunnel itself would not be placed in the blacklist since it is originally tied to a different peer address that it is not in the blacklist. As such it would be eligible for selection the next time a new session request for it arrives. To block selection of this failed tunnel, we can optionally (by configuration) force it into the blacklist.

```
This behavior can be enabled with the following CLI:
configure router l2tp
configure service vprn <id> l2tp
     tunnel-selection-blacklist
          add-tunnel on <reason> [<reason>...(upto 7 max)]
<reason> : cdn-err-code|cdn-inv-dest|cdn-tmp-no-facilities|cdn-perm-no-facilities|tx-cdn-
not-established-in-time|stop-ccn-err-code|stop-ccn-other|addr-change-timeout
```

Tunnel Selection Mechanism

Once the L2TP tunnel failover is triggered (timeout or specific L2TPsession/tunnel setup error message), a new tunnel spec in the list of available tunnel specs will be selected. This tunnel selection mechanism can be controlled via CLI so that the new tunnel-spec is selected from the next preference level. Alternatively the tunnel selection mechanism can be set to a mode where once all the possibilities within the same preference are exhausted, tunnel specs on a higher preference level will be tried.

```
configure router l2tp
configure service vprn <id> l2tp
     next-attempt same-preference-level | next-preference-level
```

In case that ALL tunnels on a given preference levels are blacklisted, then the behavior will depend on the configuration option as per the following:

- next-attempt = next-preference - only one tunnel spec from the current preference level will be tried before switching to the next preference level.
- next-attempt = same-preference – all tunnel specs will be tried before switching to the next preference level.

Tunnel Probing

Tunnel probing refers to the mechanism where the blacklisted tunnel or an end-point can be selected to serve only a single L2TP session initialization request. Only in case that this single L2TP session is successfully established over the selected tunnel, the tunnel can be removed from the blacklist and consequently can serve new L2TP sessions. The tunnel is eligible for probing once its preconfigured time in the blacklist has expired.

This behavior will ensure that the new session initialization requests are not buffered while waiting for the tunnel to transition into operational state. Buffering would incur session setup delay and in the worst case it would cause session timeout in case that the L2TP tunnel cannot be established.

Without tunnel probing enabled, tunnels will be automatically removed from the blacklist upon the expiry of the preconfigured timer. New consecutive L2TP session initialization requests for such tunnels will always be buffered.

Controlling the Size of Blacklist

The size of the blacklist and the time that an item remains ineligible for selection within the blacklist, is configurable.

```
configure router l2tp
configure service vprn <id> l2tptunnel-selection-blacklist
         max-time   1..60 (minutes)
         max-list-length unlimited | 1..65535
```

Displaying the Content of a Blacklist

The content of a blacklist along with the remaining time that each entity is confined to the blacklist can be displayed with the following command:

```
show router <id> l2tp peer blacklisted|not-blacklisted|selectable
```

Example:

```
show router l2tp peer 10.100.0.2
===============================================================================
Peer IP: 10.100.0.2
===============================================================================
Roles capab/actual: LAC LNS /LAC  -     Draining          : false
Tunnels           : 1                   Tunnels Active    : 0
Sessions          : 1                   Sessions Active   : 0
Reachability      : blacklisted         Time Unreachable  : 01/31/2013 08:55:06
Time Blacklisted  : 01/31/2013 08:55:06 Remaining (s)     : 34
===============================================================================
Conn ID                      Loc-Tu-ID Rem-Tu-ID State              Ses Active
  Group                                                            Ses Total
    Assignment
-------------------------------------------------------------------------------
977207296                    14911     0         closed             0
  base_lac_base_lns                                                1
    t1
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================


show router l2tp tunnel detail
===============================================================================
L2TP Tunnel Status
===============================================================================

Connection ID: 831782912
State        : closedByPeer
IP           : 10.0.0.1
Peer IP      : 10.100.0.2
Tx dst-IP    : 10.100.0.2
Rx src-IP    : 10.100.0.2
```

```
Name         : lac
Remote Name  :
Assignment ID: t1
Group Name   : base_lac_base_lns
Acct. Policy : l2tp-base
Error Message: N/A

                                     Remote Conn ID    : 4294901760
Tunnel ID         : 12692            Remote Tunnel ID  : 65535
UDP Port          : 1701             Remote UDP Port   : 1701
Preference        : 50               Receive Window    : 64
Hello Interval (s): 300
Idle TO (s)       : 5                Destruct TO (s)   : 60
Max Retr Estab    : 5                Max Retr Not Estab: 5
Session Limit     : 32767            AVP Hiding        : sensitive
Transport Type    : udpIp            Challenge         : never
Time Started      : 01/31/2013 08:56:58 Time Idle       : 01/31/2013 08:56:58
Time Established  : N/A              Time Closed       : 01/31/2013 08:56:58
Stop CCN Result   : reqShutDown      General Error     : noError
Blacklist-state   : blacklisted
Blacklist Time    : 01/31/2013 08:56:58 Remaining (s)  : 49
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================
```

Generating Trap when the Blacklist is Full

A log is generated when the blacklist reaches its max limit of items. The log event is tmnxL2tpTunnelSelectionBlacklistFull.

Premature Removal of Blacklisted Entries

In case that the total number of supported tunnels and peers in blacklist and in the LAC in general has reached its maximum, then on the new session initialization request, the oldest tunnel entry in the blacklist will be removed from the blacklist irrespective of whether their blacklist max-time has expired or not.

Manual Purging of Entities within the Blacklist

The items can be manually purged from the blacklist using the following commands .

```
clear router <id> l2tp tunnel-selection-blacklist
clear router <id> l2tp peer <ip-address> [udp-port <port>] tunnel-selection-blacklist
clear router <id> l2tp group <tunnel-group-name> [tunnel <tunnel-name>] tunnel-selection-
blacklist
clear router <id> l2tp tunnel <connection-id> tunnel-selection-blacklist
```

Stateless Address Auto-configuration (SLAAC) Management

SLAAC Principles

In a Triple Play network, client devices can use SLAAC to dynamically obtain their IP address and other network configuration information.

1. During boot-up, the client sends a Router Solicit message to get an IP prefix.
2. The BNG address server can assign a prefix statically to the subscriber through Radius or LUDB. Or, dynamically through the use of the local-address-server.
3. The BNG address server will reply to the client with a Router Advertisement which contains a /64 prefix.

Configuration Overview

The trigger for creating a SLAAC host is AAC host can choose to authenticate through Radius, LUDB, or bypass authentication. Address assignment can be assigned statically or dynamically. Static prefix assignment is accomplished through Radius or LUDB. Dynamic prefix assignment requires the use of the local-address-server (reusing the local DHCPv6 server), and a pool name returned from RADIUS or LUDB. The DHCPv6 server for SLAAC is used for address management only, there are no lease state associated with SLAAC users. The DHCPv6 server can be shared with regular DHCPv6 users as well.

Router-solicit trigger

The following example shows a router-solicit (RS) triggered configuration.

```
*A:eng-BNG-2>config>service>vprn>sub-if>grp-if>ipv6# info
----------------------------------------------
                        router-solicit
                            no shutdown
                        exit
```

To add authentication to the above configuration, there are two options.

For radius authentication, similar to DHCP and PPP authentication, add a radius-policy under group-interface

For LUDB, add the following to the router-solicit configuration.

```
*A:eng-BNG-2>config>service>vprn>sub-if>grp-if>ipv6# info
----------------------------------------------
                        router-solicit
                            user-db "slaac-users"
                            no shutdown
                        exit
```

SLAAC Address Assignment

After a RS is received to trigger the creation of a SLAAC host, address assignment can be provided statically or dynamically.

Static SLAAC Prefix Assignment

If using RADIUS, the attribute “framed-ipv6-prefix” VSA is used. The attribute must be a /64 prefix.

```
*A:eng-BNG-2>config>subscr-mgmt>loc-user-db>ipoe>host# info
----------------------------------------------
                    ipv6-slaac-prefix 2001::/64
```

Dynamic SLAAC Prefix Assignment

SLAAC prefix can be dynamically assigned to a user at real time. Prefixes are assignment through the local DHCPv6 pool. Therefore a DHCPv6 pool must be defined first. The following displays an example configuration.

```
*A:eng-BNG-2>config>service>vprn>dhcp6# info
----------------------------------------------
       local-dhcp-server "dhcp6-server" create
              use-pool-from-client
              pool "pool-01" create
                     prefix 2001::/32 wan-host create
                     exit
              exit
        exit
```

To associate the dhcpv6 server for SLAAC address assignment, the following configuration is used. Notice the server name configured under local-address-assignment “dhcp6-server” matches the name configured under dhcp6 pool.

```
*A:eng-BNG-2>config>service>vprn>sub-if>grp-if# info
----------------------------------------------
```

```
local-address-assignment
    ipv6
        client-application ppp-slaac ipoe-slaac
        server "dhcp6-server"
    exit
    no shutdown
exit
```

In order to specify the pool to be used for SLAAC prefix assignment, the pool name can either be returned from LUDB or Radius.

If using Radius, the attribute “Alc-slaac-ipv6-pool” is used.

If using LUDB, the following configuration is used.

```
*A:eng-BNG-2>config>subscr-mgmt>loc-user-db>ipoe>host# info
----------------------------------------------
                    ipv6-slaac-prefix-pool "pool-01"
```

In this example, the pool named “pool-01” provisioned in the LUDB or returned from Radius will match the pool name configured in the dhcp6 server. A prefix from the 2001::/32 pool will be assigned to the SLAAC subscribers.

CDN Result Code Overwrite

When the number of L2TP sessions reaches the configured maximum value, the LNS sends an out-of-resource Result Code (4 or 5) in a CDN (Call-Disconnect-Notify) message to the LAC. This would trigger the LAC to fail over to another LNS that has the resources available. Similarly, when the tunnel is not usable due to the invalid destination CDN error, the Result-Code 6 will be sent from the LNS.

Certain third-party LAC implementations will trigger tunnel failover only when they receive Result Code 2 in CDN messages (and not 4,5 or 6). In order to support those scenarios, the LNS in 7x50 can overwrite result codes 4, 5 and 6 with result code 2 just before they are sent to the LAC. Result Codes can be overwritten only during the L2TP session initialization phase. These codes have the following meanings and are described in RFC 2661, 4.4.2:

- 2 — Call disconnected for the reason indicated in error code
- 4 — Call failed due to lack of appropriate facilities being available (temporary condition)
- 5 — Call failed due to lack of appropriate facilities being available (permanent condition)
- 6 — Invalid Destination

This functionality will be enabled on LNS via the following CLI hierarchy:

```
configure router l2tp
configure service vprn <id> l2tp
   replace-result-code {cdn-tmp-no-facilities | cdn-prem-no-facilities | cdn-inv-dest}
    no replace-result-code
```

L2TP LAC VPRN

Layer 2 Tunneling Protocol (L2TP) allows for PPP sessions to be carried over an IP network.

Each L2TP session transports PPP frames, irrespective of link-layer encapsulation, allows the LNS to terminate PPP sessions that were either PPPoE or PPPoA. L2TP is carried over IPv4 packets in UDP datagrams (default port 1701).

If session data is not reliably delivered, that is, if there is a packet loss, there is no retransmission, a sequence numbers is used within each L2TP session to identify packet loss and re-ordering.

L2TP is comprised of the following concepts:

- L2TP tunnels- L2TP tunnel is a connection between one LAC (L2TP Access Concentrator) and one LNS (L2TP Network Serve) that share a common control channel.
- L2TP sessions -Within each L2TP tunnel, there exists one or more L2TP sessions (one PPP session corresponds to exactly one L2TP session)

L2TP tunnels provide an IP transport for PPP frames between LAC and LNS. In some existing networks, BGP/MLPS VPNs (VPRN in SR-OS) are used to contain the L2TP traffic (and the routes associated with the LAC and LNS) into a dedicated routing instance.

Similar to the LNS implementation, L2TP LAC in a VPRN allows L2TP control and data traffic to be sourced from and received by any valid IP interface within the VPRN (including loopback and interface addresses). L2TP frames may ingress a network port (with up to five MPLS tags) or access ports with SAPs associated with the VPRN IP interfaces.

Non-hitless multi-chassis LAC resiliency

In dual-homed PPPoEv4/v6 wholesale/retail environment over L2TP, the subscriber-hosts are synchronized via Multi-Chassis Synchronization (MCS) protocol. The failover detection mechanism might be implemented via SRRP or Layer 3 MC-LAG with SRRP. When an interface or an entire node fails, the newly selected Master sends PADT to all sessions that were moved over from the failed node.

In case of interface-only failure, CDN is sent towards the LNS to terminate sessions on the LNS.

The PPPoE sessions will be reestablished on the newly selected Master, but because PADT was sent to clients the recovery time is faster (no need to wait for PPPoE session timeout). On the network side (towards the LNS) an existing tunnel towards the LNS can be used to re-establish the sessions or in case that none exists, a new tunnel will be established. There is no need for redundant interface in this case. Note that the L2TP tunnel carrying the sessions must always be terminated on the Master LAC.

In case of nodal failure, the sessions within the old tunnel on the LAC will time out (CDN cannot be sent from the new Master since there is no tunnel state preserved across redundant LAC nodes).

During the time-out period, the LNS will have to maintain double the amount of failed sessions (stale ones plus the new ones).

This model is shown in Figure 37.

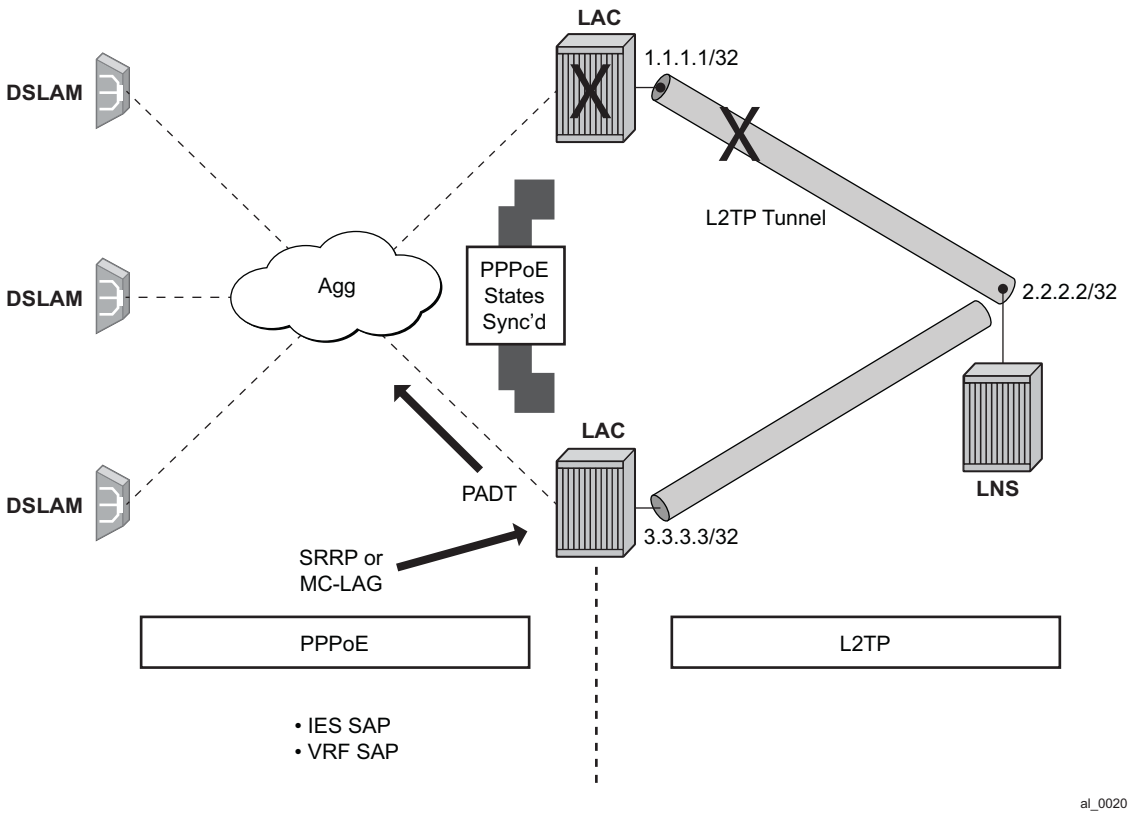


Figure 37: Non-Hitless Interface/Node Protection on the LAC

Per-ISP Egress L2TP DSCP Reclassification

Wholesale providers can deliver Internet access to directly connected PPP users through third party ISPs. This involves the users connecting to an L2TP Access Concentrator (LAC) with their traffic being tunneled to and from an L2TP Network Server (LNS) in their ISP.

If there is a requirement to support per-ISP (and per-subscriber host) QOS control for downstream traffic on the LAC towards the users based on the DSCP marking in the L2TP header, the command **use-ingress-l2tp-dscp** must be configured within the sla-profile selected for the users.

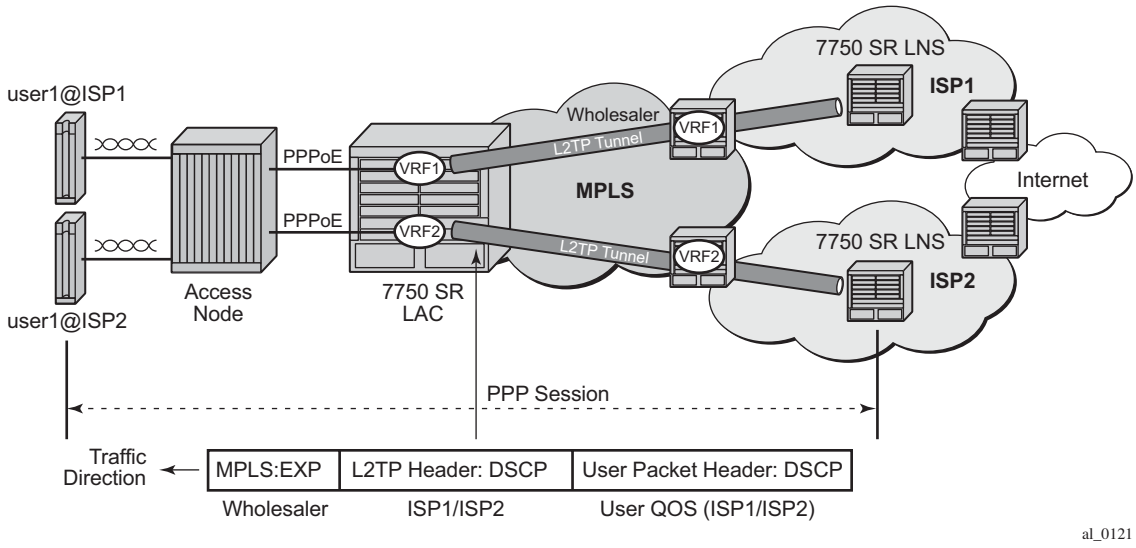


Figure 38: ISP Internet Access through Wholesale Provider

An example topology is shown in Figure 38 in which the downstream traffic arrives at the LAC with:

- An MPLS header (because of the VRF encapsulation). This contains EXP bits which are set based on the wholesale provider's QOS scheme.
- An L2TP header (because of the L2TP tunnel to the ISP). This contains DSCP bits in its IP header which are set by the originating ISP.
- A user IP packet header. This contains DSCP bits which could be set by the ISP or by the originating Internet application.

The network ingress on the LAC would normally use the MPLS EXP bits for traffic QoS classification, however, this matches the wholesale provider's QoS scheme.

It would be possible to apply the **ler-use-dscp** parameter at the LAC network ingress to classify based on the L2TP header DSCP, but this would require the QoS schemes used by all ISPs, and the wholesale provider, to have a consistent interpretation of the DSCP bits.

If the standard egress IP reclassification is used, the QOS would be dependent on the DSCP in the user packet.

Configuring the parameter **use-ingress-l2tp-dscp** in the sla-profile of the ISP1 and ISP2 users will force the egress QoS control to be based on the DSCP from the L2TP header received on the LAC (which is set by ISP1/ISP2). This provides per-ISP (and per-subscriber host) QoS control for downstream traffic on the LAC towards the users.

L2TP Tunnel RADIUS Accounting

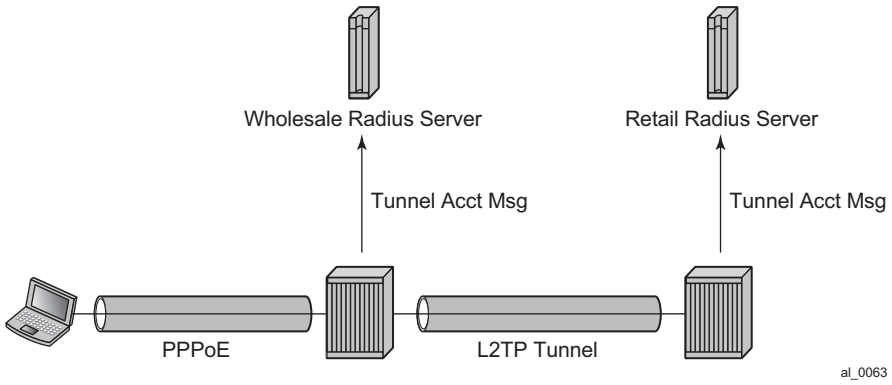


Figure 39: L2TP Tunnel Accounting

When L2TP tunnel accounting is enabled, except for **host** or **sla-profile**-based accounting packets and attributes, the following are additional accounting packets and attributes:

- Accounting packets: tunnel-start/stop/reject; tunnel-link-start/stop/reject — There are no interim updates for L2TP tunnel/session accounting.
- RADIUS accounting attributes:
  - → Tunnel-Assignment-Id (LAC only)
  - → Acct-Tunnel-Connection
  - → Acct-Tunnel-Packets-Lost

These attributes were added into current account-start/stop/interim-update packets (host accounting/sla-profile accounting)

Tunnel level accounting and session level accounting can be enabled or disabled independently.

New accounting packets and related RADIUS attribute list are described in Table 10.

Some considerations of RADIUS attributes are described in RADIUS Attributes Value Considerations on page 702.

Accounting Packets List

Table 10 describes L2TP tunnel accounting behavior along with some key RADIUS attributes (apply for both LAC and LNS):

Table 10: L2TP Tunnel Accounting Behavior

Act-Packet	When	Key Attributes	Remark
Tunnel-Start	A new L2TP tunnel is created	Acct-Session-ID	
		Event-Timestamp	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Tunnel-Server-Auth-Id:0	
Tunnel-Reject	A new L2TP tunnel creation failed	Acct-Session-Id	
		Event-Timestamp	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Acct-Terminate-Cause	
Tunnel-Stop	An established L2TP tunnel is removed	Acct-Session-Id	
		Event-Timestamp	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Tunnel-Server-Auth-Id:0	
		Acct-Session-Time	
		Acct-Input-Gigawords	
		Acct-Input-Octets	
		Acct-Output-Gigawords	
		Acct-Output-Octets	
		Acct-Input-Packets	

Table 10: L2TP Tunnel Accounting Behavior (Continued)

Act-Packet	When	Key Attributes	Remark
		Acct-Output-Packets	
		Acct-Terminate-Cause	
Tunnel-Link-Start	An L2TP session is created	User-Name	
		Acct-Session-Id	This is the same as Acct-Session-id in access-request of host auth
		Event-Timestamp	
		Service-Type	Framed
		Class	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Tunnel-Server-Auth-Id:0	
		Acct-Tunnel-Connection	See RADIUS Attributes Value Considerations on page 702
Tunnel-Link-Reject	A new L2TP session creation is failed	Acct-Session-Id	Should be as same as Acct-Session-id in access-request of host auth
		Event-Timestamp	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Acct-Terminate-Cause	
		Acct-Tunnel-Connection	
Tunnel-Link-Stop	A established L2TP session is removed	User-Name	
		Acct-Session-Id	Should be as same as Acct-Session-id in access-request of host auth
		Event-Timestamp	
		Service-Type	Framed

Table 10: L2TP Tunnel Accounting Behavior (Continued)

Act-Packet	When	Key Attributes	Remark
		Class	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Tunnel-Server-Auth-Id:0	
		Acct-Tunnel-Connection	
		Acct-Session-Time	
		Acct-Input-Gigawords	
		Acct-Input-Octets	
		Acct-Output-Gigawords	
		Acct-Output-Octets	
		Acct-Input-Packets	
		Acct-Output-Packets	
		Acct-Tunnel-Packets-Lost	
		Acct-Terminate-Cause	

Notes:

- Errors will occur if there are multiple hosts sharing the same sla-profile instance and then these hosts go to different tunnel.
- 7750 SRs have an internal limitation of 500 pps for accounting messages. This feature shares the same limitation

RADIUS Attributes Value Considerations

- The value of Acct-Tunnel-Connection uniquely identify a L2TP session, and in order to match LAC and LNS accounting record, the value of Acct-Tunnel-Connection is determined by a method shared by LAC and LNS. This means for a given L2TP session, Acct-Tunnel-Connection from the LAC and LNS are the same.
- Current ESM stats are used in Tunnel-Link and tunnel level accounting. This applies for both standard attribute and the 7750's own VSA.
- Tunnel level accounting stats need to aggregate all sessions stats that belong to the tunnel. Note: there could be sessions come and go before tunnel is down, so system need to remember the stats of every session that has been created within the tunnel.

  This applies for both standard attribute and 7750's own VSA.
- The value of Acct-Tunnel-Packets-Lost is the aggregation of all discarded packets on both ingress and egress.

Other Optional RADIUS Attributes

Table 11 lists the optional attributes that could be optionally included in tunnel accounting packet, some of them are applied for link level accounting only.

Table 11: Optional RADIUS Attributes

Attribute	Tunnel/Link
nas-identifier	Both
nas-port	Link level only
nas-port-id	Link level only
nas-port-type	Link level only

RADIUS VSA to Enable L2TP Tunnel Accounting

In order to support pure RADIUS-enabled L2TP tunnel accounting on LAC side, the following RADIUS VSA are supported:

Table 12: Supported RADIUS VSAs

VSA	Type	Value
ALC-Tunnel-Accounting-Policy	String	Policy-name; if the name is **disable** then this means L2TP tunnel accounting is disabled for this tunnel

Note: ALC-Tunnel-Accounting-Policy takes precedence over what has been defined in CLI when Alc-Tunnel-Group is also returned.

MLPPP on the LNS Side

With MLPPP, the counter on LNS side is only available for the bundle, not for each link, so the SR OS's behavior is:

- For each new link session system sends a tunnel-link-start.
- For each link session that is deleted system sends a tunnel-link-stop.
- For all link sessions except the last one system reports 0 for all counters.
- For the last link session, system reports the actual counters for the bundle.

LNS Reassembly

LNS reassembly is supported in the BB-ISA. Fragments are collected and reassembled. Once the entire L2TP packet is reassembled, the packet will either be de-capsulated or sent to the CPM as is.

The delivery of the L2TP packets to the BB-ISA depends on the certain fields in the L2TP header. The forwarding decision on the ingress LNS side in the upstream direction (LAC->LNS) is based on the tunnel-id/session-id combination and the T-bit (message type bit – control or data) in L2TP header.

Control type messages are delivered directly to the CPM. CPM performs L2TP de-capsulation and processes the message (tunnel or session setup/teardown related messages or tunnel hellos). The CPM provides forwarding information to the forwarding plane (ingress/egress IOM and the carrier IOM) and to the BB-ISA (tunnel-src + tunnel-id/session-id + generated-mac-addr and SAP).

Data type messages are delivered directly to the BB-ISA. The BB-ISA decapsulates the L2TP packets and forwards them to the carrier IOM as a quasi-PPPoE frame (ESM forwarding module).

Since the LAC fragments the packets in the upstream direction, the L2TP header is preserved only in the first fragment. Therefore, the crucial forwarding information needed by LNS is lost in all consecutive fragments. If a fragments ends up in the wrong BB-ISA with no reassembly context for the fragment, the fragment will be dropped.

Similarly, the information whether to forward the fragment to the BB-ISA (data packet) or the CPM (control packet) is lost.

In order to support LSN reassemble, the following configuration limitations are imposed:

- Only one pair of active/standby BB-ISAs are supported. This way all fragments will be forwarded to the same active BB-ISA that maintains all reassembly contexts for all fragments.
- All fragments, regardless of the packet type, are forwarded to the active BB-ISA. Once the L2TP packet is reassembled, it will be determined whether the packet is:
  - → A data packet — The packet will be de-capsulated and a quasi PPPoE packet will be forwarded to the carrier IOM (ESM function).
  - → A control packet — The packet will not be decapsulated but instead it will be forwarded as L2TP packet to the CPM.

The **lns-reassembly** commands that inform the ingress forwarding plane that all L2TP packets should be sent to the BB-ISA are configured in the **config>router>l2tp** and **config>service>vprn>l2tp** contexts.

L2TP Command Reference

Configuration Commands

L2TP Configuration Commands

```
configure
    — router
        — l2tp
            — df-bit-lac {always|never}
            — no df-bit-lac
            — group tunnel-group-name [create]
            — no group tunnel-group-name
                — df-bit-lac {always|never|default}
                — no df-bit-lac
                    — tunnel tunnel-name [create]
                    — no tunnel tunnel-name
                        — df-bit-lac {always|never|default}
                        — no df-bit-lac
            — tunnel-selection-blacklist
                — add-tunnel never
                — add-tunnel on reason>[reason...(upto 8 max)]
                — no add-tunnel
                — max-list-length
                — max-list-length count
                — no max-list-length
                — max-time minutes
                — no max-time
                — no timeout-action
                — timeout-action action

configure
    — system
        — l2tp
            — non-multi-chassis-tunnel-id-range start l2tp-tunnel-id end l2tp-tunnel-id
            — non-multi-chassis-tunnel-id-range default
            — no non-multi-chassis-tunnel-id-range
configure
    — redundancy
        — multi-chassis
            — peer
                — sync
                    — track-srrp-instances
                        — [no] track-srrp [1..4294967295]
                            — l2tp-tunnel-id-range start l2tp-tunnel-id end
                              l2tp-tunnel-id
                            — no l2tp-tunnel-id-range
configure
    — router
        — l2tp
            — failover
                — recovery-method method
                — no recovery-method
                — track-srrp srrp-instance peer ip-address sync-tag tag
                — [no] track-srrp srrp-instance
            — group tunnel-group-name [create]
            — no group tunnel-group-name
```

— **failover**
    — **recovery-method** *method*
    — **no recovery-method**
— **tunnel** *tunnel-name* [**create**]
— **no tunnel** *tunnel-name*
    — **failover**
        — **recovery-method** *method*
        — **no recovery-method**

L2TP Tunnel RADIUS Accounting Commands

```
configure
    — aaa
        — l2tp-tunnel-accounting-policy policy-name [create]
        — no l2tp-tunnel-accounting-policy policy-name
            — accounting-type [session] [tunnel]
            — no accounting-type
            — description description-string
            — no description
            — include-radius-attribute
                — [no] nas-identifier
                — nas-port binary-spec
                — no nas-port
                — nas-port-id
                — nas-port-id [prefix-string string ] [suffix suffix-option]
                — no nas-port-id
                — nas-port-type [[0..255]]
                — no nas-port-type
            — radius-accounting-server
                — access-algorithm {direct | round-robin}
                — no access-algorithm
                — retry count
                — no retry
                — router service-name service-name
                — router router-instance
                — no router
                — server server-index address , ip-address,  secret , key ,  [hash|hash2]
                  [port , port, ]
                — no server server-index
                — source-address-range ip-address
                — no source-address-range
                — timeout  [sec , seconds, ] [min , minutes, ]
                — no timeout
            — request-script-policy radius-script-policy-name
            — no request-script-policy
```

Show Commands

```
show
    — subscriber-mgmt
        — ppp-policy [ppp-policy-name [association]]
    — service
        — id service-id
            — pppoe
                — session [interface ip-int-name|ip-address | sap sap-id] [type pppoe-session-type] [session-id session-id] [mac ieee-address] [ip-address ip-address[/mask]] [port port-id] [no-inter-dest-id | inter-dest-id intermediate-destination-id] [detail|statistics]
                — session l2tp-connection-id connection-id [detail|statistics]
                — statistics [{sap sap-id | interface ip-int-name | ip-address}
                — summary
    — system
        — l2tp
    — redundancy
        — multi-chassis
            — sync [peer ip-address] [statistics]
            — sync peer ip-address detail
```

Clear Commands

```
clear
    — service
        — id service-id
            — pppoe
                — session all [no-padt]
                — session {interface ip-int-name | ip-address | sap sap-id} [mac ieee-address] [session-id session-id] [ip-address ip-address[/mask]] [port port-id] [no-inter-dest-id | inter-dest-id intermediate-destination-id] [no-padt]
                — statistics [{sap sap-id | interface ip-int-name | ip-address}]
```

Debug Commands

```
debug
    — service
        — id service-id
            — [no] ppp
                — [no] event
                    — dhcp-client [terminate-only]
                    — no dhcp-client
                    — ppp [terminate-only]
                    — no ppp
                — [no] mac ieee-address
                — [no] packet
                    — detail-level {low | medium | high}
                    — no detail-level
                    — [no] dhcp-client
                    — discovery [padi] [pado] [padr] [pads] [padt]
                    — no discovery
                    — mode {dropped-only | ingr-and-dropped |egr-ingr-and-dropped}
                    — no mode
                    — ppp [lcp] [pap] [chap] [ipcp]
                    — no ppp
                — [no] sap sap-id
```

— **router** [*router-instance*]
— [**no**] **l2tp**
— **assignment-id** *assignment-id*
— [**no**] **event**
— [**no**] **recovery**
— [**no**] **recovery-failed**
— [**no**] **event**
— [**no**] **recovery**
— [**no**] **recovery-failed**
— **group** *tunnel-group-name*
— [**no**] **event**
— [**no**] **recovery**
— [**no**] **recovery-failed**
— **peer** *ip-address* [**udp-port** *port*]
— [**no**] **event**
— [**no**] **recovery**
— [**no**] **recovery-failed**
— **tunnel** *connection-id*
— [**no**] **event**
— [**no**] **recovery**
— [**no**] **recovery-failed**

Tools Commands

tools
- **perform**
  - **subscriber-mgmt**
    - **edit-ppp-session** **sap** *sap-id* **ip** *ip-address* [**subscriber** *sub-ident-string*] [**sub-profile-string** *sub-profile-string*] [**sla-profile-string** *sla-profile-string*] [**inter-dest-id** *intermediate-destination-id*] [**ancp-string** *ancp-string*] [**app-profile-string** *app-profile-string*][user-name *user-name*]
    - **edit-ppp-session** **svc-id** *service-id* **ip** *ip-address* [**subscriber** *sub-ident-string*] [**sub-profile-string** *sub-profile-string*] [**sla-profile-string** *sla-profile-string*] [**inter-dest-id** *intermediate-destination-id*] [**ancp-string** *ancp-string*] [**app-profile-string** *app-profile-string*][user-name *user-name*]
    - **eval-lease-state** [**svc-id** *service-id*] [**sap** *sap-id*] [**subscriber** *sub-ident-string*] [**ip** *ip-address*]
    - **local-user-db** *local-user-db-name*
      - **dhcp**
        - **host-lookup** [**mac** *ieee-address*] [**remote-id** *remote-id*] [**sap-id** *sap-id*] [**service-id** *service-id*] [**string** *vso-string*] [**system-id** *system-id*] [**option60** *hex-string*] [**circuit-id** *circuit-id* | **circuit-id-hex** *circuit-id-hex*]
      - **ppp**
        - **authentication** **password** *password* [**mac** *ieee-address*] [**remote-id** *remote-id*] [**circuit-id** *circuit-id*] **user-name** *user-name* [**service-name** *service-name*]
        - **authentication** **password** *password* [**mac** *ieee-address*] [**remote-id** *remote-id*] [**circuit-id-hex** *circuit-id-hex*] **user-name** *user-name* [**service-name** *service-name*]
        - **host-lookup** [**mac** *ieee-address*] [**remote-id** *remote-id*] [**user-name** *user-name*] [**service-name** *service-name*] [**circuit-id** *circuit-id* | **circuit-id-hex** *circuit-id-hex*]

L2TP Configuration Commands

Global Commands

description

Syntax **description** *description-string*
no description

Context config>aaa>l2tp-acct-plcy

Description This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the content in the configuration file.

The **no** form of this command removes the string from the configuration.

Default No description associated with the configuration context.

Parameters *description-string* — The description character string. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

shutdown

Syntax [**no**] **shutdown**

Context config>aaa>l2tp-acct-plcy

Description This command administratively disables an entity. When disabled, an entity does not change, reset, or remove any configuration settings or statistics.

The operational state of the entity is disabled as well as the operational state of any entities contained within. Many objects must be shut down before they may be deleted.

The **no** form of this command places the entity into an administratively enabled state.

L2TP Tunnel Account Commands

next-attempt

Syntax **next-attempt** {**same-preference-level** | **next-preference-level**}
no next-attempt

Context configure>router>l2tp
configure>service>vprn>l2tp

Description This command enables tunnel selection algorithm based on the tunnel preference level.

Parameters **same-preference-level —** In case that the tunnel-spec selection algorithm evaluates into a tunnel that is currently unavailable (for example tunnel in a blacklist) then the next elected tunnel, if available, will be chosen within the same preference-level as the last attempted tunnel. Only when all tunnels within the same preference level are exhausted, the tunnel selection algorithm will move to the next preference level.

In case that a new session setup request is received while all tunnels on the same preference level are blacklisted, the L2TP session will try to be established on blacklisted tunnels before the tunnel selection moves to the next preference level.

next-preference-level — In case that the tunnel-spec selection algorithm evaluates into a tunnel that is currently unavailable (for example tunnel in a blacklist) then the selection algorithm will try to select the tunnel from the next preference level, even though the tunnels on the same preference level might be available for selection.

Default next-preference-level

replace-result-code

Syntax **replace-result-code** *code* [code...(upto 3 max)]
no replace-result-code

Context configure>router>l2tp
configure>service>vprn>l2tp

Description This command will replace CDN Result-Code 4, 5 and 6 on LNS with the Result Code 2. This is needed for interoperability with some implementation of LAC which only take action based on CDN Result-Code 2, while ignore CDN Result-Code 4, 5 and 6.

Default no replace-result-code

Parameters *code* — Specifies the L2TP Result codes that need to be replaced.

Values cdn-tmp-no-facilities — CDN Result-Code 4 on LNS will be replaced with the result code 2 before it is sent to LAC.
cdn-prem-no-facilities — CDN Result-Code 5 on LNS will be replaced with the result code 2 before it is sent to LAC.

cdn-inv-dest — CDN Result-Code 6 on LNS will be replaced with the result code 2 before it is sent to LAC.

df-bit-lac

Syntax **df-bit-lac** {**always**|**never**}
no df-bit-lac

Context config>router>l2tp
config>service>vprn>l2tp

Description By default, the LAC df-bit-lac is always set and sends all L2TP packets with the DF bit set to 1. The DF bit is configurable to allow downstream routers to fragment the L2TP packets. The LAC itself will not fragment L2TP packets. L2TP packets that have a larger MTU size than what the LAC egress ports allows are dropped.

Default df-bit-lac always

Parameters **always —** Specifies that the LAC will send all L2TP packets with the DF bit set to 1.

never — Specifies that the LAC will send all L2TP packets with the DF bit set to 0.

df-bit-lac

Syntax **df-bit-lac** {**always**|**never**|**default**}
no df-bit-lac

Context config>router/service>vprn>l2tp>group
config>router/service>vprn>l2tp>group>tunnel

Description By default, the LAC df-bit-lac is set to default and sends all L2TP packets with the DF bit set to 1. The DF bit is configurable to allow downstream routers to fragment the L2TP packets. The LAC itself will not fragment L2TP packets. L2TP packets that have a larger MTU size than what the LAC egress ports allows are dropped. The configuration of the df-bit can be overridden at different levels: l2tp, tunnel, and group. The configuration at the tunnel level overrides the configuration on both group and l2tp. The configuration at the group level overrides the configuration on l2tp.

Default df-bit-lac default

Parameters **always —** Specifies that the LAC will send all L2TP packets with the DF bit set to 1.

never — Specifies that the LAC will send all L2TP packets with the DF bit set to 0.

default — Follows the DF-bit configuration specified on upper levels.

group

Syntax **group** *tunnel-group-name* [**create**]
no group *tunnel-group-name*

Context config>router>l2tp
config>service>vprn>l2tp

Description This command configures an L2TP tunnel group.

Parameters *tunnel-group-name* — Specifies a name string to identify a L2TP group up to 63 characters in length.

create — This keyword is mandatory when creating a tunnel group name. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

tunnel

Syntax **tunnel** *tunnel-name* [**create**]
no tunnel *tunnel-name*

Context config>router>l2tp>group
config>service>vprn>l2tp>group

Description This command configures an L2TP tunnel. A tunnel exists between a LAC-LNS pair and consists of a Control Connection and zero or more L2TP sessions. The tunnel carries encapsulated PPP datagrams and control messages between the LAC and the L2TP Network Server (LNS).

Parameters *tunnel-name* — Specifies a valid string to identify a L2TP up to 32 characters in length.

create — mandatory while creating a new tunnel

tunnel-selection-blacklist

Syntax **tunnel-selection-blacklist**

Context config>router>l2tp

Description This command enables the context to configure L2TP Tunnel Selection Blacklist parameters.

add-tunnel

Syntax **add-tunnel never**
add-tunnel on *reason* [*reason*...(upto 8 max)]
no add-tunnel

Context configure>router>l2tp>tunnel-selection-blacklist
configure>service>vprn>l2tp>tunnel-selection-blacklist

Description This command will force the tunnel to the blacklist and render it unavailable for new sessions for the duration of pre-configured time. Peers are always forced to the black list in case that they time out (failure to receive response to control packets). In addition to time outs, certain events can be used to trigger placement of the tunnel on the black list.

Parameters *reason* — Specifies the return codes or events that determine which tunnels are added to the blacklist

Values **cdn-err-code** — A tunnel will be forced to the blacklist in case that CDN message with the Result Code 2 (Call disconnected for the reasons indicated in error code) is received.
cdn-inv-dest — A tunnel will be forced to the blacklist in case that CDN message with the Result Codes 6 (Invalid destination) is received.
cdn-tmp-no-facilities — A tunnel will be forced to the blacklist in case that CDN message with the Result Code 4 is received (Call failed due to lack of appropriate facilities being available - temporary condition) is received.
cdn-perm-no-facilities — A tunnel will be forced to the blacklist in case that CDN message with the Result Codes 5 (Call failed due to lack of appropriate facilities being available - permanent condition) is received.
tx-cdn-not-established-in-time — A tunnel will be forced to the blacklist in case that CDN message with the Result Code 10 (Call was not established within time allotted by LAC) is sent from the LAC to the LNS.
stop-ccn-err-code — A tunnel will be forced to the blacklist in case that StopCCN message with the Result Code 2 (General error – Error Code indicates the problem) is sent or received.
stop-ccn-other — A tunnel will be forced to the blacklist in case that StopCCN message with the following Result Codes is received:

(1) General request to clear control connection
(4) Requestor is not authorized to establish a control channel
(5) Protocol version not supported
(6) Requestor is being shutdown
Or in the case that the StopCCN with the following result codes is transmitted:
(4) Requestor is not authorized to establish a control channel.
(5) Protocol version not supported
The receipt of the following Result Codes will NEVER blacklist a tunnel:
(0) Reserved
(3) Control channel already exist
(7) Finite state machine error
(8) Undefined
Transmission of the following Result Codes will NEVER blacklist a tunnel:
(1) General request to clear control connection
(3) Control channel already exist
(6) Requestor is being shutdown
(7) Finite state machine error

addr-change-timeout — A timed-out tunnel for which the peer IP address has changed mid-session (from the one that is provided initially during configuration) will be forced to the blacklist. In absence of this configuration option, only the configured peer for the tunnel will be blacklisted, but not the tunnel itself which now has a different peer address than the one initially configured.

never — When specified, no tunnels will be placed on blacklist under any circumstance. This parameter will available to preserve backward compatibility.

max-list-length

Syntax **max-list-length unlimited**
max-list-length *count*
no max-list-length

Context configure>router>l2tp>tunnel-selection-blacklist
configure>service>vprn>l2tp>tunnel-selection-blacklist

Description This command configured the maximum length of the peer/tunnel blacklist.

This command specifies how many items (tunnels or peers) can be in the tunnel-selection-blacklist. If a tunnel or peer needs to be added to the tunnel-selection-blacklist and the tunnel-selection-blacklist is full, the system will remove the item (tunnel or peer) from the blacklist that was in this blacklist forthe longest time.

Default unlimited

Parameters **unlimited —** Specifies there is no limit.

count — Specifies how many items (tunnels or peers) can be in the tunnel-selection-blacklist.

Values 1..65635

max-time

Syntax **max-time** *minutes*
no max-time

Context configure>router>l2tp>tunnel-selection-blacklist
configure>service>vprn>l2tp>tunnel-selection-blacklist

Description This command configures time for which an entity (peer or a tunnel) are kept in the blacklist.

Default 5 minutes

Parameters *minutes* — Specifies the maximum time a tunnel or peer may remain in the blacklist

Values 1..60

timeout-action

Syntax **timeout-action** *action*
no timeout-action

Context configure>router>l2tp>tunnel-selection-blacklist
configure>service>vprn>l2tp>tunnel-selection-blacklist

Description This command defines an action that will be executed on the entity (peer/tunnel) in the blacklist once the entity becomes eligible for selection again.

Default remove-from-blacklist

Parameters *action* — Specifies the Action to be taken when a tunnel or peer has been in the blacklist for the max-period of time.

Values **remove-from-blacklist** — The peer or tunnel in the blacklist will be removed completely from the blacklist and made eligible for the selection process once the max-time expires. In this mode of operation, multiple new sessions can be mapped into the same, newly released tunnel from the blacklist. The first such session will try to setup the tunnel, while the other will be buffered until the tunnel establishment process is completed. In case that the tunnel remains unavailable, it will be placed in the blacklist again. Consequently all new sessions will have be re-negotiated over an alternate tunnel.
try-one-session — Once the max-time expired, the peer or tunnel in the blacklist is made available for selection only to a single new session request. Only upon successful tunnel establishment will the incoming new sessions be eligible to be mapped into this tunnel. This behavior will avoid session establishment delays in case that the tunnel just removed from the blacklist is still unavailable.

non-multi-chassis-tunnel-id-range

Syntax **non-multi-chassis-tunnel-id-range start** *l2tp-tunnel-id* **end** *l2tp-tunnel-id*
non-multi-chassis-tunnel-id-range default
no non-multi-chassis-tunnel-id-range

Context config>system>l2tp

Description This command sets the tunnel-id range that will be used to allocate a new tunnel-id for a tunnel for which no multi-chassis redundancy is configured.

Default Sets the tunnel-id range to the full tunnel-id range available on this system

The default for **start** *l2tp-tunnel-id* is 1. No tunnel-ids are available for which no multi-chassis redundancy is configured when set to 0.

The default for **end** *l2tp-tunnel-id* is the maximum tunnel-id allowed on this system. The **end** *l2tp-tunnel-id* must be set to 0 when the **start** *l2tp-tunnel-id* is set to 0 and vice verso.

track-srrp-instances

Syntax **track-srrp-instances**

Context

track-srrp

Syntax [**no**] **track-srrp** [1..4294967295]

l2tp-tunnel-id-range

Syntax **l2tp-tunnel-id-range start** *l2tp-tunnel-id* **end** *l2tp-tunnel-id*
no l2tp-tunnel-id-range

Context config>redundancy>multi-chassis>peer>sync>track-srrp-instances>track-srrp

Description This command sets the tunnel-id range that will be used to allocate a new tunnel-id for a tunnel for which multi-chassis redundancy is configured to this MCS peer.

Default Makes the tunnel ID empty.

Parameters **start** *l2tp-tunnel-id* — Specifies the start of the range of L2TP tunnel identifiers that can be allocated by L2TP on this system, and will not be synchronized with Multi Chassis Redundancy Synchronization (MCS).

Values 1 — 16383

end *l2tp-tunnel-id* — Specifies the end of the range of L2TP tunnel identifiers that can be allocated by L2TP on this system, and will not be synchronized with Multi Chassis Redundancy Synchronization (MCS).

Values 1 — 16383

recovery-method

Syntax **recovery-method** *method*
no recovery-method

Context configure>router>l2tp>failover
configure>service>vprn>l2tp>failover
configure>router>l2tp>group>failover
configure>service>vprn>l2tp>group>failover
configure>router>l2tp>group>tunnel>failover
configure>service>vprn>l2tp>group>tunnel>failover

Description This command the recovery method to be used for newly created tunnels.

Default **mcs** on **configure>router>l2tp>failover**

default on **configure>service>vprn>l2tp>failover**

Parameters **method** — Describes how a pair of redundant LAC peers recover tunnel and session state (sequence numbers, for example) immediately after a failover; note that, while failover is enabled, the tunnels and sessions proper are always kept synchronized between the redundant pair, regardless of the recovery method for the sequence numbers when a failover really occurs.

mcs — Specifies that the stateful information is recovered from the failover peer directly, using Multi-Chassis Redundancy Synchronization (MCS).

default — Specifies that the actual value must be derived from another object of the same type with a wider scope. Takes the value of the next higher level (not available in **configure>router>l2tp>failover** and **configure>service>vprn>l2tp>failover**)

track-srrp

Syntax **track-srrp** *srrp-instance* **peer** *ip-address* **sync-tag** *tag*
no track-srrp srrp-instance

Context configure>router>l2tp>failover
configure>service>vprn>l2tp>failover

Description This command sets the sync-tag to be used to synchronize the tunnels with track-srrp <srrp-id> to MCS peer <IP-@>. The same sync-tag should be configured on the MCS peer.

Default Removes the sync-tag for the indicated track-srrp.

Parameters *srrp-instance* — Specifies the Simple Router Redundancy Protocol (SRRP) instance used for Multi-Chassis redundancy failover that is associated with this Layer Two Tunneling Protocol Tunnel.

sync-tag sync-tag **—** Specifies a synchronization tag to be used while synchronizing with the peer.

group

group *tunnel-group-name* [**create**]
no group *tunnel-group-name*

tunnel

Syntax **tunnel** *tunnel-name* [**create**]
no tunnel *tunnel-name*

Context config>router>l2tp>group

Description This command configures an L2TP tunnel.

Parameters *tunnel-name* — Specifies a string to identify a L2TP tunnel up to 32 characters in length.

L2TP Tunnel RADIUS Accounting Commands

l2tp-tunnel-accounting-policy

Syntax **l2tp-accounting-policy** *policy-name* [**create**]
no l2tp-accounting-policy

Context config>aaa

Description This command enables the L2TP accounting.

The **no** form of this command disables accounting.

Default None

Parameters *name* — The name of L2TP tunnel accounting policy.

create — Mandatory keyword to create a policy name.

accounting-type

Syntax **accounting-type** [**session**] [**tunnel**]
no accounting-type

Context config>aaa>l2tp-acct-plcy

Description This command specifies the accounting type for the L2TP tunnel accounting policy.

The **no** form of the command reverts to the default.

Default session tunnel

Parameters **session —** Enables tunnel level accounting, including:

Tunnel-Link-Start
Tunnel-Link-Stop
Tunnel-Link-Reject

tunnel — Enables link level accounting, including:

Tunnel-Start
Tunnel-Stop
Tunnel-Reject

include-radius-attribute

Syntax [**no**] **include-radius-attribute**

Context config>aaa>l2tp-acct-plcy

Description This command enables the context to specify the RADIUS parameters that the system should include into RADIUS authentication-request messages.

The **no** form of the command rdisables

nas-identifier

Syntax [**no**] **nas-identifier**

Context config>aaa>l2tp-acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-identifier RADIUS attribute.

nas-port

Syntax [**no**] **nas-port** *bit-specification binary-spec*

Context config>aaa>l2tp-acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-port RADIUS attribute. You enter decimal representation of a 32-bit string that indicates your port information. This 32-bit string can be compiled based on different information from the port (data types). By using syntax number-of-bits data-type you indicate how many bits from the 32 bits are used for the specific data type. These data types can be combined up to 32 bits in total. In between the different data types 0's and/or 1's as bits can be added.

The **no** form of this command disables your nas-port configuration.

Parameters *bit-specification binary-spec* — Specifies the NAS-Port attribute

Values

binary-spec	<bit-specification> <binary-spec>
bit-specification	0 | 1 | <bit-origin>
bit-origin	*<number-of-bits><origin>
number-of-bits	1 — 32
origin	o | i | s | m | p

o outer VLAN ID
i inner VLAN ID
s slot number
m MDA number
p port number or lag-id

Sample

```
*12o*12i00*2s*2m*2p => oooo oooo oooo iiii iiii iiii 00ss mmpp
If outer vlan = 0 & inner vlan = 1 & slot = 3 & mda = 1 & port = 1
=>  0000 0000 0000 0000 0000 0001 0011 0101 => nas-port = 309
```

nas-port-id

Syntax **nas-port-id**

nas-port-id [**prefix-string** *string*] [**suffix** *suffix-option*]
no nas-port-id

Context config>aaa>l2tp-acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-port-id RADIUS attribute. Optionally, the value of this attribute (the SAP-id) can be prefixed by a fixed string and suffixed by the circuit-id or the remote-id of the client connection. If a suffix is configured, but no corresponding data is available, the suffix used will be 0/0/0/0/0/0.

Parameters **prefix-string** *string* — Specifies that a user configurable string will be added to the RADIUS NAS port attribute, up to 8 characters in length.

suffix *suffix-option* — Specifies the suffix type to be added to the RADIUS NAS oort attribute.

Values circuit-id, remote-id

nas-port-type

Syntax **nas-port-type**
nas-port-type [0..255]
no nas-port-type

Context config>aaa>l2tp-acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-port-type RADIUS attribute. If set to **nas-port-type**, the following will be sent: values: 32 (null-encap), 33 (dot1q), 34 (qinq), 15 (DHCP hosts). The **nas-port-type** can also be set as a specified value, with an integer from 0 to 255.

The **no** form of the command reverts to the default.

Default no nas-port-type

Parameters **0 — 255** — Specifies an enumerated integer that specifies the value that will be put in the RADIUS nas-port-type attribute.

radius-accounting-server

Syntax **radius-accounting-server**

Context config>aaa>l2tp-acct-plcy>include-radius-attribute

Description This command creates the context for defining RADIUS accounting server attributes under a given session authentication policy.

access-algorithm

Syntax **access-algorithm** {**direct** | **round-robin**}
no access-algorithm

Context config>aaa>l2tp-acct-plcy>include-radius-attribute

Description This command configures the algorithm used to access the list of configured RADIUS servers.

Default direct

Parameters **direct —** Specifies that the first server will be used as primary server for all requests, the second as secondary and so on.

round-robin — Specifies that the first server will be used as primary server for the first request, the second server as primary for the second request, and so on. If the router gets to the end of the list, it starts again with the first server.

retry

Syntax **retry** *count*

Context config>aaa>l2tp-acct-plcy>radius-acct-server

Description This command configures the number of times the router attempts to contact the RADIUS server for authentication. Note that the retry count includes the first attempt.

The **no** form of the command reverts to the default value.

Default 3 (the initial attempt as well as two retried attempts)

Parameters *count* — Specifies the retry count.

Values 1 — 10

router

Syntax **router** *router-instance*
router service-name *service-name*
no router

Context config>aaa>l2tp-acct-plcy>radius-acct-server

Description This command specifies the number of times the router attempts to contact the RADIUS server for authentication, if not successful the first time.

The **no** form of the command reverts to the default value.

server

Syntax **server** *server-index* **address** *ip-address* **secret** *key* [**hash** | **hash2**] [**port** *port*] [**create**]
no server *server-index*

Context config>aaa>l2tp-acct-plcy>radius-acct-server

Description This command adds a RADIUS server and configures the RADIUS server IP address, index, and key values.

Up to five RADIUS servers can be configured at any one time. RADIUS servers are accessed in order from lowest to highest index for authentication requests until a response from a server is received. A higher indexed server is only queried if no response is received from a lower indexed server (which implies that the server is not available). If a response from a server is received, no other RADIUS servers are queried.

The **no** form of the command removes the server from the configuration.

Default none

Parameters *server-index* — The index for the RADIUS server. The index determines the sequence in which the servers are queried for authentication requests. Servers are queried in order from lowest to highest index.

Values 1 — 16 (a maximum of 5 accounting servers)

address *ip-address* — The IP address of the RADIUS server. Two RADIUS servers cannot have the same IP address. An error message is generated if the server address is a duplicate.

secret *key* **— Values** The secret key to access the RADIUS server. This secret key must match the password on the RADIUS server.
secret-key — A string up to 20 characters in length.
hash-key — A string up to 33 characters in length.
hash2-key — A string up to 55 characters in length.

hash — Specifies the key is entered in an encrypted form. If the hash parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the hash parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form. If the hash2 parameter is not used, the less encrypted hash form is assumed.

port — Specifies the UDP port number on which to contact the RADIUS server for authentication.

Values 1 — 65535

source-address-range

Syntax **source-address-range** *start-ip-address end-ip-address*
no source-address

Context config>aaa>l2tp-acct-plcy>radius-acct-server

Description This command configures the source address range of the RADIUS messages.

The **no** form of the command reverts to the default value.

Default systemIP address

Parameters *start-ip-address* — Specifies the start of the the range of source addresses to be used for NAT RADIUS accounting.

end-ip-address — Specifies the end of the the range of source addresses to be used for NAT RADIUS accounting.

timeout

Syntax **timeout** *seconds*

Context config>aaa>l2tp-acct-plcy>radius-acct-server

Description This command configures the number of seconds the router waits for a response from a RADIUS server.

The **no** form of the command reverts to the default value.

Default 5

Parameters *seconds* — Specifies the time the router waits for a response from a RADIUS server.

Values 1 — 90

request-script-policy

Syntax **request-script-policy** *radius-script-policy-name*
no request-script-policy

Context config>aaa>l2tp-acct-plcy>radius-acct-server

Description This command specifies the RADIUS script policy to be used for accounting-request packets.

The **no** form of the ocmmand removes the policy from the configuration.

Parameters *radius-script-policy-name* — Configure a Python script policy name to modify Access-Request messages.

Show Commands

peer

Syntax **peer** *ip-address* [**udp-port** *port*]
peer *ip-address* statistics [**udp-port** *port*]
peer [**draining**] [**blacklisted**|**selectable**|**unreachable**]

Context show>router>l2tp

Description This comand displays L2TP peer operational information/

Values

ip-address	ipv4-address - a.b.c.d
ipv6-address	x:x:x:x:x:x:x:x (eight 16-bit pieces) x:x:x:x:x:x:d.d.d.d x - [0..FFFF]H d - [0..255]D
draining	keyword
statistics	keyword
port	[1..65535]

Sample Output

```
show router l2tp peer 10.100.0.2
===============================================================================
Peer IP: 10.100.0.2
===============================================================================
Roles capab/actual: LAC LNS /LAC  -     Draining          : false
Tunnels           : 1                   Tunnels Active    : 0
Sessions          : 1                   Sessions Active   : 0
Reachability      : blacklisted         Time Unreachable  : 01/31/2013 08:55:06
Time Blacklisted  : 01/31/2013 08:55:06 Remaining (s)     : 34
===============================================================================
Conn ID                     Loc-Tu-ID Rem-Tu-ID State              Ses Active
  Group                                                           Ses Total
    Assignment
-------------------------------------------------------------------------------
977207296                   14911     0         closed             0
  base_lac_base_lns                                               1
    t1
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================


show router l2tp tunnel detail
===============================================================================
L2TP Tunnel Status
===============================================================================
Connection ID: 831782912
State        : closedByPeer
IP           : 10.0.0.1
```

```
Peer IP      : 10.100.0.2
Tx dst-IP    : 10.100.0.2
Rx src-IP    : 10.100.0.2
Name         : lac
Remote Name  :
Assignment ID: t1
Group Name   : base_lac_base_lns
Acct. Policy : l2tp-base
Error Message: N/A

                                       Remote Conn ID    : 4294901760
Tunnel ID         : 12692              Remote Tunnel ID  : 65535
UDP Port          : 1701               Remote UDP Port   : 1701
Preference        : 50                 Receive Window    : 64
Hello Interval (s): 300
Idle TO (s)       : 5                  Destruct TO (s)   : 60
Max Retr Estab    : 5                  Max Retr Not Estab: 5
Session Limit     : 32767              AVP Hiding        : sensitive
Transport Type    : udpIp              Challenge         : never
Time Started      : 01/31/2013 08:56:58 Time Idle        : 01/31/2013 08:56:58
Time Established  : N/A                Time Closed       : 01/31/2013 08:56:58
Stop CCN Result   : reqShutDown        General Error     : noError
Blacklist-state   : blacklisted
Blacklist Time    : 01/31/2013 08:56:58 Remaining (s)    : 49
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================
```

l2tp

Syntax **l2tp**

Context show>system

Description This command displays L2TP system information.

Sample Output

```
*A:Dut-C# show system l2tp
===============================================================================
L2TP system
===============================================================================
Non MC tunnel ID range                                 : 8193-16383
Max number of tunnels                                  : 16383
Max number of sessions                                 : 131071
Max number of sessions per tunnel                      : 32767
===============================================================================
```

sync

Syntax **sync** [**peer** *ip-address*] [**statistics**]
sync peer *ip-address* **detail**

Context show>redundancy>multi-chassis

Description This command displays synchronization information.

Parameters *ip-address* — Specifies the IP address of the peer.

Values ipv4-address - a.b.c.d

detail — Keyword to display detailed output.

statistics — Keyword to display statistics.

Sample Output

```
*A:Dut-C# show redundancy multi-chassis sync peer 2.1.2.2 detail

===============================================================================
Multi-chassis Peer Table
===============================================================================
Peer
-------------------------------------------------------------------------------
Peer IP Address         : 2.1.2.2
Description             : Mc-Lag peer 2.1.2.2
Authentication          : Disabled
Source IP Address       : 1.1.1.1
Admin State             : Enabled
-------------------------------------------------------------------------------
Sync-status
-------------------------------------------------------------------------------
Client Applications     : SUBMGMT-PPPOE SRRP l2tp
Sync Admin State        : Up
Sync Oper State         : Up
Sync Oper Flags         :
DB Sync State           : inSync
Num Entries             : 2028
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
Rem Num Entries         : 2028
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0

===============================================================================
MCS Application Stats
===============================================================================
Application             : igmp
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
```

```
-------------------------------------------------------------------------------
Application             : igmpSnooping
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : subMgmtIpoe
Num Entries             : 0
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : srrp
Num Entries             : 26
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 26
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : mcRing
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : mldSnooping
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
```

```
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : dhcpServer
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : subHostTrk
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : subMgmtPppoe
Num Entries             : 2000
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 2000
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : mcIpsec
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : mld
Num Entries             : 0
Lcl Deleted Entries     : 0
```

```
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : python
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : l2tp
Num Entries             : 2
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 2
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : diamProxy
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
===============================================================================

===============================================================================
Ports synced on peer 2.1.2.2
===============================================================================
Port/Encap                    Tag
-------------------------------------------------------------------------------
3/2/5
  1-999                       pppoe1
  1000-1000                   srrp1
3/2/6
  1-999                       pppoe2
```

```
===============================================================================

===============================================================================
DHCP Server instances synced on peer 2.1.2.2
===============================================================================
Router-Name                     Server-Name
  Tag
-------------------------------------------------------------------------------
No instances found
===============================================================================

===============================================================================
Python cache instances synced on peer 2.1.2.2
===============================================================================
Python-Policy                   Tag
-------------------------------------------------------------------------------
No instances found
===============================================================================

===============================================================================
L2TP instances
===============================================================================
Router         Tag                              SRRP
-------------------------------------------------------------------------------
Base           lac1                             1
Base           lac2                             2
===============================================================================

===============================================================================
Track SRRP instances
===============================================================================
SRRP                    : 1
-------------------------------------------------------------------------------
L2TP tunnel ID start    : 1
L2TP tunnel ID end      : 1

SRRP                    : 2
-------------------------------------------------------------------------------
L2TP tunnel ID start    : 2
L2TP tunnel ID end      : 2

===============================================================================

===============================================================================
Diameter proxy instances synced on peer 2.1.2.2
===============================================================================
Diameter-Peer-Policy            Tag
-------------------------------------------------------------------------------
No instances found
===============================================================================
===============================================================================
*A:Dut-C#
```

Debug Commands

assignment-id

Syntax **assignment-id** *assignment-id*

Context debug>router>l2tp

Description This command enables and configures debugging for the L2TP tunnel with a given assignment-id.

Parameters *assignment-id* — Specifies a string that distinguishes this L2TP tunnel.

event

Syntax [**no**] **event**

Context debug>router>l2tp
debug>router>l2tp>assignment-id
debug>router>l2tp>group
debug>router>l2tp>peer
debug>router>l2tp>tunnel

Description This command configures an L2TP debugging event.

group

Syntax **group** *tunnel-group-name*

Context debug>router>l2tp

Description This command enables and configures debugging for an L2TP group.

Parameters *tunnel-group-name* — Specifies the tunnel group name up to 63 characters in length.

peer

Syntax **peer** *ip-address* [**udp-port** *port*]

Context debug>router>l2tp

Description This command enables and configures debugging for an L2TP peer.

Parameters *ip-address* — Specifies the IP address of the session.

Values <ip-address> : ipv4-address - a.b.c.d
ipv6-address - x:x:x:x:x:x:x:x (eight 16-bit pieces)

x:x:x:x:x:x:d.d.d.d
x - [0..FFFF]H
d - [0..255]D

udp-port *port* — Specifies the local UDP port of this L2TP.

Values 1 — 65535

tunnel

Syntax **tunnel** *connection-id*

Context debug>router>l2tp

Description This command enables and configures debugging for an L2TP tunnel.

Parameters *connection-id* — Specifies the connection ID of the L2TP session associated with this session.

Values 1 — 4294967295

recovery

Syntax [**no**] **recovery**

Context debug>router>l2tp>assignment-id>event
debug>router>l2tp>event
debug>router>l2tp>group>event
debug>router>l2tp>peer>event
debug>router>l2tp>tunnel>event

Description This command configures L2TP LAC state recovery event debugging.

recovery-failed

Syntax [**no**] **recovery-failed**

Context debug>router>l2tp>assignment-id>event
debug>router>l2tp>event
debug>router>l2tp>group>event
debug>router>l2tp>peer>event
debug>router>l2tp>tunnel>event

Description This command configures L2TP LAC state recovery failed event debugging.

Triple Play Security

In This Chapter

This chapter provides information about configuring specific security aspects for Triple Play services, including configuration process overview, and application notes.

Please note that the7750 SR supports many additional security features, which are described in the 7750 SR System Management Guide.

Topics in this chapter include:

Triple Play Security Features

Anti-Spoofing Filters

This section describes the Alcatel-Lucent 7750 SR acting as a Broadband Subscriber Aggregator (BSA).

Anti-spoofing is useful to prevent certain packets gaining unauthorized network access. Such packets originate from within a network and with an invalid source address.

Enabling anti-spoof filtering on a subscriber-facing SAP causes the anti-spoof table to be populated with all static and dynamic host information available on the SAP. Enabling anti-spoof filtering on the SAP will fail if any static hosts are defined without the proper addresses specified for the selected anti-spoof filter type.

When enabled, forwarding IP packets that ingress the SAP is dependent on a successful anti-spoof table match with an entry in the table. DHCP and non-IP packets (including ARP) are not subject to anti-spoof filtering. If an entry does not match the ingress packet, the packet will be silently discarded while incrementing the SAP discard counter.

Anti-spoof filtering is only allowed on VPLS SAPs, IES SAP-based IP interfaces, and VPRN SAP-based IP interfaces. Anti-spoof filtering is not available on IES or VPRN SDP bound IP interfaces. Anti-spoof filtering is not supported on Epipe and other VLL type services. Support for anti-spoofing is dependent on SAP based service interfaces.

Note that anti-spoofing filters, with type **ip-mac**, must be enabled to do Enhanced Subscriber Management (as described in section Triple Play Enhanced Subscriber Management on page 929).

Topics in this section are:

Anti-spoofing Filter Types

A SAP or interface that supports anti-spoof filtering can be configured to use one of three types of anti-spoof tables. The type of table used by the SAP is dependent on the type of anti-spoof filtering desired, only one anti-spoofing table type is supported per SAP:

- When only the incoming source MAC address is to be verified, the source MAC table must be defined (anti-spoof type = **mac**).
- When only the incoming source IP address is to be verified, the source IP table must be defined (anti-spoof type = **ip**).
- When both the incoming source MAC and source IP addresses are to be verified, the combination source IP and source MAC table must be defined (anti-spoof type = **ip-mac**).

Note that setting the anti-spoof filter type for the SAP is dependent on pre-existing static host definitions, for example, attempting to set the SAP anti-spoof filtering to mac will fail if any static hosts exist that do not have a defined MAC address.

The anti-spoof table of a SAP or interface will be populated from the DHCP lease state table and from any statically defined hosts on the SAP or interface.

Filtering Packets

Packets from a client that match an anti-spoof filter entry when anti-spoof filtering is enabled are allowed to be further processed by the system. The matching packet is still subject to other forwarding criteria including potentially ACL filtering.

All packets that are not exempt from anti-spoofing and do not match a entry in the anti-spoof table are discarded. Every discard event will increment the SAP discard packet counter. The discard event is not logged or alarmed, but a threshold alarm could be configured for the counter (see Configuring System Monitoring Thresholds in the 7750 SR Basic System Configuration Guide).

Not all ingress packets are subject to the anti-spoof filtering when enabled. Non-IP packets are exempt for anti-spoof filter lookups and are allowed to be further processed by the system. This includes ARP requests and replies, as well as PPPoE packets. The only IP packets exempt from anti-spoof filtering are DHCP packets destined to the server UDP port 67. DHCP packets destined to the client UDP port number (port 68) are not exempt.

Layer 2 Triple Play Security Features

Topics in this section include:

MAC Pinning

This section describes the Alcatel-Lucent 7750 SR acting as a Broadband Subscriber Aggregator (BSA).

DHCP snooping and IP/MAC auto-filters can be employed to prevent Theft of Service (by a malicious user spoofing another user's address). However, these auto-filters do not discard non-IP packets such as PPPoE packets, thus potentially allowing a MAC address to be relearned on another SAP. MAC pinning closes this loophole, by not allowing a MAC address to be relearned on another SAP.

When MAC pinning is enabled, a MAC address learned on one SAP or SDP can not be re-learned on another SAP or SDP in the same VPLS, until the FIB entry for the MAC address times out. (Note that in case MAC aging is disabled, MAC entries on a SAP/SDP with MAC pinning enabled will effectively become permanent.)

MAC pinning is implicitly enabled when DHCP auto-filters are enabled, and cannot be disabled. For MAC addressing learned during DHCP address assignment (when DHCP snooping function is active at least on one port of the VPLS), the MAC address is tied to a given SAP for the duration of the DHCP lease.

When a SAP or spoke SDP is part of a Residential Split Horizon Group (RSHG), MAC pinning is automatically enabled at creation of the SAP, but can be disabled if desired.

MAC Protection

In a Layer 2 environment, a malicious subscriber could create a denial-of-service attack by sending Ethernet frames, with as source MAC address the address of a gateway (for example, the IP next hop upstream). As MAC learning is typically enabled, this would move the learned gateway MAC from the uplink SAP or SDP to the subscriber’s SAP, causing all communication to the gateway to be disrupted. If a local content server is attached to the same VPLS, a similar attack could be launched against it.

Communication between subscribers can be disallowed using Split Horizon Groups, but this by itself will not be sufficient to prevent such an attack.

The solution is to create a mechanism to explicitly protect some MAC addresses against being relearned on other SAPs.

The **mac-protect** feature on the Alcatel-Lucent 7750 SR allows a list of special MAC addresses to be configured in a VPLS. Two checks can then be made on incoming packets against these protected MAC addresses:

- **[no] auto-learn-mac-protect**: Used to enable the automatic protection of source MAC addresses learned on the associated object. MAC protection is used in conjunction with restrict-protected-src, restrict-unprotected-dst and mac-protect. When this command is applied or removed, the MAC addresses are cleared from the related object.
- **restrict-protected-src**: Used to prevent denial-of-service attacks. If the source MAC address of a packet from a subscriber matches a protected entry, probably this subscriber tried to impersonate the gateway or server. Such packets are discarded, a trap is generated, and the SAP on which it arrived is placed operationally down.
- **restrict-unprotected-dst**: Used to force traffic from subscribers to only go towards a few defined destinations (the gateways or servers). Any packet from a subscriber whose destination MAC address does not match a protected entry is discarded.

DoS Protection

This section describes the mechanisms and limitations of DoS protection related to subscriber management snooping functions. This feature is only supported on 7750 SR-Series and 7450 ESS-Series redundant chassis models. In subscriber aggregation networks, these routers play an active role in several protocols. Subscribers either intentionally or unknowingly interfere with the operation of the node’s processing capacity (for example, excessive ARP handling) or other user traffic.

Routing protocols such as OSPF and ISIS could also be a threat as packets can be injected by customers (erroneously or maliciously) which could cause high CPM overload. Service providers are concerned about DoS protection including DoS attacks when acting as a subscriber aggregation device and guarding against DoS attacks using unprovisioned protocols.

Subscriber Aggregation Network

In a subscriber aggregation network, multiple devices such as the 7750 SR and 7450 ESS routers provide access to a DHCP or a RADIUS server. These servers usually do not scale high enough to provide the means to control access to snooping functions through a controlled queue. It is possible, under severe conditions, that the network could become unavailable if the node cannot handle requests from subscribers.

Because the IOMs cannot be scaled to provide a per-subscriber queue to control traffic, a monitoring function, handled by the CPM, is provided. With this monitoring system, the CPM tracks the number of control plane messages set per subscriber and limits the rate to a specified level and provides feedback using event generation to alert a centralized system of a possible DoS attack.

The CPM provides a prioritized access to the CPU. Since the number of control packets expected from a subscriber should have a low rate, and under normal conditions, the system will provide a rate limit on a per subscriber/MAC basis and will drop a subscriber control packet before it is queued or processed by the CPU. The system will be configured with expected arrival rate of per MAC/subscriber control packet rates and optionally total rate per interface/SAP.

The system maintains a per-second running rate monitor per SAP and per MAC. If an entry is using more than the configured rate, the system will not forward that packet to be queued. Every existing subscriber host will be monitored. A subscriber host will be flagged and the system observed with an excessive rate of control packets. In the case of PPPoE, the CPM will monitor subscriber hosts before the IP address is provided by the SAP/MAC/session-id combination.

The control protocols affected by this mechanism include:

- ARP (in arp-reply-agent)
- DHCP (for discover and renew)
- ICMP
- PPPoE
- IGMP

Network Control Filtering

Alcatel-Lucent's 7750 SR and 7450 ESS can block network control traffic for unconfigured protocols. For example, if OSPF is not configured on an IP interface, all OSPF- related traffic should be dropped before the traffic reaches the CPU.

Protocols are blocked based on whether that particular protocol is configured to run on the given IP interface. It is not required to re-configure the permitted protocols.

Protocol traffic control by this mechanism includes:

- OSPFv2
- OSPFv3
- IS-IS
- RSVP-TE
- LDP
- RIP
- PIM

- MLD
- IGMP
- BGP
- BFD
- L2PT
- PPP
- DHCP

VPLS Redirect Policy

This section describes the Alcatel-Lucent 7750 SR acting as a Broadband Subscriber Aggregator (BSA) with Layer 2 aggregation towards a Broadband Subscriber Router (BSR).

In a Triple Play network it may be desired to route some traffic from/to subscribers through a Deep Packet Inspection (DPI) device, for example, to limit peer-to-peer traffic. However such a DPI device typically has limited bandwidth available, so only those packets that need inspection should be sent to it.

In a Layer 3 network, such policy-based redirection can be achieved using “next-hop redirect” ACL entries. In a layer 2 (VPLS) aggregation network, the same result can be achieved using “redirect to SAP” or “redirect to SDP” policy.

Refer to the ACL Next-Hop for VPLS section in the 7750 SR Services Guide.

ARP Handling

ARP Reply Agent

This section describes the Alcatel-Lucent 7750 SR acting as a Broadband Subscriber Aggregator (BSA).

In Triple Play networks, typically downstream broadcast is not allowed on subscriber SAPs. As a result, subscribers can not receive ARP requests from the network. Instead, the 7750 SR will respond to ARP requests from the network, with information from the DHCP lease state table.

In the upstream direction (towards the network), the ARP reply agent intercepts ARP Requests on subscriber SAPs, and checks them against the DHCP lease state table. The purpose is to prevent a malicious subscriber spoofing ARP Request or ARP reply messages and thus populating the upstream router's ARP table with incorrect entries.

When the keyword **sub-ident** is added in the ARP reply agent configuration, also the subscriber identity is checked. If an upstream ARP request is targeted to the same subscriber, it is dropped. Otherwise, it is flooded to all VPLS interfaces outside the received Split Horizon Group (SHG).

Static hosts can be defined on the SAP using the **host** command. Dynamic hosts are enabled on the system by enabling the **lease-populate** command in the SAP's **dhcp** context. In the event that both a static host and a dynamic host share the same IP and MAC address, the VPLS ARP reply agent will retain the host information until both the static and dynamic information are removed. In the event that both a static and dynamic host share the same IP address, but different MAC addresses, the VPLS ARP reply agent is populated with the static host information.

In brief, the ARP Replay Agent operation is as follows:

- For ARP request received from a customer SAP:
  - → first check in DHCP lease state table - if no match: discard
  - → if (**sub-ident** enabled) and (destination = same subscriber): discard
  - → otherwise: flood to all SAPs/SDPs outside this SHG
- For ARP request received from the network:
  - → lookup IP address in DHCP lease state table - if no match: discard
  - → otherwise: respond with MAC address from the DHCP lease state table

Dynamic ARP Table Population

This section describes the Alcatel-Lucent 7750 SR acting as a Broadband Subscriber Aggregator (BSA) with Layer 3 forwarding towards the network.

In an IES service, the system's ARP table can be populated dynamically using entries in the DHCP lease state table (in turn populated from snooping DHCP ACK messages (see DHCP Snooping on page 356)), and from static hosts defined on the SAP. In the router ARP table these are indicated with state managed.

In the event that both a static host is created with the same IP and MAC address as an existing managed entry, creation will fail and a trap is generated.

In the event that a DHCP Lease needs to be populated with the same IP and MAC address as an existing static host entry, creation will fail and a trap is generated.

No **static-arp** creation is possible when combined with **arp-populate**.

Local Proxy ARP

This section describes the Alcatel-Lucent 7750 SR acting as a Broadband Subscriber Aggregator (BSA) with Layer 3 forwarding towards the network.

Local proxy ARP allows the Alcatel-Lucent 7750 SR to respond to ARP requests received on an interface, for an IP address which is part of a subnet assigned to the interface. When the local proxy ARP feature is enabled, the switch responds to all ARP requests for IP addresses belonging to the subnet with the MAC address of the interface, and forwards all traffic between hosts in the subnet.

This feature is intended to be used in situations (such as DSL aggregation networks) when hosts belonging to the same subnet are prevented from directly communicating with each other over the subnet by the configuration of the switch (or DSLAM) to which they are connected.

Note: When local-proxy-arp is enabled under a IES service, all ICMP redirects on the ports associated with the service are automatically blocked. This prevents users from learning each other's MAC address (from ICMP redirects).

The implementation of proxy ARP with support for local proxy ARP allows the 7750 SR to respond to ARP requests in the subnet assigned to an IES or VPRN interface, thus allowing multiple customers to share the same IP subnet.

Web Portal Redirect

This section describes the Alcatel-Lucent 7750 SR acting as a Broadband Subscriber Aggregator (BSA).

In a Triple Play network it may not be desired (or feasible) to perform manual provisioning of new services and service changes. The ideal way of working is automatic provisioning, with the end-user supplying his details at a retailer, or (if physical connectivity is already present through an on-line customer portal).

The 7750 SR supports a special ACL that automatically redirects subscribers to a predefined URL. This is done by sending a HTTP 302 (moved) message to the subscriber, regardless of the requested URL.

The message flow is as follows (see Figure 40 below):

a. The subscriber gets an IP address using DHCP (if the customer is trying to use a static IP he will be blocked by the anti-spoofing filter).
b. The subscriber tries to connect to a website (TCP SYN, TCP ACK, HTTP GET).
c. The 7750 SR intercepts the HTTP GET request and discards it.
d. The 7750 SR then responds to the subscriber with a HTTP 302 message (service temporarily unavailable/moved), containing a new target URL (that of the portal) configured by the operator. This target URL can include the subscriber's IP and MAC addresses as part of the portal's URL string.
e. The subscriber's web browser will close the original TCP connection and open a new connection to the web portal, where the subscriber can sign up or change his/her service Profile.
f. After approving the changes, the web portal updates the ACL (directly or through another system such as the Alcatel-Lucent 5750 SSC) to remove the redirection policy.
g. The subscriber can now connect to the original site.

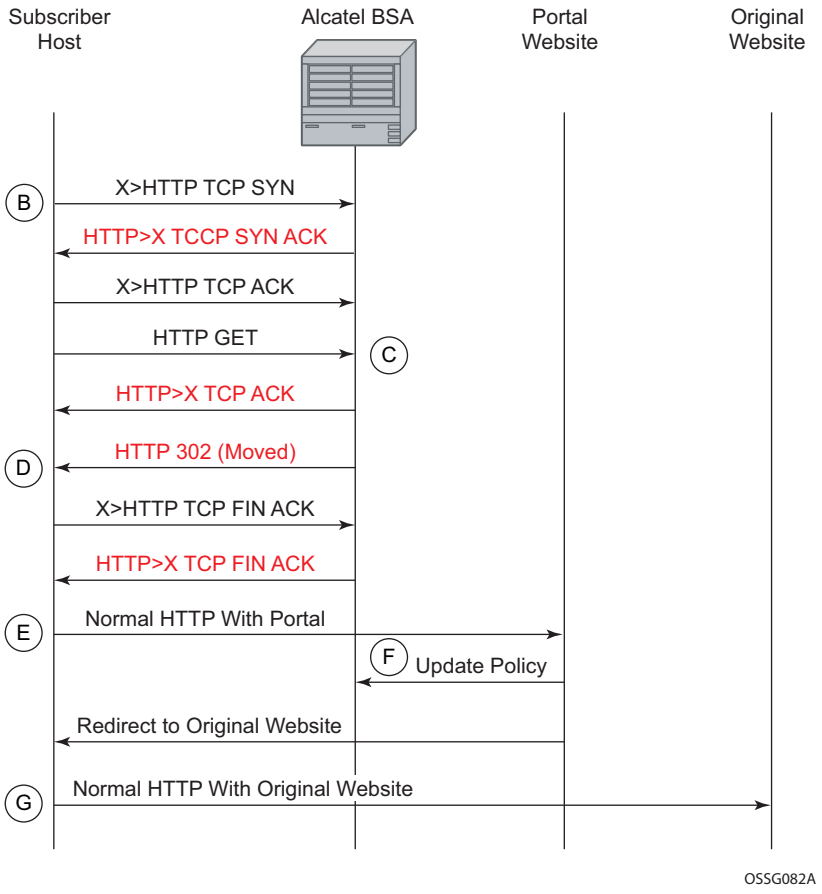


Figure 40: IP Illustration of Message Flow in Web Portal Redirect

The items in red text in Figure 40 are messages the 7750 SR will send (masquerading as the destination), regardless of the destination IP address or type of service.

The following displays information that can optionally be added as variables in the portal URL (http-redirect url):

- $IP – Customer's IP address
- $MAC – Customer's MAC address
- $URL – Original requested URL
- $SAP – Customer's SAP
- $SUB – Customer's subscriber identification string
- $CID – string that represents the circuit-id or interface-id of the subscriber host (hexadecimal format)
- $RID – string that represents the remote-id of the subscriber host (hexadecimal format)

Note that the subscriber's IP and MAC address variables are populated from the anti-spoofing list, and thus anti-spoofing must be enabled (see section Anti-Spoofing Filters on page 738).

Since most web sites are accessed using the domain name, the 7750 SR will need to allow DNS queries, and an ACL entry to this effect should be included in the filter (see example in section Configuring Web Portal Redirect on page 763).

Configuring Triple Play Security with CLI

This section provides information to configure Residential Broadband Aggregation services using the command line interface. It is assumed that the reader is familiar with VPLS, IES and VPRN services.

Topics in this section include:

Common Configuration Tasks

Topics in this section are:

Configuring Anti-Spoofing Filters

Anti-spoofing filters are used to prevent malicious subscribers sending IP packets with a forged IP or MAC address, and thus mis-directing traffic. The anti-spoofing filter is populated from the DHCP lease state table, and DHCP snooping must be enabled on the SAP.

There are three types of filters (MAC, IP and IP+MAC), one type is allowed per SAP.

The following displays an IES service interface configuration with anti-spoofing.

```
A:ALA-48>config>service>ies# info
----------------------------------------------
            interface "test123" create
                address 10.10.42.41/24
                local-proxy-arp
                proxy-arp
                    policy-statement "ProxyARP"
                exit
                sap 1/1/7:0 create
                    anti-spoof ip
                exit
                arp-populate
                dhcp
                    lease-populate 1
                    no shutdown
                exit
            exit
            no shutdown
----------------------------------------------
A:ALA-48>config>service>ies#
```

Configuring Triple Play Security features

Topics in this section are:

Configuring MAC Pinning

The following example displays a partial BSA configuration with MAC pinning enabled on a SAP:

```
A:ALA-48>config>service# info
----------------------------------------------
vpls 800 customer 6001 create
     description "VPLS with residential split horizon for DSL"
     stp
          shutdown
     exit
     sap 2/1/4:100 split-horizon-group "DSL-group2" create
          description "SAP for RSHG"
               mac-pinning
     exit
     no shutdown
----------------------------------------------
A:ALA-48>config>service#
```

Configuring MAC Protection

Preventing Access By Residential Subscribers Using Protected (Gateway) MAC Addresses

The first step is to create a list of MAC addresses to be protected, the second step is to prevent access using these source addresses inside an SHG or a SAP.

The following example displays a partial BSA configuration with some protected MAC addresses on any SAP created inside the SHG:

```
A:ALA-48>config>service# info
----------------------------------------------
vpls 800 customer 6001 create
     no shutdown
     split-horizon-group "mygroup" create
          restrict-protected-src
     exit
     description "VPLS with residential split horizon for DSL"
     mac-protect
          mac 00:00:17:FE:82:D8
          mac 93:33:00:00:BF:92
     exit
----------------------------------------------
A:ALA-48>config>service#
```

Restricting Access By Residential Subscribers To a Small List Of Upstream MAC Addresses:

The first step is to create a list of MAC addresses to be protected, the second step is to restrict access to these addresses only from an SHG or a SAP. (If the MAC address of an upstream server is not known, it can be discovered using e.g. the cpe-ping OAM tool.)

The following example displays a partial BSA configuration with restricted access to some MAC addresses from a specified SAP (an unrestricted access from any other SAP within the VPLS):

```
A:ALA-48>config>service# info
----------------------------------------------
vpls 800 customer 6001 create
     no shutdown
     description "VPLS with restricted access on a SAP"
     mac-protect
          mac 00:00:17:FE:82:D8
          mac 93:33:00:00:BF:92
     exit
     sap 1/1/4:30 create
          restrict-unprotected-dst
     exit
----------------------------------------------
A:ALA-48>config>service#
```

Configuring VPLS Redirect Policy

Figure 41 displays an IP filter entry configuration for VPLS redirect policy.

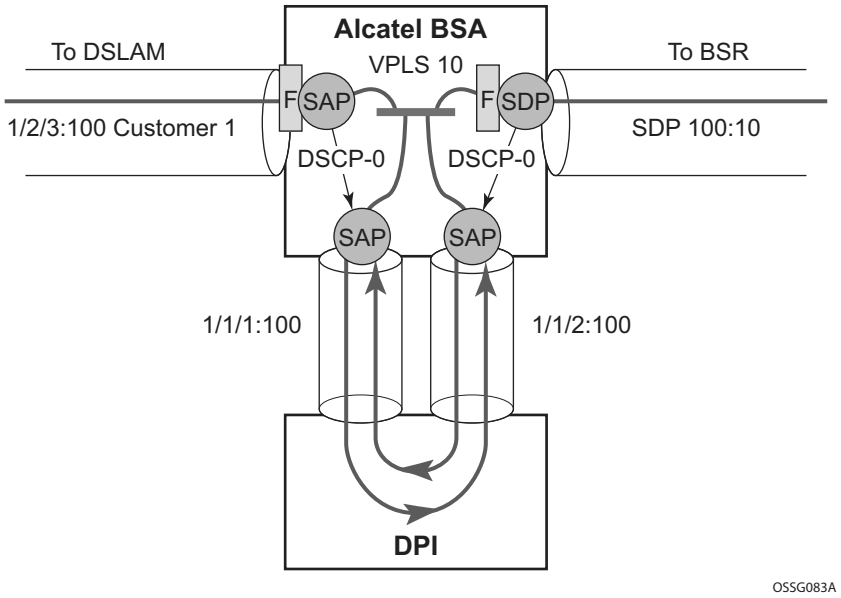


Figure 41: VPLS Redirect Policy Example

Information about defining and applying IP and MAC filters is described in the7750 SR Router Configuration Guide .

Creating the Filter

The following displays a redirect filter entry:

```
A:ALA-A>config>filter# info
----------------------------------------------
     ip-filter 10
          default-action forward
          entry 10
               match
                    dscp be
               exit
               action forward next-hop sap 1/1/1:100
               exit
          exit
     exit
     ip-filter 11
          default-action forward
          entry 10
               match
                    dscp be
               exit
                    dscp be
               exit
               action forward next-hop sap 1/1/2:100
          exit
     exit
----------------------------------------------
A:ALA-A>config>filter#
```

Applying the Filter to a VPLS Service

The following displays how the redirection filter configured above is assigned to the ingress SAP from the DSLAM, and the ingress SDP from the BSR:

```
A:ALA-A>config>service>vpls# info
----------------------------------------------
     vpls 10 customer 1 create
          description "vpls10"
               sap 1/2/3:100 create
                    ingress ip filter 10
               exit
               sap 1/1/1:100 create
               exit
               sap 1/1/2:100 create
               exit
               mesh-sdp 100:10 create
                    ingress ip filter 11
               exit
          exit
     exit
----------------------------------------------
A:ALA-A>config>service>vpls#
```

Configuring ARP Handling

Topics in this section are:

Configuring Proxy ARP

The implementation of proxy ARP with support for local proxy ARP allows the 7750 SR to respond to ARP requests in the subnet assigned to an IES or VPRN interface.

Configuring this command will allow multiple customers to share the same IP subnet.

The following example displays an IES proxy ARP configuration:

```
A:ALA-48>config>service>ies# info
----------------------------------------------
            interface "test123" create
                address 10.10.42.41/24
                local-proxy-arp
                proxy-arp-policy "ProxyARP"
                exit
            exit
            no shutdown
----------------------------------------------
A:ALA-48>config>service>ies#
```

Configuring Local Proxy ARP

When local proxy ARP is enabled on an IP interface, the 7750 SR responds to all ARP requests for IP addresses belonging to the subnet with it's own MAC address, and forwards all traffic between hosts in that subnet. Local proxy ARP is disabled by default.

Note: When local-proxy-arp is enabled under a IES or VPRN service, all ICMP redirects on the ports associated with the service are automatically blocked. This prevents users from learning each other's MAC address (from ICMP redirects).

The following example displays a local proxy ARP IES configuration:

```
A:ALA-A>config>service>ies# info
----------------------------------------------
         interface "test" create
              shutdown
              address 10.10.36.2/24
              local-proxy-arp
         exit
----------------------------------------------
A:ALA-A>config>service>ies#
```

Configuring ARP Reply Agent in a VPLS Service

When ARP reply agent is enabled, the 7750 SR will respond to ARP requests from the network, with information from the DHCP lease state table.

In the upstream direction (towards the network), the ARP reply agent intercepts ARP requests on subscriber SAPs, and checks them against the DHCP lease state table. The purpose is to prevent a malicious subscriber spoofing ARP request or ARP reply messages and thus populating the upstream router's ARP table with incorrect entries.

The following example displays a partial BSA configuration with ARP Reply Agent enabled on a SAP:

```
A:ALA-48>config>service# info
----------------------------------------------
...
     vpls 800 customer 6001 create
          description "VPLS with ARP Reply Agent active"
          sap 2/1/4:100 split-horizon-group "DSL-group2" create
             arp-reply-agent sub-ident
          exit
          sap 3/1/4:200 split-horizon-group "DSL-group2" create
              arp-reply-agent sub-ident
          exit
          no shutdown
...
----------------------------------------------
A:ALA-48>config>service#
```

Configuring Remote Proxy ARP

The following example displays the IES configuration to enable remote proxy ARP:

```
A:ALA-49>config>service>ies# info
----------------------------------------------
            interface "test-1A" create
                address 10.10.26.3/24
                remote-proxy-arp
            exit
            no shutdown
----------------------------------------------
A:ALA-49>config>service>ies#
```

Configuring Automatic ARP Table Population in an IES or VPRN Interface

The following example displays the IES DHCP configuration to enable automatic population of the ARP table using snooped DHCP information on an IES or VPRN interface:

```
A:ALA-1>config>service>ies>if# info
----------------------------------------------
                arp-populate
                dhcp
                    description "snooping_only"
                    lease-populate 1
                    no shutdown
                exit
----------------------------------------------
A:ALA-1>config>service>ies>if#


A:ALA-1>config>service>vprn>if# info
----------------------------------------------
                dhcp
                    description "test"
                    lease-populate 1
                    no shutdown
                exit
----------------------------------------------
A:ALA-1>config>service>ies>if#
```

Configuring CPU Protection

CPU Protection can be used to protect the SR OS router in subscriber management scenarios. Refer to the SR OS System Management Guide for information about CPU Protection operation and configuration.

Configuring Web Portal Redirect

The generic CLI structure for defining and applying IP and MAC filters is described in the 7750 SR Router Configuration Guide.

The following example displays an IP filter entry configuration for web-portal redirect:

```
A:ALA-A>config>filter# info
----------------------------------------------
     ip-filter 10 create
          description "filter to forward DNS and web traffic to my portal; redirect all
other web traffic to the portal and drop everything else"
          default-action drop
          entry 10 create
               description "allows DNS traffic"
                    match protocol 17
                    dst-port 53
               exit
               action forward
          exit
          entry 20 create
               description "allows web traffic destined to portal (IP address 10.0.0.1)"
               match protocol 6
                    dst-port eq 80
                    dst-ip 10.0.0.1
               exit
               action forward
          exit
          entry 30
               description "redirects all web traffic to portal"
               match protocol 6
                    dst-port eq 80
               exit
               action http-redirect http://www.myportal.com/defaultportal
/login.cgi?ip=$IP&mac=$MAC&orig_url=$URL&usb=$SUB
          exit
     exit
----------------------------------------------
A:ALA-A>config>filter#
```

- Filter entry 10 in the example output allows the customer to access DNS to get the IP address of the original website they are trying to view.
- Entry 20 allows HTTP packets destined to the captive portal itself to be forwarded. Note that the actual IP address (a.b.c.d) needs to be entered, not the DNS name (“www.myportal.com”). The IP address can be easily resolved from the 7750 SR CLI using the “ping” command.
- Entry 30 (which is the last option that does not drop the customer packets) checks for HTTP protocol and then starts the redirection process:
  - → The 7750 SR will intercept the HTTP GET from the subscriber and respond with an HTTP 302 (temporarily moved) with the URL configured in the filter entry. This URL can contain some variables, notably the customer IP and MAC addresses to allow the portal to create an entry for the customer. The original requested URL is also included to redirect the client site back to the original requested site when the process is done.
  - → The client will then close the connection with the original IP address and open a connection to the redirected server. Entry 20 will allow this connection.

The following displays how the redirection filter configured above is assigned to an ingress SAP:

```
A:ALA-A>config>service>vpls# info
----------------------------------------------
     vpls 3 customer 6 create
          description "VPLS with web portal redirection filter applied"
          sap 2/1/5:0 create
               ingress
                    filter ip 10
               exit
          exit
          no shutdown
     exit
----------------------------------------------
A:ALA-A>config>service>vpls#
```

Triple Play Security Command Reference

Command Hierarchies

Note: This command tree is limited to those commands specific to Triple Play security. For the full command trees of a particular service type, consult the 7750 SR Services Guide.

Anti-Spoofing Commands

```
config
    — service
        — vpls service-id [customer customer-id] [vpn vpn-id] [m-vpls]
            — sap sap-id [split-horizon-group group-name]
                — anti-spoof {ip | mac | ip-mac}
                — no anti-spoof
config
    — service
        — ies service-id [customer customer-id] [vpn vpn-id]
            — [no] interface ip-int-name
                — sap sap-id
                    — anti-spoof {ip | mac | ip-mac}
                    — no anti-spoof
            — subscriber-interface
                — group-interface ip-int-name
                    — sap sap-id
                        — anti-spoof {ip | ip-mac}
                        — no anti-spoof
```

Layer 2 Security Commands

config
- **service**
  - [**no**] **vpls** *service-id* [**customer** *customer-id*] [**vpn** *vpn-id*] [**m-vpls**]
    - **mac-protect**
      - [**no**] **mac** [*ieee-mac-address]*
    - [**no**] **split-horizon-group** [*group-name*] [**residential-group**]
      - [**no**] **restrict-protected-src**
      - [**no**] **restrict-unprotected-dst**
    - **mesh-sdp** *sdp-id*[:*vc-id*] [**vc-type** {**ether** | **vlan**}]
      - [**no**] **mac-pinning**
      - [**no**] **restrict-protected-src**
      - [**no**] **restrict-unprotected-dst**
    - **spoke-sdp** *sdp-id*[:*vc-id*] [**vc-type** {**ether** | **vlan** | **vpls**}] [**split-horizon-group** *group-name*]
      - [**no**] **mac-pinning**

ARP Handling Commands

config
- **service**
  - [**no**] **vpls** *service-id* [**customer** *customer-id*] [**vpn** *vpn-id*] [**m-vpls**]
    - **sap** *sap-id*
      - **arp-reply-agent** [*sub-ident*]
      - **no arp-reply-agent**

config
- **service**
  - **ies** *service-id* [**customer** *customer-id*] [**vpn** *vpn-id*]
    - [**no**] **interface** *ip-int-name*
      - [**no**] **arp-populate**
      - **arp-timeout** *seconds*
      - **no arp-timeout**
      - [**no**] **local-proxy-arp**
      - **proxy-arp-policy** *policy-name* [*policy-name*...(up to 5 max)]
      - **no proxy-arp-policy**
      - [**no**] **remote-proxy-arp**
      - **static-arp** *ip-address ieee-address*
      - **no static-arp** *ip-address* [*ieee-address*]

Triple Play Security Configuration Commands

Topics in this section include:

Triple Play Anti-Spoofing Commands

anti-spoof

Syntax **anti-spoof** {**ip** | **mac** | **ip-mac**}
no anti-spoof

Context config>service>vpls>sap
config>service>ies>if>sap

Description This command enables anti-spoof filtering and optionally changes the anti-spoof matching type for the SAP.

The type of anti-spoof filtering defines what information in the incoming packet is used to generate the criteria to lookup an entry in the anti-spoof filter table. The type parameter (**ip**, **mac**, **ip-mac**) defines the anti-spoof filter type enforced by the SAP when anti-spoof filtering is enabled.

The **no** form of the command disables anti-spoof filtering on the SAP.

Default **no anti-spoof**

Parameters **ip —** Configures SAP anti-spoof filtering to use only the source IP address in its lookup. If a static host exists on the SAP without an IP address specified, the **anti-spoof ip** command will fail.

mac — Configures SAP anti-spoof filtering to use only the source MAC address in its lookup. If a static host exists on the SAP without a specified MAC address, the **anti-spoof mac** command will fail.

ip-mac — Configures SAP anti-spoof filtering to use both the source IP address and the source MAC address in its lookup. If a static host exists on the SAP without both the IP address and MAC address specified, the **anti-spoof ip-mac** command will fail.

anti-spoof

Syntax **anti-spoof** {**ip** | **ip-mac**}
no anti-spoof

Context config>service>ies>subscriber-interface>grp-if>sap

Description This command enables anti-spoof filtering and optionally change the anti-spoof matching type for the SAP.

The type of anti-spoof filtering defines what information in the incoming packet is used to generate the criteria to lookup an entry in the anti-spoof filter table. The type parameter (**ip**, **ip-mac**) defines the anti-spoof filter type enforced by the SAP when anti-spoof filtering is enabled.

The **no** form of the command disables anti-spoof filtering on the SAP.

Default **no anti-spoof**

Parameters **ip —** Configures SAP anti-spoof filtering to use only the source IP address in its lookup. If a static host exists on the SAP without an IP address specified, the **anti-spoof ip** command will fail.

ip-mac — Configures SAP anti-spoof filtering to use both the source IP address and the source MAC address in its lookup. If a static host exists on the SAP without both the IP address and MAC address specified, the **anti-spoof ip-mac** command will fail.

Triple Play Layer 2 Security Commands

split-horizon-group

Syntax [**no**] **split-horizon-group** [*group-name*] [*residential-group*]

Context config>service>vpls

Description This command creates a new split horizon group for the VPLS instance. Traffic arriving on a SAP or spoke SDP within this split horizon group will not be copied to other SAPs or spoke SDPs in the same split horizon group.

A split horizon group must be created before SAPs and spoke SDPs can be assigned to the group.

The split horizon group is defined within the context of a single VPLS. The same group-name can be re-used in different VPLS instances.

Up to 30 split horizon groups can be defined per VPLS instance.

The **no** form of the command removes the group name from the configuration.

Parameters *group-name* — Specifies the name of the split horizon group to which the SDP belongs.

residential-group — Defines a split horizon group as a residential split horizon group (RSHG). Doing so entails that:

a) SAPs which are members of this Residential Split Horizon Group will have:

- Double-pass queuing at ingress as default setting (can be disabled)
- STP disabled (can not be enabled)
- ARP reply agent enabled per default (can be disabled)
- MAC pinning enabled per default (can be disabled)
- Besides the multicast downstream also broadcast packets are discarded thus also blocking the unknown, flooded traffic.

b) Spoke SDPs which are members of this Residential Split Horizon Group will have:

- Downstream multicast traffic supported
- Double-pass queuing is not applicable
- STP is disabled (can be enabled)
- ARP reply agent is not applicable (dhcp-lease-states are not supported on spoke SDPs)
- MAC pinning enabled per default (can be disabled)

Default A split horizon group is by default not created as a residential-group.

mac-protect

Syntax **mac-protect**

Context config>service>vpls

Description This command indicates whether or not this MAC is protected on the MAC protect list. When enabled, the agent will protect the MAC from being learned or re-learned on a SAP, spoke SDP or mesh-SDP that has restricted learning enabled. The MAC protect list is used in conjunction with **restrict-protected-src**, **restrict-unprotected-dst** and **auto-learn-mac-protect**.

Default disabled

mac

Syntax [**no**] **mac** *ieee-address*

Context config>service>vpls>mac-protect

Description This command specifies the 48-bit IEEE 802.3 MAC address.

Parameters *ieee-address* — Specifies the 48-bit MAC address in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers.

auto-learn-mac-protect

Syntax [**no**] **auto-learn-mac-protect**

Context config>service>vpls>sap
config>service>vpls>spoke-sdp
config>service>vpls >mesh-sdp
config>service>vpls>split-horizon-group
config>service>vpls>endpoint
config>service>pw-template
config>service>pw-template>split-horizon-group

Description This command enables the automatic protection of source MAC addresses learned on the associated object. MAC protection is used in conjunction with restrict-protected-src, restrict-unprotected-dst and mac-protect. When this command is applied or removed, the MAC addresses are cleared from the related object.

When the auto-learn-mac-protect is enabled on an SHG the action only applies to the associated SAPs (no action is taken by default for spoke SDPs in the SHG). In order to enable this function for spoke SDPs within a SHG, the auto-learn-mac-protect must be enabled explicitly under the spoke-SDP. If required, auto-learn-mac-protect can also be enabled explicitly under specific SAPs within the SHG.

Default no auto-learn-mac-protect

restrict-protected-src

Syntax **restrict-protected-src** [*alarm-only* | *discard-frame*]
no restrict-protected-src

Context config>service>vpls>sap
config>service>vpls>spoke-sdp
config>service>vpls>mesh-sdp
config>service>vpls>split-horizon-group
config>service>vpls>endpoint
config>service>pw-template>
config>service>pw-template>split-horizon-group

Description This command indicates how the agent will handle relearn requests for protected MAC addresses, either manually added using the mac-protect command or automatically added using the auto-learn-mac-protect command. While enabled all packets entering the configured SAP, spoke-SDP, mesh-SDP , or any SAP that is part of the configured split horizon group (SHG) will be verified not to contain a protected source MAC address. If the packet is found to contain such an address, the action taken depends on the parameter specified on the restrict-protected-src command, namely:

- No parameter

  The packet will be discarded, an alarm will be generated and the SAP, spoke-SDP or mesh-SDP will be set operationally down. The SAP, spoke-SDP or mesh-SDP must be shutdown and enabled (no shutdown) for this state to be cleared.

- alarm-only

  The packet will be forwarded, an alarm will be generated but the source MAC is not learned on the SAP/spoke-SDP/mesh-SDP.

- discard-frame

  The packet will be discarded and an alarm generated. The frequency of alarm generation is fixed to be at most one alarm per MAC address per FP2 per 10 minutes in a given VPLS service. This parameter is only applicable to automatically protected MAC addresses.

When the **restrict-protected-src** is enabled on an SHG the action only applies to the associated SAPs (no action is taken by default for spoke SDPs in the SHG). In order to enable this function for spoke SDPs within a SHG, the **restrict-protected-src** must be enabled explicitly under the spoke-SDP. If required, **restrict-protected-src** can also be enabled explicitly under specific SAPs within the SHG.

When this command is applied or removed, with either the alarm-only or discard-frame parameters, the MAC addresses are cleared from the related object.

The use of "**restrict-protected-src discard-frame**" is mutually exclusive with both the "**restrict-protected-src** [**alarm-only**]" command and with the configuration of manually protected MAC addresses within a given VPLS. "restrict-protected-src discard-frame" can only be enabled on SAPs on FP2 or later hardware or on SDPs where all network interfaces are on FP2 or later hardware.

Parameters *alarm-only* — Specifies that the packet will be forwarded, an alarm will be generated but the source MAC is not learned on the SAP/spoke-SDP/mesh-SDP.

Default no alarm-only

discard-frame — Specifies that the packet will be discarded and an alarm generated. The frequency of alarm generation is fixed to be at most one alarm per FP2 per MAC address per 10 minutes within a given VPLS service.

Default no discard-frame

Default no restrict-protected-src

restrict-unprotected-dst

Syntax **restrict-unprotected-dst**
no restrict-unprotected-dst

Context config>service>pw-template>split-horizon-group
config>service>vpls>split-horizon-group
config>service>vpls>sap

Description This command indicates how the system will forward packets destined to an unprotected MAC address, either manually added using the mac-protect command or automatically added using the auto-learn-mac-protect command. While enabled all packets entering the configured SAP or SAPs within a split-horizon-group (but not spoke or mesh-SDPs) will be verified to contain a protected destination MAC address. If the packet is found to contain a non-protected destination MAC, it will be discarded. Detecting a non-protected destination MAC on the SAP will not cause the SAP to be placed in the operationally down state. No alarms are generated.

If the destination MAC address is unknown, even if the packet is entering a restricted SAP, with restrict-unprotected-dst enabled, it will be flooded.

Default no restrict-unprotected-dst

mac-pinning

Syntax [**no**] **mac-pinning**

Context config>service>vpls>sap
config>service>vpls>spoke-sdp
config>service>vpls>mesh-sdp

Description Enabling this command will disable re-learning of MAC addresses on other SAPs within the VPLS. The MAC address will remain attached to a given SAP for duration of its age-timer.

The age of the MAC address entry in the FIB is set by the age timer. If **mac-aging** is disabled on a given VPLS service, any MAC address learned on a SAP/SDP with **mac-pinning** enabled will remain in the FIB on this SAP/SDP forever.

Every event that would otherwise result in re-learning will be logged (MAC address; original-SAP; new-SAP).

Note that MAC addresses learned during DHCP address assignment (DHCP snooping enabled) are not impacted by this command. MAC-pinning for such addresses is implicit.

Default When a SAP or spoke SDP is part of a Residential Split Horizon Group (RSHG), MAC pinning is activated at creation of the SAP. Otherwise MAC pinning is not enabled by default.

ARP Handling Commands

arp-reply-agent

Syntax **arp-reply-agent** [**sub-ident**]
no arp-reply-agent

Context config>service>vpls>sap

Description This command enables a special ARP response mechanism in the system for ARP requests destined to static or dynamic hosts associated with the SAP. The system responds to each ARP request using the host's MAC address as the both the source MAC address in the Ethernet header and the target hardware address in the ARP header.

ARP replies and requests received on a SAP with **arp-reply-agent** enabled will be evaluated by the system against the anti-spoof filter entries associated with the ingress SAP (if the SAP has anti-spoof filtering enabled). ARPs from unknown hosts on the SAP will be discarded when anti-spoof filtering is enabled.

The ARP reply agent only responds if the ARP request enters an interface (SAP, spoke-SDP or mesh-SDP) associated with the VPLS instance of the SAP.

A received ARP request that is not in the ARP reply agent table is flooded to all forwarding interfaces of the VPLS capable of broadcast except the ingress interface while honoring split-horizon constraints.

Static hosts can be defined on the SAP using the **host** command. Dynamic hosts are enabled on the system by enabling the **lease-populate** command in the SAP's **dhcp** context. In the event that both a static host and a dynamic host share the same IP and MAC address, the VPLS ARP reply agent will retain the host information until both the static and dynamic information are removed. In the event that both a static and dynamic host share the same IP address, but different MAC addresses, the VPLS ARP reply agent is populated with the static host information.

The **arp-reply-agent** command will fail if an existing static host on the SAP does not have both MAC and IP addresses specified. Once the ARP reply agent is enabled, creating a static host on the SAP without both an IP address and MAC address will fail.

The ARP-reply-agent may only be enabled on SAPs supporting Ethernet encapsulation.

The **no** form of the command disables ARP-reply-agent functions for static and dynamic hosts on the SAP.

Default not enabled

Parameters **sub-ident** — Configures the arp-reply-agent to discard ARP requests received on the SAP that are targeted for a known host on the same SAP with the same subscriber identification.

Hosts are identified by their subscriber information. For DHCP subscriber hosts, the subscriber hosts, the subscriber information is configured using the optional subscriber parameter string.

When arp-reply-agent is enabled with **sub-ident**:

- If the subscriber information for the destination host exactly matches the subscriber information for the originating host and the destination host is known on the same SAP as the source, the ARP request is silently discarded.

- If the subscriber information for the destination host or originating host is unknown or undefined, the source and destination hosts are not considered to be the same subscriber. The ARP request is forwarded outside the SAP's Split Horizon Group.
- When **sub-ident** is not configured, the arp-reply-agent does not attempt to identify the subscriber information for the destination or originating host and will not discard an ARP request based on subscriber information.

arp-populate

Syntax [**no**] **arp-populate**

Context config>service>ies>interface
config>service>ies>subscriber-int

Description This command, when enabled, disables dynamic learning of ARP entries. Instead, the ARP table is populated with dynamic entries from the DHCP lease state table (enabled with **lease-populate**), and optionally with static entries entered with the **host** command.

Enabling the **arp-populate** command will remove any dynamic ARP entries learned on this interface from the ARP cache.

The **arp-populate** command will fail if an existing static ARP entry exists for this interface.

The **arp-populate** command will fail if an existing static subscriber host on the SAP does not have both MAC and IP addresses specified.

Once **arp-populate** is enabled, creating a static subscriber host on the SAP without both an IP address and MAC address will fail.

When **arp-populate** is enabled, the system will not send out ARP requests for hosts that are not in the ARP cache. Only statically configured and DHCP learned hosts are reachable through an IP interface with **arp-populate** enabled. The **arp-populate** command can only be enabled on IES and VPRN interfaces supporting Ethernet encapsulation.

Use the **no** form of the command to disable ARP cache population functions for static and dynamic hosts on the interface. All static and dynamic host information for this interface will be removed from the system's ARP cache.

Default not enabled

arp-timeout

Syntax **arp-timeout** *seconds*
no arp-timeout

Context config>service>ies>interface
config>service>ies>subscriber-interface>group-interface

Description This command configures the minimum time in seconds an ARP entry learned on the IP interface will be stored in the ARP table. ARP entries are automatically refreshed when an ARP request or gratuitous ARP is seen from an IP host, otherwise, the ARP entry is aged from the ARP table. If **arp-timeout** is set to a value of zero seconds, ARP aging is disabled.

When the **arp-populate** and **lease-populate** commands are enabled on an IES interface, the ARP table entries will no longer be dynamically learned, but instead by snooping DHCP ACK message from a DHCP server. In this case the configured **arp-timeout** value has no effect.

The default value for **arp-timeout** is 14400 seconds (4 hours).

The **no** form of this command restores **arp-timeout** to the default value.

Default 14400 seconds

Parameters *seconds* — The minimum number of seconds a learned ARP entry will be stored in the ARP table, expressed as a decimal integer. A value of zero specifies that the timer is inoperative and learned ARP entries will not be aged.

Values 0 — 65535

authentication-policy

Syntax **authentication-policy** *name*
no authentication-policy

Context config>service>ies>sub-if>grp-if

Description This command assigns a RADIUS authentication policy to the interface.

The **no** form of this command removes the policy name from the group interface configuration.

Default no authentication-policy

Parameters *name* — Specifies the authentication policy name.

host-connectivity-verify

Syntax **host-connectivity-verify** [**interval** *interval*] [**action** {**remove** | **alarm**}][**family** *family*]

Context config>service>ies>sub-if>grp-if

Description This command enables subscriber host connectivity verification for all hosts on this interface. This tool will periodically scan all known hosts (from dhcp-state) and perform a UC ARP request. The subscriber host connectivity verification will maintain state (connected vs. not-connected) for all hosts.

Default no host-connectivity-verify

Parameters **interval *interval* —** The interval, expressed in minutes, which specifies the time interval at which all known sources should be verified. The actual rate is then dependent on number of known hosts and interval.

Values 1— 6000

Note that a zero value can be used by the SNMP agent to disable host-connectivity-verify.

action {**remove** | **alarm**} **—** Defines the action taken on a subscriber host connectivity verification failure for a given host. The **remove** keyword raises an alarm and removes dhcp-state and

releases all allocated resources (queues, table entries and etc.). DHCP release will be signaled to corresponding DHCP server. Static hosts will be never removed. The **alarm** keyword raises an alarm indicating that the host is disconnected.

family *family* — The family configuration allows the host connectivity checks to be performed for IPv4 endpoint, IPv6 endpoint or both. With family IPv6 configured, host connectivity checks will be performed on the global unicast address (assigned via SLAAC or DHCPv6 IA_NA) and link-local address of a Layer 3 RG or bridged hosts. In case of SLAAC assignment, host connectivity can only be performed if the /128 is known (via downstream ND). DHCPv6 PD assigned prefixes will be removed if link-local address is determined to be unreachable via "host connectivity check". Reachability checks for GUA and link-local address will be done simultaneously.

local-proxy-arp

Syntax [**no**] **local-proxy-arp**

Context config>service>ies>interface
config>service>ies>subscriber-interface>group-interface

Description This command enables local proxy ARP. When local proxy ARP is enabled on an IP interface, the system responds to all ARP requests for IP addresses belonging to the subnet with its own MAC address, and thus will become the forwarding point for all traffic between hosts in that subnet.

When local-proxy-arp is enabled, ICMP redirects on the ports associated with the service are automatically blocked.

Default no local-proxy-arp

remote-proxy-arp

Syntax [**no**] **remote-proxy-arp**

Context config>service>ies>interface

Description This command enables or disables remote proxy ARP on the interface.

Default no remote-proxy-arp

qos-route-lookup

Syntax [**no**] **qos-route-lookup**

Context config>service>ies>subscriber-interface>group-interface
config>service>ies>sub-if>grp-if>ipv6

Description This command enables or disables Qos route lookup for the interface.

proxy-arp-policy

Syntax **proxy-arp-policy** *policy-name* [*policy-name*...(up to 5 max)]
no proxy-arp-policy

Context config>service>ies>interface
config>service>ies>subscriber-interface>group-interface

Description This command specifies an existing policy-statement to analyze match and action criteria that controls the flow of routing information to and from a given protocol, set of protocols, or a particular neighbor.

Default none

Parameters *policy-name* — The export route policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

The specified name(s) must already be defined.

static-arp

Syntax **static-arp** *ip-address ieee-mac-address*
no static-arp *ip-address* [*ieee-mac-address*]

Context config>service>ies>interface

Description This command configures a static address resolution protocol (ARP) entry associating a subscriber IP address with a MAC address for the core router instance. This static ARP appears in the core routing ARP table. A static ARP can only be configured if it exists on the network attached to the IP interface.

If an entry for a particular IP address already exists and a new MAC address is configured for the IP address, the existing MAC address will be replaced with the new MAC address.

The **no** form of the command removes a static ARP entry.

Default None

Parameters *ip-address* — Specifies the IP address for the static ARP in IP address dotted decimal notation.

ieee-mac-address — Specifies the 48-bit MAC address for the static ARP in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

Show Commands

arp

Syntax **arp**

Context show>service>id

Description This command displays the ARP cache entries for this service.

Output **Show All Service-ID Output —** The following table describes the show command output fields:

Label	Description
IP Address	Specifies the IP address of the ARP cach entry.
MAC Address	Specifies the MAC address associated with the IP address.
Type	Other – Learned through normal ARP queries. Static – Configured by **static-arp** commands. Managed – Learned from DHCP snooping or configured by **host** commands.
Age	Indicates age of the ARP entry.
Interface	Indicates the name of the IP interface.
Port	Indicates the port that the entry was learned on.

Sample Output

```
A:ALA-A# show service id 100 base
===============================================================================
ARP Table
===============================================================================
IP Address      MAC Address       Type    Age       Interface         Port
-------------------------------------------------------------------------------
101.1.0.1       00:00:66:66:66:01 Other   00h00m00s ies-100-101.1.0.1 1/1/4
200.1.1.2       00:00:5e:00:01:64 Other   00h00m00s ies-100-200.1.1.2 1/1/3
200.1.1.201     00:00:22:2e:a5:61 Static  00h00m00s ies-100-200.1.1.2 1/1/3
200.1.1.202     00:00:22:2e:a5:62 Static  00h00m00s ies-100-200.1.1.2 1/1/3
===============================================================================
A:ALA-A#
```

Triple Play Multicast

In This Chapter

This chapter provides information about Triple Play Multicast aspects, including configuration process overview, and implementation notes.

Topics in this chapter include:

Introduction to Multicast

IP multicast provides an effective method of many-to-many communication. Delivering unicast datagrams is fairly simple. Normally, IP packets are sent from a single source to a single recipient. The source inserts the address of the target host in the IP header destination field of an IP datagram, intermediate routers (if present) simply forward the datagram towards the target in accordance with their respective routing tables.

Sometimes distribution needs individual IP packets be delivered to multiple destinations (like audio or video streaming broadcasts). Multicast is a method of distributing datagrams sourced from one (or possibly more) host(s) to a set of receivers that may be distributed over different (sub) networks. This makes delivery of multicast datagrams significantly more complex.

Multicast sources can send a single copy of data using a single address for the entire group of recipients. The routers between the source and recipients route the data using the group address route. Multicast packets are delivered to a multicast group. A multicast group specifies a set of recipients who are interested in a particular data stream and is represented by an IP address from a specified range. Data addressed to the IP address is forwarded to the members of the group. A source host sends data to a multicast group by specifying the multicast group address in datagram's destination IP address. A source does not have to register in order to send data to a group nor do they need to be a member of the group.

Routers and Layer 3 switches use the Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) to manage membership for a multicast session. When a host wants to receive one or more multicast sessions, it will send a join message for each multicast group it wants to join. When a host wants to leave a multicast group, it will send a leave message.

Multicast in the Broadband Service Router

This section describes the multicast protocols employed when an Alcatel-Lucent router is used as a Broadband Service Router (BSR) in a Triple Play aggregation network.

The protocols used are:

- Internet Group Management Protocol (Internet Group Management Protocol on page 784)
- Multicast Listener Discovery (Multicast Listener Discovery on page 786)
- Source Specific Multicast Groups (Internet Group Management Protocol on page 784)
- Protocol Independent Multicast (Sparse Mode) (PIM-SM on page 788)

Internet Group Management Protocol

Internet Group Management Protocol (IGMP) is used by IPv4 hosts and routers to report their IP multicast group memberships to neighboring multicast routers. A multicast router keeps a list of multicast group memberships for each attached network, and a timer for each membership.

Multicast group memberships include at least one member of a multicast group on a given attached network, not a list of all of the members. With respect to each of its attached networks, a multicast router can assume one of two roles, querier or non-querier. There is normally only one querier per physical network.

A querier issues two types of queries, a general query and a group-specific query. General queries are issued to solicit membership information with regard to any multicast group. Group-specific queries are issued when a router receives a leave message from the node it perceives as the last group member remaining on that network segment.

Hosts wanting to receive a multicast session issue a multicast group membership report. These reports must be sent to all multicast enabled routers.

IGMP Versions and Interoperability Requirements

If routers run different versions of IGMP, they will negotiate the lowest common version of IGMP that is supported on their subnet and operate in that version.

Version 1 — Specified in RFC-1112, *Host extensions for IP Multicasting*, was the first widely deployed version and the first version to become an Internet standard.
Version 2 — Specified in RFC-2236, *Internet Group Management Protocol*, added support for low leave latency, that is, a reduction in the time it takes for a multicast router to learn that there are no longer any members of a particular group present on an attached network.

Version 3 —Specified in RFC-3376, *Internet Group Management Protocol*, adds support for source filtering, that is, the ability for a system to report interest in receiving packets only from specific source addresses, as required to support Source-Specific Multicast (See Source Specific Multicast (SSM)), or from all but specific source addresses, sent to a particular multicast address.

IGMPv3 must keep state per group per attached network. This group state consists of a filter-mode, a list of sources, and various timers. For each attached network running IGMP, a multicast router records the desired reception state for that network.

IGMP Version Transition

Alcatel-Lucent's SRs are capable of interoperating with routers and hosts running IGMPv1, IGMPv2, and/or IGMPv3. *Draft-ietf-magma-igmpv3-and-routing-0x.txt* explores some of the interoperability issues and how they affect the various routing protocols.

IGMP version 3 specifies that if at any point a router receives an older version query message on an interface that it must immediately switch into a compatibility mode with that earlier version. Since none of the previous versions of IGMP are source aware, should this occur and the interface switch to Version 1 or 2 compatibility mode, any previously learned group memberships with specific sources (learned from the IGMPv3 specific INCLUDE or EXCLUDE mechanisms) MUST be converted to non-source specific group memberships. The routing protocol will then treat this as if there is no EXCLUDE definition present.

Multicast Listener Discovery

Multicast Listener Discovery (MLD) is used by IPv6 hosts and routers to report their IP multicast group memberships to neighboring multicast routers. A multicast router keeps a list of multicast group memberships for each attached network, and a timer for each membership. Multicast group memberships include at least one member of a multicast group on a given attached network, not a list of all of the members. With respect to each of its attached networks, a multicast router can assume one of two roles, querier or non-querier. There is normally only one querier per physical network.

A querier issues two types of queries, a general query and a group-specific query. General queries are issued to solicit membership information with regard to any multicast group. Group-specific queries are issued when a router receives a leave message from the node it perceives as the last group member remaining on that network segment.

Hosts wanting to receive a multicast session issue a multicast group membership report. These reports must be sent to all multicast enabled routers.

MLD Versions and Interoperability Requirements

If routers run different versions of MLD, they will negotiate the lowest common version of MLD that is supported on their subnet and operate in that version.

Version 1 — Specified in RFC 2710, *Multicast Listener Discovery (MLD) for IPv6*, was the first deployed version and included low leave latency, that is, a reduction in the time it takes for a multicast router to learn that there are no longer any members of a particular group present on an attached network.

Version 2 — Specified in RFC 3810, *Multicast Listener Discovery Version 2 (MLDv2) for IPv6*, adds support for source filtering, that is, the ability for a system to report interest in receiving packets only from specific source addresses, as required to support Source-Specific Multicast.

Multicast (SSM)), or from all but specific source addresses, sent to a particular multicast address. MLDv2 must keep state per group per attached network. This group state consists of a filter mode, a list of sources, and various timers. For each attached network running MLD, a multicast router records the desired reception state for that network.

Source Specific Multicast Groups

IGMPv3and MLDv2 permits a receiver to join a group and specify that it only wants to receive traffic for a group if that traffic comes from a particular source. If a receiver does this, and no other receiver on the LAN requires all the traffic for the group, then the Designated Router (DR) can omit performing a (*,G) join to set up the shared tree, and instead issue a source-specific (S,G) join only.

For IPv4, the range of multicast addresses from 232.0.0.0 to 232.255.255.255 is currently set aside for source-specific multicast. For groups in this range, receivers should only issue source specific IGMPv3 joins. If a PIM router receives a non-source-specific join for a group in this range, it should ignore it.

For IPv6, the multicast prefix FF3x::/32 is currently set aside for source-specific multicast. For groups in this range, receivers should only issue source specific MLDv2 joins. If a PIM router receives a non-source-specific join for a group in this range, it should ignore it.

An Alcatel-Lucent PIM router must silently ignore a received (*, G) PIM join message where G is a multicast group address from the multicast address group range that has been explicitly configured for SSM. This occurrence should generate an event. If configured, the IGMPv2 (MLDv1for IPv6) request can be translated into IGMPv3 (MLDv2 for IPv6). The SR allows for the conversion of an IGMPv2 (*,G) request into a IGMPv3 (S,G) request based on manual entries. A maximum of 32 SSM ranges is supported.

IGMPv3 and MLDv2 also permits a receiver to join a group and specify that it only wants to receive traffic for a group if that traffic does not come from a specific source or sources. In this case, the DR will perform a (*,G) join as normal, but can combine this with a prune for each of the sources the receiver does not wish to receive.

Protocol Independent Multicast Sparse Mode (PIM-SM)

PIM-SM leverages the unicast routing protocols that are used to create the unicast routing table: OSPF, IS-IS, BGP, and static routes. Because PIM uses this unicast routing information to perform the multicast forwarding function it is effectively IP protocol independent. Unlike DVMRP, PIM does not send multicast routing tables updates to its neighbors.

PIM-SM uses the unicast routing table to perform the Reverse Path Forwarding (RPF) check function instead of building up a completely independent multicast routing table.

PIM-SM only forwards data to network segments with active receivers that have explicitly requested the multicast group. PIM-SM in the ASM model initially uses a shared tree to distribute information about active sources. Depending on the configuration options, the traffic can remain on the shared tree or switch over to an optimized source distribution tree. As multicast traffic starts to flow down the shared tree, routers along the path determine if there is a better path to the source. If a more direct path exists, then the router closest to the receiver sends a join message toward the source and then reroutes the traffic along this path.

As stated above, PIM-SM relies on an underlying topology-gathering protocol to populate a routing table with routes. This routing table is called the Multicast Routing Information Base (MRIB). The routes in this table can be taken directly from the unicast routing table, or it can be different and provided by a separate routing protocol such as MBGP. Regardless of how it is created, the primary role of the MRIB in the PIM-SM protocol is to provide the next hop router along a multicast-capable path to each destination subnet. The MRIB is used to determine the next hop neighbor to whom any PIM join/prune message is sent. Data flows along the reverse path of the join messages. Thus, in contrast to the unicast RIB that specifies the next hop that a data packet would take to get to some subnet, the MRIB gives reverse-path information, and indicates the path that a multicast data packet would take from its origin subnet to the router that has the MRIB.

Ingress Multicast Path Management (IMPM) Enhancements

Refer to the SR OS Advanced Configuration Guide for more information on IMPM as well as detailed configuration examples.

Ingress multicast path management (IMPM) allows the system to dynamically manage Layer 2 and Layer 3 IP multicast flows into the available multicast paths through the switch fabric. The ingress multicast manager understands the amount of available multicast bandwidth per path and the amount of bandwidth used per IP multicast stream.

Two policies define how each path should be managed, the bandwidth policy, and how multicast channels compete for the available bandwidth, the multicast information policy.

Chassis multicast planes should not be confused with IOM/IMM multicast paths. The IOM/IMM uses multicast paths to reach multicast planes on the switch fabric. An IOM/IMM may have less or more multicast paths than the number of multicast planes available in the chassis.

Each IOM/IMM multicast path is either a primary or secondary path type. The path type indicates the multicast scheduling priority within the switch fabric. Multicast flows sent on primary paths are scheduled at multicast high priority while secondary paths are associated with multicast low priority.

The system determines the number of primary and secondary paths from each IOM/IMM forwarding plane and distributes them as equally as possible between the available switch fabric multicast planes. Each multicast plane may terminate multiple paths of both the primary and secondary types.

The system ingress multicast management module evaluates the ingress multicast flows from each ingress forwarding plane and determines the best multicast path for the flow. A particular path may be used until the terminating multicast plane is “maxed” out (based on the rate limit defined in the **per-mcast-plane-capacity** commands) at which time either flows are moved to other paths or potentially blackholed (flows with the lowest preference are dropped first). In this way, the system makes the best use of the available multicast capacity without congesting individual multicast planes.

The switch fabric is simultaneously handling both unicast and multicast flows. The switch fabric uses a weighted scheduling scheme between multicast high, unicast high, multicast low and unicast low when deciding which cell to forward to the egress forwarding plane next. The weighted mechanism allows some amount of unicast and lower priority multicast (secondary) to drain on the egress switch fabric links used by each multicast plane. The amount is variable based on the number of switch fabric planes available on the amount of traffic attempting to use the fabric planes. The per-mcast-plane-capacity commands allows the amount of managed multicast traffic to be tuned to compensate for the expected available egress multicast bandwidth per multicast plane. In conditions where it is highly desirable to prevent multicast plane congestion, the per-mcast-plane-capacity commands should be used to compensate for the non-multicast or secondary multicast switch fabric traffic.

Multicast in the BSA

IP Multicast is normally not a function of the Broadband Service Aggregator (BSA) in a Triple Play aggregation network being a Layer 2 device. However, the BSA does use IGMP snooping to optimize bandwidth utilization.

IGMP Snooping

For most Layer 2 switches, multicast traffic is treated like an unknown MAC address or broadcast frame, which causes the incoming frame to be flooded out (broadcast) on every port within a VLAN. While this is acceptable behavior for unknowns and broadcasts, as IP Multicast hosts may join and be interested in only specific multicast groups, all this flooded traffic results in wasted bandwidth on network segments and end stations.

IGMP snooping entails using information in layer 3 protocol headers of multicast control messages to determine the processing at layer 2. By doing so, an IGMP snooping switch provides the benefit of conserving bandwidth on those segments of the network where no node has expressed interest in receiving packets addressed to the group address.

On the Alcatel-Lucent 7750 SR, IGMP snooping can be enabled in the context of VPLS services. The IGMP snooping feature allows for optimization of the multicast data flow for a group within a service to only those Service Access Points (SAPs) and Service Distribution Points (SDPs) that are members of the group. In fact, the Alcatel-Lucent 7750 SR implementation performs more than pure snooping of IGMP data, since it also summarizes upstream IGMP reports and responds to downstream queries.

The Alcatel-Lucent 7750 SR maintains a number of multicast databases:

- A port database on each SAP and SDP lists the multicast groups that are active on this SAP or SDP.
- All port databases are compiled into a central proxy database. Towards the multicast routers, summarized group membership reports are sent based on the information in the proxy database.
- The information in the different port databases is also used to compile the multicast forwarding information base (MFIB). This contains the active SAPs and SDPs for every combination of source router and group address (S,G), and is used for the actual multicast replication and forwarding.

When the router receives a join report from a host for a particular multicast group, it adds the group to the port database and (if it is a new group) to the proxy database. It also adds the SAP or SDP to existing (S,G) in the MFIB, or builds a new MFIB entry.

When the router receives a leave report from a host, it first checks if other devices on the SAP or SDP still want to receive the group (unless fast leave is enabled). Then it removes the group from

the port database, and from the proxy database if it was the only receiver of the group. The router also deletes entries if it does not receive periodic membership confirmations from the hosts.

The fast leave feature finds its use in multicast TV delivery systems, for example. Fast Leave speeds up the membership leave process by terminating the multicast session immediately, rather then the standard procedure of issuing a group specific query to check if other group members are present on the SAP or SDP.

IGMP/MLD Message Processing

Figure 42 illustrates the basic IGMP message processing by the 7750 SR in several situations.

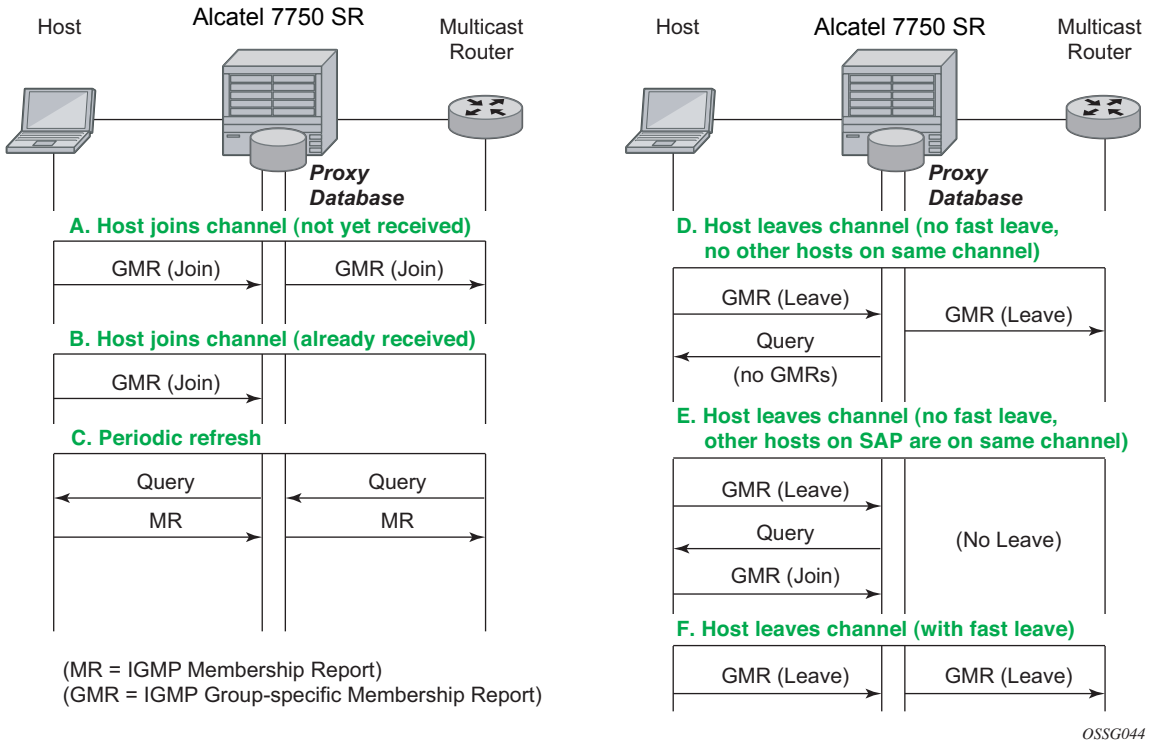


Figure 42: IGMP/MLD Message Processing

IGMP Message Processing

Scenario A: A host joins a multicast group (TV channel) which is not yet being received by other hosts on the router, and thus is not yet present in the proxy database. The 7750 SR adds the group

to the proxy database and sends a new IGMP Join group-specific membership report upstream to the multicast router.

Scenario B: A host joins a channel which is already being received by one or more hosts on the 7750 SR, and thus is already present in the proxy database. No upstream IGMP report is generated by the router.

Scenario C: The multicast router will periodically send IGMP queries to the router, requesting it to respond with generic membership reports. Upon receiving such a query, the 7750 SR will compile a report from its proxy database and send it back to the multicast router.

In addition, the router will flood the received IGMP query to all hosts (on SAPs and spoke SDPs), and will update its proxy database based on the membership reports received back.

Scenario D: A host leaves a channel by sending an IGMP leave message. If fast-leave is not enabled, the router will first check whether there are other hosts on the same SAP or spoke SDP by sending a query. If no other host responds, the 7750 SR removes the channel from the SAP. In addition, if there are no other SAPs or spoke SDPs with hosts subscribing to the same channel, the channel is removed from the proxy database and an IGMP leave report is sent to the upstream Multicast Router.

Scenario E: A host leaves a channel by sending an IGMP leave message. If fast-leave is not enabled, the router will check whether there are other hosts on the same SAP or spoke SDP by sending a query. Another device on the same SAP or spoke SDP still wishes to receive the channel and responds with a membership report. Thus the 7750 SR does not remove the channel from the SAP.

Scenario F: A host leaves a channel by sending an IGMP leave report. Fast-leave is enabled, so the 7750 SR will not check whether there are other hosts on the same SAP or spoke SDP but immediately removes the group from the SAP. In addition, if there are no other SAPs or spoke SDPs with hosts subscribing to the same group, the group is removed from the proxy database and an IGMP leave report is sent to the upstream multicast router.

MLD Message Processing

MLD message processing differs from IGMP. An IPv6 host can have two WAN IPv6 addresses and an IPv6 prefix. MLD messages source address are link local addresses. This makes it difficult to know if the originating host is a WAN host or a PD host. By default, all requested IPv6 (s,g) are first associated with a WAN host. If this particular WAN host disconnects or ends its IPv6 session, the (s,g) is then associated with the remaining WAN host. If there are no more WAN hosts, the (s,g) is then associated with the remaining PD host. The (s,g) is always transferred to the remaining IPv6 host until there are no more report replies to corresponding to the queries. Scenarios A — F will not differ for IPv6 hosts.

IGMP/MLD Filtering

A provider may want to block receive or transmit permission to individual hosts or a range of hosts. To this end, the Alcatel-Lucent 7750 SR supports IGMP/MLD filtering. Two types of filter can be defined:

- Filter IGMP/MLD membership reports from a particular host or range of hosts. This is performed by importing an appropriately defined routing policy into the SAP or spoke SDP.
- Filter to prevent a host from transmitting multicast streams into the network. The operator can define a data-plane filter (ACL) which drops all multicast traffic, and apply this filter to a SAP or spoke SDP.

Multicast VPLS Registration (MVR)

Multicast VPLS Registration (MVR) is a bandwidth optimization method for multicast in a broadband services network. MVR allows a subscriber on a port to subscribe and unsubscribe to a multicast stream on one or more network-wide multicast VPLS instances.

MVR assumes that subscribers join and leave multicast streams by sending IGMP join and leave messages. The IGMP leave and join message are sent inside the VPLS to which the subscriber port is assigned. The multicast VPLS is shared in the network while the subscribers remain in separate VPLS services. Using MVR, users on different VPLS cannot exchange any information between them, but still multicast services are provided.

On the MVR VPLS, IGMP snooping must be enabled. On the user VPLS, IGMP snooping and MVR work independently. If IGMP snooping and MVR are both enabled, MVR reacts only to join and leave messages from multicast groups configured under MVR. Join and leave messages from all other multicast groups are managed by IGMP snooping in the local VPLS. This way, potentially several MVR VPLS instances could be configured, each with its own set of multicast channels.

MVR by proxy — In some situations, the multicast traffic should not be copied from the MVR VPLS to the SAP on which the IGMP message was received (standard MVR behavior) but to another SAP. This is called MVR by proxy.

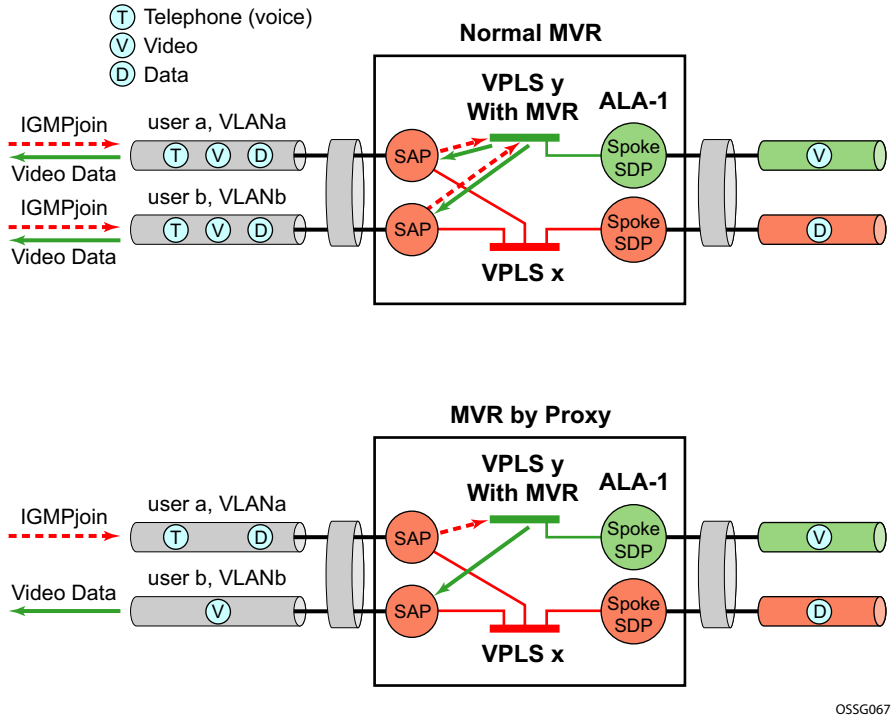


Figure 43: MVR and MVR by Proxy

Layer 3 Multicast Load Balancing

Layer 3 multicast load balancing establishes a more efficient distribution of Layer 3 multicast data over ECMP and LAG links. Operators have the option to redistribute multicast groups over ECMP and/or LAG links if the number of links changes either up or down.

When implementing this feature, there are several considerations. When multicast load balancing is not configured, the distribution remains as is. Multicast load balancing is based on the number of “s,g” groups. This means that bandwidth considerations are not taken into account. The multicast groups are distributed over the available links as joins are processed. When link failure occurs, the load is distributed on the failed channel to the remaining channels so multicast groups are evenly distributed over the remaining links. When a link is added (or failed link returned) all multicast joins on the added link(s) are allocated until a balance is achieved.

When multicast load balancing is configured, but the channels are not found in the multicast-info-policy, then multicast load balancing is based on the number of “s,g” groups. This means that bandwidth considerations are not taken into account. The multicast groups are distributed over the available links as joins are processed. The multicast groups are evenly distributed over the remaining links. When link failure occurs, the load is distributed on the failed channel to the remaining channels. When a link is added (or failed link returned) all multicast joins on the added link(s) are allocated until a balance is achieved.A manual redistribute command enables the operator to re-evaluate the current balance and, if required, move channels to different links to achieve a balance.A timed redistribute parameter allows the system to automatically, at regular intervals, redistribute multicast groups over available links. If no links have been added or removed from the ECMP/LAG interface, then no redistribution is attempted.

When multicast load balancing is configured, multicast groups are distributed over the available links as joins are processed based on bandwidth configured for the specified group address. If the bandwidth is not configured for the multicast stream then the configured default value is used.

If link failure occurs, the load is distributed on the failed channel to the remaining channels. The bandwidth required over each individual link is evenly distributed over the remaining links.

When an additional link is available for a given multicast stream, then it is considered in all multicast stream additions applied to the interface. This multicast stream is included in the next scheduled automatic rebalance run. A rebalance run re-evaluates the current balance with regard to the bandwidth utilization and if required, move multicast streams to different links to achieve a balance.

A rebalance, either timed or executing the **mc-ecmp-rebalance** command, should be administered gradually in order to minimize the effect of the rebalancing process on the different multicast streams. If multicast re-balancing is disabled and subsequently (re)enabled, keeping with the rebalance process, the gradual and least invasive method is used to minimize the effect of the changes to the customer.

By default multicast load balancing over ECMP links is enabled and set at 30 minutes.

The rebalance process can be executed as a low priority background task while control of the console is returned to the operator. When multicast load rebalancing is not enabled, then ECMP changes will not be optimized, however, when a link is added occurs an attempt is made to balance the number of multicast streams on the available ECMP links. This however may not result in balanced utilization of ECMP links.

Only a single **mc-ecmp-rebalance** command can be executed at any given time, if a rebalance is in progress and the command is entered, it is rejected with the message saying that a rebalance is already in progress. A low priority event is generated when an actual change for a given multicast stream occurs as a result of the rebalance process.

IGMP State Reporter

The target application for this feature is linear TV delivery. In some countries, wholesale Service Providers are obligated by the government regulation to provide information about channel viewership per subscriber to retailers.

A service provider (wholesaler or retailer) my use this information for:

- billing purposes
- market research/data mining to gain view into the most frequently watched channels, duration of the channel viewing, frequency of channel zapping by the time of the day, etc.

The information about channel viewership is based on IGMP states maintained per each subscriber host. Each event related to the IGMP state creation is recorded and formatted by the IGMP process. The formatted event is then sent to another task in the system (Exporter), which allocates a TX buffer and start a timer.

The event is then be written by the Exporter into the buffer. The buffer in essence corresponds to the packet that will contain a single event or a set of events. Those events are transported as data records over UDP transport to an external collector node. The packet itself has a header followed by a set of TLV type data structures, each describing a unique filed within the IGMP event.

The packet is transmitted when it reaches a preconfigured size (1400bytes), or when the timer expires, whichever comes first. Note that the timer started when the buffer was initially created.

The receiving end (collector node) accepts the data on the destination UDP port. It must be aware of the data format so that it can interpret incoming data accordingly. The implementation details of the receiving node are outside of the scope of this description and are left to the network operator.

The IGMP state recording per subscriber host must be supported for hosts which are replicating multicast traffic directly as well as for those host that are only keeping track of IGMP states for the HQoS Adjustment purpose. The latter will be implemented via redirection and not the Host Tracking (HT) feature as originally proposed. The IGMP reporting must differentiate events between direct replication and redirection.

It further distinguish events that are related to denial of IGMP state creation (due to filters, MCAC failure, etc.) and the ones that are related to removal of an already existing IGMP state in the system.

IGMP Data Records

Each IGMP state change generates a data record that is formatted by the IGMP task and written into the buffer. IGMP state transitions configured statically through CLI are not reported.

In order to minimize the size of the records when transported over the network, most fields in the data record are HEX coded (as opposed to ASCII descriptive strings).

Each data record has a common header as shown in Figure 44:

Figure 44: Common IGMP Data Record Header

Application:

- 0x01 - IGMP
- 0x02 - IGMP Host Tracking Event:

Event:

- Related to denial of a new state creation:
  - → 0x01 – Join
  - → 0x02 – (Join_Deny_Filter) Join denied due to filtering via an import policy
  - → 0x03 – (Join_Deny_CAC) Join denied due to MCAC
  - → 0x04 – (Join_Deny_MaxGrps) Join denied due to maximum groups per host limit reached
  - → 0x05 – (Join_Deny_MaxSrcs) Join denied due to maximum sources limit reached
  - → 0x06 - Join (Join_Deny_SysErr) Join denied due to an internal error (for example: out of memory)
  - → Related to removal of an existing IGMP state:
  - → 0x07 - (Drop_Leave_Rx) IGMP state is removed due to the Leave message
  - → 0x08 - (Drop_Expiry) IGMP state is removed due to time out (by default 2*query_interval + query_response_interval = 260sec)
  - → 0x09 - (Drop_Filter) IGMP state is removed due to filter (import policy) change
  - → 0x0A - (Drop_CfgChange) IGMP state is removed due to configuration change (clear grp, intf shutdown, PPPoE session goes unexpectedly down)

→ 0x0B - (Drop_CAC) an existing stream is stopped due to configuration change in MCAC

Length:

- The length of the entire data record (including the header and TLVs) in octets.

16 bit Sequence Number

- Since IGMP Reporting is based on connectionless transport (UDP), a 16 bit sequence numbers are used in each data record so that data loss in the network can be tracked.
- The 16 bit sequence number is located after the timestamp field. The sequence numbers will increase sequentially from 0 — 65535 and then rollover back to 0.

Timestamp:

- Timestamp is in Unix format (32 bit integer in seconds since 01/01/1970) plus an extra 8 bits for 10msec resolution.

TLVs describing the IGMP state record will have the following structure:

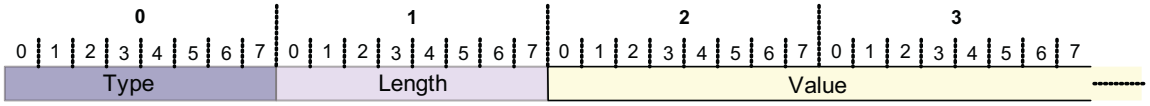


Figure 45: Data Record Field TLV Structure

Table 13: Data Record Field Description

Type	Description	Encoding/Length	Mandatory/Optional
0x02	Subscriber ID	ASCII	M
0x03	Sub Host IP	4 Bytes IPv4	M
0x04	Mcast Group IP	4 Bytes IPv4	M
0x05	Mcast Source IP	4 Bytes IPv4	M
0x06	Host MAC	6 Bytes	M
0x07	PPPoE Session-ID	2 Bytes	M
0x08	Service ID	4 Bytes	M
0x09	SAP ID	ASCII	M
0x0A	Redirection vRtrId	4 Bytes	M
0x0B	Redirection ifIndex	4 Bytes	M

The *redirection destination* TLV is a mandatory TLV that is sent only in cases where redirection is enabled. It contains two 32 bit integer numbers. The first number identifies the VRF where IGMPs are redirected; the second number identifies the interface index.

Optional fields can be included in the data records according to the configuration.

In IGMPv3, if an IGMP message (Join or Leave) contains multiple multicast groups or a multicast group contains multiple IP sources, only a single event is generated per group-source combination. In other words, data records are transmitted with a single source IP address and multiple mcast group addresses or a single multicast group address with multiple source IP addresses, depending on the content of the IGMP message. (*,G)

Transport Mechanism

Data is transported via UDP socket. Destination IP address, the destination port and the source IP address are configurable. The default UDP source and destination port number is 1037.

Upon the arrival of an IGMP event, the Exporter allocates a buffer for the packet (if not already allocated) and starts writing the events into the buffer (packet). Along with the initial buffer creation, a timer is started. The trigger for the transmission of the packet is either the TX buffer being filled up to 1400B (hard coded value), or the timer expiry, whichever comes first.

The source IP address is configurable within GRT (by default system IP), and the destination IP address can be reachable only via GRT. The source IP address is modified via **system>security>source-address>application** CLI hierarchy.

The receiving end (the collector node) collects the data and process them according to the formatting rules defined in this document. The capturing and processing of the data on the collector node is outside of the context of this description.

It should be noted that the processing node will need to have sufficient resources to accept and process packets that contain information about every IGMP state change for every host from a set of network BRASes that are transporting data to this particular collector node.

Multicast Reporter traffic will be marked as BE (all 6 DSCP bits are set to 0) exiting our system.

HA Compliance

IGMP Events are synchronized between two CPMs before they are transported out of the system.

QoS Awareness

IGMP Reporter is a client of sgt-qos so that DSCP/dot1p bits can be appropriately be marked when egressing the system.

Hardware Support

The following hardware is supported on the 7750 platform.

IOM support: IOM3, HSMDAv2, Ethernet based non HS-MDAs

Chassis mode: B, C, and D.

IGMP Reporting Caveats

The following are not supported:

- Regular (non-subscriber) interfaces
- SAM support as the collector device

Multicast Support over Subscriber Interfaces in Routed CO Model

Applications for multicast over Subscriber Interfaces in Routed CO ESM model can be divided in two main categories:

Residential customers where the driver applications are:

- IPTV in an environment with legacy non-multicasting DSLAMs
- Internet multicast where users connect to a multicast stream sourced from the Internet.

For the business customers, the main drivers are enterprise multicast and Internet multicast applications.

On multicast-capable ANs, a single copy of each multicast stream is delivered over a separate regular IP interface. AN would then perform the replication. This is how multicast would be deployed in Routed CO environment with 7x50s.

On legacy, non-multicast ANs, or in environments with low volume multicast traffic where it is not worth setting up a separate multicast topology (from BNG to AN), multicast replication is performed via subscriber-interfaces in 7x50. There are differences in replicating multicast traffic on IPoE vs PPPoX which will be described in subsequent sessions.

An example of a business connectivity model is shown in Figure 46.

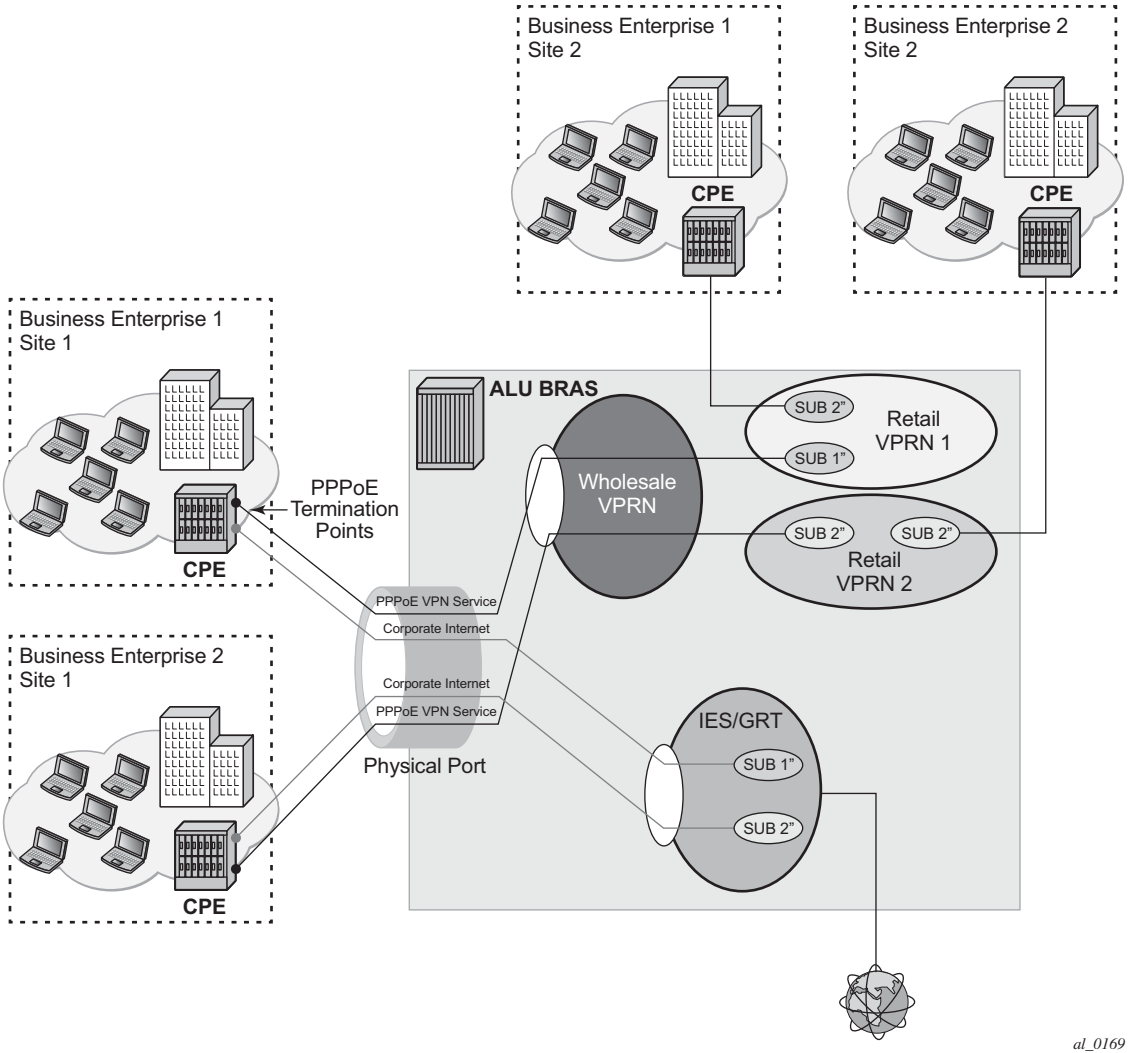


Figure 46: A Typical Business Connectivity Model

In this example, HSI is terminated in a Global Routing Table (GRT) whereas VPRN services are terminated in Wholesale/Retail VPRN fashion, with each customer using a separate VPRN.

The actual connectivity model that will be deployed depends on many operational aspects that are present in the customer environment.

Multicast over subscriber-interfaces in a Routed CO model is supported for both types of hosts, IPoE and PPPoE which can be simultaneously enabled on a shared SAP.

There are some fundamental differences in multicast behavior between two host types (IPoE and PPPoX). The differences will be discussed further in the next sections.

Hardware Support

Multicast over subscriber interfaces is supported on all FP2 based hardware that supports Routed CO model. This includes:

- 7750 SR-7/12
- 7750-c4/12
- 7450 in mixed mode

Chassis modes B, C and D are supported.

Multicast Over IPoE

There are several deployment scenarios for delivering multicast directly over subscriber hosts:

- 1:1 model (subscriber per VLAN/SAP) with the Access Node (AN) that is not IGMP/MLD aware.
- N:1 model (service per VLAN/SAP) with the AN in the Snooping mode.
- N:1 model with the AN in the Proxy mode.
- N:1 model with the AN that is not IGMP/MLD aware.

There are two modes of operation for subscriber multicast that can be chosen to address the above mentioned deployment scenarios:

1. Per SAP replication — A single multicast stream per group is forwarded on any given SAP. Even if the SAP has a multicast group (channel) that is registered to multiple hosts, only a single copy of the multicast stream is forwarded over this SAP. The multicast stream will have a multicast destination MAC address (as opposed to unicast). IGMP/MLD states will be maintained per host. This is the default mode of operation.
2. Per subscriber host replication in this mode of operation, multicast is replicated per subscriber host even if this means that multiple copies of the same stream will be forwarded over the same SAP. For example, if two hosts on the same SAP are registered to receive the same multicast group (channel), then this multicast channel will be replicated twice on the same SAP. The streams will have a unique unicast destination MAC address (otherwise it would not make sense to replicate the streams twice).

In all deployment scenarios and modes of operation the IGMP/MLD states per source IP address of the incoming IGMP/MLD message is maintained. This source IP address might represent a subscriber hosts or the AN (proxy mode).

For MLD, the source IP address is the host link local address. Therefore, the MLD message is associated with all IP address/prefix of the host.

Per SAP Replication Mode

In the per SAP replication mode a single copy of the multicast channel is forwarded per SAP. In other words, if a subscriber (in 1:1 mode) or a group of subscribers (in N:1 mode) have multiple hosts and all of them are subscribed to the same multicast group (watching the same channel), then only a single copy of the multicast stream for that group will be sent. The destination MAC address will always be a multicast MAC (there will be no conversion to unicast mac address).

IGMP/MLD states are maintained per subscriber host and per SAP.

Per SAP Queue

Multicast traffic over subscribers in a per SAP replication mode is flowing via a SAP queue which is outside of the subscriber queues context. Sending the multicast traffic over the default SAP queue is characterized by:

- The inability to classify multicast traffic into separate subscriber queues and therefore include it natively in HQoS. However, multicast traffic can be classified into a specific SAP queues, assuming that such queues are enabled via SAP based QoS policy. While multiple SAP queues can be defined under static SAPs, the dynamic SAPs (MSAPs) are limited to a single SAP queue defined in the default egress-sap policy. This default egress-sap policy under MSAP cannot be replaced or modified.
- Redirection of multicast traffic via internal queues in case that the SAP queue in subscriber environment is disabled (**sub-sla-mgmt>single-sub-parameters>profiled-traffic-only**). This is applicable only to 1:1 subscriber model.
- A possible necessity for HQoS Adjustment as multicast traffic is flowing outside of the subscriber queues.
- De-coupling of the multicast forwarding statistics from the overall subscriber forwarding statistics obtained via subscriber specific show commands.

IPoE 1:1 Model (Subscriber per VLAN/SAP) — No IGMP/MLD in AN

This model is shown in Figure 47. The AN is not IGMP/MLD aware, all replications are performed in the BNG. From the BNG perspective this deployment model has the following characteristics:

- IGMP/MLD states are kept per hosts and SAPs. Each host can be registered to more than one group.
- MLD utilize link-local as source address, which makes it difficult to associate with the originating host. MLD (S,G) are always first associated with a IPv6 WAN host if available. If this WAN host terminate its IPv6 session (via lease expiry, session terminate, etc.), the (S,G) is then associated to any remaining WAN host. Only when there are no more WAN hosts available will the (S,G) be associated to the PD host, if any.
- IGMP/MLD Joins will be accepted only from the active subscriber hosts as dictated by antispoofing.
- IGMP/MLD statistics can be displayed per host or per group.
- Multicast traffic for the subscriber is forwarded through the egress SAP queue. In case that the SAP queue is disabled (profiled-traffic-only command), multicast traffic will flow via internal queues outside of the subscriber context.
- A single copy of any multicast stream is generated per SAP. This can be viewed as replication per unique multicast group per SAP, rather than the replication per host. In other words, the number of multicast streams on this SAP is equal to the number of unique groups across all hosts on this SAP (subscriber).

- Traffic statistics are kept per the SAP queue. Consequently multicast traffic stats will be shown outside of the subscriber context.
- HQoS Adjustment might be necessary.
- Traffic cannot be explicitly classified (forwarding classes and queue mappings) inside of the subscriber queues.
- Redirection to the common multicast VLAN (or Layer 3 interface) is supported.
- Multicast streams have multicast destination MAC.
- MLD utilize link-local as source address, which makes it difficult to associate with the originating host. MLD (s,g) is associated with the IPv6 host. Therefore, if any WAN host or PD host end their IPv6 session (via lease expire, etc.), the (s,g) is associated with the remaining host address/prefix. The (s,g) will be delivered to the subscriber as long as a IPv6 address or prefix remains.

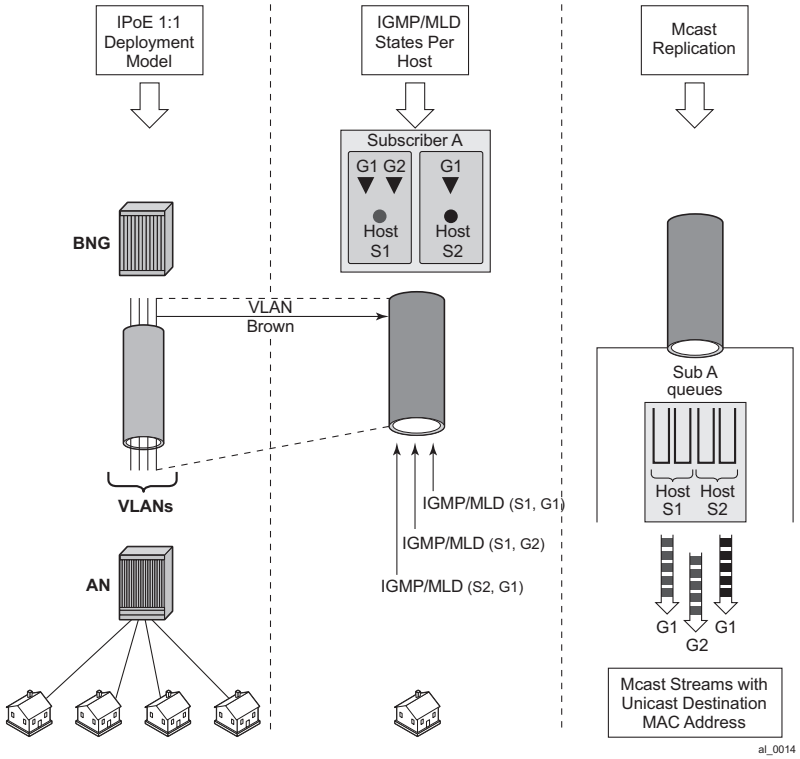


Figure 47: 1:1 Model

IPoE N:1 Model (Service per VLAN/SAP) — IGMP/MLD Snooping in the AN

This model is shown in Figure 48. The AN is IGMP/MLD aware and is participating in multicast replication. From the BNG perspective this deployment model has the following characteristics:

- IGMP/MLD states are kept per hosts and SAPs. Each host can be registered to more than one group.
- IGMP/MLD Joins are accepted only from the active subscriber hosts as dictated by antispoofing.
- IGMP/MLD statistics are displayed per host, per group or per subscriber.
- Multicast traffic for ALL subscribers on this SAP is forwarded through the egress SAP queues.
- A single copy of any multicast stream is generated per SAP. This can be viewed as the replication per unique multicast group per SAP, rather than the replication per host or subscriber. In other words, the number of multicast streams on this SAP is equal to the number of unique groups across all hosts and subscribers on this SAP.
- The AN will receive a single multicast stream and based on its own (AN) IGMP/MLD snooping information, it will replicate the mcast stream to the appropriate subscribers.
- Traffic statistics are kept per the SAP queue. Consequently multicast traffic stats will be shown on a per SAP basis (aggregate of all subscribers on this SAP).
- Traffic cannot be explicitly classified (forwarding classes and queue mappings) inside of the subscriber queues.
- Redirection to the common multicast VLAN is supported.
- Multicast streams have multicast destination MAC.
- IGMP Joins are accepted (src IP address) only for the sub hosts that are already created in the system. IGMP Joins coming from the hosts that are nonexistent in the system will be rejected, unless this functionality is explicitly enabled by the sub-hosts-only command under the IGMP group-int CLI hierarchy level.
- MLD utilize link-local as source address, which makes it difficult to associate with the originating host. MLD (S,G) are always first associated with a IPv6 WAN host, if available.If this WAN host terminate its IPv6 session (via lease expiry, session terminate, etc), the (S,G) is then associated to any remaining WAN host. Only when there are no more WAN hosts available, will the (S,G) be associated to the PD host, if any.
- MLD join are only accepted if it matches the subscriber host link local address. MLD Joins coming from the hosts that are nonexistent in the system will be rejected, unless this functionality is explicitly enabled by the sub-hosts-only command under the MLD group-int CLI hierarchy level.

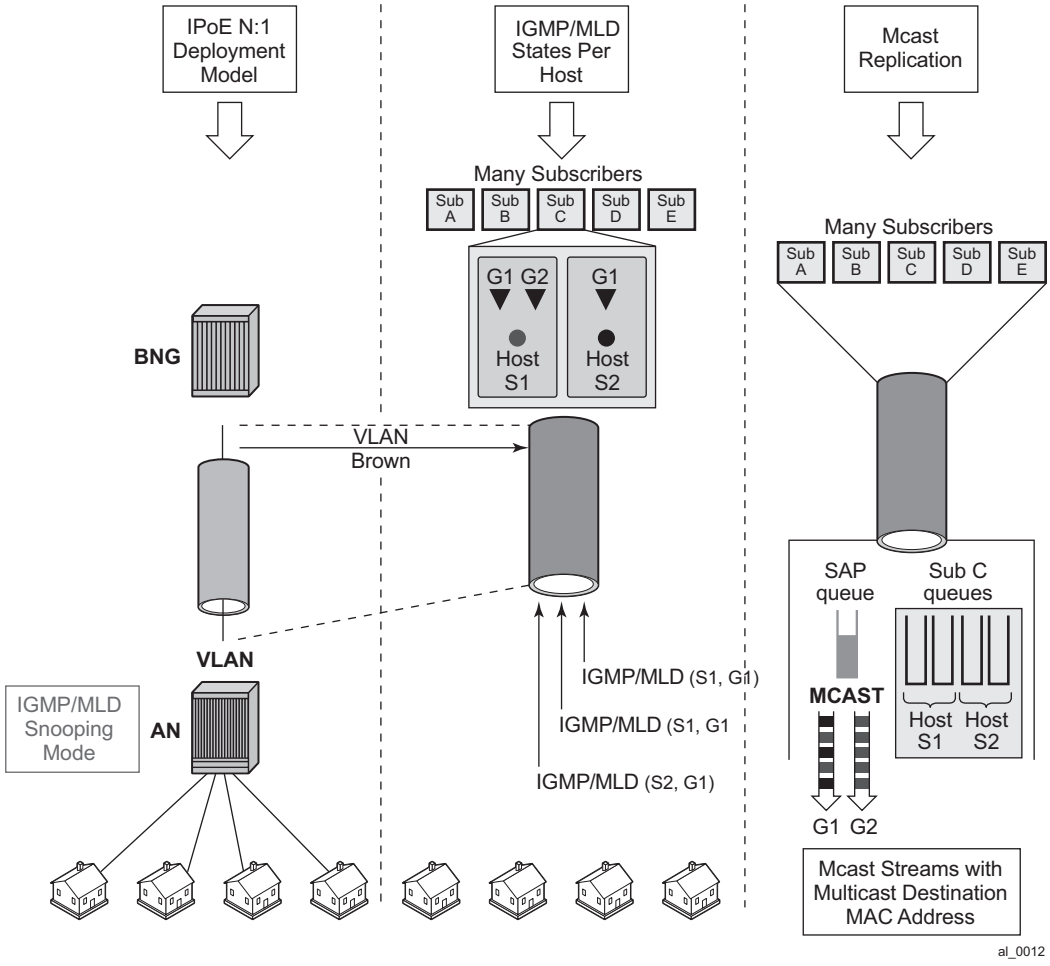


Figure 48: - N:1 Model - AN in IGMP Snooping Mode

IPoE N:1 Model (Service per VLAN/SAP) — IGMP/MLD Proxy in the AN

This model is shown in Figure 49. The AN is configured as IGMP/MLD Proxy node and is participating in downstream multicast replication.

For IPv4, IGMP messages from multiple sources (subscribers hosts) for the same multicast group are consolidated in the AN into a single IGMP messages. This single IGMP message has the source IP address of the AN.

For IPv6, MLD messages from multiple sources (subscribers hosts) for the same multicast group are consolidated in the AN into a single MLD messages. This single MLD message has the link-local IP address of the AN.

From the BNG perspective this deployment model has the following characteristics:

- Subscriber IGMP/MLD states are maintained in the AN.
- IGMP Joins are accepted from the source IP address that is different from any of the subscriber' IP addresses already existing in the BNG. This will be controlled via an IGMP filter on a per group-interface level assuming that the IGMP processing for subscriber hosts is disabled with the no **sub-hosts-only** command under the router/service **vprn>igmp>group-interface** CLI hierarchy. In this case all IGMP messages that cannot be related to existing hosts will be treated in the context of the sap while IGMP messages from the existing hosts will be treated in the context of the subscriber hosts.
- MLD Joins are only accepted if the link-local address matches the subscriber' link local address. To allow processing of foreign link-local address such as the AN link local address, the MLD processing for subscriber hosts should be disabled with the no sub-hosts-only command under the **router/service vprn>mld>group-interface** CLI hierarchy. In this case all MLD messages that cannot be related to existing hosts will be treated in the context of the sap while MLD messages from the existing hosts will be treated in the context of the subscriber hosts.
- IGMP/MLD statistics can be displayed per group-interface.
- Multicast traffic for all subscribers on this SAP is forwarded through the egress SAP queue.
- A single copy of any multicast stream is generated per SAP.
- The AN will receive a single multicast stream. Based on the IGMP/MLD proxy information, the AN will replicate the mcast stream to the appropriate subscribers.
- Traffic statistics are maintained per SAP queue.
- HQoS Adjustment is not useful because the per host/subscriber IGMP/MLD granularity is lost. IGMP/MLD states are aggregated per AN.
- Traffic can be explicitly classified into a specific SAP queues via a QoS policy applied under the SAP.
- Multicast streams have multicast destination MAC.

In the following example, IGMPs from the source IP address <ip> is accepted even though there is no subscriber-host with that IP addresses present in the system. An IGMP state will be created under the sap context (service per vlan, or N:1 model) for the group <pref-definition>. All other IGMP messages originated from non-subscriber hosts will be rejected. IGMP messages for subscriber hosts will be processed according to the igmp-policy applied to each subscriber host.

```
configure
     service vprn <id>
          igmp
               group-interface <name>
                    import <policy-name>

configure
     router
          policy-options
               begin
                    prefix-list <pref-name>
                         prefix <pref-definition>

                    policy-statement proxy-policy
                entry 1
                    from
                          group-address <pref-name>
                            source-address <ip>
                            protocol igmp
                        exit
                   action accept
                   exit
                      exit
                      default-action reject
```

This functionality (accepting IGMP from non-subscriber hosts) can be disabled with the following flag.

```
configure
     service vprn <id>
          igmp
               group-interface <name>
    sub-host-only
```

In this case only per host IGMP processing will be allowed.

In the following example, MLDs with foreign link-local-address is accepted even though there is no subscriber-host with that link local addresses present in the system. An MLD state will be created under the sap context (service per vlan, or N:1 model) for the group <pref-definition>. All other MLD messages originated from non-subscriber hosts will be rejected. MLD messages for subscriber hosts will be processed according to the igmp-policy applied to each subscriber host.

```
configure
     service vprn <id>
          mld
               group-interface <name>
                    import <policy-name>

configure
     router
          policy-options
               begin
                    prefix-list <pref-name>
                         prefix <pref-definition>

                    policy-statement proxy-policy
                entry 1
                    from
                          group-address <pref-name>
                            source-address <ip>
                            protocol igmp
                        exit
                   action accept
                   exit
                      exit
                      default-action reject
```

This functionality (accepting MLD from non-subscriber hosts) can be disabled with the following flag.

```
configure
     service vprn <id>
          mld
               group-interface <name>
                    sub-host-only
```

In this case only per host MLD processing will be allowed.

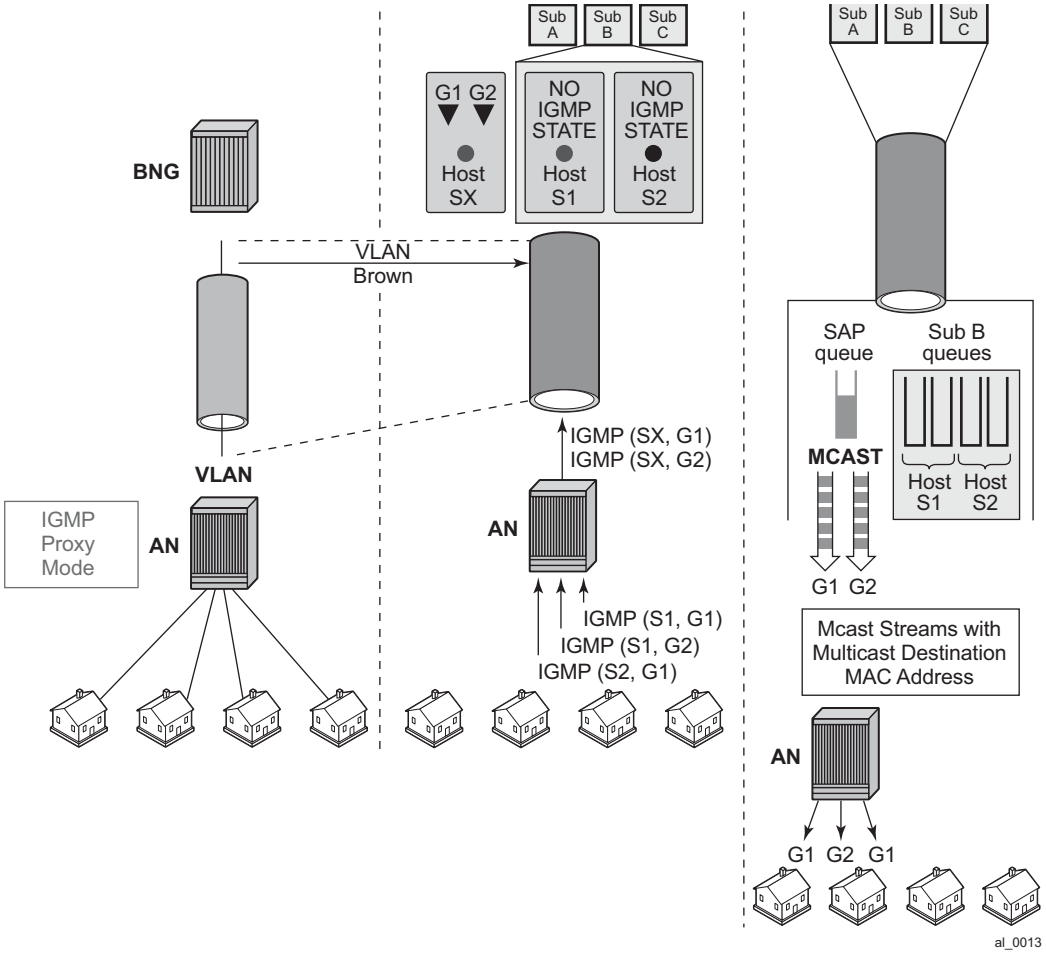


Figure 49: N:1 Model - AN in Proxy mode

Per Subscriber Host Replication Mode

In this mode a multicast stream is transmitted per subscriber hosts for each registered multicast group (channel). As a result, multiple copies of the same multicast stream destined to different destinations can be transmitted over the same SAP. In this case traffic flows within the subscriber queues and consequently it is accounted in HQoS. As a result, HQoS Adjustment is not needed. Each copy of the same multicast stream have a unique unicast destination MAC addresses. The per host unicast MAC destination addresses are necessary to differentiate multiple copies between different receivers on the same SAP.

Per host replication mode can be enabled on a subscriber basis with the **per-host-replication** command in the **config>subscriber-management>igmp-policy** context.

For IPv6, the command is in the **config>subscriber-management>mld-policy** context.

IPoE 1:1 Model (Subscriber per VLAN/SAP) — No IGMP/MLD in AN

This model is shown in Figure 50. The AN is not IGMP/MLD aware and multicast replication is performed in the BNG. Multicast streams are sent directly to the hosts using their unicast MAC addresses. HQoS adjustment is not needed as multicast traffic is flowing through subscriber queues. From the BNG perspective this deployment model has the following characteristics:

- IGMP/MLD states are kept per hosts. Each host can be registered to multiple IGMP/MLD groups.
- MLD utilize link-local as source address, which makes it difficult to associate with the originating host. MLD (S,G) are always first associated with a IPv6 WAN host if available. If this WAN host terminate its IPv6 session (via lease expiry, session terminate, etc), the (S,G) is then associated to any remaining WAN host. Only when there are no more WAN hosts available, will the (S,G) be associated to the PD host, if any.
- IGMP/MLD Joins will be accepted only from the active subscriber hosts. In other words antispoofing is in effect for IGMP/MLD messages.
- IGMP/MLD statistics can be displayed per host, per group or per subscriber.
- Multicast traffic is forwarded through subscriber queues using unicast destination MAC address of the destination host.
- Multiple copies of the same multicast stream can be generated per SAP. The number of copies depends on the number of hosts on the SAP that are registered to the same multicast group (channel). In other words, the number of multicast streams on the SAP is equal to the number of groups registered across all hosts on this SAP.
- Traffic statistics are kept per the host queue. In case that multicast statistics need to be separated from unicast, the multicast traffic should be classified in a subscriber separate queue.
- HQoS Adjustment is not needed as traffic is flowing within the subscriber queues and is automatically accounted in HQoS.
- Multicast traffic can be explicitly classified into forwarding classes and consequently directed into desired queues.
- MCAC is supported.
- profiled-traffic-only mode defined under sub-sla-mgmt is supported. This mode (profiled-traffic-only) is used to save the number of queues in 1:1 model (sub-sla-mgmt-> no multi-sub-SAP) by preventing the creation of the SAP queues. Since multicast traffic is not using the SAP queue, enabling this feature will not have any effect on the multicast operation.

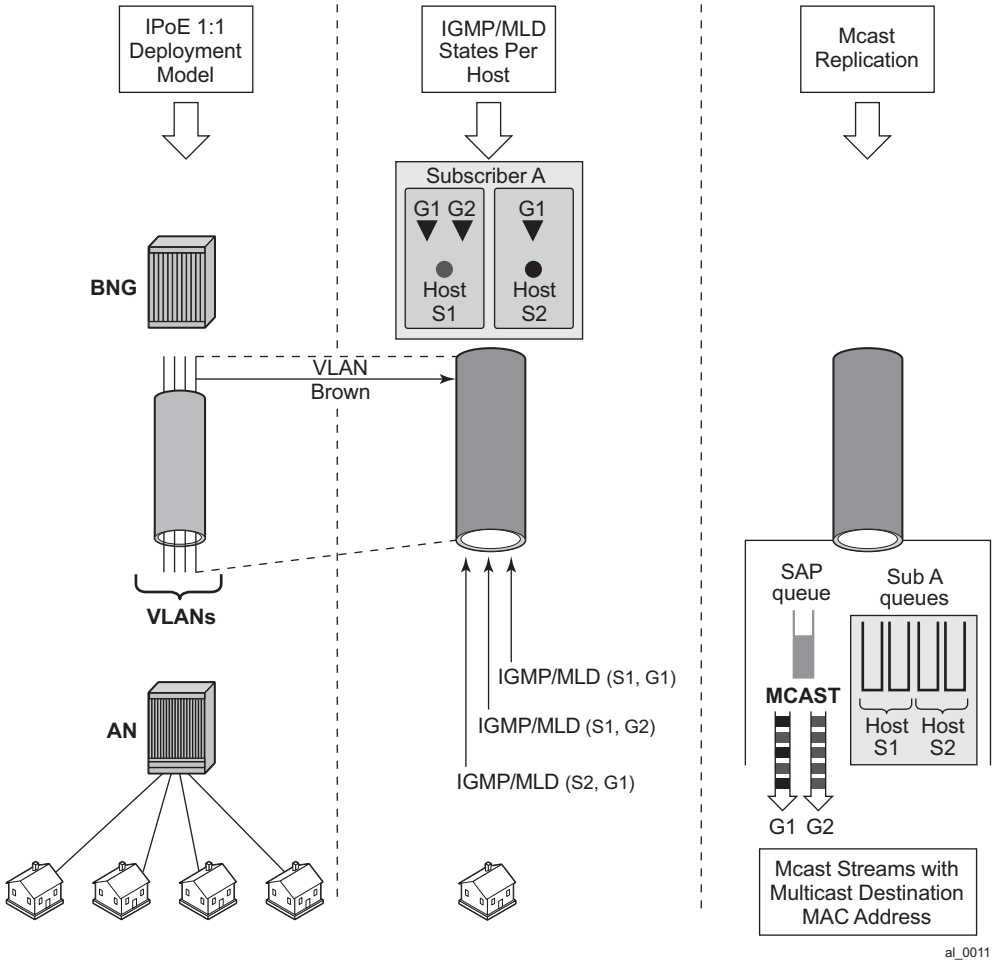


Figure 50: 1:1 Model

IPoE N:1 Model (Service per VLAN/SAP) — No IGMP/MLD in the AN

This model is shown in Figure 51. The AN is not IGMP/MLD aware and is not participating in multicast replication. From the BNG perspective this deployment model has the following characteristics:

- IGMP/MLD states are kept per hosts. Each host can be registered to multiple multicast groups.
- MLD utilize link-local as source address, which makes it difficult to associate with the originating host. MLD (S,G) are always first associated with a IPv6 WAN host if available. If this WAN host terminate its IPv6 session (via lease expiry, session terminate, etc), the (S,G) is then associated to any remaining WAN host. Only when there are no more WAN hosts available, will the (S,G) be associated to the PD host, if any.
- IGMP/MLD Joins will be accepted only from the active subscriber hosts, subject to antispoofing.
- IGMP/MLD statistics can be displayed per host, per group or per subscriber.
- Multicast traffic is forwarded through subscriber queues using unicast destination MAC address of the destination host.
- Multiple copies of the same multicast stream can be generated per SAP. The number of copies depends on the number of hosts on the SAP that are registered to the same multicast group (channel). In other words, the number of multicast streams on the SAP is equal to the number of groups registered across all hosts on this SAP.
- Traffic statistics are kept per the host queue. In case that multicast statistics need to be separated from unicast, the multicast traffic should be classified in a separate subscriber queue.
- HQoS Adjustment is NOT needed as traffic is flowing within the subscriber queues and is automatically accounted in HQoS.
- Multicast traffic can be explicitly classified into forwarding classes and consequently directed into desired queues.
- MCAC is supported.

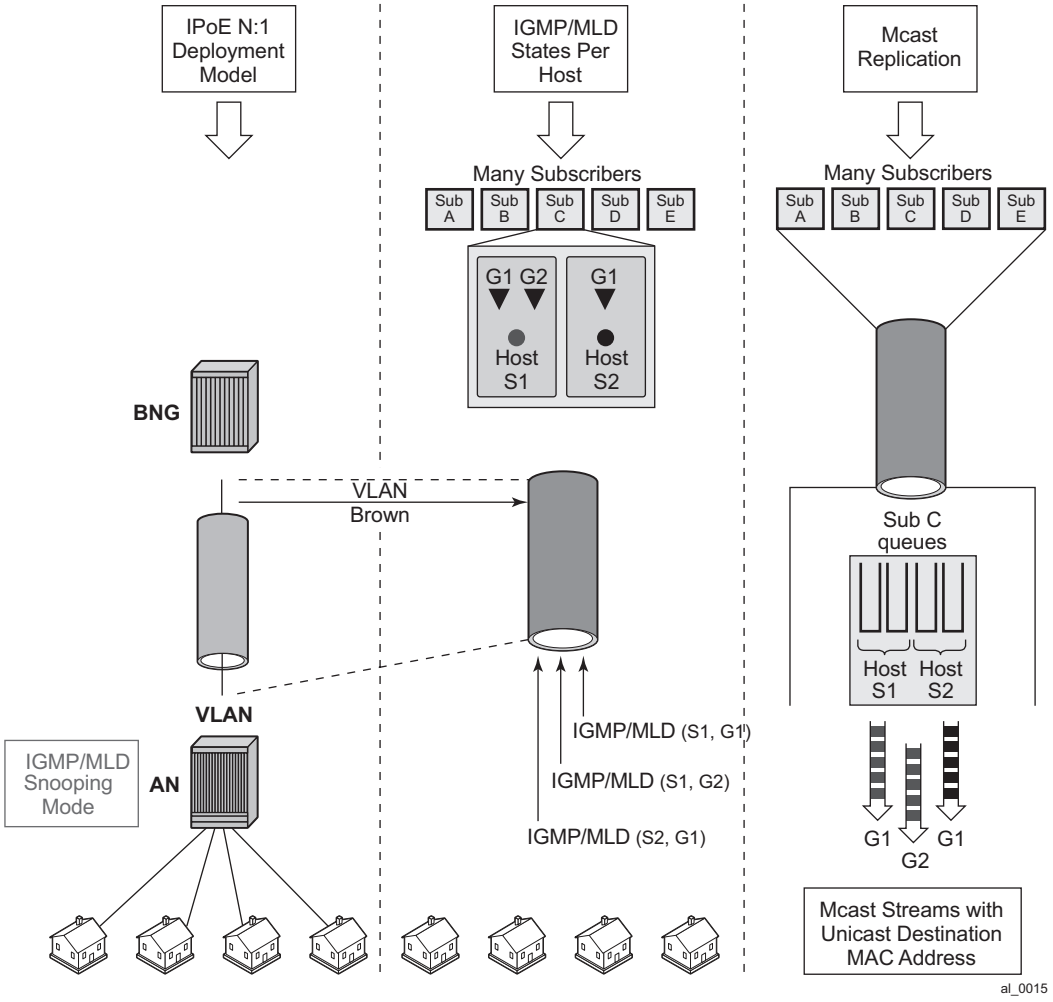


Figure 51: N:1 Model — No IGMP/MLD in the AN

Multicast Over PPPoE

In a PPPoE environment, multicast replication is performed per session (host) regardless of whether those sessions are shared per SAP or they reside on individual SAPs. This is due to the point-to-point nature of PPPoE sessions. There will be no need for HQoS adjustment as multicast is part of the PPPoE session traffic that is flowing via subscriber queues. Multicast packets are sent with unicast MAC address to each CPE. PPP protocol field is set to IP and the destination IP address is the multicast group address for each unique session ID (Figure 52).

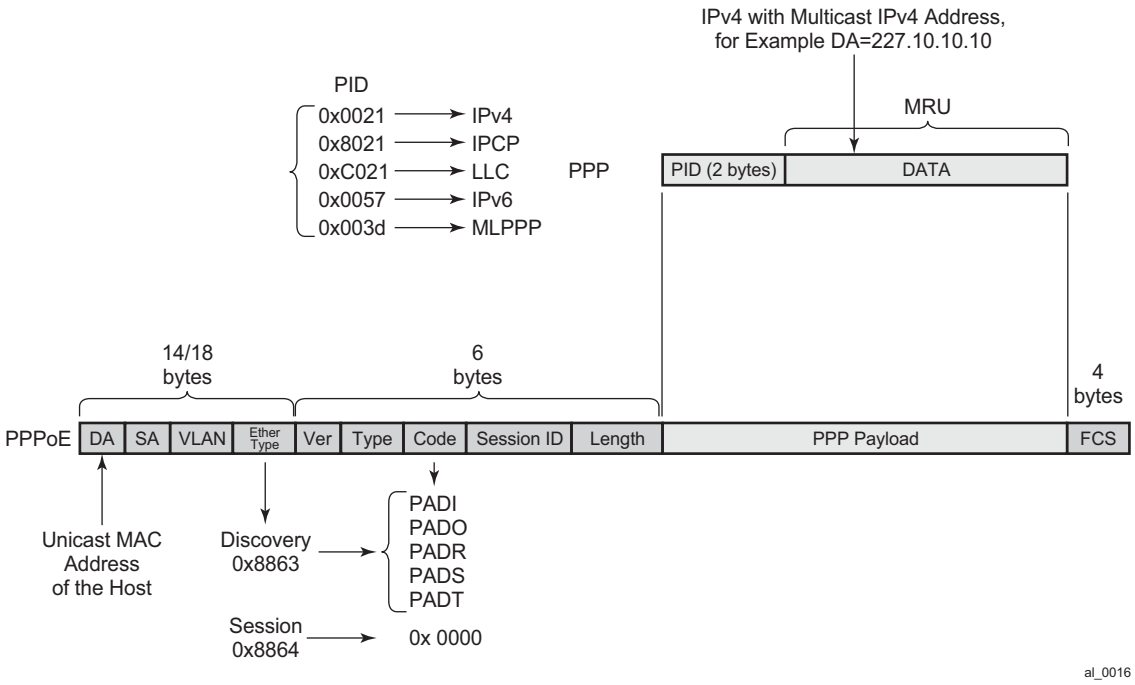


Figure 52: Multicast IPv4 Address and Unicast MAC Address in PPPoE Subscriber Multicast

IGMP Flooding Containment

The query function in IGMP can cause some unintended flooding in N:1 IPoE deployment model with AN in the IGMP snooping mode. By maintaining IGMP session states per host, it is assumed that the IGMP interaction between multicast receivers and the BNG will be on a one-to-one basis. Upon arrival of an IGMP leave from a host for a specific multicast group, the IGMP querier would normally multicast a group-specific query (fast-leave). In N:1 model with sap-replication mode enabled, 7x50 will send a group-specific query (fast-leave) only when it receives the IGMP leave message for the last group shared amongst all subscribers on this SAP.

IGMP/MLD Timers

IGMP/MLD timers are maintained under the following hierarchy:

IPv4:

configure>router>igmp

configure>service vprn>igmp

IPv6:

configure>router>mld

configure>service vprn>mld

As it can be seen, the IGMP/MLD timers are controlled on a per routing instance (VRF or GRT) level.

The timer values are used to:

- Determine the interval at which queries are transmitted (query-interval).
- To determine the amount of time after which a join will time out.

However, the timers can be different for hosts and redirected interface in case that redirection between VRFs is enabled.

IGMP/MLD Query Intervals

IGMP/MLD query related intervals (query-interval, query-last-member-interval, query-response-interval, robust-count) are configured on a global router/vprn IGMP/MLD level. They are used to determine the IGMP/MLD timeout states and the rates at which queries are transmitted.

In case of redirection, the subscriber-host IGMP/MLD state will determine the IGMP/MLD state on the redirected interface, assuming that IGMP/MLD messages are not directly received on the redirected interface (for example from the AN performing IGMP/MLD forking). For example if the redirected interface is not receiving IGMP/MLD messages from the downstream node, then the IGMP/MLD state under redirected interface will be removed simultaneously with the removal of the IGMP/MLD state for the subscriber host (due to leave or a timeout).

In case that the redirected interface is receiving IGMP/MLD message directly from the downstream node, the IGMP/MLD states on that redirected interface will be driven by those direct IGMP/MLD messages.

For example, an IGMP/MLD host in VRF1 has an expiry time of 60 seconds and the expiry time defined under the VRF2 where multicast traffic is redirected is set to 90 seconds. The IGMP/MLD state will time out for the host in VRF1 after 60s, and if no host has joined the same multicast group in VRF2 (where redirected interface resides), the IGMP state will be removed there too.

If a join was received directly on the redirection interface in VRF2, the IGMP/MLD state for that group will be maintained for 90s, regardless of the IGMP/MLD state for the same group in VRF1.

HQoS Adjustment

HQoS Adjustment is required in the scenarios where subscriber multicast traffic flow is disassociated from subscriber queues. In other words, the unicast traffic for the subscriber is flowing through the subscriber queues while at the same time multicast traffic for the same subscriber is explicitly (through redirection) or implicitly (per-sap replication mode) redirected through a separate non-subscriber queue. In this case HQoS Adjustment can be deployed where preconfigured multicast bandwidth per channel is artificially included in HQoS. For example, bandwidth consumption per multicast group must be known in advance and configured within the 7x50. By keeping the IGMP state per host, the bandwidth for the multicast group (channel) to which the host is registered is known and is deducted as consumed from the aggregate subscriber bandwidth.

The multicast bandwidth per channel must be known (this is always an approximation) and provisioned in the BNG node in advance.

In PPPoE and in IPoE per host replication environment, HQoS Adjustment is not needed as multicast traffic is unicasted to each subscriber and therefore is flowing through subscriber queues.

For HQoS Adjustment, the channel bandwidth definition and association with an interface is the same as in the MCAC case. This is a departure from the legacy HT channel bandwidth definition which is done via multicast-info-policy.

Example of HQoS adjustment:

Channel definition:

```
configure
     router
          mcac
               policy <name>
                    <channel definition>
```

Channel bandwidth definition policy can be applied under:

- group-interface

```
configure
     service vprn <id>
          igmp
               group-interface <grp-if-name>
                    mcac
                         policy <mcac-policy-name>
```

- plain interface

```
configure
     router/service vprn
          igmp
               interface <name>
                    mcac
                         policy <mcac-policy-name>
```

- retailer group-interface:

```
configure
     service vprn <id>
          igmp
               group-interface fwd-service <svc-id> <grp-if-name>
                    mcac
  policy <mcac-policy-name>
```

Enabling HQoS adjustment:

```
configure
    subscriber-management
     igmp-policy <name>
```

```
        egress-rate-modify [egress-aggregate-rate-limit | scheduler <name>]
```

Applying HQoS adjustment to the subscriber:

```
configure
    subscriber-management
     sub-profile <name>
          igmp-policy <name>
```

In order to activate HQoS adjustment on the subscriber level, the sub-mcac-policy must be enabled under the subscriber via the following CLI:

```
configure
     subscriber-management
          sub-mcac-policy <pol-name>
               no shutdown

configure
     subscriber-management
          sub-profile <name>
               sub-mcac-policy <pol-name>
```

The adjusted bandwidth during operation can be verified with the following commands (depending whether agg-rate-limit or scheduler-policy is used):

```
*B:BNG-1# show service active-subscribers subscriber "sub-1" detail
===============================================================================
Active Subscribers
===============================================================================
-------------------------------------------------------------------------------
Subscriber sub-1
-------------------------------------------------------------------------------
I. Sched. Policy : up-silver
E. Sched. Policy : N/A                           E. Agg Rate Limit: 4000
I. Policer Ctrl. : N/A
E. Policer Ctrl. : N/A
Q Frame-Based Ac*: Disabled
Acct. Policy     : N/A                           Collect Stats    : Enabled
Rad. Acct. Pol.  : sub-1-acct
Dupl. Acct. Pol. : N/A
ANCP Pol.        : N/A
HostTrk Pol.     : N/A
IGMP Policy      : sub-1-IGMP-Pol
Sub. MCAC Policy : sub-1-MCAC
NAT Policy       : N/A
Def. Encap Offset: none                          Encap Offset Mode: none
Avg Frame Size   : N/A
Preference       : 5
Sub. ANCP-String : "sub-1"
Sub. Int Dest Id : ""
Igmp Rate Adj    : -2000
RADIUS Rate-Limit: N/A
Oper-Rate-Limit  : 2000
...
-------------------------------------------------------------------------------
*B:BNG-1#
```

Consider a different example with a scheduler instead of agg-rate-limit:

```
*A:Dut-C>config>subscr-mgmt>sub-prof# info
----------------------------------------------
            igmp-policy "pol1"
            sub-mcac-policy "smp"
            egress
                scheduler-policy "h1"
                    scheduler "t2" rate 30000
                exit
            exit
----------------------------------------------

*A:Dut-C>config>subscr-mgmt>igmp-policy# info
----------------------------------------------
            egress-rate-modify scheduler "t2"
            redirection-policy "mc_redir1"
----------------------------------------------
```

Now, assume that the subscriber joins now a new channel with bandwidth of 1mbps (1000 kbps).

```
A:Dut-C>config>subscr-mgmt>sub-prof>egr>sched># show qos scheduler-hierarchy subscriber
"sub_1" detail
===============================================================================
Scheduler Hierarchy - Subscriber sub_1
===============================================================================
Ingress Scheduler Policy:
Egress Scheduler Policy : h1
-------------------------------------------------------------------------------
Legend :
(*) real-time dynamic value
(w) Wire rates
B   Bytes
-------------------------------------------------------------------------------
Root (Ing)
|
No Active Members Found on slot 1

Root (Egr)
| slot(1)
|--(S) : t1
|   |    AdminPIR:90000      AdminCIR:10000
|   |
|   |
|   |    [Within CIR Level 0 Weight 0]
|   |    Assigned:0          Offered:0
|   |    Consumed:0
|   |
|   |    [Above CIR Level 0 Weight 0]
|   |    Assigned:0          Offered:0
|   |    Consumed:0
|   |    TotalConsumed:0
|   |    OperPIR:90000
|   |
|   |    [As Parent]
|   |    Rate:90000
|   |    ConsumedByChildren:0
|   |
|   |
|   |--(S) : t2
```

```
|   |   |    AdminPIR:29000      AdminCIR:10000(sum)       <==== bw 1000 from igmp sub-
stracted
|   |   |
|   |   |
|   |   |    [Within CIR Level 0 Weight 1]
|   |   |    Assigned:10000      Offered:0
|   |   |    Consumed:0
|   |   |
|   |   |    [Above CIR Level 1 Weight 1]
|   |   |    Assigned:29000      Offered:0                 <==== bw 1000 from igmp sub-
stracted
|   |   |    Consumed:0
|   |   |
|   |   |
|   |   |    TotalConsumed:0
|   |   |    OperPIR:29000                             <==== bw 1000 from igmp substracted
|   |   |
|   |   |    [As Parent]
|   |   |    Rate:29000                                <==== bw 1000 from igmp substracted
|   |   |    ConsumedByChildren:0
|   |   |
|   |   |
|   |   |--(S) : t3
|   |   |   |    AdminPIR:70000      AdminCIR:10000
|   |   |   |
|   |   |   |
|   |   |   |    [Within CIR Level 0 Weight 1]
|   |   |   |    Assigned:10000      Offered:0
|   |   |   |    Consumed:0
|   |   |   |
|   |   |   |    [Above CIR Level 1 Weight 1]
|   |   |   |    Assigned:29000      Offered:0
|   |   |   |    Consumed:0
|   |   |   |
|   |   |   |
|   |   |   |    TotalConsumed:0
|   |   |   |    OperPIR:29000
|   |   |   |
|   |   |   |    [As Parent]
|   |   |   |    Rate:29000
|   |   |   |    ConsumedByChildren:0
|   |   |   |
```

```
*A:Dut-C>config>subscr-mgmt>igmp-policy# show service active-subscribers sub-mcac
===============================================================================
Active Subscribers Sub-MCAC
===============================================================================
Subscriber                          : sub_1
MCAC-policy                         : smp (inService)
In use mandatory bandwidth          : 1000
In use optional bandwidth           : 0
Available mandatory bandwidth       : 1147482647
Available optional bandwidth        : 1000000000
-------------------------------------------------------------------------------
Subscriber                          : sub_2
MCAC-policy                         : smp (inService)
In use mandatory bandwidth          : 0
In use optional bandwidth           : 0
Available mandatory bandwidth       : 1147483647
Available optional bandwidth        : 1000000000
-------------------------------------------------------------------------------
```

```
-------------------------------------------------------------------------------
Number of Subscribers : 2
===============================================================================
*A:Dut-C#


*A:Dut-C# show service active-subscribers subscriber "sub_1" detail
===============================================================================
Active Subscribers
===============================================================================
-------------------------------------------------------------------------------
Subscriber sub_1 (1)
-------------------------------------------------------------------------------
I. Sched. Policy : N/A
E. Sched. Policy : h1                              E. Agg Rate Limit: Max
I. Policer Ctrl. : N/A
E. Policer Ctrl. : N/A
Q Frame-Based Ac*: Disabled
Acct. Policy     : N/A                             Collect Stats    : Disabled
Rad. Acct. Pol.  : N/A
Dupl. Acct. Pol. : N/A
ANCP Pol.        : N/A
HostTrk Pol.     : N/A
IGMP Policy      : pol1
Sub. MCAC Policy : smp
NAT Policy       : N/A
Def. Encap Offset: none                            Encap Offset Mode: none
Avg Frame Size   : N/A
Preference       : 5
Sub. ANCP-String : "sub_1"
Sub. Int Dest Id : ""
Igmp Rate Adj    : N/A
RADIUS Rate-Limit: N/A
Oper-Rate-Limit  : Maximum
...
===============================================================================
*A:Dut-C#


*A:Dut-C# show subscriber-mgmt igmp-policy "pol1"
===============================================================================
IGMP Policy pol1
===============================================================================
Import Policy                         :
Admin Version                         : 3
Num Subscribers                       : 2
Host Max Group                        : No Limit
Host Max Sources                      : No Limit
Fast Leave                            : yes
Redirection Policy                    : mc_redir1
Per Host Replication                  : no
Egress Rate Modify                    : "t2"
Mcast Reporting Destination Name      :
Mcast Reporting Admin State           : Disabled
===============================================================================
*A:Dut-C#
```

Host Tracking (HT) Considerations

HT is a light version of HQoS Adjustment feature. The use of HQoS Adjustment functionality in place of HT is strongly encouraged.

When HT is enabled, the AN will fork off (duplicate) the IGMP messages on the common mcast SAP to the subscriber SAP. IGMP states will not be fully maintained per sub-host in the BNG, instead they will be only tracked (less overhead) for bandwidth adjustment purposes.

Example of HT

```
Channel Definition:
configure
    mcast-management
         multicast-info-policy <name>
              <channel to b/w mapping definition>
```

Applying channel definition policy on a router/VPRN global level:

```
configure>router>multicast-info-policy <name>
configure>service>vrpn>multicast-info-policy <name>
```

Defining the rate object on which HT will be applied:

```
configure
    subscriber-management
     host-tracking-policy <name>
         egress-rate-modify [agg-rate-limit | scheduler <sch-name>]
```

Applying the HT to the subscriber:

```
configure
    subscriber-management
     sub-profile <name>
         host-tracking-policy <name>  => mutually exclusive with igmp-policy
```

HQoS Adjust Per Vport

HQoS adjust per Vport can be used in environments where Vport represents a physical medium over which traffic for multiple subscribers is shared. Typical example of this scenario is shown in Figure 53. Multicast traffic within 7x50 is taking a separate path from unicast traffic, only for the two traffic flows to merge later in the PON (represented by Vport in 7x50) and ONT (represented by subscriber in 7x50).

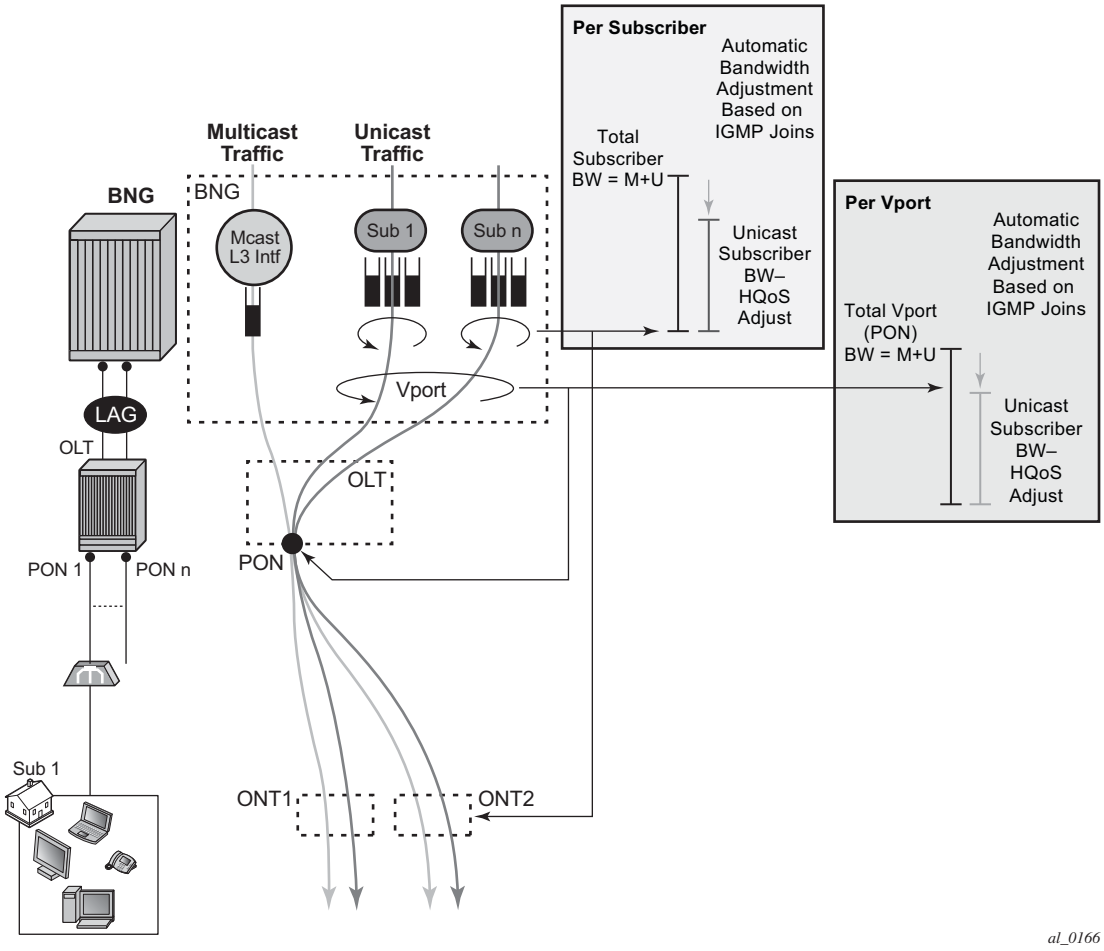


Figure 53: HQoS Adjustment per Subscriber and Vport

A single copy of each channel is replicated on the PON as long as there is at least one subscriber on that PON interested in this channel (has joined the IGMP/MLD group).

7x50 monitors IGMP/MLD Joins at the subscriber level and consequently the channel bandwidth is subtracted from the current Vport rate limit only in the case that this is the first channel flowing through the corresponding PON. Otherwise, the Vport bandwidth is not modified. Similarly, when

the channel is removed from the last subscriber on the PON, the channel bandwidth is returned to the VPort.

Association between the Vport and the subscriber is performed via inter-destination-string or svlan during the subscriber setup phase. Inter-destination-string can be obtained either via Radius or LUDB. In case that the association between the Vport and the subscriber is performed based on the svlan (as specified in sub-sla-mgmt under the sap/msap), then the destination string under the Vport must be a number matching the svlan.

The mcac-policy (channel definition bandwidth) can be applied on the group interface under which the subscribers are instantiated or in case of redirection under the redirected-interface.

In a LAG environment, the Vport instance is instantiated per member LAG link on the IOM. For accurate bandwidth control, it is prerequisite for this feature that subscriber traffic hashing is performed per Vport.

The CLI structure is as follows.

```
configure
     port <port-id>
          ethernet
               access
                    egress
                         vport <name>
                              egress-rate-modify
                              agg-rate
                              host-match <destination-string>
                              port-scheduler-policy <port-scheduler-policy-name>

configure
     port <port-id>
          sonnet-sdh
               path [<sonnet-sdh-index>]
                    access
                         egress
                              vport <name>
                                   egress-rate-modify
                                   agg-rate
                                   host-match <destination-string>
                                   port-scheduler-policy <port-scheduler-policy-name>
```

The Vport rate that will be affected by this functionality depends on the configuration:

- In case the agg-rate-limit within the Vport is configured, its value will be modified based on the IGMP activity associated with the subscriber under this Vport.
- In case that the port-scheduler-policy within the Vport is referenced, the max-rate defined in the corresponding port-scheduler-policy will be modified based on the IGMP activity associated with the subscriber under this Vport.

Note that HQoS adjust is not supported when a scheduler policy is configured under the VPORT.

The Vport rates can be displayed with the following two commands:

show port 1/1/5 vport *name*

qos scheduler-hierarchy port *port-id* **vport** *vport-name*

As an example:

```
*A:system-1# show port 1/1/7 vport
===============================================================================
Port 1/1/7 Access Egress vport
===============================================================================
VPort Name    : isam1
Description   : (Not Specified)
Sched Policy  : 1
Rate Limit    : Max
Rate Modify   : enabled
Modify delta  : -14000
```

In this case, the configured Vport aggregate-rate-limit max value has been reduced by 14Mbps.

Similarly, if the Vport had a port-scheduling-policy applied, the max-rate value configured in the port-scheduling-policy would have been modified by the amount shown in the Modify delta output in the above command.

MULTI-CHASSIS REDUNDANCY

Modified Vport rate synchronization in multi-chassis environment relies on the synchronization of the subscriber IGMP/MLD states between the redundant nodes. Upon the switchover, the Vport rate on the newly active node is adjusted according to the current IGMP/MLD state of the subscribers associated with the Vport.

SCALABILITY CONSIDERATIONS

It is assumed that the rate of the IGMP/MLD state change on the Vport level is substantially lower than on the subscriber level.

The reason for this is that the IGMP/MLD Join/Leaves are shared amongst subscribers on the same Vport (PON for example) and thus the IGMP/MLD state on the VPort level is changed only for the first IGMP/MLD Join per channel and the last IGMP/MLD leave per channel.

Redirection

Two levels of MCAC can be enabled simultaneously and in such case this is referred as Hierarchical MCAC (H-MCAC). In case that redirection is enabled, H-MCAC per subscriber and the redirected interface is supported. However, mcac per group-interface in this case is not supported. Channel definition policy for the subscriber and the redirected interface is in this case referenced under the **igmp->interface** (redirected interface) CLI or for IPv6 **mld->interface**.

In case that redirection is disabled, H-MCAC for both, the subscriber and the group-interface is supported. The channel definition policy is in this case configured under the **config>router>igmp>group interface** context or for IPv6 **config>router>mld>group interface**.

There are two options in multicast redirection. The first option is to redirect all subscriber multicast traffic to a dedicated redirect interface.

Example:

Defining redirection action:

```
configure
     router
          policy-options
               begin
               policy-statement <name>
                    default-action accept
                  multicast-redirection [fwd-service <svc id>] <interface name>
                    exit
               exit
          exit
     exit
```

The second option is to redirect only specific multicast groups to the redirect interface while the remaining groups remains on the subscriber SAP. This is applicable for both IPv4 and IPv6. For IPv6 host-ip for a policy statement is not supported.

Example:

Defining redirection action:

```
configure
     router
          policy-options
               begin
               prefix-list <name>
                    prefix <IPv4 multicast groups>
                    prefix <IPv4 multicast groups
               exit
               policy-statement <name>
                    entry 1
                         from
                              group-address <prefix-list name>
                         action accept
```

```
                    multicast-redirection [fwd-service <svc id>] <interface name>
                exit
            exit
exit
```

Applying redirection to the subscriber for IGMP and MLD respectively.

```
configure
    subscr-mgmt
        igmp-policy <name>
            redirection-policy <name>
            exit
        exit
        mld-policy <name>
            redirection-policy <name>
```

Redirection that cross-connects GRT and VPRN is not supported. Redirection can be only performed between interfaces in the GRT, or between the interfaces in any of the VPRN (cross connecting VPRNs is allowed).

Redirection is also supported in a wholesaler/retailer VPRN model where redirected Layer 3 interface resides in the retailer VPRN.

Hierarchical Multicast CAC (H-MCAC)

MCAC is supported on three levels:

- per subscriber
- per group-interface
- per redirected interface

Two levels of MCAC can be enabled simultaneously and in such case this is referred as Hierarchical MCAC (H-MCAC). In case that redirection is enabled, H-MCAC per subscriber and the redirected interface is supported. However, MCAC per group-interface in this case is not supported. Channel definition policy for the subscriber and the redirected interface is in this case referenced under the **config>router>igmp->interface** (redirected interface) CLI hierarchy or IPv6 **config>router>mld->interface**.

In case that redirection is disabled, H-MCAC for both, the subscriber and the group-interface is supported. The channel definition policy is in this case configured under the **config>router>igmp>group-interface** CLI hierarchy or IPv6 **config>router>mld>group-interface**.

Examples

Note that the same channel definition and association with interfaces is used for MCAC/H-MCAC and HQoS Adjustment.

Channel definition:

```
configure
     router
          mcac
               policy <mcac-pol-name>
                    bundle <bundle-name>
                         bandwidth <kbps>
                         channel <start-address> <end-address> bw <bw> [class {high|low}]
[type {mandatory|optional}]
                         :
                         :
```

Channel bandwidth definition policy can be referenced under the:

- group-interface — This is used for subscribers when redirection is disabled.

```
configure
          service vprn <id>
               igmp/mld
                    group-interface <grp-if-name>
                         mcac
                              policy <mcac-policy-name>
                              policy <mcac-policy-name>
```

- plain interface

```
configure
     router
          igmp/mld
               interface <name>
                    mcac
                         policy <mcac-policy-name>

configure
     service vprn <id>
          igmp/mld
               interface <if-name>
                    mcac
                         unconstrained-bw <bandwidth> mandatory-bw <mandatory-bw>
```

- retailer's VPRN reference the group-interface in the wholesaler's VPRN

```
configure
     service vprn <id>
          igmp/mld
               group-interface fwd-service <svc-id> <grp-if-name>
                    mcac
                         policy <mcac-policy-name>
```

Enabling MCAC:

- per subscriber

```
configure
     subscr-mgmt
          sub-mcac-policy <name>
               unconstrained-bw <bandwidth> mandatory-bw <mandatory-bw>

configure
     subscr-mgmt
          sub-profile <name>
               sub-mcac-policy <name>
```

- per-group-interface

```
configure
          service vprn <id>
               igmp/mld
                    group-interface <grp-if-name>
                         mcac
                              unconstrained-bw <bandwidth> mandatory-bw <mandatory-bw>
```

- per redirected interface

```
configure
     router
          igmp/mld
               interface <if-name>
                    mcac
                         unconstrained-bw <bandwidth> mandatory-bw <mandatory-bw>

configure
     service vprn <id>
          igmp/mld
               interface <if-name>
```

```
mcac
     unconstrained-bw <bandwidth> mandatory-bw <mandatory-bw>
```

MCAC Bundle Bandwidth Limit Considerations

In addition to multicast bandwidth limit that can be imposed on subscribers, group-interfaces or regular interfaces, there is another multicast bandwidth limit that can be imposed on a group of channels (channel bundle).

The MCAC policy, aside from the channel bandwidth definitions, could optionally contain this bandwidth cap for the group of channels:

```
config>router>mcac# info
----------------------------------------------
        policy "test"
            bundle "test" create
                bandwidth 100000
                channel 225.0.0.10 225.0.0.10 bw 10000 type mandatory
                channel 225.0.0.11 225.0.0.15 bw 5000 type mandatory
                channel 225.0.0.20 225.0.0.30 bw 5000 type optional
            exit
        exit
```

This can be used to prevent a single set of channels from monopolizing MCAC bandwidth allocated to the entire interface. The bandwidth of each individual bundle will be capped to some value below the interface MCAC bandwidth limit, allowing each bundle to have its own share of the interface MCAC bandwidth.

In most cases, the bandwidth limit per bundle is not necessary to configure. The aggregate limit per all channels as defined under the subscriber/interface will cover majority of scenarios. In case that one wants to explore the bundle bandwidth limits and how they affect MCAC behavior, the following text will help understanding this topic.

To further understand how various MCAC bandwidth limits are applied, one need to understand the concept of the mandatory bandwidth that is pre-allocated in the following way:

- Bandwidth of each mandatory channel in a bundle is pre-allocated. The artifacts of this are:
  - → The total mandatory bandwidth in the bundle cannot exceed the bundle cap. For the sake of deterministic behavior, the configured bandwidth of each mandatory channel in the bundle is counted towards the total mandatory bandwidth only once. This means that only one replication of each mandatory channel is assumed. This is normal behavior on a regular interface with a single SAP under it. More than one replication of the same channel per regular interface (or sap) would lead to packet duplication.
  - → Optional (non-mandatory) channels can use only the difference in bandwidth between the bundle cap and total pre-allocated mandatory bandwidth. They can NOT use more bandwidth than that even if the total pre-allocated mandatory bandwidth is not used up (mandatory channels are not being replicated).
- Mandatory bandwidth under the interface is pre-allocated and subtracted from the unconstrained bandwidth. In the configuration example below, 2mbps is pre-allocated

(guaranteed for mandatory channels) and the remaining 8mbps can be used by the optional channels on a first come first serve basis.

```
config>router>igmp# info
----------------------------------------------
            interface "ge-1/1/1"
                mcac
                    unconstrained-bw 10000 mandatory-bw 2000
                exit
            exit
```

The bundle bandwidth limit poses a problem when the MCAC policy is applied under the group-interface. The reason is that the group-interface represents the aggregation point for the subscribers and their bandwidth. As such it is natural that the any aggregated bandwidth limit under the group interface be larger than the bandwidth limit applied to any individual subscriber under it. Since the MCAC policy, along with the bundle bandwidth limit, is inherited by all subscribers under the group-interface, the exhaustion of the bundle bandwidth limit under the group interface will coincide with the exhaustion of the bundle bandwidth limit of any individual subscriber. This will result in a single subscriber starving out of multicast bandwidth the remaining subscribers under the same group-interface. While it is perfectly acceptable for the subscribers to inherit the multicast channel definition from the group-interface, for the above reasons it is not acceptable that the subscriber inherit the bandwidth cap from the group-interface.

To remedy this situation, the MCAC bandwidth limits are independently configured under the group-interface level (aggregated level) and the subscriber level via the command unconstrained-bw <kbps> mandatory-bw <kbps>. The undesired bundle bandwidth cap in the MCAC policy will be ignored under the group-interface AND under the subscriber. However, the bundle bandwidth cap will be applied automatically to each SAP under the group interface. A SAP is a natural place for a bundle bandwidth limit since each channel on a SAP can be replicated only once and therefore the amount of pre-allocated mandatory bandwidth can be pre-calculated. This is obviously not the case for the group interface where single channel can be replicated multiple times (one per each SAP under the grp-if). Similarly, the same channel can be replicated multiple times for the same subscriber in per-host replication mode. Only subscribers in per-sap replication mode will warrant a single replication per channel. Therefore, if bundle cap is configured, it will be applied to limit the bandwidth of the bundle that is applied to a subscriber in a per-sap replication mode.

Figure 54 depicts MCAC related inheritances and MCAC bandwidth allocation model in per-sap replication mode.The MCAC policy is applied to the group interface and inherited by each subscriber as well as each SAP under the same group interface. However, the bundle bandwidth limit in the MCAC policy is ignored on the group-interface and under the subscriber (denoted by the red X in the figure). The bundle limit is applied only to each sap under the group-interface.

Overall (non-bundle) MCAC bandwidth limits are independently applied to the group-interface and the subscribers. According to our example, 20mbps of multicast bandwidth in total is allocated per group-interface. 6mbps of the 20mbps is allocated for mandatory channels. This leaves 14mbps of multicast bandwidth for the optional channels combined served on a first come first serve basis. Each physical replication (multiple replications of the same channel can occur, one per each SAP), counts towards the respective group-interface bandwidth limits.

Similar logic applies to the subscriber MCAC bandwidth limits which are applied per sub-profile.

Finally, each SAP can optionally contain the bundle bandwidth limit. Note that in a hierarchical MCAC fashion, if either of the bandwidth checks fails (SAP, sub or grp-if) the channel admission for the subscriber also fails.

In our example, 6 subscriber hosts watch the same channel but there are only 3 active replications (one per SAP). This would yield:

- 14mbps of available multicast bandwidth under the group-interface. This bandwidth can be used for optional channels on a first come first serve basis. No reserved bandwidth is left.
- Subscriber A — 3mbps is still reserved for mandatory channels and 5mps is available for optional channels (first come first serve). All this assume that the SAP and the grp-if bandwidth checks pass.
- Subscriber B — 2 mbps is still reserved for mandatory channels and 6mps is available for optional channels (first come first serve). All this assume that the SAP and the grp-if bandwidth checks pass.
- Subscriber C — No reserved bandwidth for mandatory channels is left. 3 mbps is still left for optional channels. All this assume that the SAP and the grp-if bandwidth checks pass.
- SAPs — Considering that 2mbps are currently replicating (ch A, each SAP can still accept 1 mbps of the mandatory bandwidth (channel B and 7 mbps of the remaining optional channels.

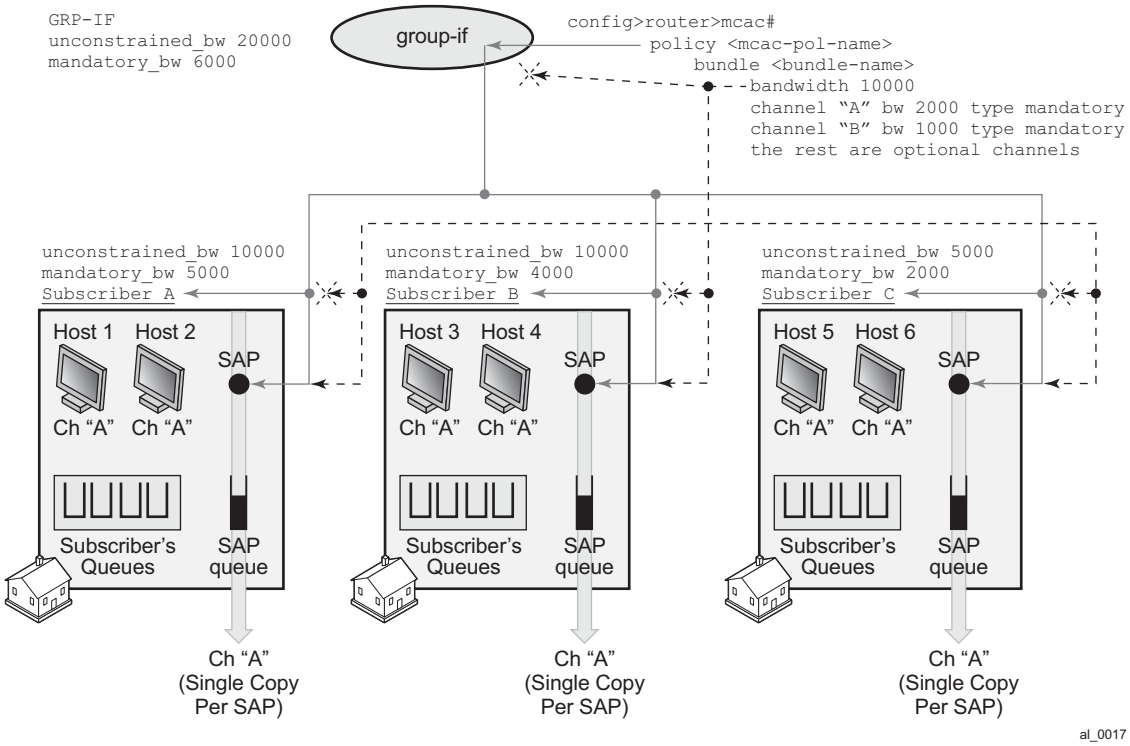


Figure 54: MCAC Policy Inheritance in Per-SAP Replication Mode

Figure 55 depicts behavior in per-host replication mode. MCAC policy inheritance flow is the same as in the previous example with the difference that the bundle limit has NO effect at all. Each host generates its own copy of the same multicast stream that is flowing via subscriber queues and not the SAP queue. Since each of the copies counts towards the subscriber or group-interface bandwidth limits, the multicast bandwidth consumption is higher in this example. This needs to be reflected in the configured multicast bandwidth limits. For example, the group-interface mandatory bandwidth limit is increased to 12mbps.

In our example, 6 subscriber hosts are still watching the same channel but now the number of replications is doubled from previous example. So the final tally for our MCAC bandwidth limit is as follows:

- Subscriber A - 1 mbps is still reserved for mandatory channels and 5mps for optional channels (first come first serve). All this assume that SAP and grp-if bandwidth checks pass.
- Subscriber B - No reserved mandatory bandwidth is left. 6 mps is s till left for optional channels (first come first serve). All this assume that SAP and grp-if bandwidth checks pass.

- Subscriber C - No reserved mandatory bandwidth is left. 1 mps is still left for optional channels (first come first serve). All this assume that SAP and grp-if bandwidth checks pass.
- No reserved bandwidth is left under the group-interface. 8 mbps of available multicast bandwidth under the group-interface is still left for optional channels on a first come first serve basis
- Bundle limit on a SAP is irrelevant in this case.

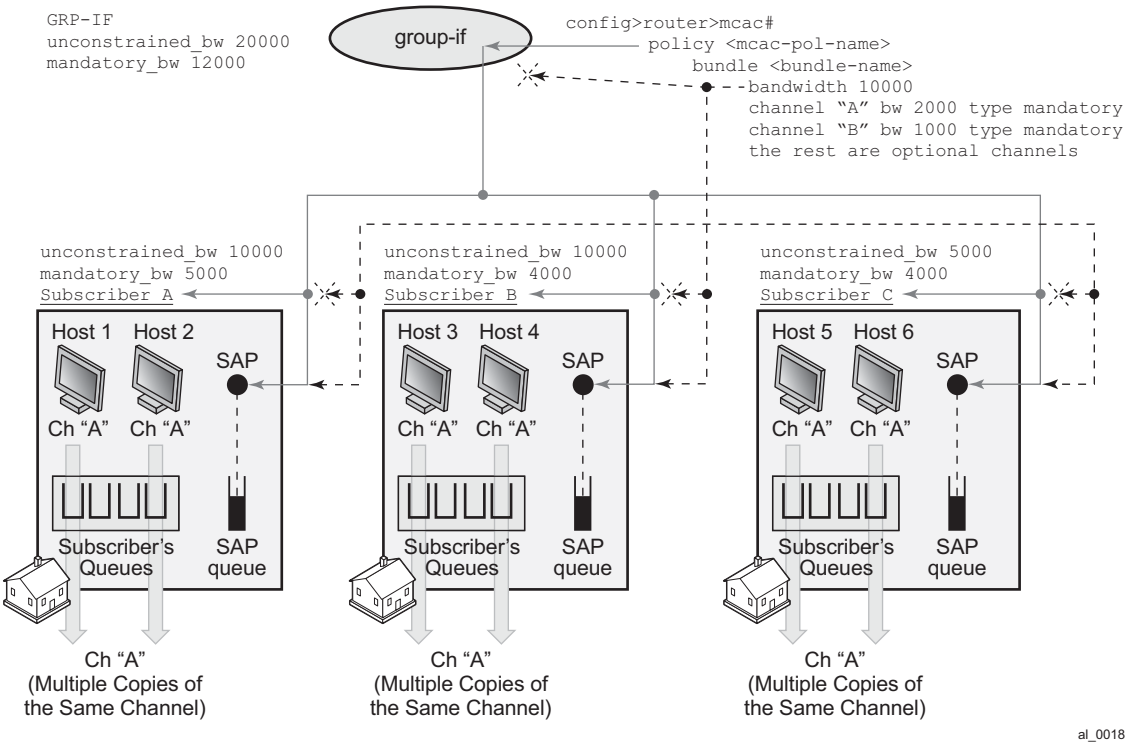


Figure 55: MCAC Policy Inheritance in Per-HOST Replication Mode

Determining MCAC Policy in Effect

Channel bandwidth definition (via MCAC policy) can be applied under the interface level (group-interface or regular interface):

configure>router/service>igmp/mld>interface/grp-if

The following configuration options can lead to the confusion as to which MCAC policy is in effect:

- The MCAC policy (channel bandwidth definition) can be applied under two different places (grp-if and/or regular intf).
- The same policy is used for (H)MCAC and HQoS Adjust with redirection enabled/disabled.

The general, the rule is that the MCAC policy under the group-interface will always be in effect in cases where redirection is disabled. This is valid for subscriber or group-interface MCAC, hMCAC (subscriber and group-interface) and HQoS Adjust in per SAP replication mode.

If redirection is enabled, the MCAC policy under the group-interface will be ignored.

If redirection is enabled, but there is no MCAC policy applied under the redirected interface[1] (regardless of whether the MCAC policy under the group-interface is applied or not) then:

- HQoS Adjust will have no effect.
- MCAC will have no effect not only per redirected interface but also per subscriber.

1. Redirected interface is the interface to which IGMP/MLD Joins are redirected from subscriber hosts.

Multicast Filtering

Multicast filtering must be done per session (host) for IPoE and PPPoE. There are two types of filters that are supported:

1. IGMP filters on access ingress. Those filters control the flow of IGMP messages between the host and the BNG. They are applied via the import statement in the igmp-policy. The same filters are used for multicast-redirection policy:

For IPv4

```
configure
     subscr-mgmt
          igmp-policy <name>
               import <policy-name>
```

For IPv6

```
configure
     subscr-mgmt
          mld-policy <name>
               import <policy-name>
```

An example of the filter definition is given below:

```
configure
     router
          policy-options
               begin
               prefix-list <pref-name>
                    prefix <pref-definition>
               policy-statement <name>
                    entry 1
                         from
                              group-address <pref-name>
                              source-address <ip>
                              protocol igmp
                         exit
                         action accept
                         exit
                    exit
                    default-action reject
```

2. Regular traffic filters where control multicast traffic flow can be controlled in both directions (ingress/egress). This is supported through ip-filters under the SLA profile.

Joining the Multicast Tree

The delivery of multicast to the subscribers-interface in a VPRN environment depends on the multicast deployment model (PIM, mBGP). In each model, a subscriber-interface is treated as a regular CE-PE interface that has registered v4 multicast listeners.

Wholesale/Retail Requirements

Multicast support on subscriber interfaces is supported in both wholesale/retail models:

- Wholesale/retail VPRN (IPoE and PPPoE)
- LAC/LNS (PPPoE only)

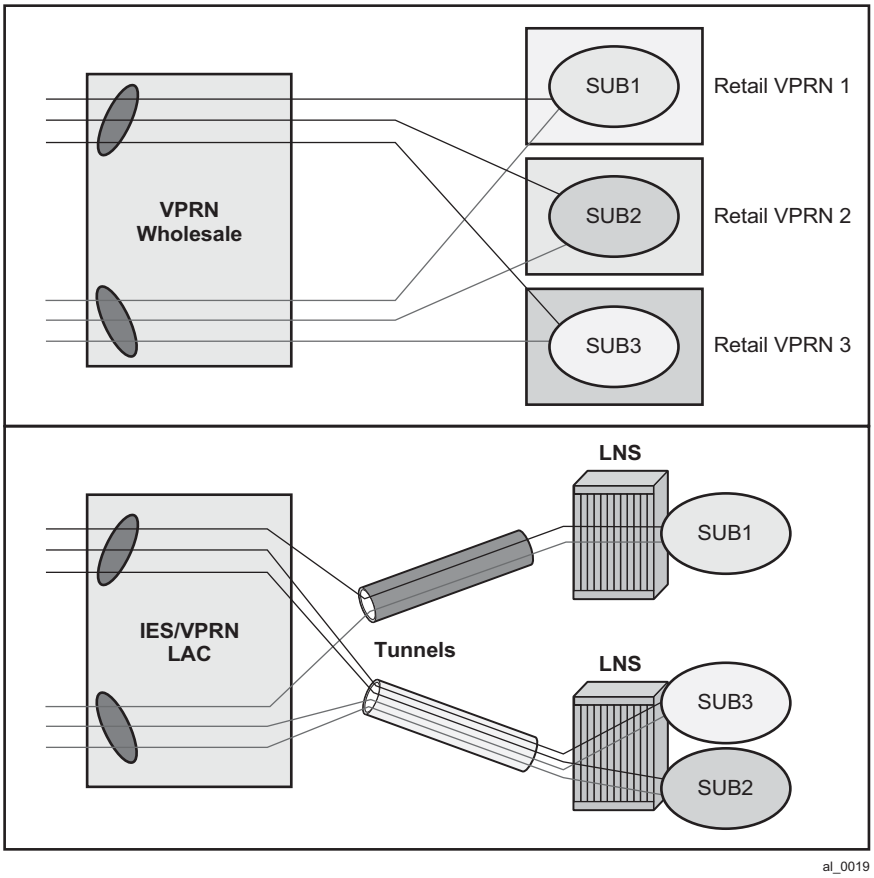


Figure 56: Wholesale/Retail Multicast Support

The distinction between these two models is that in the case of LAC/LNS, the replication will be done further up in the network on an LNS node. This means that the traffic between LAC and LNS will be multiplied by the amount of replications.

QoS Considerations

In per-sap replication mode (which is applicable only to IPoE subscribers), multicast traffic is forwarded through the SAP queue which is outside of the subscribers queues and therefore not accounted in subscriber aggregate rate limit. HQoS Adjust is used to remedy this situation.

In case that the SAP queue is removed from the static SAP in IPoE 1:1 model (with profiled-only-traffic command), multicast traffic will flow via internal queues which cannot be tied into a port-scheduler as part of HQoS. Consequently, the port-scheduler max-rate as defined in the port-scheduler-policy will be used only to rate limit unicast traffic. In other words, the max-rate value in port-scheduler-policy must be lowered for the amount of anticipated multicast traffic that will flow via the port where port-scheduler-policy is applied.

A similar logic applies to per-sap replication mode on dynamic SAPs (MSAPs) even if the SAP queue is not removed. Although the multicast traffic is flowing via the SAP queue in this case, the SAP qos policy on MSAP cannot be changed from the default one. The default QoS policy on a SAP contains a single queue that is not parented by the port-scheduler.

Those restrictions do not apply to static SAPs where the SAP QoS policy can be customized and its queues consequently tied to the port-scheduler.

Redundancy Considerations

The subscriber can receive multicast content through the subscriber SAP, the redirected interface, or a combination of both.

Multicast redundancy is only supported on a MC-LAG topology. Multicast traffic can be delivered over the subscriber SAP, the redirected interface, or a combination of both.

Subscriber IGMP states can be synchronized across multiple 7x50 nodes in order to ensure minimal interruption of (video delivery) service during network outages. The IGMP/MLD state of a subscriber-host in a 7x50 node is tied to the state of the underlying MC-LAG protection mechanism. For example, IGMP states will be activated only for subscribers that are anchored under the group-interfaces with master SRRP state or under an active MC-LAG port.

For multicast redirection on a MC-LAG topology, it must be ensured that the redirected interface (the interface to which multicast forwarding is redirected) is under the same MC-LAG as the subscriber. Otherwise, IGMP states on the redirected interface will be derived independently of the IGMP states for the subscriber from which IGMP/MLD messages are redirected.

The IGMP/MLD synchronization process in conjunction with underlying access protection mechanisms will work as follows:

- IGMP/MLD states for the subscriber will be updated only if IGMP/MLD messages (Joins/Leaves/Reports, etc.) are received:

→ Directly from the downstream node on an active MC-LAG link. This is valid irrespective of the IGMP querier status for the subscriber.

In all other cases, assuming that some protection mechanism in the access is present, the IGMP/MLD messages are discarded and consequently no IGMP/MLD state is updated. Similar logic applies to regular Layer 3 interfaces, where SRRP is replaced with VRRP.

- Once the subscriber IGMP/MLD state is updated as a result of directly received IGMP/MLD message on an active subscriber (SRRP master of active MC-LAG), the sync IGMP/MLD message is sent to the standby subscriber over the Multi-Chassis Synchronization protocol. Synchronized IGMP states will be populated in Multi-chassis Synchronization (MCS) DB in all pairing 7x50 nodes.
- In case that a IGMP/MLD sync (MCS) message is received from the peering node, the IGMP state for the standby subscriber is updated in the MCS DB but it is not downloaded into the forwarding plane unless there is a switchover. In case that the IGMP/MLD sync message is received for the active subscriber, the message will be discarded.
- IGMP/MLD queries are sent out only by IGMP/MLD querier. In a MC-LAG environment, it is the node with the active MC-LAG link. Note that MC-LAG is usually configured with SRRP and the SRRP state is derived from the MC-LAG.
- IGMP/MLD states from the MCS DB will be:

  → Activated on non-querier subscriber in case that neither SRRP nor MC-LAG is deployed. It is assumed that the querier subscriber has received the original IGMP/MLD message and consequently sent the IGMP/MLD MCS Sync to the non-querier (standby). Non-querier interface will accept the MCS sync message and also it will propagate the IGMP/MLD states to PIM.

  The querier subscriber will not accept the IGMP/MLD update from the MCS database.

  → Aware of the state of MC-LAG. As soon as the standby MC-LAG becomes active, the IGMP/MLD states will be activated and they will be propagated to PIM. Traffic will be forwarded as soon as multicast streams are delivered to the node and the IGMP states under the subscriber are activated. On a standby MC-LAG, IGMP states will not be propagated from the MCS DB to PIM and consequently subscribers.

  → Aware of the SRRP state. Since the subscriber with SRRP Master state is considered active, the states will be propagated to PIM as well. On standby SRRP, IGMP states will not be propagated from MCS DB to PIM and consequently to subscribers.
- For MC-lag setups, once the switchover is triggered via MC-LAG or SRRP, the IGMP/MLD states from MCS DB on the newly active MC-LAG node or subscriber under the newly SRRP Master will be sent to PIM and consequently to the forwarding plane effectively turning on multicast forwarding.

An active and standby subscriber refers to the state of underlying protection mechanism (active MC-LAG). Note that the subscribers themselves are always instantiated (or active) on both nodes. However, traffic forwarding over those subscribers will be driven by the state of the underlying protection mechanism (MC-LAG). Hence the terms active and standby subscriber.

Note that in subscriber environment, SRRP should be always activated in dual-homing scenario. SRRP in subscriber environment will ensure that downstream traffic is forwarded via the same node that is forwarding upstream traffic. In this fashion, accounting and QoS for the subscriber are consolidated within a single node.

To summarize, in multi-chassis environment with subscribers, IGMP synchronization enabled and an access layer protection mechanism in place (MC-LAG), the behavior for is the following:

- IGMP/MLD states are synchronized between the chassis.
- On a MC-LAG setup, only the SRRP master or active MC-LAG will forward downstream multicast traffic.
- Length of outage during the switchover is determined by the detection and recovery of the underlying protection mechanism (MC-LAG or MCS) in addition to local propagation of IGMP/MLD states from MCS DB to PIM and consequently to forwarding plane. Note that IGMP/MLD states can be statically configured on both redundant nodes in order to attract multicast traffic from upstream and therefore minimize outage during the switchover.

Redirection Considerations

The redirection policy has two options wither to redirect only a certain set of multicast groups to the redirect interface or redirect all multicast to the redirect interface. The redirect policy is source agnostic.

On a MC-LAG setup, for redirection and MCS to work simultaneously in predictable manner, the redirected interface and the corresponding subscribers have to be protected by the same MC-LAG. This binds the redirected interfaces and the subscriber-hosts to the same physical port(s).

The following describe some guidelines for a MC-LAG setup:

- The active subscriber will replicate its received IGMP/MLD message to the redirected Layer 3 interface. The Layer 3 redirected interface will accept this message:
  - → Independently of the corresponding VRRP state if MC-LAG is not used.
  - → Only if the Layer 3 interface is IGMP querier.
  - → MC-LAG is used and in active state.
- In all other cases the IGMP message under the Layer 3 redirected interface will be rejected. Note that Layer 3 redirected interface can also receive IGMP message directly from the downstream node in case that IGMP forking in the access node is activated.
- The Layer 3 redirected interface will NOT accept the IGMP state update from the MCS DB unless the Layer 3 interface is a non-querier.
- In case that the Layer 3 redirected interface is part of MC-LAG, the IGMP state update sent to it via MCS DB will be accepted only during the transitioning phase from standby to active MC-LAG state.

Briefly, IGMP states on Layer 3 interface are not VRRP aware. However, they are MC-LAG aware.

Configuring Triple Play Multicast Services with CLI

This section provides information to configure multicast parameters in a Triple Play network using the command line interface.

Topics in this section include:

Configuring IGMP Snooping in the BSA

Enabling IGMP Snooping in a VPLS Service

With IGMPv3 Multicast Routers

When multicast routers use IGMPv3, it is sufficient to just enable IGMP snooping, without any further modification of parameters.

The following displays an example of an IGMP snooping configuration:

```
A:ALA-48>config>service>vpls# info
----------------------------------------------
            igmp-snooping
                no shutdown
            exit
            no shutdown
----------------------------------------------
A:ALA-48>config>service>vpls#
```

With IGMPv1/2 Multicast Routers

When the multicast routers don't support IGMPv3, some timing parameters need to be configured locally in the Alcatel-Lucent SR-Series. Note that all routers in the multicast network must use the same values for these parameters.

The following displays an example of a modified IGMP snooping configuration:

```
A:ALA-48>config>service>vpls# info
----------------------------------------------
            stp
                shutdown
            exit
            igmp-snooping
                query-interval 60
                robust-count 5
                no shutdown
            exit
            no shutdown
----------------------------------------------
A:ALA-48>config>service>vpls#
```

Modifying IGMP Snooping Parameters

For interoperability with some multicast routers, the source IP address of IGMP group reports can be configured. Use the following CLI syntax to customize this IGMP snooping parameter:

The following displays an example of a modified IGMP snooping configuration:

```
A:ALA-48>config>service>vpls# info
----------------------------------------------
            stp
                shutdown
            exit
            igmp-snooping
                query-interval 60
                robust-count 5
                report-src-ip 10.20.20.20
                no shutdown
            exit
            no shutdown
----------------------------------------------
A:ALA-48>config>service>vpls#
```

Modifying IGMP Snooping Parameters for a SAP or SDP

Use the following CLI syntax to customize IGMP snooping parameters on an existing SAP. Commands for spoke or mesh SDPs are identical.

CLI Syntax:
```
config>service# vpls service-id
    sap sap-id
       igmp-snooping
          fast-leave
          import policy-name
          last-member-query-interval interval
          max-num-groups max-num-groups
          mrouter-port
          query-interval interval
          query-response-interval interval
          robust-count count
          send-queries
```

To enable and customize sending of IGMP queries to the hosts:

Example:
```
config>service# vpls 1
config>service>vpls# sap 1/1/3:0
config>service>vpls>sap# igmp-snooping
config>service>vpls>sap>snooping# send-queries
config>service>vpls>sap>snooping# query-interval 100
config>service>vpls>sap>snooping# query-response-interval 60
config>service>vpls>sap>snooping# robust-count 5
config>service>vpls>sap>snooping# exit
config>service>vpls>sap# no shutdown
```

To customize the leave delay:

Example:
```
config>service# vpls 1
config>service>vpls# sap 1/1/1:1
config>service>vpls>sap# igmp-snooping
config>service>vpls>sap>snooping# last-member-query-interval 10
config>service>vpls>sap>snooping# no fast-leave
config>service>vpls>sap>snooping# exit
config>service>vpls>sap# exit
```

To enable Fast Leave:

Example:
```
config>service# vpls 1
config>service>vpls# sap 1/1/1:1
config>service>vpls>sap# igmp-snooping
config>service>vpls>sap>snooping# no last-member-query-interval
config>service>vpls>sap>snooping# fast-leave
config>service>vpls>sap>snooping# exit
config>service>vpls>sap# exit
```

To limit the number of streams that a host can join:

Example:
```
config>service# vpls 1
config>service>vpls# sap 1/1/1:1
config>service>vpls>sap# igmp-snooping
config>service>vpls>sap>snooping# max-num-groups 4
config>service>vpls>sap>snooping# exit
config>service>vpls>sap# exit
```

To enable sending group reports on a SAP to standby multicast routers:

Example:
```
config>service# vpls 1
config>service>vpls# sap 1/1/1:1
config>service>vpls>sap# igmp-snooping
config>service>vpls>sap>snooping# mrouter-port
config>service>vpls>sap>snooping# exit
config>service>vpls>sap# exit
```

The following example displays the modified IGMP snooping configuration on a SAP:

```
A:ALA-48>config>service>vpls>sap>snooping# info detail
----------------------------------------------
                  no fast-leave
                  no import
                  max-num-groups 4
                  last-member-query-interval 10
                  no mrouter-port
                  query-interval 100
                  query-response-interval 60
                  robust-count 5
                  send-queries
----------------------------------------------
A:ALA-48>config>service>vpls>sap>snooping#
```

Configuring Static Multicast Groups on a SAP or SDP

Use the following CLI syntax to add static group membership entries on an existing SAP (commands for spoke or mesh SDPs are identical):

The following displays an example of a static IGMP snooping configuration on a SAP:

```
A:ALA-48>config>service>vpls>sap# info
----------------------------------------------
                max-nbr-mac-addr 4
                igmp-snooping
                    fast-leave
                    mrouter-port
                    static
                        group 224.0.10.10
                            source 10.10.10.1
                            source 10.10.10.2
                        exit
                    exit
                exit
----------------------------------------------
A:ALA-48>config>service>vpls>sap#
```

Enabling IGMP Group Membership Report Filtering

Routing policies can be defined to limit the multicast channels that can be joined by a host. For example, it is possible to define a policy listing a group of multicast streams (for example, 'basic' containing a basic set of TV channels or 'extended' containing a more extended set of TV channels), and to apply this policy to subscribers of IGMP snooping (SAPs and/or SDPs).

The following displays an example of a configuration to import a routing policy on a SAP:

```
A:ALA-48>config>service>vpls# info
----------------------------------------------
            stp
                shutdown
            exit
            igmp-snooping
                query-interval 60
                robust-count 5
                report-src-ip 10.20.20.20
                no shutdown
            exit
            sap 1/1/3:0 create
                igmp-snooping
                    query-interval 100
                    query-response-interval 60
                    robust-count 5
                    send-queries
                exit
            exit
            sap 1/1/3:22 create
                max-nbr-mac-addr 4
                igmp-snooping
                    fast-leave
                    import "test_policy"
                    mrouter-port
                    static
                        group 224.0.10.10
                            source 10.10.10.1
                            source 10.10.10.2
                        exit
                    exit
                exit
            exit
            no shutdown
----------------------------------------------
A:ALA-48>config>service>vpls#
```

For details configuring a routing policy, see the Configuring Route Policies section in the 7750 SR Router Configuration Guide.

The following shows a sample routing policy configuration accepting IGMP messages for only five multicast channels:

```
A:ALA-48>config>router>policy-options# info
----------------------------------------------
            prefix-list "basic_channels"
                prefix 224.10.0.1/32 exact
                prefix 224.10.0.2/32 exact
                prefix 224.10.0.3/32 exact
                prefix 224.10.0.4/32 exact
                prefix 224.10.0.5/32 exact
            exit
            policy-statement "test_policy"
                description "basic set of 5 multicast channels"
                entry 1
                    from
                        group-address "basic_channels"
                    exit
                    action accept
                    exit
                exit
                default-action reject
            exit
----------------------------------------------
A:ALA-48>config>router>policy-options#
```

Enabling IGMP Traffic Filtering

For security, it might be advisable to only allow multicast traffic into the SR-Series from recognized multicast routers and servers. Multicast packets arriving on other interfaces (for example, customer-facing SAPs or spoke SDPs) can be filtered out by defining an appropriate IP filter policy.

For details on how to configure a filter policy, see section Creating an IP Filter Policy in the 7750 SR Router Configuration Guide

The following example shows a sample IP filter policy configuration dropping all multicast traffic:

```
A:ALA-48>config>filter>ip-filter# info
----------------------------------------------
        ip-filter 1 create
            entry 1 create
                match
                    dst-ip 224.0.0.0/24
                exit
                action accept
            exit
            entry 2 create
                match
                    dst-ip 224.0.0.0/4
                exit
                action drop
            exit
        exit
----------------------------------------------
A:ALA-48>config>filter>ip-filter#
```

The following example shows how to apply this sample IP filter policy to a SAP:

```
A:ALA-48>config>service>vpls # info
----------------------------------------------
          sap 1/1/1:1
              ingress
                  filter ip 1
                  exit
              exit
          exit
----------------------------------------------
A:ALA-48>config>service>vpls>snooping#
```

Configuring Multicast VPLS Registration (MVR)

Use the following CLI syntax to configure Multicast VPLS Registration. The first step is to register a VPLS as a multicast VPLS.

CLI Syntax:
```
config>service# vpls service-id
    igmp-snooping
        mvr
            no shutdown
            description description
            group-policy policy-name
```

Example:
```
config>service# vpls 1000
config>service>vpls# igmp-snooping
config>service>vpls>snooping# mvr
config>service>vpls>snooping>mvr# no shutdown
config>service>vpls>snooping>mvr# description "MVR VPLS"
config>service>vpls>snooping>mvr# group-policy "basic_chan-
nels_policy"
```

The second step is to configure a SAP to take the multicast channels from the registered multicast VPLS.

CLI Syntax:
```
config>service# vpls service-id
    sap sap-id
        igmp-snooping
            mvr
                from-vpls vpls-id
```

Example:
```
config>service# vpls 1
config>service>vpls# sap 1/1/1:100
config>service>vpls>sap# igmp-snooping
config>service>vpls>snooping# mvr
config>service>vpls>snooping>mvr# from-vpls 1000
```

For MVR by proxy also the destination SAP for the multicast channels should be configured.

CLI Syntax:
```
config>service# vpls service-id
    sap sap-id
        igmp-snooping
            mvr
                from-vpls vpls-id
                to-sap sap-id
```

Example:
```
config>service# vpls 1
config>service>vpls# sap 1/1/1:100
config>service>vpls>sap# igmp-snooping
config>service>vpls>snooping# mvr
config>service>vpls>snooping>mvr# from-vpls 1000
config>service>vpls>snooping>mvr# to-sap 1/1/1:200
```

Configuring IGMP, MKD, and PIM in the BSR

Refer to the Multicast section in the 7750 SR Routing Protocols Guide for information about multicast and the commands required to configure basic IGMP and PIM parameters.

IGMP

MLD

PIM

Enabling IGMP

The following displays an example of enabled IGMP.

```
A:LAX>>config>router/service>vprn info detail
...
#------------------------------------------
echo "IGMP Configuration"
#------------------------------------------
        igmp
            query-interval 125
            query-last-member-interval 1
            query-response-interval 10
            robust-count 2
            no shutdown
        exit
#------------------------------------------
...
A:LAX>>config>system#
```

Configuring IGMP Interface Parameters

The following example displays an IGMP configuration:

```
A:LAX>config>router/service>vprn>igmp# info
----------------------------------------------
        interface "lax-sjc"
        exit
        interface "lax-vls"
        exit
        group-interface "Mcast-subscribers"
        exit
----------------------------------------------
A:LAX>config>router>igmp# exit
```

Configuring Static Parameters

The following example displays a configuration to add IGMP a static multicast source::

```
A:LAX>config>router/service>vprn>igmp# info
----------------------------------------------
        interface "lax-sjc"
        exit
        interface "lax-vls"
            static
                group 229.255.0.2
                    source 172.22.184.197
                exit
            exit
        exit
        ggroup-interface "mcast-subscribers"
        interface "lax-vls"
        static
        group 229.255.0.2
        source 172.22.184.197
        exit
        exit
        exit
        exit----------------------------------------------
A:LAX>config>router>igmp#
```

:The following example displays the configuration to add a IGMP static starg entry:

```
A:LAX>config>router/service>vprn>igmp# info
----------------------------------------------
        interface "lax-sjc"
            static
                group 230.1.1.1
                    starg
                exit
            exit
        exit
        interface "lax-vls"
            static
                group 229.255.0.2
                    source 172.22.184.197
                exit
            exit
        exit
        group-interface "mcast-subscribers"
        static
        group 230.1.1.1
        starg
        exit
        exit
        exit
----------------------------------------------
A:LAX>config>router>igmp#
```

Configuring SSM Translation

The following displays an SSM translation configuration:

```
A:LAX>config>router/service>vprn>igmp# info
----------------------------------------------
        ssm-translate
            grp-range 229.255.0.1 231.2.2.2
                source 10.1.1.1
            exit
        exit
        interface "lax-sjc"
            static
                group 230.1.1.1
                    starg
                exit
            exit
        exit
        interface "lax-vls"
            static
                group 229.255.0.2
                    source 172.22.184.197
                exit
            exit
        exit
        group-interface "mcast-subscribers"
        static
        group 230.1.1.1
        starg
        exit
        exit
        exit
----------------------------------------------
A:LAX>config>router/service>vprn>igmp# exit
```

Enabling MLD

The following displays an example of enabled MLD.

```
A:LAX>>config>router/service>vprn # info detail

#------------------------------------------
echo "MLD Configuration"
#------------------------------------------
mld
query-interval 125
query-last-member-interval 1
query-response-interval 10
robust-count 2
no shutdown
exit
#------------------------------------------
...
A:LAX>>config>router/service>vprn #
```

Configuring MLD Interface Parameters

The following example displays an MLD configuration:

```
A:LAX>config>router/service>vprn>mld# info
----------------------------------------------
interface "lax-sjc"
exit
interface "lax-vls"
exit
group-interface "mcast-subscribers"
exit
----------------------------------------------
A:LAX>config>router/service>vprn>mld#exit
```

Configuring Static Parameters

The following example displays a configuration to add MLD a static multicast source:

```
A:LAX>config>router/service>vprn>mld# info
----------------------------------------------
interface "lax-sjc"
exit
interface "lax-vls"
       static
               group ffe8::1
                      source 2001::1
               exit
       exit
exit
group-interface "mcast-subscribers"
```

```
        static
                group ffe8::1
                       source 2001::1
                exit
        exit
exit
-------------------------------------------
A:LAX>config>router/service>vprn>mld#
```

The following example displays the configuration to add a MLD static starg entry:

```
A:LAX>config>router/service>vprn>mld# info
-------------------------------------------
interface "lax-sjc"
        static
                group ffe8::2
                       starg
                       exit
                exit
        exit
interface "lax-vls"
        static
                group ffe8::1
                       source 2001::1
                       exit
                exit
        exit
group-interface "mcast-subscribers"
        static
                group ffe8::2
                       starg
                       exit
                exit
        exit
exit
-------------------------------------------
A:LAX>config>router/service>vprn>mld#
```

Configuring SSM Translation

The following displays an SSM translation configuration:

```
A:LAX>config>router/service>vprn>mld# info
-------------------------------------------
ssm-translate
        grp-range ff31::1  ff32::1
                source 2001::2
                exit
        exit
interface "lax-sjc"
        static
                group ffe8::2
                       starg
                       exit
                exit
        exit
interface "lax-vls"
```

```
        static
                group ffe8::1
                       source 2001::1
                       exit
                exit
        exit
group-interface "mcast-subscribers"
        static
                group ff31::20
                       starg
                       exit
                exit
        exit
exit
-------------------------------------------
A:LAX>config>router/service>vprn>mld# exit
```

Configuring PIM

Enabling PIM

When configuring PIM, make sure to enable PIM on all interfaces for the routing instance, otherwise multicast routing errors can occur.

The following example displays detailed output when PIM is enabled.

```
A:LAX>>config>router# info detail
...
#------------------------------------------
echo "PIM Configuration"
#------------------------------------------
        pim
            no import join-policy
            no import register-policy
            apply-to none
            rp
                no bootstrap-import
                no bootstrap-export
                static
                exit
                bsr-candidate
                    shutdown
                    priority 0
                    hash-mask-len 30
                    no address
                exit
                rp-candidate
                    shutdown
                    no address
                    holdtime 150
                    priority 192
                exit
            exit
            no shutdown
        exit
#------------------------------------------
...
A:LAX>>config>system#
```

Configuring PIM Interface Parameters

The following displays a PIM interface configuration:

```
A:LAX>config>router>pim# info
----------------------------------------------
            interface "system"
            exit
            interface "lax-vls"
            exit
            interface "lax-sjc"
            exit
            interface "p1-ix"
            exit
            rp
                static
                    address 2.22.187.237
                        group-prefix 224.24.24.24/32
                    exit
                    address 10.10.10.10
                    exit
                exit
                bsr-candidate
                    shutdown
                exit
                rp-candidate
                    shutdown
                exit
            exit
----------------------------------------------
A:LAX>config>router>pim#


A:SJC>config>router>pim# info
----------------------------------------------
            interface "system"
            exit
            interface "sjc-lax"
            exit
            interface "sjc-nyc"
            exit
            interface "sjc-sfo"
            exit
            rp
                static
                    address 2.22.187.237
                        group-prefix 224.24.24.24/32
                    exit
                exit
                bsr-candidate
                    shutdown
                exit
                rp-candidate
                    shutdown
                exit
            exit
----------------------------------------------
A:SJC>config>router>pim#
```

```
A:MV>config>router>pim# info
----------------------------------------------
            interface "system"
            exit
            interface "mv-sfo"
            exit
            interface "mv-vlc"
            exit
            interface "p3-ix"
            exit
            rp
                static
                    address 2.22.187.237
                        group-prefix 224.24.24.24/32
                    exit
                exit
                bsr-candidate
                    address 2.22.187.236
                    no shutdown
                exit
                rp-candidate
                    address 2.22.187.236
                    no shutdown
                exit
            exit
----------------------------------------------
A:MV>config>router>pim#


A:SFO>config>router>pim# info
----------------------------------------------
            interface "system"
            exit
            interface "sfo-sjc"
            exit
            interface "sfo-was"
            exit
            interface "sfo-mv"
            exit
            rp
                static
                    address 2.22.187.237
                        group-prefix 224.24.24.24/32
                    exit
                exit
                bsr-candidate
                    address 2.22.187.239
                    no shutdown
                exit
                rp-candidate
                    address 2.22.187.239
                    no shutdown
                exit
            exit
----------------------------------------------
A:SFO>config>router>pim#
```

```
A:WAS>config>router>pim# info
----------------------------------------------
            interface "system"
            exit
            interface "was-sfo"
            exit
            interface "was-vlc"
            exit
            interface "p4-ix"
            exit
            rp
                static
                    address 2.22.187.237
                        group-prefix 224.24.24.24/32
                    exit
                exit
                bsr-candidate
                    address 2.22.187.240
                    no shutdown
                exit
                rp-candidate
                    address 2.22.187.240
                    no shutdown
                exit
            exit
----------------------------------------------
A:WAS>config>router>pim#
```

Importing PIM Join/Register Policies

The import command provides a mechanism to control the (*,g) and (s,g) state that gets created on a router. Import policies are defined in the **config>router>policy-options** context. See Configuring PIM Join/Register Policies on page 874.

Note, in the import policy, if an action is not specified in the entry then the default-action takes precedence. If no entry matches then the default-action also takes precedence. If no default-action is specified, then the default default-action is executed.

The following example displays the command usage to apply the policy statement will not allow join messages for group 229.50.50.208/32 and source 192.168.0.0/16 but allows join messages for 192.168.0.0/16, 229.50.50.208:

Example:

```
config>router# pim
config>router>pim# import join-policy "foo"
config>router>pim# no shutdown
```

The following example displays the PIM configuration:

```
A:LAX>config>router>pim# info
----------------------------------------------
            import join-policy "foo"
            interface "system"
            exit
            interface "lax-vls"
            exit
            interface "lax-sjc"
            exit
            interface "p1-ix"
            exit
            rp
                static
                    address 2.22.187.237
                        group-prefix 224.24.24.24/3
                    exit
                    address 10.10.10.10
                    exit
                exit
                bsr-candidate
                    shutdown
                exit
                rp-candidate
                    shutdown
                exit
            exit
----------------------------------------------
A:LAX>config>router>pim#
```

Configuring PIM Join/Register Policies

Join policies are used in Protocol Independent Multicast (PIM) configurations to prevent the transportation of multicast traffic across a network and the dropping of packets at a scope at the edge of the network. PIM Join filters reduce the potential for denial of service (DoS) attacks and PIM state explosion—large numbers of Joins forwarded to each router on the RPT, resulting in memory consumption.

*,g or s,g is the information used to forward unicast or multicast packets.

- **group-address** matches the group in join/prune messages

  `group-address 229.55.150.208/32 exact`
- **source-address** matches the source in join/prune messages

  `source-address 192.168.0.0/16 longer`
- **interface** matches any join message received on the specified interface

  `interface port 1/1/1`
- **neighbor** matches any join message received from the specified neighbor

  `neighbor 1.1.1.1`

The following configuration example will not allow join messages for group 229.50.50.208/32 and source 192.168.0.0/16 but allows join messages for 192.168.0.0/16, 229.50.50.208.

```
A:ALA-B>config>router>policy-options# info
----------------------------------------------
...
            policy-statement "foo"
                entry 10
                    from
                        group-address "229.50.50.208/32"
                        source-address 192.168.0.0
                    exit
                    action reject
                exit
            exit
            policy-statement "reg-pol"
                entry 10
                    from
                        group-address "224.0.0.0/8"
                    exit
                    action accept
                    exit
                exit
            exit
...
----------------------------------------------
A:ALA-B>config>router>policy-options#
```

Configuring Bootstrap Message Import and Export Policies

Bootstrap import and export policies are used to control the flow of bootstrap messages to and from the RP.

The following configuration example specifies that no BSR messages received or sent out of interface port 1/1/1.

```
:A:ALA-B>config>router>policy-options# policy-statement pim-import
:A:ALA-B>config>router>policy-options>policy-statement$ entry 10
:A:ALA-B>config>router>policy-options>policy-statement>entry$ from
:A:ALA-B>config>router>policy-options>policy-statement>entry>from$ interface port1/1/1/
:A:ALA-B>config>router>policy-options>policy-statement>entry>from$ exit
:A:ALA-B>config>router>policy-options>policy-statement>entry# action reject
:A:ALA-B>config>router>policy-options>policy-statement>entry# exit
:A:ALA-B>config>router>policy-options>policy-statement# exit

:A:ALA-B>config>router>policy-options# policy-statement pim-export
:A:ALA-B>config>router>policy-options>policy-statement$ entry 10
:A:ALA-B>config>router>policy-options>policy-statement>entry$ to
:A:ALA-B>config>router>policy-options>policy-statement>entry>to$
```

Triple Play Multicast Command Reference

Command Hierarchies

MCAST Management Commands

```
config
    — mcast-management
        —  bandwidth-policy policy-name [create]
        — no bandwidth-policy policy-name
            — admin-bw-threshold kilo-bits-per-second
            — no admin-bw-threshold
            — ancillary-path
                — path-limit megabits-per-second
                — no path-limit
                — queue-parameters
                    — cbs percentage
                    — no cbs
                    — hi-priority-only  percent-of-mbs
                    — no hi-priority-only
                    — mbs percentage
                    — no mbs
            — description description
            — no description
            — falling-percent-reset percent-of-highest
            — no falling-percent-reset
            — mcast-pool percent-of-total percent-of-buffers resv-cbs percent-of-pool slope-pol-
              icy policy-name
            — no mcast-pool
        — chassis-level
            — [no] mmrp-impm-override
            — [no] per-mcast-plane-capacity
                — mcast-capacity primary-percentage secondary secondary-percentage
                — no mcast-capacity
```

```
                    — redundant-mcast-capacity primary-percentage secondary secondary-
                      percentage
                    — no redundant-mcast-capacity
                    — total-capacity capacity
                    — no total-capacity
                — [no] round-robin-inactive-records
— mcast-reporting-dest mcast-reporting-dest-name [create]
— no mcast-reporting-dest mcast-reporting-dest-name
                — description description
                — no description
                — dest-ip-address ip-address
                — no dest-ip-address
                — max-tx-delay delay
                — no max-tx-delay
                — udp-dst-port port
                — no udp-dst-port
                — [no] shutdown
```

Multicast Info Policy Bundle Commands

```
config
    — mcast-management
        — multicast-info-policy policy-name [create]
        — no multicast-info-policy policy-name
            — bundle bundle-name [create]
            — no bundle bundle-name
                — admin-bw kbps
                — no admin-bw
                — bw-activity {use-admin-bw|dynamic [falling-delay seconds]} [black-hole-rate kbps]
                — no bw-activity
                — channel ip-address [ip-address] [create]
                — no channel ip-address [ip-address]
                    — admin-bw kbps
                    — no admin-bw
                    — bw-activity {use-admin-bw|dynamic [falling-delay seconds]} [black-hole-rate kbps]
                    — no bw-activity
                    — explicit-sf-path {primary | secondary | ancillary}
                    — no explicit-sf-path
                    — keepalive-override keepalive-timer
                    — no keepalive-override
                    — preference preference-level
                    — no preference
                    — primary-tunnel-interface {rsvp-p2mp | ldp-p2mp p2mp-id} lsp-name sender ip-address
                    — no primary-tunnel-interface
                    — source-override ip-address [create]
                    — no source-override ip-address
                        — admin-bw kbps
                        — no admin-bw
                        — bw-activity {use-admin-bw|dynamic [falling-delay seconds]} [black-hole-rate kbps]
                        — no bw-activity
                        — cac-type {mandatory | optional}
                        — no cac-type
                        — explicit-sf-path {primary | secondary | ancillary}
                        — no explicit-sf-path
                        — keepalive-override keepalive-timer
                        — no keepalive-override
                        — preference preference-level
                        — no preference
                        — primary-tunnel-interface {rsvp-p2mp | ldp-p2mp p2mp-id} lsp-name sender ip-address
                        — no primary-tunnel-interface
                — cong-priority-threshold preference-level
                — no cong-priority-threshold
                — description description
                — no description
                — ecmp-opt-threshold preference-level
                — no ecmp-opt-threshold
```

- explicit-sf-path {primary | secondary | ancillary}
- no explicit-sf-path
- keepalive-override *keepalive-timer*
- no keepalive-override
- preference *preference-level*
- no preference
- primary-tunnel-interface {rsvp-p2mp | ldp-p2mp *p2mp-id*} *lsp-name* sender *ip-address*
- no primary-tunnel-interface
- description *description-string*
- no description

Refer to the 7750 SR OS Interface Configuration Guide for command descriptions.

config

- card
  - fp [*fp-number*]
    - ingress
      - multicast-path-management
        - bandwidth-policy *policy-name*
        - no bandwidth-policy
        - [no] shutdown
  - mda
    - ingress
      - multicast-path-management
        - ancillary-override
          - path-limit *megabits-per-second*
          - no path-limit
        - bandwidth-policy *policy-name*
        - no bandwidth-policy
        - primary-override
          - path-limit *megabits-per-second*
          - no path-limit
        - secondary-override
          - path-limit *megabits-per-second*
          - no path-limit
        - [no] shutdown

Triple Play Multicast Service Commands

```
config
    — service
        — [no] vpls service-id [customer customer-id] [vpn vpn-id] [m-vpls]
            — igmp-snooping
                — mvr
                    — description description-string
                    — no description
                    — group-policy policy-name
                    — no group-policy
                    — [no] shutdown
                — query-interval seconds
                — no query-interval
                — query-src-ip ipv6-address
                — no query-src-ip
                — report-src-ip ipv6-address
                — no report-src-ip
                — robust-count robust-count
                — no robust-count
                — [no] shutdown
            — fdb-table-high-wmark high-water-mark
            — no fdb-table-high-wmark
            — fdb-table-low-wmark low-water-mark
            — no fdb-table-low-wmark
            — fdb-table-size table-size
            — no fdb-table-size
            — mld-snooping
                — mvr
                    — description description-string
                    — no description
                    — group-policy policy-name
                    — no group-policy
                    — [no] shutdown
                — query-interval seconds
                — no query-interval
                — query-src-ip ipv6-address
                — no query-src-ip
                — report-src-ip ipv6-address
                — no report-src-ip
                — robust-count robust-count
                — no robust-count
                — [no] shutdown
            — multicast-info-policy policy-name
            — no multicast-info-policy
            — sap sap-id [split-horizon-group group-name]
            — no sap sap-id
                — igmp-snooping
                    — [no] fast-leave
                    — import policy-name
                    — no import
                    — last-member-query-interval interval
                    — no last-member-query-interval
```

```
                    — max-num-groups max-num-groups
                    — no max-num-groups
                    — [no] mrouter-port
                    — mvr
                        — from-vpls vpls-id
                        — no from-vpls
                        — to-sap sap-id
                        — no to-sap
                    — query-interval interval
                    — no query-interval
                    — query-response-interval interval
                    — no query-response-interval
                    — robust-count count
                    — no robust-count
                    — [no] send-queries
                    — static
                        — [no] group group-address
                            — [no] source ip-addr
                            — [no] starg
— mesh-sdp sdp-id[:vc-id] [vc-type {ether | vlan | vpls}]
— no mesh-sdp sdp-id[:vc-id]
        — igmp-snooping
                    — [no] fast-leave
                    — import policy-name
                    — no import
                    — last-member-query-interval interval
                    — no last-member-query-interval
                    — max-num-groups max-num-groups
                    — no max-num-groups
                    — mcac
                      — policy policy-name
                      — no policy
                      — unconstrained-bw bandwidth mandatory-bw mandatory-
                        bw
                      — no unconstrained-bw
                    — query-interval interval
                    — no query-interval
                    — query-response-interval interval
                    — no query-response-interval
                    — robust-count count
                    — no robust-count
                    — [no] send-queries
                    — static
                        — [no] group group-address
                            — [no] source ip-addr
                            — [no] starg
        — mld-snooping
                    — [no] disable-router-alert-check
                    — [no] fast-leave
                    — import policy-name
                    — no import
                    — last-member-query-interval interval
                    — no last-member-query-interval
                    — max-num-groups max-num-groups
                    — no max-num-groups
```

```
                    — mvr
                        — fast-leave service-id
                        — no fast-leave
                        — to-sap sap-id
                        — no to-sap
                    — query-interval seconds
                    — no query-interval
                    — query-response-interval seconds
                    — no query-response-interval
                    — robust-count robust-count
                    — no robust-count
                    — [no] send-queries
— spoke-sdp sdp-id[:vc-id] [vc-type {ether | vlan | vpls}] [split-horizon-group
  group-name]
— no spoke-sdp sdp-id[:vc-id]
        — igmp-snooping
                    — [no] fast-leave
                    — import policy-name
                    — no import
                    — last-member-query-interval interval
                    — no last-member-query-interval
                    — max-num-groups max-num-groups
                    — no max-num-groups
                    — query-interval interval
                    — no query-interval
                    — query-response-interval interval
                    — no query-response-interval
                    — robust-count count
                    — no robust-count
                    — [no] send-queries
                    — static
                        — [no] group group-address
                            — [no] source ip-addr
                            — [no] starg
                    — mvr
                        — fast-leave service-id
                        — no fast-leave
                        — to-sap sap-id
                        — no to-sap
                    — query-interval seconds
                    — no query-interval
                    — query-response-interval seconds
                    — no query-response-interval
                    — robust-count robust-count
                    — no robust-count
                    — [no] send-queries
```

Ingress Multicast Path Management Commands

```
config
    — mcast-management
        —  bandwidth-policy policy-name [create]
        — no bandwidth-policy policy-name
            — admin-bw-threshold kilo-bits-per-second
            — no admin-bw-threshold
            — ancillary-path
                — path-limit megabits-per-second
                — no path-limit
                — queue-parameters
                    — cbs percentage
                    — no cbs
                    — hi-priority-only  percent-of-mbs
                    — no hi-priority-only
                    — mbs percentage
                    — no mbs
            — description description-string
            — no description
            — falling-percent-reset percent-of-highest
            — no falling-percent-reset
            — mcast-pool percent-of-total percent-of-buffers resv-cbs percent-of-pool slope-pol-
              icy policy-name
            — no mcast-pool
            — primary-path
                — path-limit megabits-per-second
                — no path-limit
                — queue-parameters
                    — cbs percentage
                    — no cbs
                    — hi-priority-only  percent-of-mbs
                    — no hi-priority-only
                    — mbs percentage
                    — no mbs
            — secondary-path
                — path-limit megabits-per-second
                — no path-limit
                — queue-parameters
                    — cbs percentage
                    — no cbs
                    — hi-priority-only  percent-of-mbs
                    — no hi-priority-only
                    — mbs percentage
                    — no mbs
            — t2-paths
                — primary-path
                    — queue-parameters
                        — cbs percentage
                        — no cbs
                        — hi-priority-only  percent-of-mbs
                        — no hi-priority-only
                        — mbs percentage
                        — no mbs
                — secondary-path
```

```
                                    — number-paths number-of-paths [dual-sfm number-of-paths]
                                    — queue-parameters
                                        — cbs percentage
                                        — no cbs
                                        — hi-priority-only  percent-of-mbs
                                        — no hi-priority-only
                                        — mbs percentage
                                        — no mbs

config
    — router
        — multicast-info-policy policy-name
        — no multicast-info-policy
        — pim
            — [no] mc-ecmp-balance
            — mc-ecmp-balance-hold minute
            — no mc-ecmp-balance-hold
tools
    — perform
        — router
            — pim
                — mc-ecmp-rebalance [ecmp-opt-threshold]
```

Multicast Redirection

```
config
    — router/service VPRN
        — policy-options
            — policy-statement
                — entry
                    — action {accept|next-entry|next-policy|reject}
                    — no action
        — igmp
            — interface port:tags
            — mld
                — interface port:tags
config
    — service
        — ies service-id
        — vprn service-id
            — interface port:tags
```

Show Commands

```
show
    — service
        — id service-id
            — host-tracking
                — saps [detail|statistics|summary|mcast-reporting-statistics]
                — saps sap sap-id [host ip-address] [detail|statistics|summary|mcast-
                  reporting-statistics]
            — igmp-snooping
                — all
                — mrouters [detail]
                — mvr
                — port-db sap sap-id [detail]
                — port-db sap sap-id group grp-address
                — port-db sdp-id:vc-id [detail]
                — port-db sdp sdp-id:vc-id group grp-address
                — proxy-db [detail]
                — proxy-db group grp-address
                — static [sap sap-id | sdp sdp-id:vc-id]
                — static [sap sap-id | sdp sdp-id:vc-id]
            — mfib brief
            — mfib [group grp-address]
            — mfib statistics [group grp-address]
            — mld-snooping
                — all
                — base
                — mrouters [detail]
                — mvr
                — port-db sap sap-id
                — port-db sap sap-id detail
                — port-db sap sap-id group grp-ipv6-address
                — port-db sdp sdp-id:vc-id
                — port-db sdp \sdp-id:vc-id detail
                — port-db sdp \sdp-id:vc-id group grp-ipv6-address
                — proxy-db [detail]
                — proxy-db group grp-ipv6-address
                — querier
                — static [sap sap-id | sdp sdp-id:vc-id]
                — statistics [sap sap-id | sdp sdp-id:vc-id]
show
    — router
        — pim
            — mc-ecmp-balance [detail]
show
    — mcast-management
        — bandwidth-policy [policy-name] [detail]
        — channel [router router-instance | vpls service-id] [mda slot[/mda]] [group ip-address [source
          ip-address]] [path path-type] [detail]
        — mcast-reporting-dest [mcast-reporting-dest-name]
        — mda [slot[/mda]] [path path-type]

show
    — router
```

```
— igmp
    — group [grp-ip-address]
    — group summary
    — group-interface [fwd-service service-id] [ip-int-name] [detail]
    — hosts [group grp-address] [detail] [fwd-service service-id] [grp-interface ip-int-
      name]
    — hosts [host ip-address] [group grp-address] [detail]
    — hosts summary
    — interface [ip-int-name|ip-address] [group] [grp-ip-address] [detail]
    — mcast-reporting-statistics [host]
    — mld
        — interface port:tags
    — ssm-translate [interface-name]
    — static [ip-int-name|ip-addr]
    — statistics [ip-int-name|ip-address]
    — statistics host [ip-address]
    — status
    — tunnel-interface
```

Clear Commands

```
clear
— service
    — id
        — igmp-snooping
            — port-db sap sap-id [group grp-address [source ip-address]]
            — port-db sdp sdp-id:vc-id [group grp-address [source ip-address]]
            — querier
            — querier [all | sap sap-id | sdp sdp-id:vc-id
        — mfib
            — statistics [all | group grp-address ]
        — mld-snooping
            — port-db sap sap-id [group grp-ipv6-address]
            — port-db sap sap-id group grp-ipv6-address source src-ipv6-address
            — port-db sdp sdp-id:vc-id [group grp-ipv6-address]
            — port-db sdp sdp-id:vc-id group grp-ipv6-address source src-ipv6-address
            — querier
            — statistics all
            — statistics sap sap-id
            — statistics sdp sdp-id:vc-id
```

Debug Commands

```
debug
— mcast-management
    — [no] mcast-reporting-dest [dest-name]
        — [no] igmp [host ip-address] [group grp-address]
— service
    — id service-id
        — mld-snooping
            — detail-level {low|medium|high}
            — no detail-level
```

— [**no**] **mac** *ieee-address*
— **mode** {**dropped-only**|**ingr-and-dropped**|**egr-ingr-and-dropped**}
— **no mode**
— [**no**] **sap** *sap-id*
— [**no**] **sdp** *sdp-id:vc-id*

Multicast Management Configuration Commands

Generic Commands

description

Syntax **description** *description-string*
no description

Context config>card>mda>ingress>mcast-mgmt
config>card>mda>ingress>mcast-path-management
config>mcast-management>bandwidth-policy
config>mcast-management>multicast-info-policy
config>mcast-management>multicast-info-policy>bundle
config>mcast-mgmt>mcast-rprt-dest
config>mcast-mgmt>mcast-info-plcy>bundle
config>mcast-mgmt>mcast-info-plcy
config>card>fp>ingress>mcast-mgmt
config>card>mda>ingress

Description This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the context in the configuration file.

The **no** form of this command removes any description string from the context.

Default No description is associated with the configuration context.

Parameters *description-string* — A text string describing the entity. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

shutdown

Syntax [**no**] **shutdown**

Context config>card>mda>ingress>mcast-mgmt
config>card>mda>ingress>mcast-path-management
config>mcast-mgmt>mcast-rprt-dest

Description The shutdown command is used to disable ingress multicast path management for a forwarding plane or MDA. The default state is shutdown. When the no shutdown command is executed, ingress multicast path management is enabled and the system will evaluate all multicast channels on the MDA or forwarding plane based on the default or explicit bandwidth policy applied and multicast information policies associated with the channels.

The **no** form of the command is used to enable ingress multicast path management on the MDA or forwarding plane.

Multicast Management Commands

mcast-management

Syntax **mcast-management**

Context config

Description The mcast-management CLI node contains the bandwidth-policy and multicast-info-policy definitions. The bandwidth-policy is used to manage the ingress multicast paths into the switch fabric. The multicast-info-policy defines how each multicast channel is handled by the system. The policy may be used by the ingress multicast bandwidth manager, the ECMP path manager and the egress multicast CAC manager.

The mcast-management node always exists and contains the default bandwidth-policy and the default multicast-info-policy. Enter the mcast-management node when editing, deleting or creating a bandwidth-policy or multicast-info-policy. The default bandwidth-policy and multicast-info-policy cannot be edited or deleted.

A chassis-level node within multicast-management is used to control the switch fabric multicast planes replication limits. The switch fabric multicast planes are the individual multicast spatial replication contexts available in the system.

mcast-reporting-dest

Syntax **mcast-reporting-dest** *dest-name* [**create**]
no mcast-reporting-dest *dest-name*

Context configure>mcast-management

Description This command will create a Multicast Reporting Destination hierarchy in CLI under which parameters defining this destination can be specified. The destination refers to an external node that will collect and analyze IGMP events.

The Multicast Reporting Destination is associated with a name that each subscriber can reference in order to send the IGMP related events.

It can be also referenced in the Host Tracking Policy in case that IGMP events are related to Host Tracking feature.

Default No mcast-reporting-dest is defined.

Parameters *dest-name* — Name of the Multicast Reporting Destination.

dest-ip-address

Syntax **dest-ip-address** *ip-addr*
no dest-ip-address

Context configure>mcast-management>mcast-reporting-dest

Description This command specifies the IP address of the external node to which IGMP events will be exported. The destination IP address can only be reachable from the global routing table (no vrf access).

Default No IP address is configured.

Parameters *ip-addr* — Specifies the IP address of the external node.

max-tx-delay

Syntax **max-tx-delay** *deci-seconds*
no max-tx-delay

Context configure>mcast-management>mcast-reporting-dest

Description This command specifies the time interval before the packet starts transmitting towards the destination. When an IGMP event is encoded and ready to be transported, a buffer for the packet will be allocated (if not already existent). The events will be written into this buffer. Along with the initial buffer creation, a timer is started. The trigger for the transmission of the packet is either the TX buffer being filled up to 1400B, or the timer expiry, whichever comes first.

Default no max-tx-delay. This indicates there is no delay. Events are transported immediately.

Parameters *deci-seconds* — interval in deciseconds

Values 0 — 100

udp-dst-port

Syntax **udp-dst-port** *port*
no udp-dst-port

Context configure>mcast-management>mcast-reporting-dest

Description This command specifies the UDP destination port of the external node to which IGMP events will be exported.

Default No UDP port is configured.

Parameters *port* — Specifies the destination UDP port.

Values 1 — 65535

Bandwidth Policy Commands

bandwidth-policy

Syntax **bandwidth-policy** *policy-name* [**create**]
no bandwidth-policy *policy-name*

Context config>mcast-mgmt

Description This command creates a multicast bandwidth policy. Bandwidth policies are used to manage the ingress multicast path bandwidth. Each forwarding plane supports multicast forwarding paths into the switch fabric. By default, two paths are available; the multicast high priority path and the multicast low priority path. Multicast packets are forwarded on either path based on the expedited or non-expedited (best-effort) nature of the queue the packets are scheduled from. The ingress forwarding plane uses the classification rules to determine the forwarding class of each multicast packet and uses the forwarding class to queue mapping to decide which ingress multipoint queue will forward the packet. When multicast path management has been enabled on an ingress forwarding plane, the multicast bandwidth manager adds a third path for ingress multicast forwarding (ancillary path) and changes the way multicast packets are mapped to the three paths. This new forwarding plane behavior only applies to Layer 2 snooped or Layer 3 routed IP multicast forwarding. VPLS broadcast and unknown or non-snooped flooding is not affected.

When multicast path management is enabled, the ingress forwarding plane allows IP multicast snooped or routed packets to be placed on to the three multicast paths independently of the ingress classification rules. The high priority multicast path is treated as the primary path and the low priority multicast path is treated as the ësecondaryí path. The ancillary path is the point-to-point bandwidth unused by switch fabric point-to-point traffic. The ingress bandwidth manager evaluates each multicast FIB (M-FIB) record to determine which path is best based on ingress bandwidth, number of switch fabric destinations and the fill level of each path. Explicit path association is also supported.

Dynamic Bandwidth Activity Monitoring

When ingress multicast path management is enabled on an MDA, the system monitors the in-use bandwidth associated with each Layer 2 and Layer 3 ingress multicast record. When records are first populated by static, snooping or routing protocols, they are first assumed to be inactive. An inactive record is not considered to be currently consuming ingress multicast path bandwidth.

Within the multicast-info-policy, the bandwidth activity of the new record was configured to be either managed based on an administrative bandwidth, or based on the dynamic bandwidth rate table. The bandwidth-policy associated with ingress MDA contains the configuration parameters for creating the dynamic bandwidth rate table. The purpose of the table is to allow for the system to monitor the bandwidth activity associated with a multicast record and compare the current rate against a number of rate thresholds. Rate thresholds are used to allow a multicast streams rate to fluctuate between a given range while keeping the managed rate at a certain level. Multiple dynamic managed rates are supported in the table to allow monitoring of different types of multicast traffic. Each rate threshold is associated with a rising and falling threshold that defines when the specified rate should be used and when the next lower rate should be used.

Once a record’s monitored current rate rises to the first dynamic rising threshold, the record is considered to be active and the system will then manage the bandwidth the record represents

based on the parameters associated with the record in the records multicast-info-policy and the configured path information in the MDAs associated bandwidth-policy.

Ingress Multicast Path Parameters

The bandwidth-policy also contains the configuration parameters for each of the managed ingress multicast paths. Each path may be configured with a path-limit rate used to override a specific paths default rate. Also, forwarding on each path is managed though an ingress path queue. The queue default parameters may be overridden for each path.

Default Bandwidth Policy

A bandwidth policy with the name 'default' always exists and is used as the default bandwidth policy when ingress multicast path management is enabled without an explicit bandwidth policy defined on an MDA. The default policy cannot be deleted or edited.

The **no** form of the command removes the specified bandwidth policy from the system. The bandwidth policy associations must be removed from MDA configurations before it can be removed.

Parameters *policy-name* — Specifies the name of the bandwidth policy, up to 32 characters in length. Each bandwidth policy must be uniquely named within the system. 32 policies can be configured per system.

create — The create keyword is required if creating a new bandwidth policy when the system is configured to require the explicit use of the keyword to prevent accidental object creation. Objects may be accidentally created when this protection is disabled and an object name is mistyped when attempting to edit the object. This keyword is not required when the protection is disabled. The keyword is ignored when the bandwidth policy name already exists.

admin-bw-threshold

Syntax **admin-bw-threshold** *kilo-bits-per-second*
no admin-bw-threshold

Context config>mcast-management>bandwidth-policy

Description This command defines at which bandwidth rate a multicast channel configured to use an administrative rate will start and stop using that rate as the in-use ingress bandwidth when managing ingress multicast paths. This parameter only applies to channels that are configured to use the admin-bw rate with the bw-activity use-admin-bw command (both are configured in the multicast-info-policy associated with the channel context).

To be effective, the admin-bw-threshold must be less than the channels configured admin-bw. If the administrative bandwidth configured on the channel is less than the administrative bandwidth threshold defined in the bandwidth policy, the admin-bw value is ignored for ingress multicast path management and the system continually uses the dynamic ingress bandwidth associated with the channel. Since the admin-bw-threshold is defined in the bandwidth-policy and the channel admin-bw value is defined in the multicast-info-policy, it is not possible to pre-determine that a given administrative bandwidth value is less than an administrative bandwidth threshold. Since a typical administrative bandwidth threshold will be set significantly lower than any administrative bandwidth values, this corner case is not expected to be prevalent. However, if the case does arise in a production environment, no ill behavior is expected as the threshold is simply a tuning parameter used to detect when the bandwidth associated with a channel has risen above any OAM or background type traffic.

While a channel that is configured to use-admin-bw (in the bw-activity command) current bandwidth is less than the admin-bw-threshold, the system treats the channel as a dynamic type channel. Once the threshold is crossed, the system immediately allocates the full admin-bw value to the channel and manages the ingress multicast path accordingly. If the bandwidth monitored on the channel rises above the admin-bw value, the system reverts to dynamic bandwidth management operation. If the bandwidth drops below the admin-bw value, but is above the admin-bw-threshold, the system uses the admin-bw value. If the bandwidth drops below the admin-bw-threshold, the system goes back to dynamic bandwidth management operation.

This command has no effect on multicast ECMP or egress CAC management operations.

The no for of the command restores the default threshold value of 10 Kbps.

kilobits-per-second — The kilobits-per-second parameter must follow the admin-bw-threshold command and defines rate at which channels configured to use administrative bandwidths change from dynamic bandwidth management to using the channels configured administrative bandwidth. The parameter is expressed as an integer value and represents multiples of 1,000 bits per second. A value of 3000 indicates 3,000,000 bits per second.

Values 1 — 40,000,000

Default 10

primary-path

Syntax **primary-path**

Context config>mcast-mgmt>bandwidth-policy

Description This command enables the context to configure primary path parameters.

ancillary-path

Syntax **ancillary-path**

Context config>mcast-mgmt>bandwidth-policy

Description This command overrides the default path limit for the ancillary path, which is one of the three ingress multicast paths into the switch fabric.

t2-paths

Syntax **t2-paths**

Context config>mcast-management>bandwidth-policy

Description The t2-paths CLI node contains the primary and secondary path CLI nodes for IOM-3s. The commands within this context are ignored when the policy is applied to an IOM-1 or IOM-2.

secondary-path

Syntax **secondary-path**

Context config>mcast-mgmt>bandwidth-policy
config>mcast-mgmt>bw-plcy>t2-paths

Description This command overrides the default path limit for the secondary path, which is one of the three ingress multicast paths into the switch fabric.

number-paths

Syntax **number-paths** *number-of-paths* [**dual-sfm** *number-of-paths*]
config>mcast-management>bandwidth-policy>t2-paths>secondary-paths>queue-parameters

Description This command is used to explicitly provision the number of secondary paths (and imply the number of primary paths) supported by the T2 TChip based forwarding plane the bandwidth policy is managing. The default (and minimum) number of secondary paths is 1 and the maximum configurable is 15. The number of primary paths is total number of available paths minus the number of secondary paths.

Secondary paths are used by:

- Expedited VPLS, IES and VPRN service ingress multipoint queues
- Expedited network ingress multipoint queues
- Managed multicast explicit path primary channels (using the primary paths managed multipoint queue)
- All managed multicast dynamic path channels when the primary paths or multicast planes are not at their limit (using the primary paths managed multipoint queue)
- Highest preference managed multicast dynamic path channels when the primary paths or multicast planes are at their limit (using the primary paths managed multipoint queue)

Secondary paths are used by:

- Best-Effort VPLS, IES and VPRN service ingress multipoint queues
- Best-Effort network ingress multipoint queues
- Managed multicast explicit path secondary channels (using the secondary paths managed multipoint queue)
- Lower preference managed multicast dynamic path channels when the primary paths or multicast planes are at their limit (using the secondary paths managed multipoint queue)

The number of secondary paths should be increased from the default value of 1 when a single secondary path is insufficient for the amount of explicit secondary path managed traffic or the amount of best-effort multipoint non-managed queue traffic.

The **no** form of the command restores the default number of secondary paths.

Parameters *number-of-paths* — The number-paths parameter specifies the number of secondary paths when only one switch fabric is active, while the dual-sfm parameter specifies the same value when two switch fabrics are active.

Values 1 — 15

Default 1

path-limit

Syntax **path-limit** *megabits-per-second*
no path-limit

Context config>card>mda>ingress>mcast-mgmt>prim-override
config>card>mda>ingress>mcast-mgmt>sec-override
config>card>mda>ingress>mcast-mgmt>anc-override
config>mcast-mgmt>bandwidth-policy >primary-path
config>mcast-mgmt>bandwidth-policy >secondary-path
config>mcast-mgmt>bandwidth-policy >ancillary-path

Description This command is used to individually override the default path limit for each of the three ingress multicast paths into the switch fabric on an IOM-1 or IOM-2. When the bandwidth policy is applied to an IOM-3, the path-limit commands are ignored. The configured path limit may be less than, equal to or greater than the terminating switch fabric multicast plane limit.

The system will not violate the configured path limit or the multicast plane limits. The system uses all bandwidth limits and record preferences when determining which records should be allowed on which path, which records should be moved and which records should be placed in the black-hole state.

Changing a paths bandwidth limit causes the system to immediately reevaluate each record on the path. For dynamic path records, this could cause records to be moved to other paths and records on other paths to be placed in the black-hole state.

Changing a path-limit value within the bandwidth policy affects all MDAs where the policy is applied. The policy derived path limit may be overridden on each MDA using the primary-override, secondary-override or ancillary-override nodes in the MDA context.

The **no** form of the command returns the default path bandwidth limit for the ingress multicast path. The command has no effect for MDAs with a path override in effect for the given path.

Default no path-limit

Parameters *megabits-per-second* — Specifies the primary path limit in megabits per seconds.

Values 1 — 5000

Default

primary-path:	2,000
secondary-path	1,500
ancillary-path:	5,000

queue-parameters

Syntax **queue-parameters**

Context config>mcast-management>bandwidth-policy>primary-path
config>mcast-management>bandwidth-policy>secondary-path
config>mcast-management>bandwidth-policy>ancillary-path
config>mcast-management>bandwidth-policy>t2-paths

Description This command defines the individual parameters for the queues through which multicast packets are forwarded into the switch fabric on each path.

The individual path queues may be viewed as shared queues. All multicast packets forwarded through the switch fabric associated with one of the paths traverses bypass the normal queuing behavior. Instead of being forwarded through the normal service or network multicast queue, a single queue associated with the multicast path is used. In order to retain billing and diagnostic information, the forwarding and discard statistics for the service or network queue the packet would have traversed without ingress multicast management is used to account for each packets behavior.

Note that any ingress scheduling policy functions attempting to manage the service or network multicast queues will only be able to read the statistics of the multicast queues and will not be able to manage the queues dynamic rate since the packets are flowing through different, non-managed queues. Since this is the case, multicast queues parented to a scheduling policy should be parented to the root scheduler at the highest priority without any rate limitation. Any ingress rate limiting for multicast traffic will be preformed by the multicast path bandwidth manger based on each records priority and a possible “black-hole” rate threshold.

All queues created for ingress multicast path management are automatically created by the system out of the system reserved queue space. Each queue is created as an expedited queue.

When forwarding through the queues, each packets forwarding class is ignored. However, the forwarding class is retained for proper egress processing. The packets expressed or implied profile is also ignored within the ingress path queues. A packets congestion priority is derived from the records cong-priority-theshold evaluation result as indicated by the multicast-info-policy. The cong-priority-theshold sets the high or low congestion priority of a record based on the records preference value. Within each multicast information policy bundle the cong-priority-theshold is set with a value from 0 to 7 and defines the threshold at which all records with a preference equal to or higher than the defined preference will be treated as congestion priority high. Multicast records with a preference lower than the defined class threshold will be treated as congestion priority low. Low priority packets use the low priority MBS threshold of the queue while high priority packets use the standard MBS value. In the event of path congestion, low priority packets are discarded first, leaving room for the higher priority packets.

For the primary and secondary paths, a single queue exists for each path and every packet forwarded through the path by the bandwidth manager uses that queue. For the ancillary path, a single queue exists for each switch fabric destination. Ancillary path packets are replicated to each switch fabric destination. The replication process places a copy of the packet in the correct ancillary path queue that forwards to that destination.

cbs

Syntax **cbs** *percent-of-resv-cbs*
no cbs

Context config>mcast-management>bandwidth-policy>primary-path>queue-parameters
config>mcast-management>bandwidth-policy>secondary-path>queue-parameters
config>mcast-management>bandwidth-policy>ancillary-path>queue-parameters>ancillary-path
config>mcast-management>bandwidth-policy>t2-paths>primary-paths>queue-parameters
config>mcast-management>bandwidth-policy>t2-paths>secondary-paths>queue-parameters

Description This command overrides the default Committed Buffer Size (CBS) for each individual pathís queue. The queues CBS threshold is used when requesting buffers from the systems ingress buffer pool to indicate whether the requested buffer should be removed from the reserved portion of the buffer pool or the shared portion. When the queueís fill depth is below or equal to the CBS threshold, the requested buffer comes from the reserved portion. Once the queues depth exceeds the CBS threshold, buffers come from the shared portion.

The **cbs** *percent-of-resv-cbs* parameter is defined as a percentage of the reserved portion of the pool. The system allows the sum of all CBS values to equal more than 100% allowing for oversubscription of the reserved portion of the pool. If the reserved portion is oversubscribed and the queues are currently using more reserved space than provisioned in the pool, the pool automatically starts using the shared portion of the pool for within-CBS buffer allocation. On the shared early detection slopes could assume more buffers exist within the shared portion than actually do which may cause the early detection function to fail.

For the primary-path and secondary-path queues, the percentage is applied to a single queue for each path. For the ancillary-path, multiple queues are required. The **cbs** *percent-of-resv-cbs* is divided between all ancillary path queues. For example, if primary is given 10 percent, the primary path queues CBS is set to 10% of the reserved portion of the buffer pool. If ancillary is given 50 percent and 10 ancillary path queues exist, each ancillary queue gets 5%. The number of path queues required depends on the available chassis slots and the provisioned IOM types. 7450 ESS-6 chassis have 4 slots, 7450 ESS-7 and 7750 SR-7 have 5 and the 7450 ESS-12 and 7750 SR-12 have 10. An IOM-1 or IOM-2 on a slot has two switch fabric destinations.

The **no** form of the command restore the path queues default CBS value.

Parameters *percent-of-resv-cbs* — The percent of buffers reserved from the total buffer pool space, expressed as a decimal integer. If 10 MB is the total buffers in the buffer pool, a value of 10 would reserve 1MB (10%) of buffer space for the forwarding class queue. The value 0 specifies that no reserved buffers are required by the queue (a minimal reserved size can be applied for scheduling purposes).

Values 0 — 100

Default

Primary:	5
Secondary:	30
Ancillary:	65

hi-priority-only

Syntax **hi-priority-only** *percent-of-mbs*
no hi-priority-only

Context config>mcast-management>bandwidth-policy>primary-path>queue-parameters
config>mcast-management>bandwidth-policy>secondary-path>queue-parameters
config>mcast-management>bandwidth-policy>ancillary-path>queue-parameters>ancillary-path
config>mcast-management>bandwidth-policy>t2-paths>primary-paths>queue-parameters
config>mcast-management>bandwidth-policy>t2-paths>secondary-paths>queue-parameters

Description This command overrides the default percentage value used to determine the low priority MBS value for the queue. By default, 10 percent of the queue depth is reserved for high congestion priority traffic. When specified, the high-prior-only percentage value is applied to the queues MBS threshold. The resulting value is subtracted from the MBS to derive the low priority MBS threshold maintained by the queue. The low priority MBS threshold defines the point at which all low congestion priority packets destined for the queue will be discarded based on queue depth. Low and high congestion priority is derived from the multicast records preference value compared to the record's bundle priority-theshold.

The **no** form of this command restores the default value.

Parameters *percent-of-mbs* — The percentage parameter is required when specifying high-prior-only.

Values 0 — 100

0 specifies that the MBS and LP-MBS thresholds will be set to the same value resulting in high and low congestion priority packets being treated equally.

100 specifies that the LP-MBS threshold will be set to 0, resulting in a discared of all low congestion priority packets.

Values in between 0 and 100 result in a corresponding differential between the MBS and LP-MBS threshold values.

mbs

Syntax **mbs** *percent-of-pool*
no mbs

Context config>mcast-management>bandwidth-policy>primary-path>queue-parameters
config>mcast-management>bandwidth-policy>secondary-path>queue-parameters
config>mcast-management>bandwidth-policy>ancillary-path>queue-parameters>ancillary-path
config>mcast-management>bandwidth-policy>t2-paths>primary-paths>queue-parameters
config>mcast-management>bandwidth-policy>t2-paths>secondary-paths>queue-parameters

Description This command is used to override the default Maximum Buffer Size (MBS) for each individual pathís queue. The queues MBS threshold defines the point at which all packets destined for the queue will be discarded based on queue depth. The defined threshold also provides context for the queues high-prior-only parameter.

The mbs *percent-of-pool* parameter is defined as a percentage of the total pool size. The system allows the sum of all MBS values to equal more than 100% allowing for oversubscription of the pool.

For the primary-path and secondary-path queues, the mbs percent is applied to a single queue for each path. For the ancillary-path, multiple queues are required. The mbs percentage is divided between all ancillary path queues. For example, if primary is given 10 percent, the primary path queues MBS is set to 10% of the buffer pool. If ancillary is given 50 percent and 10 ancillary path queues exist, each ancillary queue gets 5%. The number of path queues required depends on the available chassis slots and the provisioned IOM types. ESS-6 chassis have 4 slots, ESS/SR-7 have 5 and ESS/SR-12 have 10. An IOM-1 or IOM-2 on a slot has two switch fabric destinations while an IOM-3 has one.

The **no** form of the command is used to restore the path queues default MBS value.

Parameters *percent-of-pool* — The percent of buffers from the total buffer pool space for the maximum amount of buffers, expressed as a decimal integer. If 10 MB is the total buffers in the buffer pool, a value of 10 would limit the maximum queue size to 1MB (10%) of buffer space for the forwarding class queue. If the total size is increased to 20MB, the existing value of 10 would automatically increase the maximum size of the queue to 2MB.

Values 0 — 100

Default

Primary Default:	7
Secondary Default:	40
Ancillary Default:	80

Default 10

falling-percent-reset

Syntax **falling-percent-reset** *percent-of-highest*
no falling-percent-reset

Context config>mcast-mgmt>bw-plcy

Description The falling-percent-reset command is used to configure the percentage of bandwidth decrease that must occur to reset the dynamic bandwidth monitoring function for a multicast channel. When a channel is configured to use the ingress dynamic bandwidth as the in-use bandwidth for ingress multicast path management, the system maintains a sliding window in time that defines how long the last highest bandwidth value associated with the channel should be used. The sliding window duration is derived from the channels bw-activity dynamic falling-delay parameter within the multicast information policy. Each time the system detects a current bandwidth for a channel that is equal to or greater than the current highest bandwidth for the channel, the sliding window is reset and the highest value is used when managing the ingress multicast paths. If the system does not detect a higher or equal bandwidth value for the channel within the window period, the system resets the sliding window and uses the next highest rate seen during the duration of the window period. In this way, the system delays relinquishing bandwidth for a dynamic bandwidth channel for a configurable period of time. If a momentary fluctuation (decrease) in ingress bandwidth occurs, the system ignores the bandwidth change.

While this is useful for momentary fluctuations in bandwidth, it may be desirable to react faster when the current bandwidth monitored for a channel drops significantly relative to the currently in-use bandwidth. When the bandwidth decrease is equal to or greater than the falling-percent-reset value, the system immediately stops using the highest bandwidth and starts using the current bandwidth while resetting the sliding window.

If falling-percent-reset is set to 50%, when the current ingress dynamic bandwidth is 50% of the current in-use highest bandwidth, the system will immediately use the current dynamic ingress bandwidth as the highest bandwidth for the channel.

By default falling-percent-reset is 50% when a new bandwidth policy is created. The default bandwidth policy also has a hard configured value of 50%. Setting falling-percent-reset to 100 is equivalent to specifying no falling-percent-reset.

The **no** form of the command restores the default value of 50%.

Parameters *percent-of-highest* — The percent-of-highest parameter is required and defines the percentage of decline between the current ingress dynamic bandwidth and the current in-use highest bandwidth at which the system will reset the dynamic ingress bandwidth monitoring for the channel. When reset in this case, the system uses the current ingress dynamic bandwidth as the highest rate and continues monitoring. The parameter must be defined as an integer value representing a percentage.

Values 1 — 100 percent

Default 100

Sample Output

The following output displays an example of bandwidth policy defaults.

```
*A:PE-1# configure mcast-management bandwidth-policy test create
```

```
*A:PE-1>config>mcast-mgmt>bw-plcy$ exit all
*A:PE-1# show mcast-management bandwidth-policy "test" detail
===============================================================================
Bandwidth Policy Details
===============================================================================
-------------------------------------------------------------------------------
Policy             : test
-------------------------------------------------------------------------------
Admin BW Thd       : 10 kbps           Falling Percent RST: 50
Mcast Pool Total   : 10                Mcast Pool Resv Cbs: 50
Slope Policy       : default
Primary
Limit              : 2000 mbps         Cbs                : 5.00
Mbs                : 7.00              High Priority      : 10
Secondary
Limit              : 1500 mbps         Cbs                : 30.00
Mbs                : 40.00             High Priority      : 10
Ancillary
Limit              : 5000 mbps         Cbs                : 65.00
Mbs                : 80.00             High Priority      : 10
T2-Primary
Cbs                : 5.00              Mbs                : 7.00
High Priority      : 10
T2-Secondary
Cbs                : 30.00             Mbs                : 40.00
High Priority      : 10                Paths(Single/Dual) : 1/1
===============================================================================
Bandwidth Policies : 1
===============================================================================
*A:PE-1#
```

mcast-pool

Syntax **mcast-pool percent-of-total** *percent-of-buffers* **resv-cbs** *percent-of-pool* **slope-policy** *policy-name*
no mcast-pool

Context config>mcast-mgmt>bw-plcy

Description This command configures the ingress multicast path management buffer pool. The pool is used by the primary, secondary and ancillary path queues through which all ingress managed multicast traffic must flow. The parameters may be used to configure the size of the pool relative to the total ingress buffer space, the amount of reserved CBS buffers within the pool and the slope policy used to manage early congestion detection functions in the shared portion of the pool.

Care should be taken when managing the buffer pool space as changes to the systems buffer pool behavior can have negative effects on multicast and unicast forwarding.

Sizing the Pool

The percent-of-total command defines how much of the total ingress buffer pool space for the MDA is dedicated for multicast channels managed by the bandwidth policy. Since multicast typically has a higher scheduling priority through the switch fabric, the buffer pool does not need to be large. By default, the system reserves 10% of the buffers on the ingress side of the MDA once multicast path management is enabled.

Reserved CBS Portion of the Pool

The multicast pool is divided into two portions; reserved and shared. The reserved portion is used by the multicast path queues until they cross there individual CBS thresholds. Since the CBS thresholds are configured as percents and the percents are allowed to oversubscribe the reserved portion of the pool, it is possible for some of the queues CBS buffer allocation to be met by the shared portion of the pool. By default, 50% of the pool is defined as reserved. This may be changed using the resv-cbs percentage parameter.

Shared Portion WRED Slopes

The shared portion of the buffer pool is used by queues that have crossed over their CBS thresholds. Since the total MBS values for the multicast path queues may oversubscribe the pool size, a buffer congestion control mechanism is supported within the pool in the form of two WRED slopes. The slope-policy parameter defines how the slopes are configured and whether they are activated. Each packet entering a path queue is defined as high or low priority within the queue based on the channels preference value relative to the cong-priority-threshold command. When getting a shared buffer of a high priority packet, the high WRED slope is used. Low priority packets use the low WRED slope.

The **no** form of the command returns the managed multicast path pool to its default settings.

Parameters **percent-of-total** *percent-of-buffers* **—** The percent-of-total keyword is required when executing the mcast-pool command and must be followed by a percent-of-buffers parameter expressed as an integer and representing the percentage of ingress buffers that will be allocated to the multicast pool.

Values 1 — 50

Default 10

resv-cbs *percent-of-pool* **—** The resv-cbs keyword is required when executing the mcast-pool command and must be followed by a percent-of-pool parameter expressed as an integer and representing the percentage of the pool that will be reserved for multicast path queues within their CBS threshold.

Values 1 — 100

Default 50

slope-policy *slope-policy-name* **—** The slope-policy keyword is required when executing the mcast-pool command and must be followed by a valid slope-policy-name. The named policy will be used to configure the WRED slopes within the multicast pool. Once a slope policy is associated with a buffer pool, it cannot be deleted.

Default default

Multicast Info Policy Commands

multicast-info-policy

Syntax **multicast-info-policy** *policy-name* [**create**]
no multicast-info-policy

Context config>mcast-management

Description This command configures a multicast information policy. Multicast information policies are used to manage parameters associated with Layer 2 and Layer 3 multicast records. Multiple features use the configured information within the policy. The multicast ingress path manager uses the policy to decide the inactive and active state behavior for each multicast record using the ingress paths to the switch fabric. The system's multicast ECMP join decisions are influenced by the channel information contained within the policy.

Multicast Bundles:

A multicast information policy consists of one or multiple named bundles. Multicast streams are mapped to a bundle based on matching the destination address of the multicast stream to configured channel ranges defined within the bundles. Each policy has a bundle named 'default' that is used when a destination address does not fall within any of the configured channel ranges.

Each bundle has a set of default parameters used as the starting point for multicast channels matching the bundle. The default parameters may be overridden by optional exception parameters defined under each channel range. Further optional parameter overrides are possible under explicit source address contexts within each channel range.

Default Multicast Information Policy

A multicast information policy always exists with the name 'default' and cannot be edited or deleted. The following parameters are contained in the default multicast information policy:

Policy Description: Default policy, cannot be edited or deleted.
Bundle: default
Bundle Description: Default Bundle, cannot be edited or deleted.
Congestion-Priority-Threshold: 4
ECMP-Optimization-Limit-Threshold: 7

Bundle Defaults:
Administrative Bandwidth:0 (undefined)
Preference: 0
CAC-Type: Optional
Bandwidth Activity: Dynamic with no black-hole rate
Explicit Ingress SF Path: None (undefined)
Configured Channel Ranges: None

The default multicast information policy is applied to all VPLS and VPRN services and all routing contexts until an explicitly defined multicast information policy has been mapped.

Explicit Multicast Information Policy Associations

Each VPLS service and each routing context (including VPRN routing contexts) supports an explicit association with an pre-existing multicast information policy. The policy may need to be unique per service or routing context due to the fact that each context has its own multicast

address space. The same multicast channels may be and most likely will be used for completely different multicast streams and applications in each forwarding context.

Interaction with Ingress Multicast Path Management

When ingress multicast path management is enabled on an MDA, the system automatically creates a bandwidth manager context that manages the multicast path bandwidth into the switch fabric used by the ingress ports on the MDA. As routing or snooping protocols generate L2 or L3 multicast FIB records that will be populated on the MDA's forwarding plane, they are processed though the multicast information policy that is associated with the service or routing context associated with the record. The policy will return the following information for the record to be used by the ingress bandwidth manager:

- The records administrative bandwidth ('0' if undefined)
- Preference level (0 to 7 with 7 being highest)
- Bandwidth activity monitoring setting (use admin bw or dynamic monitoring)
  If admin bw is indicated, will also return active and inactive thresholds
- Initial switch fabric multicast path (primary, secondary or ancillary)
  If ancillary path is indicated, will also return an SF destination threshold
- Explicit switch fabric multicast path (primary, secondary, ancillary or none)

Interaction with Multicast ECMP Optimization

The multicast information policy is used by the multicast ECMP optimization function to derive each channels administrative bandwidth. The ECMP function tallies all bandwidth information for channels joined and attempts to equalize the load between the various paths to the sender. The multicast information policy returns the following information to the ECMP path manager:

3. Administrative bandwidth ('0' if undefined)
4. Preference (0 to 7 with 7 the highest preference value)

Parameters *policy-name* — Iidentifies the name of the policy to be either created or edited. Each multicast information policy must be uniquely named within the system. Names of up to 32 ASCII characters are supported with the normal character restrictions.

create — The create keyword is required if creating a new multicast information policy when the system is configured to require the explicit use of the keyword to prevent accidental object creation. Objects may be accidentally created when this protection is disabled and an object name is mistyped when attempting to edit the object. This keyword is not required when the protection is disabled. The keyword is ignored when the multicast information policy name already exists.

multicast-info-policy

Syntax **multicast-info-policy** *policy-name*
no multicast-info-policy

Context config>service>vpls
config>router

Description This command overrides the default multicast information policy on a VPLS or routing context. When the policy association is changed, all multicast channels in the service or routing context must be reevaluated.

If a multicast information policy is not explicitly associated with the VPLS service or routing context, the default multicast information policy is used when ingress multicast path management is enabled.

While a multicast information policy is associated with a service or routing context, the policy cannot be deleted from the system.

The no form of the command removes an explicit multicast information policy from the VPLS or routing context and restores the default multicast information policy.

Parameters *policy-name* — The policy-name parameter is required and specifies an existing multicast information policy that should be associated with the VPLS service or routing context.

Default default

bundle

Syntax **bundle** *bundle-name* [**create**]
no bundle *bundle-name*

Context config>mcast-mgmt>mcast-info-plcy

Description The bundle command is used to create or edit channel bundles within a multicast information policy. Bundles are used for two main purposes. First, bundles are used by the multicast CAC function to group multicast channels into a common bandwidth context. The CAC function limits the ability for downstream nodes to join multicast channels based on the egress interfaces ability to handle the multicast traffic. Bundling allows multicast channels with common preference or application to be managed into a certain percentage of the available bandwidth.

The second function of bundles is to provide a simple provisioning mechanism. Each bundle within a multicast information policy has a set of default channel parameters. If each channel provisioned in to the bundle is able to use the default parameters for the bundle, the provisioning and configuration storage requirements are minimized.

Up to 31 explicit bundles may be defined within a multicast information policy (32 including the default bundle).

Once a bundle is created, the default channel parameters should be configured and the individual channel ranges should be defined. Within each channel range, override parameters may be defined that override the default channel parameters. Further overrides are supported within the channel range based on explicit source overrides.

A bundle may be deleted at anytime (except for the default bundle). When a bundle is deleted, all configuration information within the bundle is removed including multicast channel ranges. Any multicast records using the bundle should be reevaluated. Multicast CAC and ECMP managers should also be updated.

Default Bundle

Each multicast information policy contains a bundle named **default**. The default bundle cannot be deleted. Any multicast channel that fails to match a channel range within an explicit bundle is automatically associated with the default bundle.

The **no** form of the command removes a bundle from the multicast information policy. The default bundle cannot be removed from the policy.

Default default

bundle-name — Specifies bundle expressed as an ASCII string with up to 16 characters and must follow normal naming conventions. If bundle-name already exists, the system will enter the bundle context for editing purposes. If bundle-name does not exist, the system will create the defined bundle in the policy and enter the bundle context for editing purposes.

create — The create keyword is required if creating a new multicast information policy bundle when the system is configured to require the explicit use of the keyword to prevent accidental object creation. Objects may be accidentally created when this protection is disabled and an object name is mistyped when attempting to edit the object. This keyword is not required when the protection is disabled. The keyword is ignored when the bundle name already exists.

channel

Syntax **channel** *ip-address* [*ip-address*] [**create**]
no channel *ip-address* [*ip-address*]

Context config>mcast-mgmt>mcast-info-plcy>bundle

Description This command defines explicit channels or channel ranges that are associated with the containing bundle. A channel or channel range is defined by their destination IP addresses. A channel may be defined using either IPv4 or IPv6 addresses. If a channel range is being defined, both the start and ending addresses must be the same type.

A specific channel may only be defined within a single channel or channel range within the multicast information policy. A defined channel range cannot overlap with an existing channel range.

If a channel range is to be shortened, extended, split or moved to another bundle, it must first be removed from its existing bundle.

Each specified channel range creates a containing context for any override parameters for the channel range. By default, no override parameters exist.

The **no** form of the command removes the specified multicast channel from the containing bundle.

Parameters **start-channel-ip-address [end-channel-ip-address] —** The start-channel-ip-address parameter and optional end-channel-ip-address parameters define the starting and ending destination IP addresses for a channel range.

If only the start-channel-ip-address is given, the channel ranges comprises of a single multicast channel.

If both the starting and ending address are specified, all addresses within the range including the specified address are part of the channel range.

IPv4 or IPv6 addresses may be defined. All specified addresses must be valid multicast destination addresses. The starting IP address must be numerically lower then the ending IP address.

Values Any valid IP multicast destination address

Default None

create — The create keyword is required if creating a new multicast channel range when the system is configured to require the explicit use of the keyword to prevent accidental object creation.

Objects may be accidentally created when this protection is disabled and an object name is mistyped when attempting to edit the object. This keyword is not required when the protection is disabled. The keyword is ignored when the specified channel range already exists.

admin-bw

Syntax **admin-bw** *kbps*
no admin-bw

Context config>mcast-mgmt>mcast-info-plcy>bundle>channel
config>mcast-mgmt>mcast-info-plcy>bundle>source-override

Description This command specifies an administrative bandwidth for multicast channels.

The specified bandwidth rate may be used by the multicast ingress path manger, multicast CAC manager or multicast ECMP manager.

The admin-bw value is closely tied to the bw-activity command. When the bw-activity command is set to use-admin-bw, the multicast ingress path manager uses the configured administrative bandwidth value as the managed ingress bandwidth. The admin-bw value must be defined for the **bw-activity use-admin-bw** command to succeed. Once the bw-activity command is set to use the admin-bw value, the value cannot be set to 0 and the no admin-bw command will fail. Setting the bw-activity command to dynamic (the default setting), breaks the association between the commands.

The **no** form of the command restores the default value for admin-bw. If the command is executed in the **channel** context, the channels administrative bandwidth value is set to null. If the command is executed in the **source-override** context, the source override administrative bandwidth value is set to null.

Default none

Parameters *kbps* — Specifies the administrative bandwidth for multicast channels.

Values 1 — 40000000 kbps

Bundle default:	0
Channel default:	Null (undefined)
Source-override default:	Null (undefined)

Override sequence — The channel setting overrides the bundle setting. The source-override setting overrides the channel and bundle settings.

bw-activity

Syntax **bw-activity** {**use-admin-bw** | **dynamic** [**falling-delay** *seconds*]} [**black-hole-rate** *kbps*]
no bw-activity

Context config>mcast-mgmt>mcast-info-plcy>bundle>channel
config>mcast-mgmt>mcast-info-plcy>bundle>source-override

Description This command defines how the multicast ingress path manager determines the amount of bandwidth required by a multicast channel. The default setting is dynamic which causes the bandwidth manager to use the bandwidth policies dynamic rate table entries to determine the current rate. The alternative setting is use-admin-bw which causes the bandwidth manager to use the configured admin-bw

associated with the channel. The use-admin-bw setting also requires an active and inactive threshold to be defined which allows the bandwidth manager to determine when the channel is actively using ingress path bandwidth and when the channel is idle.

The **use-admin-bw** setting requires that the channel be configured with an admin-bw value that is not equal to 0 in the same context as the **bw-activity** command using the setting. Once a context has use-admin-bw configured, the contextís admin-bw value cannot be set to 0 and the no admin-bw command will fail.

This command also supports an optional **black-hole-rate** *kbps* command that defnes at which current rate a channel should be placed in the black-hole state. This is intended to provide a protection mechanism against multicast channels that exceed a reasonable rate and cause outages in other channels.

The **no** form of the command restores the default bandwidth activity monitoring setting (dynamic or null depending on the context).

Default no bw-activity

Parameters **use-admin-bw | dynamic —** The **use-admin-bw** and **dynamic** keywords are mutually exclusive and one must be specified when executing the **bw-activity** command. The **use-admin-bw** keyword indicates the channels current ingress bandwidth should be derived from the **admin-bw** setting. The **admin-bw** setting must not currently be set to 0 for the **use-admin-bw** setting to succeed. The **dynamic** keyword indicates that the multicast ingress path manager should use the dynamic rate table (as defined in the bandwidth-policy) to derive the channels current ingress rate.

falling-delay *seconds* **—** specifies the value the bandwidth manager uses the falling-delay threshold to hold on to the previous highest bandwidth until the delay time has expired while operating in dynamic bandwidth mode. This allows the bandwidth manager to ignore momentary drops in channel bandwidth.

Values 10 — 3600

Default 30

Bundle default:	dynamic
Channel default:	Null (undefined)
Source-override default:	Null (undefined)

black-hole-rate *kbps* **—** Specifies a rate at which a channel will be placed in the black-hole state. The kilobits-per-second parameter is expressed as an integer and represents multiples of 1,000 bits per second.

Values 0 — 40000000

Default None

cac-type

Syntax **cac-type** {**mandatory** | **optional**}

Context config>mcast-mgmt>mcast-info-plcy>bundle
config>mcast-mgmt>mcast-info-plcy>bundle>channel
config>mcast-mgmt>mcast-info-plcy>bundle>channel>source-override

Description This command defines the channels multicast CAC channel type, either **mandatory** or **optional**. The cac-type command is supported for future interaction with the egress multicast CAC manager policy.

The multicast CAC manager always reserves egress bandwidth for mandatory channels within a bundle, while optional channels are only given bandwidth when a join is received.

Parameters **mandatory —** This keyword is mutually exclusive with the **optional** keyword and specifies the the channels multicast CAC channel type.

optional — This keyword is mutually exclusive with the **mandatory** keyword and specifies the the channels multicast CAC channel type.

explicit-sf-path

Syntax **explicit-sf-path** {**primary**|**secondary**|**ancillary**}
no explicit-sf-path

Context config>mcast-mgmt>mcast-info-plcy>bundle>channel
config>mcast-mgmt>mcast-info-plcy>bundle>source-override

Description This command defines an explicit ingress switch fabric multicast path assigned to a multicast channel. When defined, the channel is setup with the explicit path as its inactive path. When an explicit path is not defined, all multicast channels are initialized on the secondary path and when they start to consume bandwidth, they are moved to the appropriate path based on the channel attributes and path limitations. Explicit path channels are not allowed to move from their defined path.

The **explicit-sf-path** command in the bundle context defines the initial path for all channels associated with the bundle unless the channel has an overriding explicit-sw-path defined in the channel context. The channel context may also be overridden by the explicit-sf-path command in the source-override context. The channel and source-override explicit-sf-path settings default to null (undefined) and have no effect unless explicitly set.

The **no** form of the command restores default path association behavior (dynamic or null depending on the context).

Default no explicit-sf-path

primary — The primary, secondary and ancillary keywords are mutually exclusive to one another. One keyword must be specified when executing the explicit-sf-path command. The primary keyword specifies that the primary ingress multicast path should be used as the explicit path for the channel.

secondary — The primary, secondary and ancillary keywords are mutually exclusive to one another. One keyword must be specified when executing the explicit-sf-path command. The secondary keyword specifies that the secondary ingress multicast path should be used as the explicit path for the channel.

ancillary — The primary, secondary and ancillary keywords are mutually exclusive to one another. One keyword must be specified when executing the explicit-sf-path command. The ancillary keyword specifies that the ancillary ingress multicast path should be used as the explicit path for the channel.

Default

Bundle :	None (no explicit-sf-path)
channel:	Null (undefined)
Source-override	Null (undefined)

Override sequence — The channel setting overrides the bundle setting. The source-override setting overrides the channel and bundle settings.

keepalive-override

Syntax **keepalive-override** *keepalive-timer*
no keepalive-override

Context config>mcast-mgmt>mcast-info-policy>bundle
config>mcast-mgmt>mcast-info-policy>bundle>channel
config>mcast-mgmt>mcast-info-policy>bundle>channel>source-override

Description This command configures the keepalive timer override. The PIM (S,G) Keepalive Timer (KAT) is used to maintain the (S,G) state when (S,G) join is not received. Expiry of the KAT causes the (S,G) entry to be removed.

The KAT override configuration is performed with an multicast information policy, which must be applied to the related PIM routing instance. When a KAT override is configured under a channel (a group or a group range), it applies to all (S,G) entries that fall under it, except when the source-override is configured and a KAT override is also configured under the source-override. In this scenario, the specific KAT override must be used for the (S,G) entries that fall under the source-override, while other (S,G) entries under the bundle use the KAT override configured under the channel.

Parameters *keepalive-timer* — Specifies the keepalive timer override, in seconds.

Values 10 — 300

preference

Syntax **preference** *preference-level*
no preference

Context config>mcast-mgmt>mcast-info-plcy>bundle
config>mcast-mgmt>mcast-info-plcy>bundle>channel
config>mcast-mgmt>mcast-info-plcy>bundle>channel>source-override

Description This command sets the relative preference level for multicast channels. The preference of a channel specifies its relative importance over other multicast channels. Eight levels of preference are supported; 0 through 7. Preference value 7 indicates the highest preference level.

When the multicast ingress path manager is congested on one or more of the switch fabric multicast paths, it uses the preference values associated with each multicast record to determine which records will be allowed on the path and which records should be placed in a black-hole state.

The preference value is also compared to the bundles cong-priority-threshold setting to determine the congestion priority of the channel. The result also dictates the channels multicast CAC class level (high or low). When the channels preference value is less than the congestion priority threshold, it is considered to have a congestion priority and CAC class value equal to low. When the channels preference value is equal to or greater than the threshold, it is considered to have a congestion priority and a CAC class value equal to high.

The preference value is also compared to the bundles ecmp-opt-threshold setting to determine whether the channel is eligible for ECMP path dynamic optimization. If the preference value is equal to or less than the threshold, the channel may be optimized. If the preference value is greater than the threshold, the channel will not be dynamically optimized.

The preference command may be executed in three contexts; bundle, channel and source-override. The bundle default preference value is 0. The channel and source-override preference settings are considered overrides to the bundle setting and have a default value of null (undefined).

The **no** form of the command restores the default preference value (0 or null depending on the context).

Parameters *preference-level* — The preference-level parameter is required and defines the preference value of the channel. It is represented by an integer value between 0 and 7.

Values 0 — 7

Bundle default:	0
Channel default:	Null (undefined)
Source-override default:	Null (undefined)

Override sequence — The channel setting overrides the bundle setting. The source-override setting overrides the channel and bundle settings.

primary-tunnel-interface

Syntax **primary-tunnel-interface** {**rsvp-p2mp** *lsp-name* | **ldp-p2mp** *p2mp-id*} **sender** *ip-address*
no primary-tunnel-interface

Context config>mcast-mgmt>mcast-info-plcy>bundle
config>mcast-mgmt>mcast-info-plcy>bundle>channel
config>mcast-mgmt>mcast-info-plcy>bundle>channel>source-override

Description This command allows the user to define a bundle in the multicast-info-policy and specify channels in the bundle that must be received from the primary tunnel interface associated with an RSVP P2MP LSP. The multicast info policy is applied to the base router instance.

The egress LER will be able to accept multicast packets via two different methods. The regular RPF check on unlabelled IP multicast packets, which is based on routing table lookup. The static assignment which specifies the receiving of a multicast group <*,G> or a specific <S,G> from a primary tunnel-interface associated with an RSVP P2MP LSP.

One or more primary tunnel interfaces in the base router instance can be configured. That is, the user will be able to specify to receive different multicast groups, <*,G> or specific <S,G>, from different P2MP LSPs. This assumes that there are static joins configured for the same multicast groups at the ingress LER to forward over a tunnel interface associated with the same P2MP LSP.

At any given time, packets of the same multicast group can be accepted from either the primary tunnel interface associated with a P2MP LSP or from a PIM interface. These are mutually exclusive options. As soon as a multicast group is configured against a primary tunnel interface in the multicast info policy, it is blocked from other PIM interfaces.

A multicast packet received on a tunnel interface associated with a P2MP LSP can be forwarded over a PIM or IGMP interface which can be an IES interface, a spoke SDP terminated IES interface, or a network interface.

The **no** form of the command removes the static RPF check.

Default none

Parameters **rsvp-p2mp** *lsp-name* **—** Species a string of up to 32 characters identifying the LSP name as configured at the ingress LER.

sender *ip-address* **—** Specifies a string of 15 characters representing the IP address of the ingress LER for the LSP.

p2mp-id — Identifier used for signaling mLDP P2MP LSP.

Values 1 - 4294967296

source-override

Syntax **source-override** *ip-address* [**create**]
no source-override *ip-address*

Context config>mcast-mgmt>mcast-info-plcy>bundle>channel

Description This command defines a multicast channel parameter override context for a specific multicast sender within the channel range. The specified senders IP address must be of the same type (IPv4 or IPv6) as the containing channel range.

The **no** form of the command removes the specifed sender override context from the channel range.

Default none

Parameters *ip-address* — Specifies either am IPv4 or IPv6 address and it must be the same type as the containing channel range.

Values		
	ipv4-address	a.b.c.d
	ipv6-address	x:x:x:x:x:x:x:x (eight 16-bit pieces)
		x:x:x:x:x:x:d.d.d.d
		x - [0..FFFF]H
		d - [0..255]D

create — The create keyword is required if creating a new source override when the system is configured to require the explicit use of the keyword to prevent accidental object creation. Objects may be accidentally created when this protection is disabled and an object name is mistyped when attempting to edit the object. This keyword is not required when the protection is disabled. The keyword is ignored when the specified source override IP address already exists.

cong-priority-threshold

Syntax **cong-priority-threshold** *preference-level*
no cong-priority-threshold

Context config>mcast-mgmt>mcast-info-plcy>bundle

Description This command defines the preference level threshold where records change from low congestion priority to high congestion priority. Congestion priority is used by the ingress multicast path queues to map packets entering the queue to either the low priority MBS (LP-MBS) or the MBS tail-drop threshold. In the event that congestion happens on the queue, the queue depth increases. As the queue depth increases beyond the low priority MBS, packets with low priority congestion priority are discarded. This leaves room in the queue for packets with high congestion priority until the queue reaches the MBS threshold.

The default congestion priority threshold is 4. This means that multicast channels with a preference level of 0 to 3 will be treated as having low congestion priority and channels with preference level of 4 to 7 will be treated as having a high congestion priority. The **cong-priority-threshold** command can be used to change the default threshold. Any multicast channel with a preference equal to or higher than the configured threshold will be treated with high congestion priority.

The **cong-priority-threshold** value is also used by the multicast CAC manager to derive the class of a channel matched by the multicast information policy. Channels with a preference less than the configured threshold will be treated as ëlowí class and channels with a preference equal to or greater than the threshold will be treated as ëhighí class.

Changing the **cong-priority-threshold** value causes all channels congestion priority to be reevaluated. Both the ingress multicast path managers and multicast CAC managers must be updated.

The **no** form of the command restores the default congestion priority preference threshold value.

Default 4

Parameters *preference-level* — The preference-level parameter is required when specifying the cong-priority-threshold.

Values 0 — 7

Default 4

ecmp-opt-threshold

Syntax **ecmp-opt-threshold** *preference-level*
no ecmp-opt-threshold

Context config>mcast-mgmt>mcast-info-plcy>bundle

Description This command defines the preference level threshold where multicast ECMP path management is allowed to dynamically optimize channels based on topology or bandwidth events. If the channels preference is equal to or less than the ecmp-opt-threshold, ECMP is allowed to move the channel between ECMP paths when bandwidth distribution events happen. Channels with a preference level higher than the threshold will not be moved during these events.

The default ECMP optimization limit threshold is 7. This means that multicast channels with a preference level of 0 to 7 (all channels) will be allowed to move between ECMP paths. The ecmp-opt-threshold command can be used to change the default threshold.

Changing the threshold causes all channels ECMP optimization eligibility to be reevaluated.

The **no** form of the command restores the default ECMP optimization preference threshold value.

Parameters *preference-level* — The preference-level parameter is required when specifying the ecmp-opt-theshold. An integer value from 0 to 7 must be specified.

Values 0 — 7

Default 7

mc-ecmp-balance

Syntax [**no**] **mc-ecmp-balance**

Context config>router>pim

Description This command enables multicast balancing of traffic over ECMP links considering multicast bandwidth. When enabled, every multicast stream that needs to be forwarded over an ECMP link will be evaluated for the sum total multicast utilization currently using the ECMP interface in question.

Note that a given interface can be shared between multiple (partially overlapping) ECMP sets. This is taken into consideration and a complete balance is attempted.

ECMP load balancing helps to avoid loss of unicast traffic over ECMP links as it will load balance over ECMP links and if multicast is not balanced then it is possible that a given link does not have sufficient bandwidth to pass its allotted unicast traffic portion.

In order to achieve a proper balance, multicast groups and their bandwidth should be configured in the config **mcast-management** context.

If the bandwidth is not configured, then the default value applies, and for the purpose of ECMP load balancing, the net effect will be that the balance achieved reflects a balance of the number of multicast groups traversing over the ECMP link. The bandwidth used in this policy is the configured value, not the actual bandwidth.

If **mc-ecmp-balance** is enabled, a redistribution may be triggered whenever a interface is added to an ECMP link.

If **mc-ecmp-balance** is enabled, a period re-balance may be configured that re-optimizes the distribution as some multicast streams may have been removed from the ECMP link.

If mc-ecmp-balance is enabled, then a threshold (ecmp-opt-threshold) can be configured to avoid moving multicast streams where interruption should be avoided.

The ecmp-opt-theshold is used to define the preference level threshold where multicast ECMP path management is allowed to dynamically optimize channels based on topology or bandwidth events. If the channels preference is equal to or less than the ecmp-opt-theshold, ECMP is allowed to move the channel between ECMP paths when bandwidth distribution events happen. Channels with a preference level higher than the threshold will not be moved during these events.

Changing the ecmp-opt-theshold causes all channels ECMP optimization eligibility to be reevaluated.

The **no** form of the command removes the re-balancing capability from the configuration.

mc-ecmp-balance-hold

Syntax **mc-ecmp-balance-hold** *minutes*
no mc-ecmp-balance-hold

Context config>router>pim

Description This command defines a hold period that applies after an interface has been added to the ECMP link. It is also used periodically to rebalance if channels have been removed from the ECMP link.

If the ECMP interface has not changed in the hold period and if no multicast streams have been removed, then no action will be taken when the timer triggers.

This parameter should be used to avoid excessive changes to the multicast distribution.

A rebalance will not occur to multicast streams that have a priority greater then the configured ecmp-opt-threshold.

The **no** form of the command reverts to default.

Parameters *minutes* — Specifies the hold down time in minutes.

Values 2 — 600

mc-ecmp-rebalance

Syntax **mc-ecmp-rebalance** [**ecmp-opt-threshold**]

Context tools>perform>router>pim

Description This command triggers an immediate rebalance, regardless if the hold timer has triggered or if any changes have occurred.

Parameters **ecmp-opt-treshold —** Forces a rebalance of all multicast streams with a priority equal or less then the specified value.

Specifying the value of 7 will force all multicast streams to be re-balanced regardless of the configured **ecmp-opt-threshold** value.

Values 1 — 7

Chassis Level Commands

chassis-level

Syntax **chassis-level**

Context config>mcast-management

Description The chassis-level CLI node contains the multicast plane replication limit for each switch fabric multicast plane.

The chassis-level node always exists and contains the configuration command to define the total replication rates for primary and secondary associated ingress paths for each switch fabric multicast plane.

mmrp-impm-override

Syntax [**no**] **mmrp-impm-override**

Context config>mcast-mgmt>chassis-level

Description This command enables enables ingress Multicast Path Management (IMPM) from monitoring PIM and IGMP.

The **no** form of the command disables the IMPM monitoring.

Default no mmrp-impm-override

per-mcast-plane-capacity

Syntax [**no**] **per-mcast-plane-capacity**

Context config>mcast-mgmt>chassis-level

Description This CLI node contains the configuration of the overall multicast (primary plus secondary) and specific secondary rate limits for each switch fabric multicast plane.

mcast-capacity

Syntax **mcast-capacity** *primary-percentage* **secondary** *secondary-percentage*
no mcast-capacity

Context config>mcast-mgmt>chassis-level>plane-capacity

Description This command configures the primary and secondary multicast plane capacities used when the full complement of possible switch fabrics in the system is not up (at least one possible switch fabric is not provisioned or is down). The rates are defined as a percentage of the total multicast plane capacity which is configured using the total-capacity command.

The **no** form of the command reverts to the default values.

Default

	primary-percentage	100.00
	secondary-percentage	90.00
with SFM5	primary-percentage	87.5
	secondary-percentage	87.5

Parameters *primary-percentage* — Specifies the percentage of the total multicast plane capacity to be used for primary multicast planes.

secondary *secondary-percentage* — Specifies the percentage of the total multicast plane capacity to be used for secondary multicast planes.

Values 0.01 — 100

redundant-mcast-capacity

Syntax **redundant-mcast-capacity** *primary-percentage* **secondary** *secondary-percentage*
no redundant-mcast-capacity

Context config>mcast-mgmt>chassis-level>plane-capacity

Description This command configures the primary and secondary multicast plane capacities used when the full complement of possible switch fabrics in the system are up. The rates are defined as a percentage of the total multicast plane capacity which is configured using the total-capacity command.

The **no** form of the command reverts to the default values.

Default

	primary-percentage	100.00
	secondary-percentage	90.00
with SFM5	primary-percentage	87.5
	secondary-percentage	87.5

Parameters *primary-percentage* — Specifies the percentage of the total multicast plane capacity to be used for primary multicast planes.

Values 0.01 — 100

secondary *secondary-percentage* — Specifies the percentage of the total multicast plane capacity to be used for secondary multicast planes.

Values 0.01 — 100

total-capacity

Syntax **total-capacity** *capacity*
no total-capacity

Context config>mcast-mgmt>chassis-level>plane-capacity

Description This command configures the total multicast plane capacity supported individually by all switch fabric multicast planes.

The **no** form of the command reverts to the default.

Default SR/ESS: 2000

SR12e/XRS: dynamic

Parameters *capacity* — Specifies the multicast plane capacity in Mbps.

Values **2000**, **4000**, **5250**, **8250**, **dynamic** (Specifies that multicast plane capacity will be determined based on provisioned line cards and switch fabrics in the chassis.)

round-robin-inactive-records

Syntax [**no**] **round-robin-inactive-records**

Context config>mcast-mgmt>chassis-level

Description This command specifies whether initially inactive multicast records use the IOM default secondary multicast path or not. When enabled, the system redistributes newly populated inactive records among all available IOM multicast paths and multicast switch fabric planes. When disabled, the system continues to set all initially inactive multicast records to use the IOM default secondary multicast path.

Default no round-robin-inactive-records

Multicast Redirection Commands

action

Syntax **action** {**accept**|**next-entry**|**next-policy**|**reject**}
no action

Context config>router>policy-options>policy-statement>entry

Description This command creates the context to configure actions to take for routes matching a route policy statement entry.

This command is required and must be entered for the entry to be active.

Any route policy entry without the **action** command will be considered incomplete and will be inactive.

The **no** form of the command deletes the action context from the entry.

Default **no action** — No action is defined.

Parameters **accept —** Specifies routes matching the entry match criteria will be accepted and propagated.

next-entry — Specifies that the actions specified would be made to the route attributes and then policy evaluation would continue with next policy entry (if any others are specified).

next-policy — Specifies that the actions specified would be made to the route attributesand then policy evaluation would continue with next route policy (if any others are specified).

reject — Specifies routes matching the entry match criteria would be rejected.

interface

Syntax **interface** *port:tags*

Context config>router>igmp
config>services>ies
config>services>vprn

Description This command enables IGMP (or MLD) on the multicast redirect interface.

Forwarding Plane Commands

fp

Syntax **fp** [*fp-number*]

Context config>card

Description The fp CLI node contains the multicast path management configuration commands for IOM-3 ingress multicast management. Ingress multicast management manages multicast switch fabric paths which are forwarding plane specific. On IOM-1 and IOM-2, each MDA has a dedicated forwarding plane and so have dedicated multicast paths to the switch fabric allowing the multicast management to be defined per MDA. IOM-3 has a single forwarding plane shared by two MDAs making the previous model of managing multicast at the MDA level problematic. The fp node has been added to simplify ingress multicast management on IOM-3.

In subsequent releases, the fp node will be moved to IOM-1 and IOM-2 and the multicast path management commands will be consistent for all IOM types. Other forwarding plane resource configuration commands (i.e. buffer pool management) are expected to also move to the fp node.

While IOM-3 only has a single forwarding plane, other IOMs that will use the node in the future will have multiple (i.e. IOM-1 and IOM-2). To accommodate multiple forwarding planes, each forwarding plane is assigned a number. The default forwarding plane is 1. When entering the fp node, if the forwarding plane number is omitted, the system will assume forwarding plane number 1. All show and save configuration output must include the forwarding plane number.

Parameters *fp-number* — The fp-number parameter is optional following the fp command. If omitted, the system assumes forwarding plane number 1. More than a single forwarding plane will be supported in the future when IOMs other then IOM-3 are supported.

Values 1

Default 1

ingress

Syntax **ingress**

Context config>card>fp

Description The ingress CLI node within the fp node contains the multicast path management configuration commands for IOM-3 ingress multicast management. For this release, on the bandwidth-policy command is supported within the ingress node.

multicast-path-management

Syntax **multicast-path-management**

Context config>card>fp>ingress
config>card>mda>ingress

Description The multicast-path-management CLI node contains the forwarding plane or MDA settings for ingress multicast path management. Enter the node to configure the bandwidth-policy, the individual path bandwidth overrides and the administrative state of ingress multicast path management.

bandwidth-policy

Syntax **bandwidth-policy** *policy-name*
no bandwidth-policy

Context config>card>fp>ingress>mcast-path-management
config>card>mda>ingress>mcast-path-management

Description This command is used to explicitly associate a bandwidth policy to a forwarding plane or MDA. The bandwidth policy defines the dynamic rate table and the multicast paths bandwidth and queuing parameters.

If a bandwidth policy is not explicitly associated with a forwarding plane or MDA, the default bandwidth policy is used when ingress multicast path management is enabled.

The **no** form of the command removes an explicit bandwidth policy from a forwarding plane or MDA and restores the default bandwidth policy.

Parameters *policy-name* — The policy-name parameter is required and defines the bandwidth policy that should be associated with the MDA or forwarding plane for ingress multicast path management. If the policy name does not exist, the bandwidth-policy command will fail.

Values Any existing bandwidth policy name

Default default

primary-override

Syntax **primary-override**

Context config>card>mda>ingress>mcast-mgmt

Description This command enables the context to configure MDA ingress multicast path-limit overrides.

The path override CLI nodes are not supported on IOM-3.

secondary-override

Syntax **secondary-override**

Context config>card>mda>ingress>mcast-mgmt

Description This command enables the context to configure MDA ingress multicast path-limit overrides.

The path override CLI nodes are not supported on IOM-3.

ancillary-override

Syntax **ancillary-override**

Context config>card>mda>ingress>mcast-mgmt

Description This command enables the context to configure MDA ingress multicast path-limit overrides.

path-limit

Syntax **path-limit** *megabits-per-second*
no path-limit

Context config>card>mda>ingress>mcast-mgmt>primary-override
config>card>mda>ingress>mcast-mgmt>secondary-override
config>card>mda>ingress>mcast-mgmt>ancillary-override

Description The path-limit command is used to override the path limits contained in the bandwidth policy associated with the MDA. The path limits are used to give the upper limit that multicast channels may use on each path.

The path-limit commands are not supported on IOM-3.

The no form of the command removes a path limit override from an ingress multicast path and restore the path limit defined in the bandwidth policy associated with the MDA.

Parameters *megabits-per-second* — The megabits-per-second parameter is required when executing the path-limit command and is expressed as an integer representing multiples of 1,000,000 bits per second.

Values

Primary-override:	1 to 2000
Secondary-override:	1 to 2000
Ancillary-override:	1 to 5000

Default None

Triple Play Enhanced Subscriber Management

In This Section

This section describes features which provide Enhanced Subscriber Management functions for Triple Play services.

Topics in this section include:

Uniform RADIUS Server Configuration

RADIUS Server Configuration

The following two configuration methods co-exist but are mutually exclusive:

- Uniform RADIUS Server Configuration (Preferred) on page 930
- Legacy RADIUS Server Configuration on page 934

Uniform RADIUS Server Configuration (Preferred)

This configuration method is preferred as it can be re-used amongst multiple applications (Subscriber authentication and accounting, L2TP tunnel accounting, WLAN gateway RADIUS proxy,) and enables additional functionality not available in the legacy configuration method. For example:

- A RADIUS server policy operational state can be controlled by reception of accounting on/off responses.
- Buffering of accounting messages: When all servers in a **radius-server-policy** are unreachable, it is possible to buffer the acct-stop and acct-interim-update messages for up to 25 hrs. When a RADIUS server becomes reachable again then the messages in the buffer are retransmitted.
- A configurable hold down time for accounting servers that are marked down and during which no new communication attempts will be made (hold-down-time).
- A configurable maximum number of outstanding RADIUS requests for accounting servers (pending-requests-limit).
- Increased retry and timeout values for unsuccessful RADIUS communication.
- Enhanced RADIUS server statistics
- IPv6 RADIUS server

Note: A RADIUS server is marked down if it detects a number of consecutive timeouts independent of transaction-id or origin of request.

Where a number of consecutive timeouts is defined by the number of retries configured below the radius-server-policy servers.

The default number of retries is 3, meaning 1 initial try and 2 retries.

If, for example, the RADIUS server has “2 timeouts, 1 reply, 1 timeouts”, whereby the timeouts are originated for the same host, the server is not marked down since intermediate replies were received.

To attach a RADIUS server policy to an authentication policy:

For example,

```
configure
    subscriber-mgmt
        authentication-policy "auth-policy-1" create
            radius-server-policy "aaa-server-policy-1"
        exit
    exit
```

Notes:

- To avoid conflicts, the following CLI commands are ignored in the authentication policy when a **radius-server-policy** is attached:
  - All commands in the **radius-authentication-server** context
  - **accept-authorization-change**
  - **coa-script-policy**
  - **accept-script-policy**
  - **request-script-policy**
- The **fallback-action** command specifies the action when no RADIUS server is available is configured direct in the **config>subscr-mgmt>auth-plcy** CLI context.

To attach a RADIUS server policy to a RADIUS accounting policy:

For example:

```
configure
    subscriber-mgmt
        radius-accounting-policy "acct-policy-1" create
            radius-server-policy "aaa-server-policy-1"
        exit
    exit
```

Note: To avoid conflicts, the following CLI commands are ignored in the RADIUS accounting policy when a **radius-server-policy** is attached:

- All commands in the **radius-accounting-server** context
- **acct-request-script-policy**

To configure the RADIUS servers in a RADIUS server policy:

For example:

```
configure
    aaa
        radius-server-policy "aaa-server-policy-1" create
            description "Radius AAA server policy"
            accept-script-policy "script-policy-2"
            acct-on-off oper-state-change
            acct-request-script-policy "script-policy-3"
            auth-request-script-policy "script-policy-1"
            no python-policy
            servers
                access-algorithm direct
                hold-down-time sec 30
                no ipv6-source-address
                retry 3
                router "Base"
                no source-address
                timeout sec 5
                buffering
                    acct-interim min 60 max 3600 lifetime 5
                    acct-stop min 60 max 3600 lifetime 5
                exit
                server 1 name "server-1"
                server 2 name "server-2"
            exit
        exit
    exit
```

To configure the RADIUS servers in the routing instance:

- In the Base routing instance: **configure>router>radius-server**.
- In a VPRN routing instance: **configure>service>vprn 10>radius-server**.
- In the management routing instance (out of band): **configure>router management>radius-server**.

For example:

```
configure
    router
        radius-server
            server "server-1" address 172.16.1.1 secret <shared secret> hash2 create
                accept-coa
                coa-script-policy "script-policy-4"
                description "Radius server 1"
                pending-requests-limit 4096
                acct-port 1813
                auth-port 1812
            exit
            server "server-2" address 172.16.1.2 secret <shared secret> hash2 create
                accept-coa
                coa-script-policy "script-policy-4"
                description "Radius server 2"
```

```
            pending-requests-limit 4096
            acct-port 1813
            auth-port 1812
        exit
    exit
exit
```

Note: To configure RADIUS CoA servers for use in Enhanced Subscriber Management, the server must be configured in the corresponding routing instance with the **accept-coa** command enabled.

Legacy RADIUS Server Configuration

Note: It is recommended to migrate to the uniform RADIUS server configuration as described above to have additional functionality enabled.

To configure a RADIUS server in an authentication policy:

```
configure
    subscriber-mgmt
        authentication-policy "auth-policy-1" create
            radius-authentication-server
                access-algorithm direct
                hold-down-time 30
                retry 3
                no source-address
                timeout 5
                router "Base"
               server 1 address 172.16.1.1 secret <shared secret> hash2 port 1812 pending-
requests-limit 4096
                server 2 address 172.16.1.2 secret <shared secret> hash2 port 1812 pending-
requests-limit 4096
            exit
            accept-authorization-change
            accept-script-policy "script-policy-2"
            coa-script-policy "script-policy-4"
            request-script-policy "script-policy-1"
        exit
    exit
```

Note: In legacy RADIUS server configuration, to configure RADIUS CoA servers for use in Enhanced Subscriber Management, the server must be configured in the authentication policy with the **accept-authorization-change** command enabled. A CoA only server can be configured with the optional coa-only flag.

To configure a RADIUS server in a RADIUS accounting policy:

```
configure
    subscriber-mgmt
        radius-accounting-policy "acct-policy-1" create
            radius-accounting-server
                access-algorithm direct
                retry 3
                timeout 5
                no source-address
                router "Base"
                server 1 address 172.16.1.1 secret <shared secret> hash2 port 1813
                server 2 address 172.16.1.2 secret <shared secret> hash2 port 1813
            exit
            acct-request-script-policy "script-policy-3"
        exit
    exit
```

RADIUS Authentication of Subscriber Sessions

This section describes the Alcatel-Lucent router acting as a Broadband Subscriber Aggregator (BSA).

Note that in the 7750 and 7710 TPSDA solutions, the Alcatel-Lucent 5750 Subscriber Services Controller (SSC) serves as the policy manager, DHCP and RADIUS server.

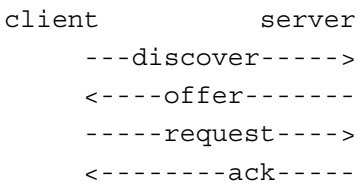
In this application, one of the required functions can be to authenticate users trying to gain access to the network.While sometimes the DHCP server (an SSC) can perform authentication, in most cases a RADIUS server (an SSC) is used to check the customer's credentials.

Note: Refer to section DHCP Principles on page 348 for an explanation of DHCP and DHCP Snooping on page 356 for an explanation of DHCP snooping.

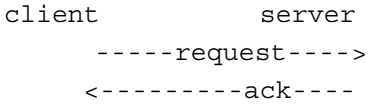
For information about the RADIUS server selection algorithm, refer to the Security chapter in the OS System Management Guide.

If authentication is enabled, the router will temporarily hold any received DHCP discover message and will send a access-request message to a configured RADIUS server containing the client's MAC address and/or Circuit-ID (from the Option 82 field) as the user name. If and when access is granted by the RADIUS server, the router will then forward or relay the DHCP discover message to the DHCP server and thus allow an IP address to be assigned. If the RADIUS authentication request is denied, the DHCP message is dropped and an event is generated.

A typical initial DHCP scenario (after client bootup) is:



But, when the client already knows its IP address (when an existing lease is being renewed), it can skip straight to the request/ack phase:



In the first scenario, the DHCP discover triggers an authentication message to RADIUS and the DHCP request also triggers RADIUS authentication. The previous reply is cached for 10 seconds, the second DHCP packet will not result in a RADIUS request.
In the second scenario, the DHCP request triggers an authentication message to RADIUS.

If the optional subscriber management authentication policy **re-authentication** command is enabled, DHCP authentication is performed at every DHCP lease renew request. Only dynamic DHCP sessions are subject to remote authentication. Statically provisioned hosts are not authenticated.

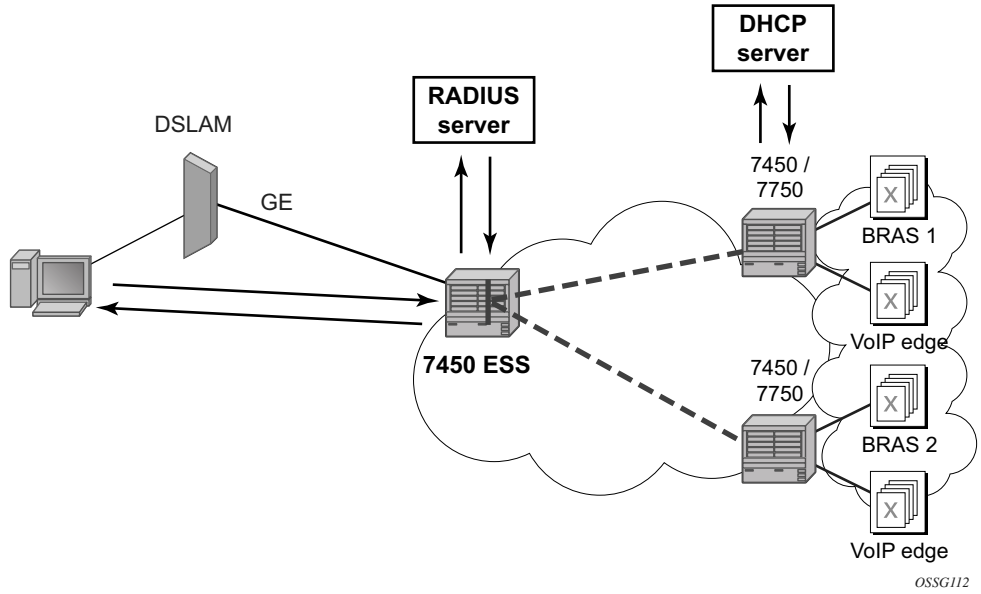
RADIUS Authentication Extensions

This section describes an extension to RADIUS functionality in the subscriber management context. As part of subscriber host authentication, RADIUS can respond with access-response message, which, in the case of an accept, can include several RADIUS attributes (standard and vendor-specific) that allow proper provisioning of a given subscriber-host.

Change-of-Authorization (CoA) messages as defined by RFC 3576, *Dynamic Authorization Extensions to Remote Authentication Dial In User Service (RADIUS)*, are supported. The goal of CoA messages is to provide a mechanism for "mid-session change" support through RADIUS.

Triple Play Network with RADIUS Authentication

7450 ESS:



7750 SR

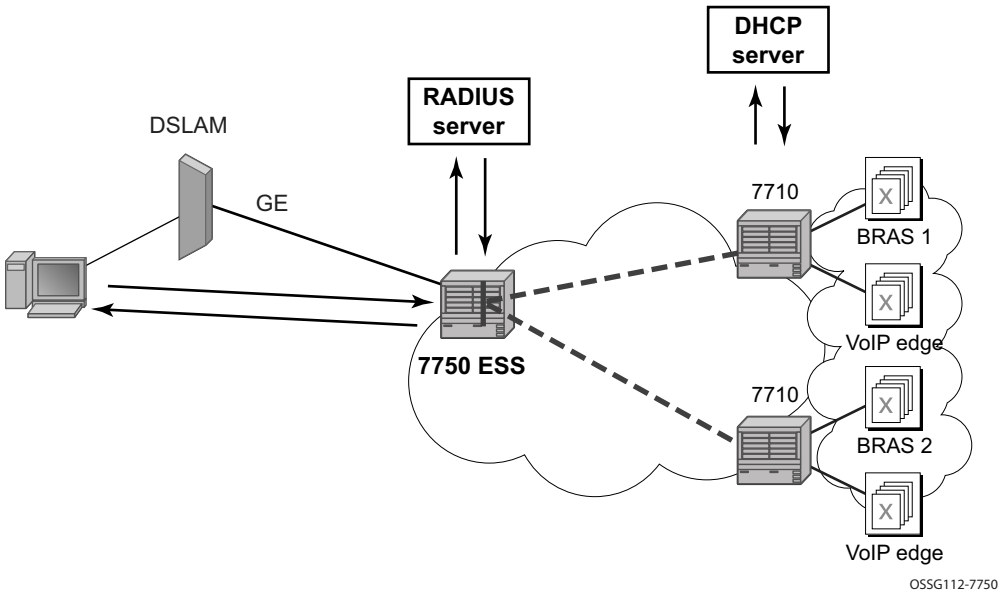


Figure 57: Triple Play Aggregation Network with RADIUS-Based DHCP Host Authentication

Figure 57 shows a flow of RADIUS authentication of DHCP hosts in the triple play aggregation environment. Besides granting the authentication of given DHCP host, the RADIUS server can include RADIUS attributes (standard and/or Vendor-Specific Attributes (VSAs)) which are then used by the network element to provision objects related to a given DHCP host.

RADIUS is a distributed client/server concept that is used to protect networks against unauthorized access. In the context of the router's subscriber management in TPSDA, the RADIUS client running on nodes sends authentication requests to the SSC.

RADIUS can be used to perform three distinct services:

- Authentication determines whether or not a given subscriber-host is allowed to access a specific service.
- Authorization associates connection attributes or characteristics with a specific subscriber host.
- Accounting tracks service use by individual subscribers.

The RADIUS protocol uses "attributes" to describe specific authentication, authorization and accounting elements in a user profile (which are stored on the RADIUS server). RADIUS messages contain RADIUS attributes to communicate information between network elements running a RADIUS client and a RADIUS server.

RADIUS divides attributes into two groups, standard attributes and Vendor-Specific Attributes (VSAs). VSA is a concept allowing conveying vendor specific configuration information in a RADIUS messages, discussed in RFC 2865, *Remote Authentication Dial In User Service (RADIUS)*. It is up to the vendor to specify the exact format of the VSAs.
Alcatel-Lucent-specific VSAs are identified by vendor-id 6527.

RADIUS Authorization Extensions

The following sections define different functional extensions and list relevant RADIUS attributes.

Basic Provisioning of Authentication Extensions

In order to comply with RFC 4679, *DSL Forum Vendor-Specific RADIUS Attributes*, the software includes the following attributes in the authentication-request message:

- agent-circuit-id (as defined by DSL forum)
- agent-remote-id (as defined by DSL forum)

The following attributes can also be included if configured and provided by downstream equipment:

- actual-data-rate-upstream
- actual-data-rate-downstream
- minimum-data-rate-upstream
- minimum-data-rate-downstream
- access-loop-encapsulation

When the node is configured to insert (or replace) Option 82, the above mentioned attributes will have the content after this operation has been performed by the software.

In addition, the following standard RADIUS attributes will be included in authentication request messages (subject to configuration):

- NAS-identifier — string containing system-name
- NAS-port-id
- NAS-port-type — Values: 32 (null encap), 33 (dot1q), 34 (qinq), 15 (DHCP hosts), specified value (0 — 255)
- MAC-address (Alcatel-Lucent VSA 27)
- dhcp-vendor-class-id (Alcatel-Lucent VSA 36)
- calling-station-id

These will only be included in the access-request if they have been configured.

In order to provide the possibility to push new policies for currently active subscribers, the routers support commands to force re-authentication of the given subscriber-host. After issuing such a command, the router will send a DHCP force-renew packet, which causes the subscriber to renew its lease (provided it supports force-renew). The DHCP request and ACK are then authenticated and processed by the routers as they would be during a normal DHCP renew.

Calling-Station-ID

A **calling-station-id** can be configured at SAP level and can be included in the RADIUS authentication and accounting messages. This attribute is used in legacy BRAS to identify the user (typically phone number used for RAS connection). In the broadband networks this was replaced by circuit-id in Option 82. However, the Option 82 format is highly dependent on access-node vendor, which makes interpretation in management servers (such as RADIUS) troublesome. Some operators use the calling-station-id attribute as an attribute indicating the way the circuit-id should be interpreted. The calling-station-id attribute can be configured as a string which will be configured on the SAP. It can also be configured to use the **sap-id**, **remote-id** or **mac-address**.

Subscriber Session Timeout

To limit the lifetime of a PPP session or DHCPv4 host to a fixed time interval, a timeout can be specified from RADIUS. By default, a PPP session or DHCPv4 host has no session timeout (infinite).

For PPP sessions, a session-timeout can be configured in the ppp-policy. A RADIUS specified session-timeout overrides the CLI configured value.

```
subscriber-mgmt
    ppp-policy "ppp-policy-1" create
        session-timeout 86400
    exit
exit
```

When the session timeout expires a PPP session is terminated and a DHCPv4 host deleted. For a DHCPv4 host, a DHCP release message is also sent to the server .

The following two attributes can be used in RADIUS Access-Accept and CoA messages to limit the PPP session or DHCPv4 host session time (Table 14):

Table 14: Subscriber Session Timeout

Attribute ID	Attribute Name	Type	Limits	Purpose and Format
27	Session-Timeout	integer	2147483647 seconds	0 = infinite (no session-timeout) [1.. 2147483647] in seconds For example: Session-Timeout = 3600
26-6527-160	Alc-Relative-Session-Timeout	integer	[0..2147483647] seconds	0 = infinite (no session-timeout) [1..2147483647] in seconds For example: Alc-Relative-Session-Timeout = 3600

When specified in a RADIUS Access-Accept message, both attributes specify an absolute value for session timeout. When specified in a RADIUS CoA message, attribute [26-6527-160] Alc-Relative-Session-Timeout specifies a relative session timeout value in addition to the current session time while attribute [27] Session-Timeout specifies an absolute session timeout value. If the current session time is greater than the received Session-Timeout, a CoA NAK is sent with error cause “Invalid Attribute Value (407)”.

Only one of the above attributes to specify a session timeout can be present in a single RADIUS message. An event is raised when both are specified in a single message.

The output of the “show service id <service-id> ppp session detail” CLI command contains following fields related to session timeout for PPP sessions:

- Up Time: the PPP session uptime
- Session Time Left: the remaining time before the session is terminated
- RADIUS Session-TO: the RADIUS received session timeout value.

The output of the “show service id <service-id> dhcp lease-state detail” CLI command contains following fields related to session timeout for DHCPv4 hosts:

- Up Time: the DHCPv4 host uptime
- Remaining Lease Time: the remaining time before the lease expires in the DHCP server. The client should renew its lease before this time.
- Remaining SessionTime: the remaining time before the DHCPv4 host is deleted
- Session-Timeout: the DHCPv4 host is deleted when its uptime reaches the Session-Timeout value.
- Lease-Time: the lease time specified by the DHCPv4 server

Note:

In a radius-proxy scenario or when a DHCPv4 host is created with a RADIUS CoA message, the RADIUS attribute [26-6527-174] Alc-Lease-Time attribute must be used to specify the lease time. If the [26-6527-174] Alc-Lease-Time is not present in these scenarios, then the RADIUS attribute [27] Session-Timeout is interpreted as DHCPv4 lease time.

Domain Name in Authentication

In many networks, the user name has specific meaning with respect to the domain (ISP) where the user should be authenticated. In order to identify the user correctly, the user name in an authentication-request message should contain a domain-name. The domain-name can be derived from different places. In PPPoE authentication the domain name is given by the PPPoE client with the user name used in PAP or CHAP authentication. For DHCP hosts similar functionality is implemented by a “pre-authentication” lookup in a local user database before performing the RADIUS request.

For example, it can be derived from option60 which contains the vendor-specific string identifying the ISP the set-box has been commissioned by.

To append a domain name to a DHCP host, the following configuration steps should be taken:

- Under the (group or IP) interface of the service, a local user database should be configured in the DHCP node and no authentication policy should be configured.
- In the local user database, there should be a host entry containing both the domain name to be appended and an authentication policy that should be used for RADIUS authentication of the host. The host entry should contain no other information needed for setting up the host (IP address, ESM string), otherwise the DHCP request will be dropped.
- In the authentication policy, the **user-name-format** command should contain the parameter **append** *domain-name*.

RADIUS Reply Message for PPPoE PAP/CHAP

The string returned in a [18] Reply-Message attribute in a RADIUS Access-Accept is passed to the PPPoE client in the CHAP Success or PAP Authentication-Ack message.

The string returned in a [18] Reply-Message attribute in a RADIUS Access-Reject is passed to the PPPoE client in the CHAP Failure or PAP Authentication-Nak message.

When no [18] Reply-Message attribute is available, the SROS default messages are used instead: “CHAP authentication success” or ”CHAP authentication failure” for CHAP and “Login ok” or ” Login incorrect” for PAP.

radius-server-policy retry Attempt Overview

This feature maximizes the use of the remaining healthy RADIUS servers for subscriber authentication and accounting. After the hold down time expires, a single radius message is used to determine the status of the RADIUS server. If the server remains unresponsive after waiting for a single timeout interval (without any retires) then it is placed back into the hold down state. If the RADIUS server responds then it is used for subscriber authentication and accounting with the rest of the healthy servers.

Provisioning of Enhanced Subscriber Management (ESM) Objects

In the ESM concept on network elements, a subscriber host is described by the following aspects:

- subscriber-id-string
- subscriber-profile-string
- sla-profile-string
- ancp-string
- intermediate-destination-identifier-string
- application-profile-string

This information is typically extracted from DHCP-ACK message using a Python script, and is used to provision subscriber-specific resources such as queues and filter entries. As an alternative to extracting this information from DHCP-ACK packet, provisioning from RADIUS server is supported.

As a part of this feature, the following VSAs have been defined:

- alc-subscriber-id-string — Contains a string which is interpreted as a subscriber-id.
- alc-subscriber-profile-string — Contains a string which is interpreted as a subscriber profile
- alc-sla-profile-string — Contains string which is interpreted as an SLA profile.
- alc-ancp-string — Contains string which is interpreted as an ANCP string.
- alc-int-dest-id-string — Contains a string which is interpreted as an intermediate destination ID
- alc-app-profile-string — Contains a string which is interpreted as an application profile

  Note that these strings can be changed in a CoA request.

When RADIUS authentication response messages contain the above VSAs, the information is used during processing of DHCP-ACK message as an input for the configuration of subscriber-host parameters, such as QoS and filter entries.

If ESM is not enabled on a given SAP, information in the VSAs is ignored.

If ESM is enabled and the RADIUS response does not include all ESM-related VSAs (an ANCP string is not considered as a part of ESM attributes), only the subscriber-id is mandatory (the other ESM-related VSAs are not included). The remaining ESM information (sub-profile, sla-profile) will be extracted from DHCP-ACK message according to “normal” flow (Python script, etc.). If the profiles are missing from RADIUS, they are not extracted from the DHCP data with Python to prevent inconsistent information. Instead, he data will revert to the configured default values.

However, if the above case, a missing subscriber ID will cause the DHCP request to be dropped. The DHCP server will not be queried in that case.

When no DHCP server is configured, DHCP-discover/request messages are discarded.

Provisioning IP Configuration of the Host

The other aspect of subscriber-host authorization is providing IP configuration (ip-address, subnet-mask, default gateway and dns) through RADIUS directory rather then using centralized DHCP server. In this case, the node receiving following RADIUS attributes will assume role of DHCP server in conversation with the client and provide the IP configuration received from RADIUS server.

These attributes will be accepted only if the system is explicitly configured to perform DHCP-server functionality on a given interface.

The following RADIUS attributes will be accepted from authentication-response messages:

- framed-ip-address — The IP address to be configured for the subscriber-host.
- framed-ip-netmask — The IP network to be configured for the subscriber host. If RADIUS does not return a netmask, the DHCP request is dropped.
- framed-pool — The pool on a local DHCP server from which a DHCP-provided IP address should be selected.
- alc-default-router — The address of the default gateway to be configured on the DHCP client.
- alc-primary-dns — The DNS address to be provided in DHCP configuration.
  - → Juniper VSA for primary DNS.
  - → Redback VSA for primary DNS.
- alc-secondary-dns
  - → Juniper VSA for secondary DNS.
  - → Redback VSA for secondary DNS.
- alc-lease-time — Defines the lease time.
- session-timeout — Defines the lease time in absence of the alc-lease-time attribute.
- NetBIOS
  - → alc-primary-nbns
  - → alc-secondary-nbns

RADIUS Based Authentication in Wholesale Environment

In order to support VRF selection, the following attributes are supported:

- alc-retail-serv-id — Indicates the service-id of the required retail VPRN service configured on the system.

Change of Authorization and Disconnect-Request

In a typical RADIUS environment, the network element serves as a RADIUS client, which means the messages are originated by a routers. In some cases, such as “mid-session” changes, it is desirable that the RADIUS server initiates a CoA request to impose a change in policies applicable to the subscriber, as defined by RFC 3576.

To configure a RADIUS server to accept CoA and Disconnect Messages is achieved in one of the following ways:

1. Configure up to 64 RADIUS CoA servers per routing instance:

```
config>router>radius-server#
config>service>vprn>radius-server#

 server "coa-1" address 10.1.1.1 secret <shared-secret> hash2 create
      accept-coa
 exit
```

   This is the preferred method.

2. Configure up to 16 RADIUS CoA servers per authentication policy.

```
config>subscr-mgmt>auth-plcy#

 accept-authorization-change
```

The UDP port for CoA and Disconnect Messages is configurable per system with the command:

```
config>aaa#

radius-coa-port {1647|1700|1812|3799}
```

Note that there is a priority in the functions that can be performed by CoA. The first matching one will be performed:

- If the CoA packet contains a force-renew attribute, the subscriber gets a force-renew DHCP packet. This function is not supported for PPPoE or ARP hosts.
- If the CoA packet contains a create-host attribute, a new lease-state is created. Only DHCP lease-states can be created by a CoA message. PPPoE sessions and ARP hosts cannot be created.
- Otherwise, the ESM strings are updated.

There are several reasons for using RADIUS initiated CoA messages:

1. Changing ESM attributes (SLA or subscriber profiles) or queues/policers/schedulers rates of the given subscriber host — CoA messages containing the identification of the given subscriber-host along with new ESM attributes.

2. Changing (or triggering the change) of IP configuration of the given subscriber-host — CoA messages containing the identification of the given subscriber-host along with VSA indicating request of forcerenew generation.
3. Configuring new subscriber-host — CoA messages containing the full configuration for the given host.

If the changes to ESM attributes are required, the RADIUS sever will send CoA messages to the network element requesting the change in attributes included in the CoA request:

- attribute(s) to identify a single or multiple subscriber host(s): "NAS-Port-Id + IP address/prefix" or "Acct-Session-Id" or "Alc-Subsc-ID-Str"
  - → Nas-Port-Id attribute + single IP address/prefix attribute:
    - Framed-IP-Address
    - Alc-Ipv6-Address
    - Framed-Ipv6-Prefix
    - Delegated-Ipv6-Prefix
  - → Acct-Session-Id (number format)
  - → Alc-Subsc-ID-Str
- alc-subscriber-profile-string
- alc-sla-profile-string
- alc-ancp-string
- alc-app-profile-string
- alc-int-dest-id-string
- alc-subscriber-id-string
- alc-subscriber-qos-override

  Note that if the subscriber-id-string is changed while the ANCP string is explicitly set, the ANCP-string **must** be changed simultaneously. When changing the alc-subscriber-id-string, the lease state is temporarily duplicated, causing two identical ANCP-strings to be in the system at the same time. This is not allowed.

As a reaction to such message, the router changes the ESM settings applicable to the given host.

If changes to the IP configuration (including the VRF-id in the case of wholesaling) of the given host are needed, the RADIUS server may send a CoA message containing VSA indicating request for forcerenew generation:

- attribute(s) to identify a single or multiple subscriber host(s): "NAS-Port-Id + IP address/prefix" or "Acct-Session-Id" or "Alc-Subsc-ID-Str":
  - → Nas-Port-Id attribute + single IP address/prefix attribute:
    - Framed-IP-Address
    - Alc-Ipv6-Address

- Framed-Ipv6-Prefix
- Delegated-Ipv6-Prefix

→ Acct-Session-Id (number format)

→ Alc-Subsc-ID-Str

- alc-force-renew
- alc-force-nak

As a reaction to such message, router will generate a DHCP forcerenew message for the given subscriber host. Consequently, during the re-authentication, new configuration parameters can be populated based on attributes included in Authentication-response message. The force-NAK attribute has the same function as the force-renew attribute, but will cause the ESR to reply with a NAK to the next DHCP renew. This will invalidate the lease state on the ESR and force the client to completely recreate its lease, making it possible to update parameters that cannot be updated through normal CoA messages, such as IP address or address pool.

If the configuration of the new subscriber-host is required, RADIUS server will send a CoA message containing VSA request new host generation along with VSAs specifying all required parameters.

- alc-create-host
- alc-subscriber-id-string — This attribute is mandatory in case ESM is enabled, and optional for new subscriber host creation otherwise.
- NAS-port-id — This attribute indicates the SAP where the host should be created.
- framed-ip-address —
- alc-client-hw-address — A string in the xx:xx:xx:xx:xx:xx format. This attribute is mandatory for new subscriber-host creation.
- alc-lease-time — Specifies the lease time. If both session-timeout and alc-lease-time are not present, then a default lease time of 7 days is used.
- session-timeout — Specifies the lease time in absence of the alc-lease-time attribute. If both session-timeout and alc-lease-time are not present, then a default lease time of 7 days is used.
- alc-retail-svc-id — This is only used in case of wholesaling for selection of the retail service. Indicates the service-id of the required retail VPRN service configured on the system.
- Optionally other VSAs describing given subscriber host. Obviously, if the ESM is enabled, but the CoA message does not contain ESM attributes the new host will not be created.

After executing the requested action, the router element responds with an ACK or NAK message depending on the success/failure of the operation. In case of failure (and hence NAK response), the element will include the error code in accordance with RFC 3576 definitions if an appropriate error code is available.

Supporting CoA messages has security risks as it essentially requires action to unsolicited messages from the RADIUS server. This can be primarily the case in an environment where RADIUS servers from multiple ISPs share the same aggregation network. To minimize the security risks, the following rules apply:

- Support of CoA messages is disabled by default. They can be enabled on a per RADIUS server or authentication-policy basis.
- When CoA is enabled, the node will listen and react only to CoA messages received from RADIUS servers. In addition, CoA messages must be protected with the key corresponding to the given RADIUS server. All other CoA messages will be silently discarded.

In all cases (creation, modification, forcerenew) subscriber host identification attributes are mandatory in the CoA request: “NAS-Port-Id + IP” or “Acct-Session-Id” or “Alc-Subsc-ID-Str”

- Nas-Port-Id + single IP address/prefix:
  - → Nas-Port-Id
  - → Framed-IP-Address
  - → Alc-Ipv6-Address
  - → Framed-Ipv6-Prefix
  - → Delegated-Ipv6-Prefix
- Acct-Session-Id (number format)
- Alc-Subsc-ID-Str

When there are no subscriber host identification attributes present in the CoA, the message will be NAK’d with corresponding error code.

- hosts, meaning only subscriber host to which the given authentication-policy is applicable.
- Receiving CoA message with the same attributes as currently applicable to the given host will be responded to with an ACK message.
- In case of dual homing (through SRRP), the RADIUS server should send CoA messages to both redundant nodes and this with all corresponding attributes (NAS-port-id with its local meaning to corresponding node).
- In the case of change requests, the node which has the given host active (active-sap for master-sap for SRRP) will process the RADIUS message and reply to RADIUS. The standby node will always reply with a NAK.
- In the case of create requests, the active node (the SAP described by NAS-port-id is “active” or “master”). Both nodes will reply, but the standby will NAK the request.

The properties of an existing RADIUS-authenticated PPPoE session can be changed by sending a Change of Authorization (CoA) message from the RADIUS server. Processing of a CoA is done in the same way as for DHCP hosts, with the exception that only the ESM settings can be changed for a PPPoE session (the force-renew attribute is not supported for PPPoE sessions and a Create-Host CoA will always generate a DHCP host.)

For terminating PPPoE sessions from the RADIUS server, the disconnect-request message can be sent from the RADIUS server. This message triggers a shutdown of the PPPoE session. The attributes needed to identify the PPPoE session are the same as for DHCP hosts.

RADIUS-Based Accounting

When a router is configured to perform RADIUS-based accounting, at the creation of a subscriber-host, it will generate an accounting-start packet describing the subscriber-host and send it to the RADIUS accounting server. At the termination of the session, it will generate an accounting-stop packet including accounting statistics for a given host. The router can also be configured to send an interim-accounting message to provide updates for a subscriber-host.

The exact format of accounting messages, their types, and communication between client running on the routers and RADIUS accounting server is described in RFC 2866, *RADIUS Accounting*. The following describes a few specific configurations.

In order to identify a subscriber-host in accounting messages different RADIUS attributes can be included in the accounting-start, interim-accounting, and accounting-stop messages. The inclusion of the individual attributes is controlled by the following commands.

```
configure
    subscriber-mgmt
        radius-accounting-policy <name>
            include-radius-attribute
                [no] acct-authentic
                [no] acct-delay-time
                [no] called-station-id
                [no] calling-station-id
                [no] circuit-id
                [no] delegated-ipv6-prefix
                [no] dhcp-vendor-class-id
                [no] framed-interface-id
                [no] framed-ip-addr
                [no] framed-ip-netmask
                [no] framed-ipv6-prefix
                [no] framed-route
                [no] framed-ipv6-route
                [no] ipv6-address
                [no] mac-address
                [no] nas-identifier
                [no] nas-port
                [no] nas-port-id
                [no] nas-port-type
                [no] nat-port-range
                [no] remote-id
                [no] sla-profile
                [no] sub-profile
                [no] subscriber-id
                [no] tunnel-server-attrs
                [no] user-name
                [no] wifi-rssi
                [no] alc-acct-triggered-reason
                [no] access-loop-options
                [no] all-authorized-session-addresses
                [no] detailed-acct-attributes
                [no] std-acct-attributes
                [no] v6-aggregate-stats
```

RADIUS volume accounting attributes are depending on the type of volume reporting and can be controlled via an **include-radius-attribute** CLI command. Multiple volume reporting types can be enabled simultaneously:

```
configure
    subscriber-mgmt
        radius-accounting-policy <name>
            include-radius-attribute
                [no] detailed-acct-attributes
                [no] std-acct-attributes
                [no] v6-aggregate-stats
```

where:

detailed-acct-attributes — Report detailed per queue and per policer counters using RADIUS VSAs (enabled by default). Each VSA contains a queue or policer id followed by the stat-mode or 64 bit counter. The VSA's included in the Accounting messages is function of the context (policer or queue, stat-mode, MDA type, …):

```
[26-6527-107] Alc-Acct-I-statmode
[26-6527-127] Alc-Acct-O-statmode
[26-6527-19] Alc-Acct-I-Inprof-Octets-64
[26-6527-20] Alc-Acct-I-Outprof-Octets-64
[26-6527-21] Alc-Acct-O-Inprof-Octets-64
[26-6527-22] Alc-Acct-O-Outprof-Octets-64
[26-6527-23] Alc-Acct-I-Inprof-Pkts-64
[26-6527-24] Alc-Acct-I-Outprof-Pkts-64
[26-6527-25] Alc-Acct-O-Inprof-Pkts-64
[26-6527-26] Alc-Acct-O-Outprof-Pkts-64
[26-6527-39] Alc-Acct-OC-O-Inprof-Octets-64
[26-6527-40] Alc-Acct-OC-O-Outprof-Octets-64
[26-6527-43] Alc-Acct-OC-O-Inprof-Pkts-64
[26-6527-44] Alc-Acct-OC-O-Outprof-Pkts-64
[26-6527-69] Alc-Acct-I-High-Octets-Drop_64
[26-6527-70] Alc-Acct-I-Low-Octets-Drop_64
[26-6527-71] Alc-Acct-I-High-Pack-Drop_64
[26-6527-72] Alc-Acct-I-Low-Pack-Drop_64
[26-6527-73] Alc-Acct-I-High-Octets-Offer_64
[26-6527-74] Alc-Acct-I-Low-Octets-Offer_64
[26-6527-75] Alc-Acct-I-High-Pack-Offer_64
[26-6527-76] Alc-Acct-I-Low-Pack-Offer_64
[26-6527-77] Alc-Acct-I-Unc-Octets-Offer_64
[26-6527-78] Alc-Acct-I-Unc-Pack-Offer_64
[26-6527-81] Alc-Acct-O-Inprof-Pack-Drop_64
[26-6527-82] Alc-Acct-O-Outprof-Pack-Drop_64
[26-6527-83] Alc-Acct-O-Inprof-Octs-Drop_64
[26-6527-84] Alc-Acct-O-Outprof-Octs-Drop_64
[26-6527-91] Alc-Acct-OC-O-Inpr-Pack-Drop_64
```

```
[26-6527-92] Alc-Acct-OC-O-Outpr-Pack-Drop_64
[26-6527-93] Alc-Acct-OC-O-Inpr-Octs-Drop_64
[26-6527-94] Alc-Acct-OC-O-Outpr-Octs-Drop_64
[26-6527-108] Alc-Acct-I-Hiprio-Octets_64
[26-6527-109] Alc-Acct-I-Lowprio-Octets_64
[26-6527-110] Alc-Acct-O-Hiprio-Octets_64
[26-6527-111] Alc-Acct-O-Lowprio-Octets_64
[26-6527-112] Alc-Acct-I-Hiprio-Packets_64
[26-6527-113] Alc-Acct-I-Lowprio-Packets_64
[26-6527-114] Alc-Acct-O-Hiprio-Packets_64
[26-6527-115] Alc-Acct-O-Lowprio-Packets_64
[26-6527-116] Alc-Acct-I-All-Octets_64
[26-6527-117] Alc-Acct-O-All-Octets_64
[26-6527-118] Alc-Acct-I-All-Packets_64
[26-6527-119] Alc-Acct-O-All-Packets_64
```

std-acct-attributes — Report IPv4 and IPv6 aggregated forwarded counters using standard RADIUS attributes (disabled by default):

```
[42] Acct-Input-Octets
[43] Acct-Output-Octets
[47] Acct-Input-Packets
[48] Acct-Output-Packets
[52] Acct-Input-Gigawords
[53] Acct-Output- Gigawords
```

v6-aggregate-stats — Report IPv6 aggregated forwarded counters of queues and policers in stat-mode v4-v6 using using RADIUS VSAs (disabled by default):

```
[26-6527-194] Alc-IPv6-Acct-Input-Packets
[26-6527-195] Alc-IPv6-Acct-Input-Octets
[26-6527-196] Alc-IPv6-Acct-Input-GigaWords
[26-6527-197] Alc-IPv6-Acct-Output-Packets
[26-6527-198] Alc-IPv6-Acct-Output-Octets
[26-6527-199] Alc-IPv6-Acct-Output-Gigawords
```

In addition to accounting-start, interim-accounting, and accounting-stop messages, a RADIUS client on a routers will send also accounting-on and accounting-off messages. An accounting-on message will be sent when a given RADIUS accounting-policy is applied to a given subscriber-profile, or the first server is defined in the context of an already applied policy. The following attributes will be included in such message:

- NAS-identifier
- alc-subscriber-profile-string
- Accounting-session-id
- Event-timestamp

Accounting-off messages will be sent at following events:

- An accounting policy has been removed from a sub-profile.
- The last RADIUS accounting server has been removed from an already applied accounting policy.

These messages contain following attributes:

- NAS-identifier
- alc-subscriber-profile-string
- Accounting-session-id
- Accounting-terminate-cause
- Event-timestamp

In case of dual homing, both nodes will send RADIUS accounting messages for the host, with all attributes as it is locally configured. The RADIUS log files on both boxes need to be parsed to get aggregate accounting data for the given subscriber host regardless the node used for forwarding.

For RADIUS-based accounting, a custom record can be defined to refine the data that is sent to the RADIUS server. Refer to the Configuring an Accounting Custom Record in the OS System Management Guide for further information.

Accounting Modes Of Operation

This section is applicable to the 7750 SR or the 7450 ESS in mixed mode
There are three basic accounting models in 7750 SR or the 7450 ESS in mixed mode:

- Per queue-instance
- Per Host
- Per Session

Each of the basic models can optionally be enabled to send interim-updates. Inclusion/exclusion of interim-updates will depend on whether volume based (start/interim-updates/stop) or time based (start/stop) accounting is required.

The difference between the three basic accounting models is in its core related to the processing of the acc-session-id for each model. The differences are related to:

- acct-session-id generation within each model.
- outcome in response to the CoA action relative to the targeted acct-session-id.

The counters for volume-based accounting are collected from queues or policers that are instantiated per sla-profile instance (SPI) on non-HSMDA based hardware or per subscriber on HSMDA based hardware. This is true irrespective of which model of accounting (or combination of models) is deployed. Within accounting context, the SPI on non-HSMDA or subscriber on HSMDA equates to queue-instance.

Table 15 summarizes the key differences between various accounting modes of operation that are supported. Interim-updates for each individual mode can be enabled/disabled via configuration (interim-updates keyword as an extension to the commands that enable three basic modes of accounting). This is denoted by the IU-Config keyword under the 'I-U' column in the table. The table also shows that any two combinations of the three basic models (including their variants for volume/time based accounting) can be enabled simultaneously.

Table 15: Accounting Modes of Operation

Accounting Mode	Accounting Entity	START	I-U	STOP	Acct-session-id	Acct-multi-session-id
queue-instance-accounting	queue-instance	X	IU-config	X	X	
	session					
	host					

Table 15: Accounting Modes of Operation (Continued)

Accounting Mode	Accounting Entity	START	I-U	STOP	Acct-session-id	Acct-multi-session-id
session-accounting	queue-instance					
	session	X	IU-config	X	X	q-instance
	host					
host-accounting	queue-instance					
	session					
	host	X	IU-config	X	X	queue-instance
queue-instance-accounting + host-accounting	queue-instance	X	IU-config	X	X	queue-instance
	session					
	host	X	IU-config	X	X	queue-instance
queue-instance-accounting + session-accounting	queue-instance	X	IU-config	X	X	queue-instance
	session	X	IU-config	X	X	queue-instance
	host					
session- accounting + host-accounting	queue-instance					queue-instance
	session	X	IU-config	X	X	
	host	X		X	X	SESSION

Note that hosts within the targeted CoA entity will be affected as follows:

- If the CoA target is the session, then both constituting members (IPv4 and IPv6) of the dual-stack host will be affected.
- If the CoA target is the queuing-instance, then up to 32 hosts that are sharing that SPI will be affected.

The same principle applies to LI.

The accounting behavior (accounting messages and accounting attributes) in case that the SPI is changed via CoA depends on the accounting mode of operation. On non-HSMDA hardware, the behavior is the following:

- SPI change in conjunction with per queuing instance accounting will trigger a STOP for the old SPI and a START for the new SPI with corresponding counters. Acct-session-id/Acct-Multi-Session-Id will be unique per SPI. Note that Acct-Multi-Session-Id is only generated if per queuing-instance accounting mode of operation is combined with some other mode of operation (host or session).
- SPI change in conjunction with per host or per session accounting (no interim updates for either method) will NOT trigger any new accounting messages. In other words, SPI change will go unnoticed from the perspective of the accounting server until the host/session is terminated. When the host/session is terminated a STOP will be sent with the VSA carrying the latest SPI name and the acct-multi-session-id attribute of the latest SPI. Acct-session-id will stay the same during the lifetime of the host. Counters are not included in STOP (interim-update not enabled).

  SPI change in conjunction with per host accounting with interim-updates or per session accounting with interim-updates will trigger two interim-update messages:

  → One with the old counters (terminated queues) and the old SPI name VSA. This behavior is similar to the triggered STOP message in per queuing-instance accounting upon SPI change.

  → One with the new counters (new queues instantiated), the VSA carrying the new SPI name and the new acct-multi-session-id referencing the new SPI. This behavior is similar to the triggered START message in per queuing-instance when SPI is changed in per queuing-instance accounting.

On HSMDA, no START/STOPS are sent since queues are not re-instantiated on ingress or egress.

Per Session Accounting

In the per session accounting mode of operation the accounting message stream[1] (START/ INTERIM-UPDATE/STOP) is generated per session.

- A session is defined for PPPoE hosts for which a state is maintained. The state of the host (single stack or dual-stack) is normally refreshed via PPP keepalives. Each PPPoE host of the same address family (v4 or v6) corresponds to a unique session which is identified by the <session-ID, mac> combination.

In dual-stack PPPoE case, IPv4 and IPv6 hosts are tied to the same (LCP) session. A single authentication request is initiated for such session (triggered by the first host that initiates the session).

For a single stack PPPoE host, the behavior defined in the per session accounting model is indistinguishable from the per host accounting model. The per session accounting model makes difference in behavior only for dual stack PPPoE hosts.

The following are the properties of the Per Session Accounting model:

- A single accounting session ID (acct-session-id) is generated per (PPPoE) session and it can optionally be sent in RADIUS Access-Request message.
- This acct-session-id is synchronized via MCS in dual homing environment.
- The accounting messages (START, INTERIM-UPDATE, STOP) carry the acct-multi-session-id attribute denoting the sla-profile instance with which the session is associated.
- The counters are collected from the queues instantiated through the sla-profile instance. If multiple sessions are sharing the same sla-profile instance, the counters are aggregated. In other words, counters per individual session cannot be extracted from the aggregated count.
- RADIUS triggered changes and LI are applicable per session:
  - → Queue/policer RADIUS overrides — Parameters for the referenced queue/policer within the session are changed accordingly.
  - → Subscriber aggregate rate limits, scheduler rates and arbiter rates are changed accordingly.
  - → CoA DISCONNECT brings down the entire session.
  - → LI — Activation based on the session acct-session-id affects the hosts within the session (dual-stack).
  - → SLA profile instance change affects all hosts (or sessions) sharing the same sla-profile instance (SPI). If the SPI is changed on a non-HSMDA based MDA, then queues are re-instantiated and counters are reset.
- All applicable IP addresses (v4 and v6 – including all v6 attributes – alc-ipv6-address, framed-ipv6-prefix, delegated-ipv6-prefix) are present in accounting messages for the session.

1. The accounting message stream refers to a collection of accounting messages (START/INTERIM-UPDATE/STOP) sharing the same acct-session-id.

Caveats

Per session accounting is supported for entities that have concept of a session. Currently only PPPoE hosts (single or dual-stack) fall into this category.

RADIUS Per Host Accounting

In SR-OS, the accounting paradigm is based on SLA profile instances yet this is at odds with traditional RADIUS authentication and accounting which is host-centric. In previous SR-OS releases, it was possible to have many hosts sharing a common SLA profile instance, and thus accounting and QoS parameters. Complications would arise with RADIUS accounting because Accounting-Start and Accounting-Stop are a function of sla-profile instance and not the hosts — this meant that some host-specific parameters (like framed-ip-address) would not be consistently included in RADIUS accounting.

Currently, dual-stack subscribers are really two different hosts sharing a single sla-profile instance. A new RADIUS accounting mode has been introduced to support multiple-host environments.

Under accounting-policy, a host-accounting command allows configurable behavior.

No Host-Accounting

In prior releases and when no host-accounting is configured, the accounting behavior is as follows:

- A RADIUS accounting start message is sent when the SLA-profile instance is created. It contains accounting (octets/packets) and the framed-ip-address of the host which caused the sla-profile instance to be created.
- Additional hosts may bind to the sla-profile instance at any time, but no additional Accounting messages are sent during these events.
- If the original host disconnects then future Accounting messages will use an IP address of one of the remaining hosts.
- When the final host associated with an sla-profile instance disconnects an Accounting Stop message will be sent.

Host-Accounting Enabled

When host-accounting is configured, additional RADIUS accounting messages are created for host activity in addition to messages for common queue accounting. The behavior is as follows:

- A RADIUS accounting start message is sent each time a host is authenticated. It contains the framed-ip-address among other things. It does not contain any octet or packet counts.
- A RADIUS accounting start message is sent each time a sla-profile instance is created.
- Whenever a host disconnects a RADIUS accounting stop message is sent for that host.
- If all host associated with an sla-profile instance disconnect, a RADIUS Accounting Stop message is sent for that instance.

This new behavior means certain AVP may be in either host; sla-profile instance or both accounting records.

Note that interim-acct records are not sent for hosts, only the start- and stop-accting messages.

RADIUS Accounting AVP	Include-radius-attrs Acct/ Auth	Host Accounting	SLA-Profile Accounting
User-Name	Yes/No	Yes	No
NAS-Identifier	Yes/No	Yes	Yes
NAS-Ip-Address	No/No	Yes	Yes
NAS-Port-Id	Yes/Yes	Yes	No
Nas-Port	Yes/No	Yes	No
NAS-Port-Type	Yes/Yes	Yes	No
Service-Type	No/No	Yes	No
Framed-Protocol	No/No	Yes	No
Framed-Ip-Address	Yes/No	Yes	No
Framed-Ip-Netmask	Yes/No	Yes	No
Framed-Route	No/No	Yes	No
Class	No/No	Yes	No
Session-Timeout	No/No	Yes	Yes
Circuit-Id VSA	Yes/Yes	Yes	No
Called-Station-Id	Yes/Yes	Yes	No
Calling-Station-Id	Yes/Yes	Yes	No
MAC-Addr VSA	Yes/Yes	Yes	No
Remote-Id VSA	Yes/Yes	Yes	No
Acct-Input-Octets	No/No	No	Yes
Acct-Output-Octets	No/No	No	Yes
Acct-Input-Gigawords	No/No	No	Yes
Acct-Output-Gigawords	No/No	No	Yes
Acct-Session-Id	No/No	Yes	Yes
Acct-Session-Time	No/No	Yes	Yes

RADIUS Accounting AVP	Include-radius-attrs Acct/ Auth	Host Accounting	SLA-Profile Accounting
Acct-Input-Packets	No/No	No	Yes
Acct-Output-Packets	No/No	No	Yes
Acct-Multi-Session-Id	No/No	Yes	Yes
Actual-Data-Rate-Upstream	No/No	Yes	No
Actual-Data-Rate-Downstream	No/No	Yes	No
Access-Loop-Encapsulation	No/Yes	Yes	No
Alc-Accounting	No/No	No	Yes
Alc-Subscriber-Id	Yes/No	Yes	Yes
Alc-Subscriber-Profile-String	Yes/No	Yes	Yes
Alc-Sla-Profile-String	Yes/No	Yes	Yes

Accounting Interim Update Message Interval

The interval between two RADIUS Accounting Interim Update messages can be configured in the RADIUS accounting policy with the **update-interval** command, for example:

```
configure
    subscriber-mgmt
        radius-accounting-policy "acct-policy-1" create
            update-interval 60
            update-interval-jitter absolute 600
```

A RADIUS specified interim interval (attribute [85] Acct-Interim-Interval) overrides the CLI configured value.

By default, a random delay of 10% of the configured **update-interval** is added to the update-interval between two Accounting Interim Update messages. This jitter value can be configured with the **update-interval-jitter** to an absolute value in seconds between zero and 3600. The effective maximum random delay value is the minimum value of the configured absolute jitter value and 10% of the configured **update-interval**.

A value of zero will send the Accounting Interim Update message without introducing an additional random delay.

Class Attribute

The RADIUS class-attribute helps to aid in user identification

User identification is used to correlate RADIUS accounting messages with the given user. During authentication process, the RADIUS authentication server inserts a class-attribute into the RADIUS authenticate response message and then the router echoes this class attribute in all RADIUS accounting messages.

User Name

The user-name, which is used for user authentication (user-name attribute in RADIUS authentication request), can be included in RADIUS accounting messages. Per RFC 2865, when a RADIUS server returns a (different) user-name attribute, the changed user name will be used in accounting and not the originally sent user name.

Accounting-On and Accounting Off

For RADIUS servers configured in a RADIUS server policy, the accounting on/off behavior is controlled via the **acct-on-off** command in the radius-server-policy.

By default, no Accounting-On or Accounting-Off messages are sent (**no acct-on-off**).

With the **acct-on-off** command configured in the radius-server-policy:

- An Accounting-On is sent for the following:
  - When the system is powered on.
  - After a system reboots.
  - When the **acct-on-off** command is added to the **radius-server-policy** configuration.
  - User triggered via CLI: tools perform aaa acct-on
- An Accounting-Off is sent for the following:
  - Before a user initiated system reboot.
  - When the **acct-on-off** command is removed from the **radius-server-policy** configuration.
  - User triggered via CLI: tools perform aaa acct-off.

The Accounting-On or Accounting-Off message is sent to the servers configured in the radius-server-policy, following the configured access-algorithm until an Accounting Response is received. If the first server responds, no message is sent to the other servers.

The Accounting-On message is repeated until an Accounting Response message is received from a RADIUS server: If after the configured retry/timeout timers for each RADIUS server in the radius-server-policy no response is received then the process starts again after a fixed one minute wait interval.

The Accounting-Off message is attempted once: If after the configured retry/timeout timers for each RADIUS server in the radius-server-policy no response is received then no new attempt is made.

It is possible to block a radius-server-policy until an Accounting Response is received from one of the RADIUS servers in the radius-server-policy that acknowledges the reception of an Accounting-On. The radius-server-policy cannot be used by applications for sending RADIUS messages until the state becomes “Not Blocked”. This is achieved with the optional “oper-state-change” flag, for example:

```
configure
    aaa
        radius-server-policy "aaa-server-policy-1" create
            acct-on-off oper-state-change
            servers
                router "Base"
                server 1 name "server-1"
            exit
        exit
    exit
```

If multiple radius-server-policies are in use for different applications (for example, authentication and accounting) and an Accounting-On must be send for only one radius-server-policy, it is possible to tie the acct-on-off states of both policies together using an acct-on-off-group. With this configuration, it is possible to block the authentication servers until the accounting servers are available. An acct-on-off-group can be referenced by:

- a single radius-server-policy as controller: the acct-on-off oper-state of the acct-on-off-group is set to the acct-on-off oper-state of the radius-server-policy (acts as master)
- multiple radius-server-policies as monitor: the acct-on-off oper-state of the radius-server-policy is inherited from the acct-on-off oper-state of the acct-on-off group. (acts as a slave)

```
configure
    aaa
        acct-on-off-group "group-1" create
            description "Grouping of radius-server-policies acct-on-off"
        exit
        radius-server-policy "aaa-server-policy-1" create
            acct-on-off oper-state-change group "group-1"
            servers
                router "Base"
                server 1 name "server-1"
            exit
        exit
        radius-server-policy "aaa-server-policy-2" create
            acct-on-off monitor-group "group-1"
            servers
                router "Base"
                server 1 name "server-2"
            exit
        exit
```

It is possible to force an Accounting-On or Accounting-Off message for a radius-server-policy with acct-on-off enabled using following CLI commands:

tools perform aaa acct-on [**radius-server-policy** *policy-name*] [**force**]

tools perform aaa acct-off [**radius-server-policy** *policy-name*] [**force**] [**acct-terminate-cause** *number*]

If an Accounting-On was sent to the radius-server-policy and it was acknowledged with an Accounting Response then a new Accounting-On can only be sent with the “force” flag.

If an Accounting-Off was sent to the radius-server-policy and it was acknowledged with an Accounting Response then a new Accounting-Off can only be sent with the “force” flag. The Acct-Terminate-Cause value in the Accounting-Off can be overwritten.

Use the following CLI command to display the Accounting On/Off information for a radius-server-policy:

```
# show aaa radius-server-policy "aaa-server-policy-3" acct-on-off
===============================================================================
RADIUS server policy "aaa-server-policy-3" AcctOnOff info
===============================================================================
Oper state                  : on
Session Id                  : 242FFF0000008F512A3985
Last state change           : 02/24/2013 16:06:41
Trigger                     : startUp
Server                      : "server-1"
===============================================================================
```

The operational state provides following state information: The sending of the Accounting-On or Accounting-Off message is ongoing (sendAcctOn, SendAcctOff), is successfully responded (on, off) or no response received (OffNoResp).

The Session-Id is a unique identifier for each RADIUS server policy accounting Accounting-On/ Accounting-Off sequence.

The Trigger field shows what triggered the Accounting On or Accounting Off message. If the radius-server-policy is part of an acct-on-off group then the group name is shown in brackets.

The Server field shows which server in the RADIUS server policy responded to the Accounting-On or Accounting-Off message.

To display the acct-on-off state of a radius-server-policy, use the command, for example:

```
# show aaa radius-server-policy "aaa-server-policy-3"
===============================================================================
RADIUS server policy "aaa-server-policy-3"
===============================================================================
Description                 : (Not Specified)
Acct Request script policy  : script-policy-1
Auth Request script policy  : script-policy-1
Accept script policy        : script-policy-1
Acct-On-Off                 : Enabled (state Blocked)
-------------------------------------------------------------------------------
RADIUS server settings
-------------------------------------------------------------------------------
Router                      : "Base"
Source address              : (Not Specified)
Access algorithm            : direct
Retry                       : 3
Timeout (s)                 : 5
Hold down time (s)          : 30
Last management change      : 02/20/2013 13:32:05
===============================================================================
===============================================================================
Servers for "aaa-server-policy-3"
===============================================================================
Idx Name                            Address         Port        Oper State
                                                    Auth/Acct
-------------------------------------------------------------------------------
1   server-3                        172.16.1.10     1812/1813   unknown
===============================================================================
```

The Acct-On-Off field indicates if the sending of Accounting-On and Accounting-Off messages is enabled or disabled. If enabled, the oper-state is displayed: state Blocked or state Not Blocked. When Blocked, the radius-server-policy cannot be used to send RADIUS messages.

To display acct-on-off-group information, use following command, for example:

```
# show aaa acct-on-off-group "group-1"
===============================================================================
Acct-On-Off-Group Information
===============================================================================
acct on off group name               : group-1
  - controlling Radius-Server-policy :
        aaa-server-policy-1
  - monitored by Radius-Serer-policy :
        aaa-server-policy-2

-------------------------------------------------------------------------------
Nbr of Acct-on-off-groups displayed : 1
-------------------------------------------------------------------------------
===============================================================================
```

RADIUS Accounting Message Buffering

When all servers in a radius-server-policy are unreachable, it is possible to buffer the Accounting Stop and Accounting Interim-Update messages for up to 25 hours. When a RADIUS server becomes reachable again then the messages in the buffer are retransmitted.

RADIUS Accounting message buffering parameters can be configured per message type, for example:

```
configure
    aaa
        radius-server-policy "aaa-server-policy-1" create
            servers
                router "Base"
                buffering
                    acct-interim min 60 max 3600 lifetime 12
                    acct-stop min 60 max 3600 lifetime 12
                exit
                server 1 name "server-1"
            exit
        exit
    exit
```

When RADIUS accounting message buffering is enabled:

1. The message is stored in the buffer, a lifetime timer is started and the message is sent to the RADIUS server.
2. If after retry*timeout seconds no RADIUS accounting response is received for the Accounting Interim Update or Accounting Stop then a new attempt to send the message is started after minimum [(min-val*2n), max-val] seconds.
3. Repeat step 2 until:

    a. RADIUS accounting response is received, or

    b. the lifetime of the buffered message expires, or

    c. (if the buffered message is an Accounting Interim-Update only) A new Accounting Interim-Update or an Accounting Stop or for the same accounting session-id and radius-server-policy is stored in the buffer, or

    d. the message is manually purged from the message buffer via a clear command
4. The message is purged from the buffer as shown in Figure 58.

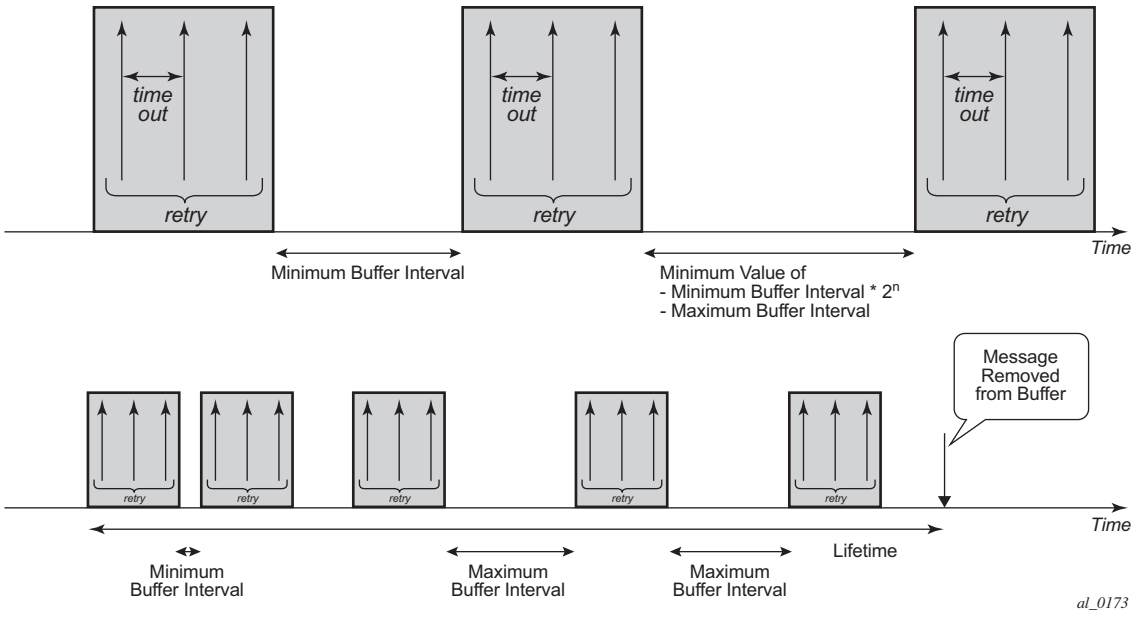


Figure 58: Purging Message from Buffer

When Accounting Interim-Update message buffering is enabled, it is recommended to also enable Accounting Stop message buffering. This will guarantee the message ordering per accounting session.

Use following clear command to manually delete messages from the RADIUS accounting message buffer:

 # clear aaa radius-server-policy *policy-name* **msg-buffer** [**acct-session-id** *acct-session-id*]

When specifying the Acct-Session-Id, only that specific message will be deleted from the message buffer. If no Acct-Session-Id is specified, all messages for that radius-server-policy are deleted from the message buffer.

Use the following show commands to display the RADIUS accounting message buffer statistics:

```
# show aaa radius-server-policy "aaa-server-policy-1" msg-buffer-stats
===============================================================================
RADIUS server policy "aaa-server-policy-1" message buffering stats
===============================================================================
buffering acct-interim      : enabled
  min interval (s)          : 60
  max interval (s)          : 3600
  lifetime (hrs)            : 12
buffering acct-stop         : enabled
  min interval (s)          : 60
  max interval (s)          : 3600
  lifetime (hrs)            : 12

Statistics
-------------------------------------------------------------------------------
```

```
Total acct-stop messages in buffer                        : 0
Total acct-interim messages in buffer                     : 5
Total acct-stop messages dropped (lifetime expired)       : 0
Total acct-interim messages dropped (lifetime expired)    : 0
Last buffer clear time                                    : N/A
Last buffer statistics clear time                         : N/A
-------------------------------------------------------------------------------
===============================================================================
```

Use following clear command to reset the RADIUS accounting message buffer statistics:

clear aaa radius-server-policy *policy-name* **statistics msg-buffer-only**

Use following tools commands to display the RADIUS accounting message buffer content:

 # tools dump aaa radius-server-policy *policy-name* **msg-buffer [session-id** *acct-session-id***]**

For example:

```
# tools dump aaa radius-server-policy "aaa-server-policy-1" msg-buffer
===============================================================================
RADIUS server policy "aaa-server-policy-1" message buffering
===============================================================================
message type Acct-Session-Id                              remaining lifetime
-------------------------------------------------------------------------------
acct-interim 242FFF0000009A512B36FC                       0d 11:58:54
acct-interim 242FFF0000009B512B36FC                       0d 11:58:48
acct-interim 242FFF0000009C512B36FC                       0d 11:58:30
acct-interim 242FFF0000009D512B36FC                       0d 11:58:29
acct-interim 242FFF0000009E512B36FC                       0d 11:59:05
-------------------------------------------------------------------------------
No. of messages in buffer: 5
===============================================================================
```

When specifying the Acct-Session-Id, the message details are displayed.

Sending an Accounting Stop Message upon a RADIUS Authentication Failure of a PPPoE Session

In scenarios where RADIUS authentication is used for PPPoE sessions, an accounting stop message can be generated to notify the RADIUS servers in case of an authentication failure.

The failure events are categorized in three categories:

- "**on-request-failure**" — All failure conditions between the sending of an Access-Request and the reception of an Access-Accept or Access-Reject.
- "**on-reject**" — When an Access-Reject is received.
- "**on-accept-failure**" — All failure conditions that appear after receiving an Access-Accept and before successful instantiation of the host or session.

Each of the categories can be enabled separately in the RADIUS authentication policy.

In the Enhanced Subscriber Management (ESM) model, the RADIUS accounting server is found after authentication and host identification as part of the subscriber profile configuration. To report authentication failures to accounting servers, an alternative RADIUS accounting policy configuration is required: local user database pre-authentication can provide the RADIUS authentication policy to be used for authentication and the RADIUS accounting policy to be used for authentication failure reporting. A duplicate RADIUS accounting policy can be specified if the accounting stop resulting from a RADIUS authentication failure must also be sent to a second RADIUS destination.

```
configure
    subscriber-mgmt
        local-user-db "ludb-1" create
            ppp
                match-list username
                host "default" create
                    auth-policy "auth-policy-1"
                    password ignore
                    acct-policy "acct-policy-1" duplicate "acct-policy-2"
                    no shutdown
                exit
            exit
            no shutdown
        exit
        authentication-policy "auth-policy-1" create
            pppoe-access-method pap-chap
            include-radius-attribute
               - - - snip - - -
            exit
            send-acct-stop-on-fail on-request-failure on-reject on-accept-failure
            radius-server-policy "aaa-server-policy-1"
        exit
        radius-accounting-policy "acct-policy-1" create
            - - - snip - - -
            radius-server-policy "aaa-server-policy-1"
        exit
        radius-accounting-policy "acct-policy-2" create
            - - - snip - - -
```

```
            radius-server-policy "aaa-server-policy-2"
        exit
```

To enable local user database pre-authentication, use the user-db configuration in the capture SAP and in the group-interface. For example:

```
configure
    service
        vpls 10 customer 1 create
            sap 1/1/1:1.* capture-sap create
                trigger-packet pppoe
                pppoe-policy "ppp-policy-1"
                pppoe-user-db "ludb-1"
            exit
            no shutdown
        exit
        ies 1000 customer 1 create
            subscriber-interface "sub-int-1" create
               - - - snip - - -
                group-interface "group-int-1-1" create
                    - - - snip - - -
                    pppoe
                        policy "ppp-policy-1"
                        user-db "ludb-1"
                        no shutdown
                    exit
                exit
            exit
            no shutdown
        exit
```

Enhanced Subscriber Management Overview

Enhanced Subscriber Management Basics

In residential broadband networks numerous subscribers can be provisioned that can require significant changes on a daily basis. Manually configuring the applicable parameters for each subscriber would be prohibitive. The Alcatel-Lucent 7750 SR has been designed to support fully dynamic provisioning of access, QoS and security aspects for residential subscribers using DHCP to obtain an IP address. Enabling Enhanced Subscriber Management drastically reduces the configuration burden.

Enhanced Subscriber Management in the 7750 SR supports many vendor's access nodes and network aggregation models, including VLAN per customer, per service or per access node.

Standard and Enhanced Subscriber Management

The system can switch between standard and enhanced subscriber management modes on a per SAP basis. The Enhanced Subscriber Management mode is supported on the SR-7 and SR-12 chassis and on the ESS-7 chassis.

Some functions are common between the standard and enhanced modes. These include DHCP lease management, static subscriber host definitions and anti-spoofing. While the functions of these features may be similar between the two modes, the behavior is considerably different.

- Standard mode — The system performs SLA enforcement functions on a per SAP basis, that is, the attachment to a SAP with DHCP lease management capabilities. The node can authenticate a subscriber session with RADIUS based on the MAC address, the circuit-id (from Option 82) or both. It will then maintain the lease state in a persistent manner. It can install anti-spoofing filters and ARP entries based on the DHCP lease state. Static subscriber hosts are not required to have any SLA or subscriber profile associations and are not required to have a subscriber identification string defined.
- Enhanced mode — When enabled on a SAP, the system expands the information it stores per subscriber host, allowing SLA enforcement and accounting features on a per subscriber basis. The operator can create a subscriber identification policy that will include a URL to a user-space script that assists with the subscriber host identification process.
  - → A subscriber host is identified by a subscriber identification string instead of the limited Option 82 values (although, the identification string is normally derived from string manipulation of the Option 82 fields). A subscriber identification policy is used to process the dynamic host DHCP events to manage the lease state information

stored per subscriber host. The static subscriber hosts also must have subscriber identification strings associations to allow static and dynamic hosts to be grouped into subscriber contexts.

→ Further processing by the subscriber identification policy derives the appropriate subscriber and SLA profiles used to define the hierarchical virtual schedulers for each subscriber and the unique queuing and filtering required for the hosts associated with each subscriber

→ The SLA profile information is used to identify which QoS policies and which queues/policers, and also which egress hierarchical virtual schedulers, will be used for each subscriber host (dynamic or static).

→ The system performs SLA enforcement functions on a per subscriber SLA profile instance basis. SLA enforcement functions include QoS (classification, filtering and queuing), security (filtering), and accounting.

When the enhanced mode is enabled on a SAP (see Subscriber SAPs on page 975), first, the router ensures that existing configurations on the SAP do not prevent proper enhanced mode operation. If any one of the following requirements is not met, enhanced mode operation is not allowed on the SAP:

- Anti-spoofing filters must be enabled and configured as IP+MAC matching.
- Any existing static subscriber hosts must have:
  - → An assigned subscriber identification string.
  - → An assigned subscriber profile name.
  - → An assigned SLA profile name.
- The system must have sufficient resources to create the required SLA profile instances and schedulers.

When the router successfully enables the enhanced mode, the current dynamic subscriber hosts are not touched until a DHCP message event occurs that allows re-population of the dynamic host information. Thus, over time, the dynamic subscriber host entries are moved from SAP-based queuing and SAP-based filtering to subscriber-based queuing and filtering. In the event that a dynamic host event cannot be processed due to insufficient resources, the DHCP ACK message is discarded and the previous host lease information is retained in the system.

Subscriber Management Definitions

Subscriber

A subscriber is typically defined by a unique subscriber identifier to which an assortment of polices (or subscriber profile) can be applied. A subscriber typically (but not always) maps into a VLAN, a VPI/VCI pair, an “ifentry” (a logical interface such as a SAP), a (source) MAC or IP address or a physical port, which uniquely identify a billable entity for the service provider.

Subscriber Management

The management of all services, policies, AAA functions and configurations that relate to the concept of a subscriber. Subscriber management can be configured in a variety of ways, but it is critical that subscriber management integrates seamlessly with element and service management across the broadband infrastructure, via for instance, the Alcatel-Lucent 5750 Subscriber Services Controller (SSC). Subscriber management can also be implemented through CLI or scripted commands at the platform level, whereby a network administrator would manually configure the set of QoS, security, AAA or anti-spoofing functions that relate to a particular billable entity or subscriber. Subscriber management is typically centralized and highly integrated with the element, services and middleware management functions for streamlined management, flowthrough provisioning, and accelerated service activation, with minimized operating expenditures.

Subscriber Policy Enforcement

Is the set of actual enforcement functions that are implemented relative to a given subscriber, possibly at multiple enforcement points in the infrastructure and as a result of a match between the subscriber profile which was defined by the subscriber management suite (Alcatel-Lucent’s 5750 SSC) and actual traffic patterns. Examples include for instance, the shaping, policing or rate limiting of traffic or the traffic of a given subscriber being dropped because it matched or violated any specific rule (packet with a mismatch between MAC and IP address suggesting an address spoof for instance)

Subscriber SAPs

A subscriber SAP is a service access point (SAP) where enhanced subscriber management is active. Enhanced subscriber management must be explicitly enabled on a per-SAP basis with the CLI **sub-sla-mgmt** command.

A subscriber SAP can be used by a single subscriber or support multiple subscribers simultaneously. Each subscriber can be represented by one or multiple subscriber hosts on the subscriber SAP. If enhanced subscriber management is enabled on a SAP, any configured QoS and

IP filter policies defined on the SAP are ignored. A subscriber SAP must refer to an existing subscriber identification policy.

Hosts and Subscribers

A host is a device identified by a unique combination of IP address and MAC address. Typically, the term “subscriber host” is used instead of the “host”.

A host can be an end-user device, such as a PC, VoIP phone or a set top box, or it can be the user’s Residential Gateway (RGW) if the RGW is using Network Address Translation (NAT).

Each subscriber host must be either statically provisioned or dynamically learned by the system. The host’s IP address + MAC address are populated in the subscriber host table on the appropriate SAP to allow packets matching the IP address and MAC address access to the provider’s network.

- A dynamic subscriber host is dynamically learned by the system through the DHCP snooping or relay process. Each subscriber SAP created on the system is configured (using the lease-populate command) to monitor DHCP activity between DHCP clients reached through the SAP and DHCP servers. DHCP ACKs from the DHCP server are used to determine that a certain IP address is in use by a specific DHCP client. This client IP address association is treated by the system as a dynamic subscriber host.
- When it is not possible to dynamically learn a subscriber host through DHCP, a static subscriber host can be created directly on a subscriber SAP. Since a subscriber identification policy is not applicable to static subscriber hosts, the subscriber identification string, subscriber profile and SLA profile must be explicitly defined with the hosts IP address and MAC address.

A subscriber (in the context of the router) is a collection of hosts getting common (overall) treatment. It is expected that this group of hosts originate from the same site and all hosts of a subscriber are reached by the same physical path (such as a DSL port).

Once a subscriber host is known by the system, it is associated with a subscriber identifier and an SLA profile instance. Subscriber hosts with a common subscriber identifier are considered to be owned by the same subscriber.

Depending on the network model, hosts associated with a single subscriber can be associated with a single subscriber SAP or spread across multiple subscriber SAPs on the same port.

Subscriber Identification Policy

The subscriber identification policy contains the URL definitions for the Programmable Subscriber Configuration Policy (PSCP) scripts used for DHCP ACK message processing. Up to three URLs can be defined per subscriber identification policy. These are designated as primary, secondary and tertiary. Each URL can be individually enabled or disabled. Only one script (the URL with the highest priority active script) is used at any one time to process DHCP ACK messages. If the system detects an error with a specified script, the URL is placed in an operationally down state. If the script is shutdown, it is placed in an administratively down state. A script that is operationally or administratively down is considered inactive. The system automatically reverts to the highest priority active script. If a script becomes operationally down, it must be cycled through the administratively down then administratively up states for the system to attempt to reactivate the script.

Multiple subscriber identification policies are provided for the event that access nodes (such as DSLAMs) from different vendors are attached to the same router. Each policy's active script can be explicitly defined to process the various DHCP message formats or idiosyncrasies of each vendor.

If a script is changed, it must be reloaded by disabling and re-enabling any URL which refers to the changed script (a **shutdown** command followed by a **no shutdown** command).

Each subscriber identification policy can also contain a subscriber profile map and/or an SLA profile map. The subscriber profile map creates a mapping between the sub-profile-strings returned from the active script with an existing subscriber profile name. The SLA profile map is used to create a mapping between the sla-profile-strings returned from the active script with an existing SLA profile name.

The subscriber identification policy is designed to accept a DHCP ACK message destined for a subscriber host and return up to three string values to the system;

- The subscriber identification string (mandatory)
- The subscriber profile string (optional)
- The SLA profile string (optional).

These strings are used to derive the subscriber profile and the SLA profile to be used for this host See Using Scripts for Dynamic Recognition of Subscribers on page 1008.

Subscriber Identification String

Subscribers are managed by the router through the use of subscriber identification strings. A subscriber identification string uniquely identifies a subscriber.

The subscriber identification string is the index key to any entry in the active subscriber table, and thus must always be available. It is derived as follows:

- For dynamic hosts, the subscriber identification string is derived from the DHCP ACK message sent to the subscriber host.
  - → The DHCP ACK message is processed by a subscriber identification script which has the capability to parse the message into an alternative ASCII string value.
  - → If enhanced subscriber management is disabled, the default value for the string is the content of the Option 82 circuit-id and remote-id fields interpreted as an octet string.
- For static hosts, the subscriber identification string must be explicitly defined with each static subscriber host.

When multiple hosts are associated with the same subscriber identification string, they are considered to be host members of the same subscriber. Hosts from multiple SAPs can be members of the same subscriber, but for proper virtual scheduling to be performed all hosts of a subscriber must be active on the same IOM.

When the first host (either dynamic or static) is created with a certain subscriber identification string, an entry is created in the active subscriber table. The entries are grouped by their subscriber identification string.

Subscriber Profile

The subscriber profile is a template which contains those hierarchical QoS (HQoS) and accounting settings which are applicable to all hosts belonging to the same subscriber. These include:

- Ingress and egress scheduler policy HQoS
- Accounting policy
- RADIUS accounting policy

Subscribers are either explicitly mapped to a subscriber profile template or are dynamically associated with a subscriber profile.

Attempting to delete any subscriber profile (including the profile named ‘default’) while in use by an existing active subscriber will fail.

SLA Profile

For the purpose of supporting multiple service types (such as high speed Internet (HSI), voice over IP (VoIP), video on demand (VoD) and Broadcast TV) for a single subscriber, the hosts associated with a subscriber can be subdivided into multiple SLA profiles.

The SLA profile contains those QoS and security settings which are applicable to individual hosts. An SLA profile acts like a template and can be used by many subscribers at one time. Settings in the SLA profile include:

- Egress and ingress QoS settings
- Egress scheduler policy HQoS
- Egress and ingress IP filters
- Host limit

If the SLA profile does not explicitly define an ingress or egress QoS policy, the default SAP ingress or default SAP egress QoS policy is used.

Refer to Determining the SLA Profile on page 1012 for information on how the SLA profile is determined for dynamic hosts.

Explicit Subscriber Profile Mapping

An explicit mapping of a subscriber identification string to a specific subscriber profile can be configured.

An explicit mapping overrides all default subscriber profile definitions while processing a DHCP ACK. In an environment where dynamic and static hosts coexist in the context of a single subscriber, care will be taken to not define a subscriber profile in the explicit subscriber map that conflicts with the subscriber profile provisioned for the static host(s). If such a conflict occurs, the DHCP ACKs will be dropped.

An explicit mapping of a subscriber identification string to the subscriber profile name ‘default’ is not allowed. However, it is possible for the subscriber identification string to be entered in the mapping table without a defined subscriber profile which can result in the explicitly defined subscriber to be associated with the subscriber profile named ‘default’.

Attempting to delete a subscriber profile that is currently defined in an explicit subscriber identification string mapping will fail.

The explicit mapping entries can be removed at any time.

ESM for IPv6

ESM for IPv6 is supported on 7750 chassis with at least IOM3-XP cards or equivalent or in 7450 chassis operating in Mixed Mode (containing one or more IOM3-XP cards that have the 7750 SR feature set enabled.) ESM for IPv6 is supported with RADIUS as the backend authentication and authorization mechanism.

Models

- PPPoE Host
- PPPoE RG
- IPoE Host/RG

PPPoE Host

For PPPoE, the ESR suggests the IPv6CP protocol to the client during the session setup phase if the appropriate attributes have been returned by the RADIUS server on authentication. The RADIUS attribute that indicates the setup of a PPPoE host is Framed-IPv6-Prefix, which should contain a /64 prefix for the client.

When a PPPoE host has successfully completed the IPv6CP negotiation, the ESR will transmit a Router Advertisement to the PPPoE host containing the suggested prefix and any other options that are configured. The client may use this information to pick one or more addresses from the suggested prefix; all addresses within the prefix are forwarded towards the client.

Alternatively, the Recursive DNS Server (RDNSS) Option as defined in RFC 6106, I*Pv6 Router Advertisement Options for DNS Configuration*, can be included in IPv6 Router Advertisements for DNS name resolution of IPv6 SLAAC hosts. The following CLI command includes the DNS info in IPv6 Router Advertisements for SLAAC hosts and sets the RDNSS liftetime:

```
config>service>ies>sub-if>grp-if>ipv6>rtr-adv
config>service>vprn>sub-if>grp-if>ipv6>rtr-adv

[no] dns-options

   [no] include-dns    - Set/reset inclusion of the RDNSS server
                         option 25 on this group-interface
   [no] rdnss-lifetime - Maximum time the RDNSS address is valid
                         in this group-interface
```

The source for DNS information to be included in Router Advertisements for IPv6 SLAAC hosts, can be (listed in priority order):

1. Local User Database IPv6 options:

```
    configure subscriber-mgmt local-user-db <ludb-name> dhcp|ppp host <host-name>
options6 dns-server <ip-address> [<ip-address>...(up to 4 max)]
```

2. RADIUS attributes [26-6527-105] Alc-Ipv6-Primary-Dns and [26-6527-106] Alc-Ipv6-Secondary-Dns
3. Default IPv6 DNS Server configured at the group interface:

```
    configure service ies|vprn <svc-id> subscriber-interface <sub-int-name> ipv6 default-
dns <ipv6-address> [secondary <secondary-ipv6-address>]
```

Note: A default IPv6 server configuration at the group interface is a last resort IPv6 DNS info that can be used for IPoEv6 hosts (IA_NA, IA_PD and SLAAC) and PPPoEv6 hosts (IA_NA, IA_PD and SLAAC).

PPPoE RG

Initially, a PPPoE RG follows the same procedure as a PPPoE host: the ESR receives a prefix from RADIUS (in this case through a Delegated-IPv6-Prefix attribute), which is used as a trigger to suggest the IPv6CP protocol to the client. The prefix that is suggested to the client should have the same prefix length as configured under the subscriber interface ipv6 node (delegated-prefix-length). This length should be between 48 and 64 bits, inclusive.

After the IPv6CP protocol has completed, however, the client should run the DHCPv6 protocol over its PPPoE tunnel to receive a Delegated Prefix (IA_PD) and optionally IPv6 DNS server information. This Delegated Prefix can then be subdivided by the client and distributed over its downstream interfaces. During DHCPv6, no extra RADIUS request will be made; the information is stored during the initial (PPPoE or PPP) authentication until the client starts DHCPv6.

Only after DHCPv6 has completed, the IPv6 subscriber host will be instantiated and the ESR will start sending Router Advertisements (if configured.) The router advertisements will not contain any prefix information, which has already been provided by DHCPv6, but it is used as an indication to the client that its default gateway should be the ESR.

IPoE Host/RG

Similar to an IPv4 DHCP client, a DHCPv6 client is authenticated at its Solicit message, where it can request one or more addresses or prefixes. The address and prefix types supported are IA_NA (Non-Temporary Address) through the Alc-IPv6-Address RADIUS attribute and IA_PD (Delegated Prefix) through the Delegated-IPv6-Prefix attribute. Contrary to the IPv4 case, the ESR will always reply to a DHCPv6 request because the client may request more than one address or prefix simultaneously and not all of the requests may be honored.

The DHCPv6 protocol handling and Router Advertisement behavior are similar to the PPPoE RG case above, with the exception that for an IA_NA address, the entire /64 prefix containing the address is allocated to the client.

For SLAAC prefix assignment, authentication is triggered on router-solicit message. The SLAAC prefix can be assigned statically or dynamically. For a static SLAAC prefix, frame-ipv6-prefix, RADIUS attribute is used. For dynamic SLAAC prefix assignment from a local pool, Alc-slaac-ipv6-pool, RADIUS attribute is used.

Setup

IPv6 ESM hosts are only supported in the Routed CO model (both VPRN and IES).

At the ipv6 node under the subscriber interface level, the length of the prefixes that are offered is defined through the delegated-prefix-length option. This setting is fixed for the subscriber interface and can not be changed once subscriber prefixes are defined.

Subscriber prefixes define the ranges of addresses that are offered on this subscriber interface. By default only these subscriber prefixes are exported to the routing protocols to keep the routing tables small. There are three types of subscriber interfaces:

- wan-host — A range of prefixes that are assigned to PPPoE hosts and as DHCPv6 IA_NA addresses. These prefixes are always /64.
- pd — A range of prefixes that are assigned as DHCPv6 IA_PD prefixes for DHCPv6 IPoE clients and for PPPoE RGs. The length of these prefixes is defined by the delegated-prefix-length.
- both — When both 'wan-host' and 'pd' are defined, the subscriber prefix is a range that can be used for both previous types. However, the delegated-prefix-length is restricted to /64 in this case.

The IPv6 node under the group interface contains the DHCPv6 proxy configuration and the router advertisement configuration.

Behavior

Dual Stack

Clients may support both IPv4 and IPv6 simultaneously (dual stack hosts.) In this case one subscriber host entry will be created for the IPv4 address family and one for the IPv6 instance. The scaling limits apply for all entries, regardless of address type.

For DHCP, these subscriber hosts are fully independent (as they are set up through different protocols), but for PPPoE hosts or RGs, the ESM information in both subscriber host entries is linked together through the PPPoE session.

Router Advertisements (RA)

RA messages are started immediately after the subscriber host is instantiated and unsolicited messages are sent in the interval defined in the configuration. Apart from unsolicited RAs, the client may also send a router solicitation (RS) to explicitly request the information. RAs are throttled so that they are not sent more often than once every three seconds.

CoA and Disconnect-Request

For IPv6 subscriber hosts, RADIUS-triggered mid-session changes and session terminations may identify the subscriber host to be changed by the same address or prefix that was originally returned from RADIUS. Only one address attribute (framed-IP-address, framed-IPv6-prefix, delegated-IPv6-prefix or Alc-IPv6-address) may be given in a single request.

For PPPoE clients, changing either the IPv4 or IPv6 information will result in both the v4 and v6 subscriber host being modified (if they are contained within the same PPPoE session.)

The only CoA action that is allowed for IPv6 hosts is a change of ESM strings; creation of new hosts and forcing a DHCPv6 RENEW is not supported.

Delegated-Prefix-Length

The delegated prefix length (DPL) is applicable to subscriber-hosts with IPv6 Prefix (IA-PD) assigned via DHCPv6 Server. IPv6 Prefix is more akin to a route then it is to an IP address. The length of the prefix plays crucial role in forwarding decisions, antispoofing, and prefix assignment via DHCPv6 pools in the local DHCPv6 Server.

The structure of an IPv6 prefix is shown in Figure 59.

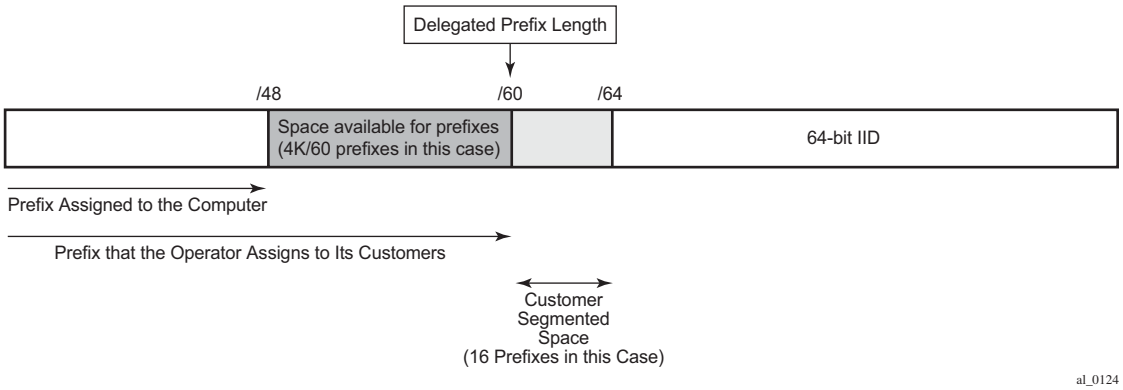


Figure 59: IPv6 Prefix

For example, a DHCPv6 server prefix pool contains an aggregated (configured) IPv6 prefix from which the delegated prefixes will be carved out. In Figure 59 this aggregated IPv6 prefix has length of /48. In addition, the DHCPv6 server needs to know the length of the delegated prefix (in the above case /60). These two values are marking the boundary within which a unique delegated prefix will be selected. This is represented by the purple area in Figure 59.

The delegated prefix length can be obtained via:

- RADIUS
  - Delegated-IPv6-Prefix attribute that contains the prefix and the length (Delegated-IPv6-Prefix = AAAA:BBBB::/56). The DPL in this case is /56.
  - Alc-Delegated-IPv6-Prefix-Length VSA (to be used in conjunction with the DHCPv6 pool name - Alc-Delegated-IPv6-Pool VSA)
- LUDB – configured via LUDB per IPoEv6/PPPoEv6 host:

```
configure
subscriber-mgmt
    local-user-db <name>
        dhcp | ppp
            host <name>
                ipv6-delegated-prefix-length [48..64]
```

This is to be used along with the DHCPv6 pool name (ipv6-delegated-prefix-pool) defined under the same CLI hierarchy.

Alternatively, the entire prefix, including the DPL can be returned via LUDB.

```
configure
    subscriber-mgmt
        local-user-db <name>
                dhcp | ppp
                    host <name>
                        ipv6-delegated-prefix <ipv6-prefix/prefix-length>
```

- DHCPv6 server – each DHCPv6 pool can optionally be configured with a DPL:

```
configure
     service/router
        dhcp6
            local-dhcp-server <name>
                pool <pool-name>
                    delegated-prefix-length [48..64]
```

- Configured statically under the ipv6 CLI node of subscriber-interface. In this case the DPL is fixed for all subscriber-hosts under the subscriber-interface.

```
configure
    service ies/vprn
        subscriber-interface <name>
                ipv6
                    delegated-prefix-length [48..64] | variable
```

Order of Preference for DPL

In case that the DPL is statically provisioned under the subscriber-interface>ipv6> hierarchy, all hosts under this subscriber-interface will inherit this fixed DPL. In case that the DPL is provided via LUDB or RADIUS in addition to static configuration under the subscriber-interface then the LUDB or the RADIUS one MUST match the DPL that is statically provisioned under the subscriber-interface. Otherwise, the prefix instantiation in 7x50 will fail.

Note that the “no delegated-prefix-length” command under the **subscriber-interface>ipv6>** hierarchy means that the DPL is set to a default-value of 64.

When the delegated-prefix-length commands under the **subscriber-interface>ipv6>** hierarchy is set to variable, prefixes under such subscriber-interface can have different lengths and the DPL can be configured via one of the following means:

- LUDB
- RADIUS
- DHCP Server

DHCP Server Address Utilization and Delegated Prefix Length

In case that the delegated prefix length is variable, for each consecutive address allocation request for the given delegated prefix, the DHCPv6 server will allocate the prefix at the end of the last delegated lease with the same delegated prefix length. This will minimize the address space fragmentation within the configured prefix.

DHCPv6 Relay Agent

A DHCPv6 Relay Agent can support a 7x50 DHCPv6 local server (same or remote chassis) and a third party DHCPv6 external server.

An incoming DHCPv6 client message is relayed within the Relay-Forward message specified in RFC 3315. If the server responds with a valid address/prefix, the ESM process attempts to install it. If it fails, the DHCPv6 Relay Agent sends an explicit RELEASE to the server. There is no retransmission of DHCPv6 Relay-Forwards in the case of failure – it requires the client to re-start or re-send the original DHCPv6 message.

A Lightweight DHCPv6 Relay Agent may insert Relay Agent Information including the Interface ID option between the DHCPv6 client and the DHCPv6 Relay Agent.

Additional Relay Agents (non-LDRA) between the DHCPv6 client and the DHCPv6 Relay Agent are not supported.

Configuring a DHCPv6 Relay Agent

A DHCPv6 Relay Agent is configured in the IPv6 DHCP6 context of a group-interface:

```
config>service>vprn>sub-if>grp-if>ipv6>dhcp6# relay ?
config>service>ies>sub-if>grp-if>ipv6>dhcp6# relay ?
  - no relay
  - relay

 [no] client-applications - Configure the set of DHCP6 relay server client
                            applications
 [no] description     - Description for DHCPv6 relay
 [no] link-address    - Configure the link address of the DHCPv6 relay messages
 [no] option          + Configure the DHCPv6 Relay information options
 [no] server          - Configure the DHCPv6 server IPv6 address
 [no] shutdown        - Administratively enable/disable DHCPv6 relay on this interface
 [no] source-address  - Configure the source IPv6 address of the DHCPv6 relay messages
```

Up to eight DHCPv6 servers can be provisioned to be served by a DHCPv6 Relay Agent. A Relay-Forward is send to all servers and the Relay-Replies from all servers are sent to the client.

The “client-applications” parameter specifies if the Relay Agent can be used for IPoE (dhcp) or PPP (ppp) hosts.
Optional configuration parameters:

- description — A free configurable description string.
- link-address — The link address field in the DHCPv6 Relay-Forward message header.

  The link address can be configured to enable link-address based pool selection in a 7x50 DHCPv6 local server. The address must be one of the IPv6 prefixes configured at the ipv6 subscriber-prefixes context for a subscriber interface. If not configured, the system selects one of the prefixes.

- option: allows to configure following options to be inserted in the Relay-Forward message:
  - → Interface-Id [18] — The interface ID option identifies the interface on which the DHCPv6 client message is received. The format options are the following:
    - ascii-tuple: — *host-name*|*service-id*|*group-interface-name*|*sap-id*
    - ifindex — Interface index for the group-interface
    - sap-id — SAP identifier (port and vlans)
    - string <string>: — A free configurable string (max. 80 chars)
  - → Remote-Id [37] — Relay Agent Remote Id option contains the DHCPv6 client DHCP Unique Identifier (DUID).
- source-address: the source-address of the Relay-Forward messages.

  If not configured, the outgoing interface IPv6 address is used. The source-address configuration is mandatory for a DHCP Relay Agent in a VPRN service when the DHCPv6 server is reachable via a tunnelled next-hop (MPLS).

DHCPv6 Relay to Third Party DHCPv6 External Server

When the DHCPv6 Relay Agent is relaying to a third party DHCPv6 external server, following conditions should be met:

- The third party DHCPv6 server must return a unique IA_PD IPv6 delegated prefix (/64 or lower) for each allocation. The length of the IA_PD IPv6 delegated prefix must match the delegated-prefix-len configured on the subscriber interface on the 7750 DHCP L3 relay. This length is also included in the Relay-Forward message as PFX_LEN option (3) in a Vendor-Specific-Information-Option (17).
- For IPv6oE routed CPE's, the 3rd party DHCPv6 server must return a unique IA_NA IPv6 address (/128) from a different /64 subnet for each allocation.
- For IPv6oE hosts behind bridged CPE's,
  - → the third party DHCPv6 server must return a unique IA_NA IPv6 address (/128) from a different /64 subnet for each allocation (host) that belongs to a different CPE.
  - → the third party DHCPv6 server may return a unique IA_NA IPv6 address (/128) from the same /64 subnet for allocations (hosts) that belong to the same CPE and that are attached to the same vlan (SAP) on the BNG.

Following information is available to the third party DHCPv6 server in a Vendor-Specific-Information-Option (17) included in the Relay-Forward message:

- WAN_POOL option (1) contains the pool name from which the IA_NA IPv6 address should be allocated.
- PFX_POOL option (2) contains the pool name from which the IA_PD IPv6 delegated prefix should be allocated.

- PFX_LEN option (3): contains the IA_PD IPv6 delegated prefix length that should be allocated.

DHCPv6 Local Server

A local DHCPv6 pool server for both addresses (IA_NA) and prefixed (IA_PD) manages the address and prefixes sent to either routing gateways or hosts.

Because IPv6 home networks lack NAT, the IPv6 addresses delegated to a routing gateway are in turn assigned to hosts in the home. These addresses are assigned with reasonably long (but configurable) lifetimes such that the loss of the WAN connection will not result in the IPv6 hosts in the LAN losing their IPv6 addresses. One consequence of these long lifetimes is that the IPv6 hosts will retain any IPv6 address provided the valid-lifetime is greater than zero. Should an operator delegate a prefix and then at a later time delegate a second IPv6 prefix, a host may end up with two or more valid prefixes. This situation plays havoc with IPv6 source address selection and may result in impaired service.

To overcome the problems of multiple IPv6 prefixes in the home, the operator must ensure that the individual subscriber has the same IPv6 prefix even across modem reboots (that is, if a subscriber session is destroyed and later re-created, an attempt should be made to use the previously delegated prefix). In release 8.0, the operator used RADIUS for all address and prefix assignment, but in release 9.0, with the introduction of the local DHCPv6 server, it requires the 7750 to process and maintain some state even after a session disconnects.

For the DHCPv6 local server to function, a DHCPv6 relay or proxy function must also operate alongside ESM. For the purposes of this document, to relay means to implement a DHCPv6 Relay as indicated in RFC 3315 : a relay encapsulates the client DHCP message within a DHCP Relay-Forward message and unicasts it to a specified destination.

A proxy is an internal concept. Unlike a DHCPv6 relay, the DHCPv6 proxy does NOT encapsulate the client message in a Relay-Forward, nor does it send packets towards the Local DHCPv6 Server. The DHCPv6 proxy is exclusively used as an interface between the RADIUS Access-Accept or local user database lookup and the DHCPv6 client in the consumer device.

The use of the DHCPv6 relay or proxy function depends on the attributes returned from authentication phase (RADIUS or LUDB).

1. DHCPv6 Proxy:
   - → If only IPv6 address/prefix information provided (Framed-IPv6-Prefix, Alc-IPv6-Address or Delegated-IPv6-Prefix).
2. DHCPv6 Relay:
   - → If no IPv6 address/prefix (Framed-IPv6-Prefix, Alc-IPv6-Address or Delegated-IPv6-Prefix) and no IPv6 pool (Framed-Pool, Delegated-Pool) information provided.
   - → If no IPv6 address/prefix (Framed-IPv6-Prefix, Alc-IPv6-Address or Delegated-IPv6-Prefix) and IPv6 pool (Framed-Pool, Delegated-Pool) information provided.
3. If both IPv6 address/prefix (Framed-IPv6-Prefix, Alc-IPv6-Address or Delegated-IPv6-Prefix) and IPv6 pool (Framed-Pool, Delegated-Pool) information are present, the DHCP packet is DROPPED.

Note: If IPv6 DNS parameters are returned in RADIUS AND a pool is specified then the DNS parameters are ignored. It is the DHCPv6 server that will need to reply with appropriate DNS servers.

Dynamic Subscriber Host Processing

Dynamic Tables

To support all processing for Enhanced Subscriber Management, several tables are maintained in the router (Figure 60).

- Active Subscriber Table on page 994
- SLA Profile Instance Table on page 994
- Subscriber Host Table on page 994
- DHCP Lease State Table on page 996

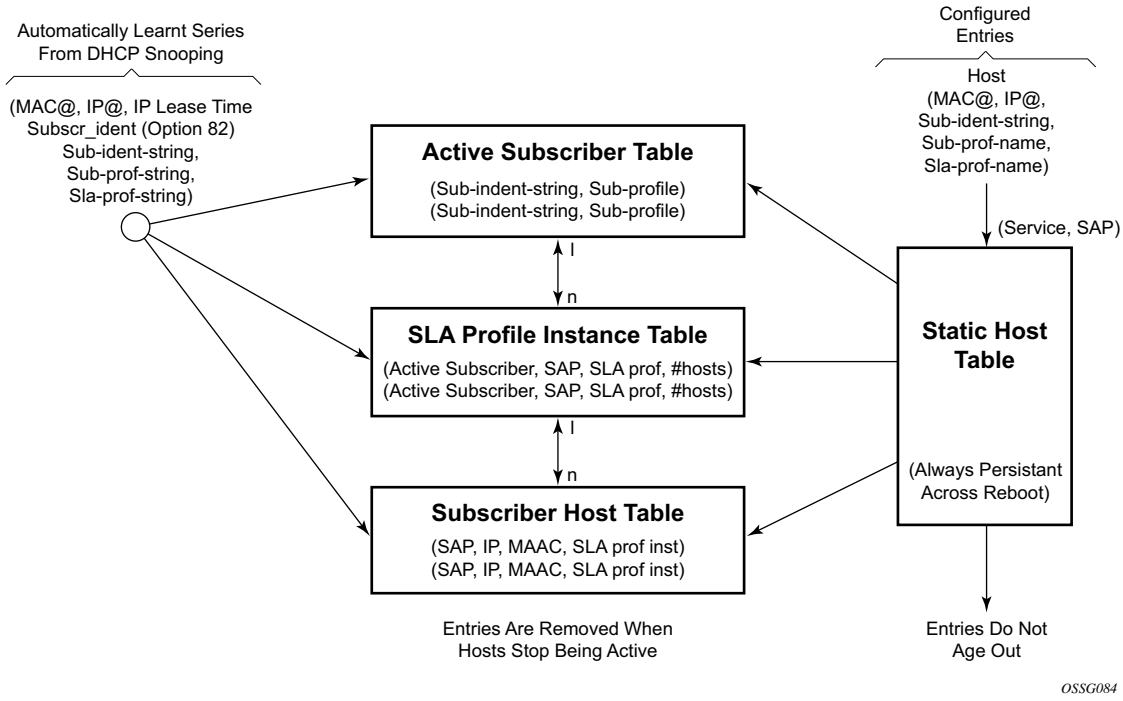


Figure 60: Enhanced Subscriber Management Dynamic Tables

Active Subscriber Table

An entry is created in the active subscriber table when the first host (either dynamic or static) is created with a certain subscriber identification string. The entries are grouped by their subscriber identification string.

Fields for each entry in the active subscriber table include:

- The subscriber identification string (see Subscriber Identification String on page 978).
- In use subscriber profiles (see Subscriber Profile on page 978).

SLA Profile Instance Table

An entry is created in the SLA profile instance table when the first subscriber host on a certain SAP is created that uses a certain SLA profile. All subsequent hosts of the same subscriber on the same SAP that use the same SLA profile will be associated with this entry. When the last host on this SAP, using this SLA profile disappears, the SLA profile instance is deleted from the table and the associated queues are removed.

SLA profile instances can not span multiple subscriber SAPs. If subscriber hosts from the same subscriber exist on multiple SAPs and are associated with the same SLA profile template, a separate SLA profile instance is created for each SAP.

Fields for each entry in the SLA profile instance table include:

- Active subscriber
- SAP
- SLA profile
- Number of active subscriber hosts that share this instance

Subscriber Host Table

An entry is created in the subscriber host table if anti-spoofing is enabled as well as:

- The first host (dynamic or static) with a specific IP and MAC combination is created. If the anti-spoof is IP only, the MAC address is masked to all 0's. If anti-spoof is MAC, only the IP address is 0.0.0.0. All dynamic hosts and static hosts with the same IP and MAC combination will be associated with the same subscriber host entry. If the anti-spoof type includes IP (IP-only or IP/MAC), there can be at most two hosts associated with the entry: one dynamic and one static. If the anti-spoof type is MAC-only, there can be a combination of several dynamic and static hosts associated with the entry.
- The non-prof-traffic is provisioned. Both IP and MAC address are all 0's.

Fields for each entry in the subscriber host table include:

- SAP

- IP address
- MAC address
- SLA profile instance (enhanced mode only)

DHCP Lease State Table

An entry in the DHCP lease state table is created for each dynamic host. Fields for each entry in the lease state table include:

- Assigned IP address
- Assigned MAC address
- Persistence key

Enhanced Subscriber Management Entities

Figure 61 illustrates the relationship between the main entities in Enhanced Subscriber Management:

- A subscriber is associated with only one subscriber profile.
- A subscriber can be associated with one or more SLA profile (a VPLS service with 2 different SAPs can have different SLA profiles for the same subscriber).
- A maximum of one SLA profile instance is generated (including ingress and egress queues) per SAP per SLA profile.
- One or more hosts can be assigned to each SLA profile instance (these will share the same queues).

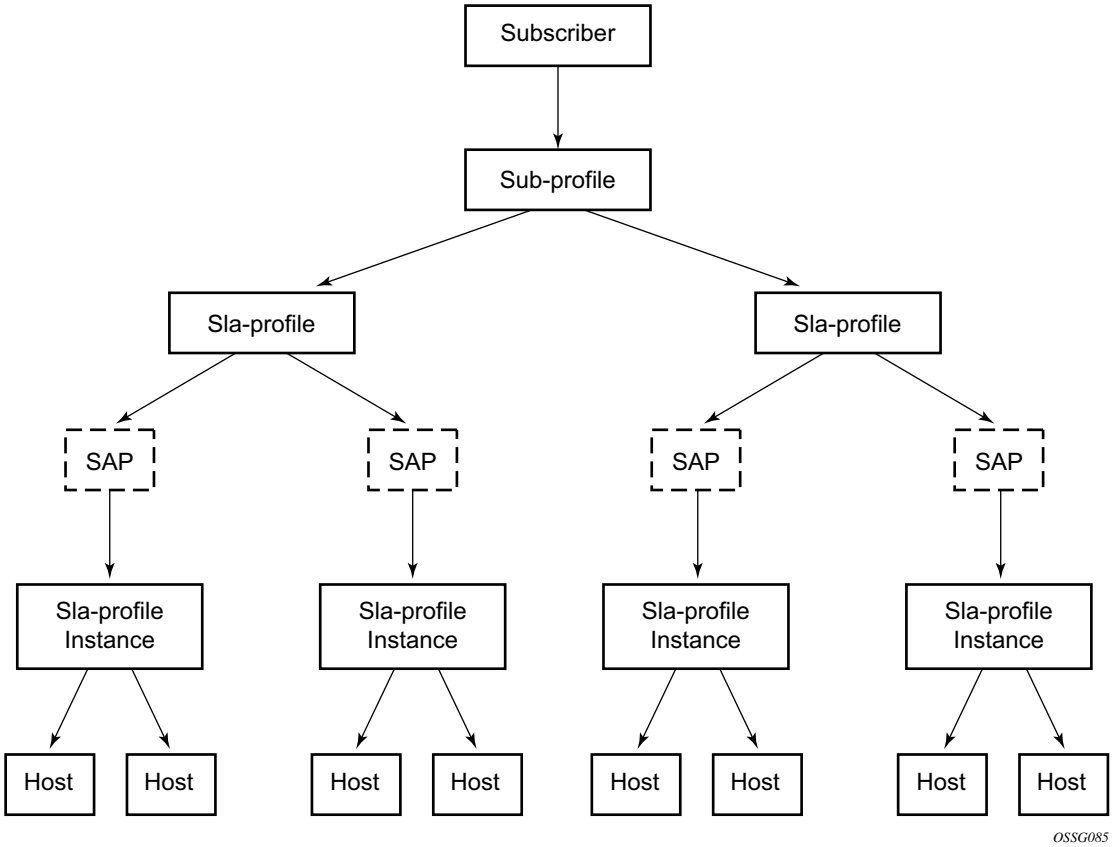


Figure 61: Relationship Between Enhanced Subscriber Management Entities

Instantiating a New Host

When a DHCP ACK is received for a new subscriber host on a particular SAP:

- The ACK message is parsed using the appropriate script.
- An entry is generated in the subscriber host table with indices:
  - → The SAP on which the host resides
  - → The assigned IP address
  - → The assigned MAC address and as lookup parameters:
    - – The subscriber profile and
    - – The SLA profile to be used (derived from using the script).

If this is the first host of a subscriber, an HQoS scheduler is instantiated using the ingress and egress scheduler policies referred to in the subscriber profile. Otherwise, if the subscriber profile of the new host equals the subscriber profile of the existing subscriber, the new host is linked to the existing scheduler. If the subscriber profile is different from the subscriber profile of the existing subscriber, a new scheduler is created and all the hosts belonging to that subscriber are linked to this new scheduler. Notice that the new subscriber profile will not conflict with the subscriber profile provisioned for a static host or non-sub-traffic under the same SAP.

If this is the first host of a subscriber on a particular SAP using a particular SLA profile, an SLA profile instance is generated and added to the SLA profile instance table. This includes instantiating a number of queues, according to the ingress and egress QoS profiles referred to in SLA profile, optionally with some specific overrides defined in the SLA profile. Otherwise the host is linked to the existing SLA profile instance for this subscriber on this SAP.

Notes:

- Any QoS and IP filter policies defined on the SAP are still processed even if Enhanced Subscriber Management is enabled on the SAP. For IPv4 traffic that is dropped due to anti-spoofing, counters, logging, and mirroring can be used. All other Layer 2 traffic that is never blocked by anti-spoofing can be processed by applying a QoS policy on the SAP and can still be classified differently, by the dot1p value.
- If insufficient hardware resources (queues) or software resources (profile instances) are available to support the new host, the DHCP ACK is dropped and an event is generated.

Packet Processing for an Existing Host

Whenever an IP packet arrives on a subscriber-facing SAP on which Enhanced Subscriber Management is enabled, a lookup is done in the subscriber host table using as the index the SAP, source IP address, and source MAC address.

- If there is no entry, this means that the host is not using his assigned IP address, so the packet is dropped;
- If there is an entry, this will refer to the subscriber profile and SLA profile to be used.

ESM Host Lockout

This feature is applicable to the 7750 SR and the 7450 ESS.

This feature increasingly penalizes hosts that fail repeated login attempts within a configurable time interval. This is done by holding off on creation attempts for these hosts for a configured but adaptable time period. A transient failure, due to a mis-configuration, is quickly corrected and does not prevent the host from logging in within a reasonable amount of time. At the same time, a malicious client or a constantly mis-configured client is locked-out and will not take up resources impacting other clients.

A lockout time per host supports exponential back-off with each retry and failure cycle, starting with a configured minimum value and increasing up to a configured maximum. The lockout time can be reset to the configured minimum value if there is no failed retry within a configured time threshold. The configurable values include:

lockout-reset-time *seconds*
lockout-time [**min** *seconds*] [**max** *seconds*]
max-lockout-hosts *hosts*

If multiple retries/failure cycles occur within the lockout time, then lockout period is exponentially increased starting from configured minimum value up to the configured maximum value. The lockout is reset to the minimum value if there is no failed retry till this lockout time.

This mechanism is supported for both single and dual-stack PPPoE and IPoE (DHCP) hosts over 1:1 or N:1 static or managed SAPs. The hold-off timer maintenance is on a per host basis (as follows):

- For 1:1 VLAN (PPPoE or IPoE hosts) per <VLAN, MAC address>
- For N:1 VLAN (PPPoE or IPv4oE hosts) per <VLAN, agent-circuit-id, agent-remote-id, MAC@>
- For 1:1 VLAN (IPv6oE hosts) per <VLAN, DUID>

A show lockout state for hosts is supported, given one or more of <SAP, MAC@, agent-circuit-id, agent-remote-id>.

A clear lockout state is supported for hosts given one or more of <SAP, MAC@, agent-circuit-id, agent-remote-id>.

Any changes in configured lockout values will not apply to hosts currently under lockout and will only apply once these hosts are out of lockout.

Functionality

ESM lockout is supported for dual-stack PPPoE hosts, dual-stack IPoE hosts and ARP hosts. ESM Lockout will track the following:

- PPPoE PADI and PADR
- DHCPv4 discover, DHCPv4 request, DHCPv6 solicit, DHCPv6 request
- ARP Request

During lockout, authentication and ESM host creation is suppressed. A lockout context will be created when a client first enters lockout. The context maintains state and timeout parameters for the lockout. If a lockout policy is configured for the underlying SAP for a host that has failed authentication or host creation, the host enters lockout for the configured minimum time (1 — 86400 seconds). When the lockout time expires, normal authentication and ESM host creation will be resumed on relevant PPP or DHCP messages. In case of another failure, the host will again enter the lockout state. The lockout time for the host on each failure will be exponentially increased up to the configured maximum time (1 — 86400 seconds). The lockout time for a client will be reset to the configured minimum value, and the corresponding lockout context will be deleted, if there is no authentication (and host creation) failure within a configured amount of time that needs to elapse after the client initially enters lockout. This time is called the **lockout-reset-time**.

The host identification for lockout includes <SAP, MAC@, circuit ID, remote ID>.

ANCP and GSMP

ANCP

Access Node Control Protocol Management (ANCP) can provide the following information to the router:

- ANCP can communicate the current access line rate to the router. This allows the router to adjust the H-QoS subscriber scheduler with the correct rate or potentially change alarm when the rate goes below a set threshold. This allows a policy manager to change the entire policy when the rate drops below a minimal threshold value. The ANCP actual upstream synchronization rate is mapped to the ingress while ANCP actual downstream synchronization rate is mapped to the egress.
- The router can send DSL line OAM commands to complete an OAM test from a centralized point or when operational boundaries prevent direct access to the DSLAM.

When ANCP is used with Enhanced Subscriber Management (ESM), a new string ancp-string can be returned from the Python script or from RADIUS. If not returned it defaults to the subscriber ID.

ANCP version 0x31 and 0x32 are both supported and will be auto detected at the start of each ANCP session. Within version 0x32, partitioning is also supported.

Multiple partitions from the same Access Node are also supported. If partitions are used, they are automatically detected during the start of an ANCP session.

Static ANCP Management

As depicted in Figure 62, a DSLAM is connected to an aggregation network that is connecting the DSLAM to a BRAS. ANCP is used to provide SAP level rate management. The DSLAM in this application maintains multiple ANCP connections. The primary connection is to the BRAS, providing rate and OAM capabilities while the secondary is to the router to provide rate management.

7750 SR and 7450 ESS:

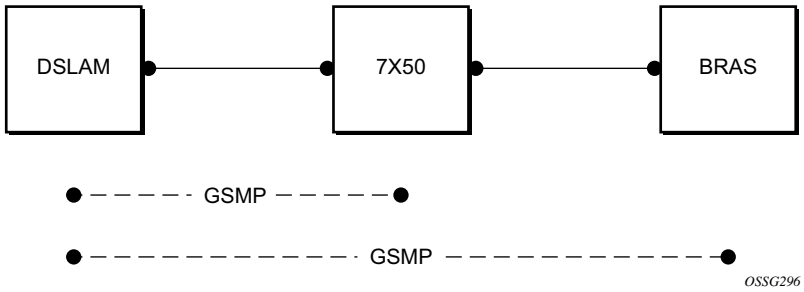


Figure 62: Static ANCP Management Example

Enhanced Subscriber Management (ESM) Dynamic ANCP

In this application ANCP is used between the DSLAM and the router to provide line control. There are multiple attributes defined as described below. Figure 63 depicts the connectivity model.

This application is used to communicate the following from the DSLAM to the router (the policy control point):

- Subscriber rate
- OAM

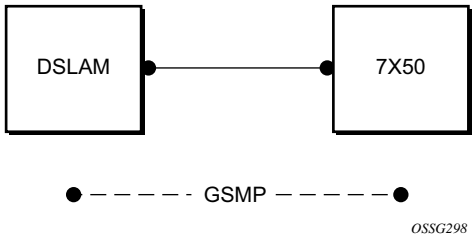


Figure 63: ESM Dynamic ANCP Example

ANCP String

To support node communication with the access device the line rate, OAM commands, etc. the node can use an “ANCP string” that serves as a key in the out-of-band channel with the access node. The string can be either provisioned in the static case, retrieved from RADIUS or from the Python script.

ANCP Persistency Support

Persistency is available for subscriber's ANCP attributes and is stored on the on-board compact flash card. ANCP data will stay persistence during an ISSU as well as nodal reboots. During recovery, ANCP attributes are first restored fully from the persistence file and incoming ANCP sessions are temporarily on hold. Afterwards new ANCP data can overwrite any existing values. This new data is then stored into the compact flash in preparation for the next event.

General Switch Management Protocol Version 3 (GSMPv3)

General Switch Management Protocol version 3 (GSMPv3) is a generic protocol that allows a switch controller node to establish and maintain connections with one or more nodes to exchange operational information. Several extensions to GSMPv3 exist in the context of broadband aggregation. These extensions were proposed to allow GSMPv3 to be used in a broadband environment as additional information is needed to synchronize the control plane between access nodes (such as DSLAMs) and broadband network gateways (such as BRAS).

In the TPSDA framework, nodes fulfill some BRAS functionality, where per subscriber QoS enforcement is one of the most important aspects. To provide accurate per-subscriber QoS enforcement, the network element not only knows about the subscriber profile and its service level agreement but it is aware of the dynamic characteristics of the subscriber access circuit.

The most important parameters in this context are the subscriber-line capacity (DSL sync-rate) and the subscriber's channel viewership status (the actual number of BTV channels received by the given subscriber in any point in time). This information can be then used to adjust parameters of aggregate scheduling policy.

Besides, the above-mentioned information, GSMPv3 can convey OAM information between a switch controller and access switch. The node can operate in two roles:

- As the intermediate controller — The router terminates a connection from the DSLAM.
- As the terminating controller— The router fulfils full the roll of BRAS.

The DSL forum working documents recommends that a dedicated Layer 2 path (such as, a VLAN in an Ethernet aggregation network) is used for this communication to provide a certain level of security. The actual connection between DSLAM and BRAS is established at TCP level, and then individual messages are transported.

DHCP Release Messages

The node supports DHCP release messages. A DHCP release message removes state from the DHCP server when the node rejects ACKs or removes hosts.

DHCP Release

DHCP release messages will be controlled by the node and sent to the DHCP server to clear stale state. There are two examples:

1. If the node drops a DHCP ACK (because of resources, duplicate host or other reasons) the servers state must be cleared and the node will send a DHCP release.
2. When a host state is removed, based on SHCV, ANCP, user clear, etc., the node will send a DHCP release to the server and the MAC will be flushed from SDPs. A new flag will allow the user to elect not to send the release message If when using a clear lease command the host was removed by the user (using a clear command) a new flag will allow the user to elect not to send the release message.

DHCP Client Mobility

Client mobility allows the node to use host monitoring (SHCV, ANCP, split DHCP) to remove network and server state when a host is removed locally. This allows for MAC addressed learned and pinned to move based on policy parameters.

Subscriber Host Connectivity Verification (SHCV) configuration is mandatory. This allows clients to move from one SAP to another SAP in the same service. This is only applicable in a VPLS service and group interfaces.

The first DHCP message on the new SAP with same MAC address (and IP address for group-interfaces) will trigger SHCV and will always be discarded.

SHCV will check that the host is no longer present on the SAP where the lease is currently populated to prevent spoofing. When SHCV detects that the host is not present on the original SAP, the lease-state will be removed. The next DHCP message on the new SAP can initiate the host.

DHCP Lease Control

DHCP lease control allows the node to be configured to present a different lease to the client. This can be used to monitor the health of the client.

Using Scripts for Dynamic Recognition of Subscribers

Whenever a host belonging to a subscriber is activated (when a PC or set-top box (STB) is turned on), the host will typically request an IP address from the network using DHCP. Refer to DHCP Management on page 347 for an explanation of DHCP and DHCP snooping in the router.

The DHCP ACK response from the DHCP server can be parsed and the contents of the message can be used to identify the "class" to which this host belongs, and thus, the QoS and security settings to apply.

The information necessary to select these settings can be codified in, the IP address by the DHCP server and/or the Option 82 string inserted by the DSLAM or other access node.

Python Language and Programmable Subscriber Configuration Policy (PSCP)

PSCP is an identification mechanism using the Python scripting language. The PSCP references a Python script that can use regular expressions to derive the sub-ident-string, sub-profile-string and sla-profile-string from the DHCP response. A tutorial of regular expressions is beyond the scope of this guide, and can be found on the Internet (refer to http://www.amk.ca/python/howto/regex/).

A tutorial of Python is beyond the scope of this guide but can be found on the Internet (refer to http://www.python.org/).

Example scripts, using some regular expressions, can be found in Sample Python Scripts on page 2100. Additional information about the service manager scripting language, see Python Script Support for ESM on page 2091.

One or more scripts can be written by the operator and stored centrally on a server (in a location accessible by the router). They are loaded into each router at bootup.

Note that if a centrally stored script is changed, it is not automatically re-loaded onto the router. The reload must be forced by executing the **shutdown** / **no shutdown** commands on the affected URL(s).

Determining the Subscriber Profile and SLA Profile of a Host

Figure 64 describes the data flow while determining which subscriber profile and SLA profile to use for a certain subscriber host based on a snooped/relayed DHCP ACK for that subscriber host.

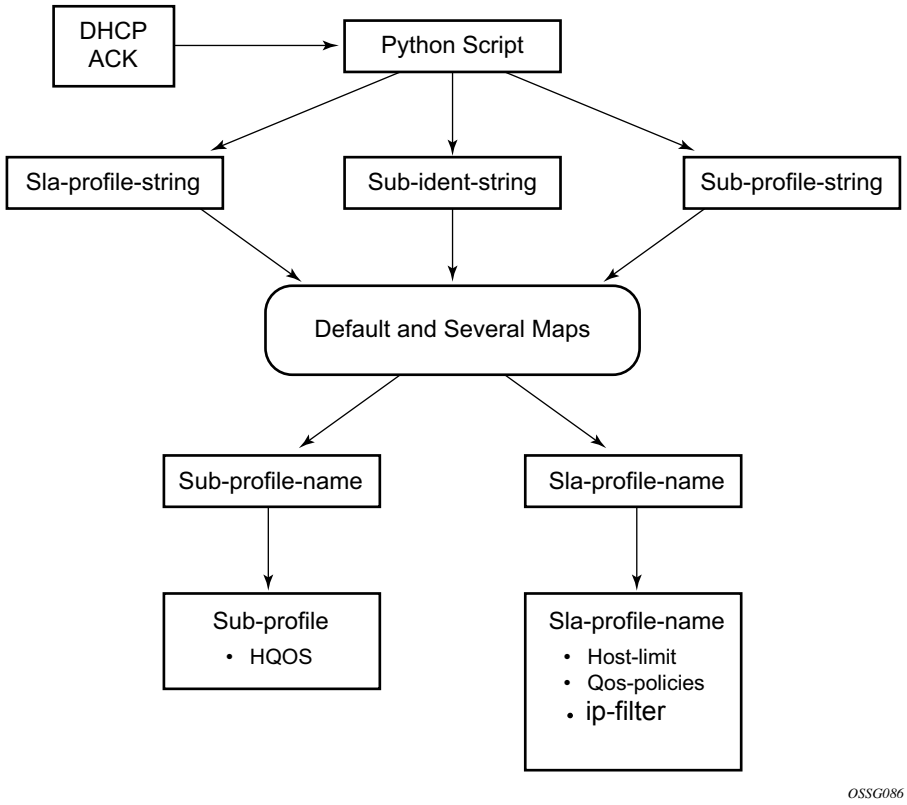


Figure 64: Data Flow in Determining Subscriber Profile and SLA Profile

An incoming DHCP ACK (relayed or snooped) is processed by the script provisioned in the sub-ident-policy defined in the SAP on which the message arrived. This script outputs one or more of the following strings:

- sub-ident — Identifies the subscriber (always needed).
- sub-profile — Identifies the subscriber class (optional).
- sla-profile — Identifies the SLA Profile for this subscriber host (optional).

These strings are used for a lookup in one or more maps to find the names of the sub-profile and sla-profile to use. If none of the maps contained an entry for these strings, the names will be determined based on a set of defaults.

Only when the names for both the sub-profile and sla-profile are known, the subscriber host can be instantiated. If even no default is found for either profile, the DHCP ACK is dropped and the host will not gain network access.

Determining the Subscriber Profile

All hosts (devices) belonging to the same subscriber will be subject to the same HQoS processing. The HQoS processing is defined in the sub-profile. A sub-profile refers to an existing scheduler policy and offers the possibility to overrule the rate of individual schedulers within this policy.

Because all subscriber hosts of one subscriber use the same scheduler policy instance, they must all reside on the same I/O module.

The figure below shows how the sub-profile is derived, based on the sub-ident string, the sub-profile string and/or the provisioned data structures. The numbers associated with the arrows pointing toward the subscriber profiles indicate the precedence of the checks.

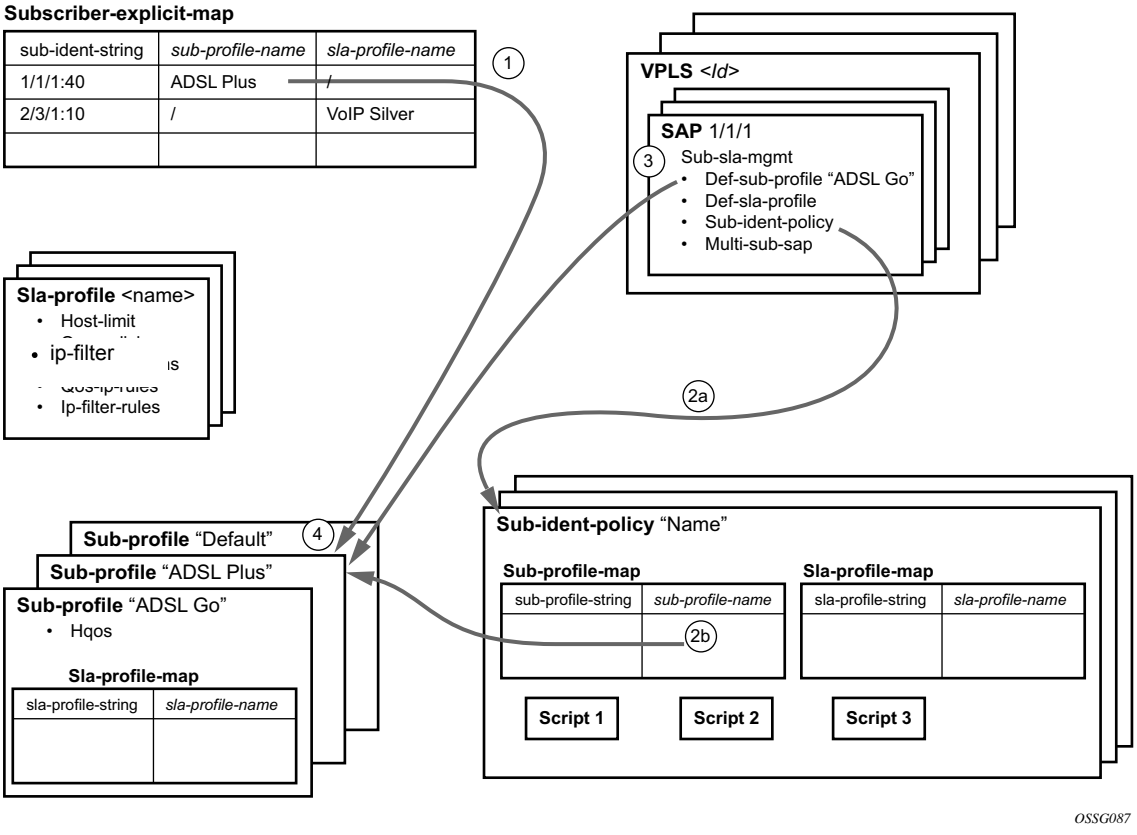


Figure 65: 7750 SR Determining the Subscriber Profile

1. A lookup in the **explicit-subscriber-map** is done with the sub-ident string returned by the script. If a matching entry is found, the sub-profile-name (if defined) is taken. Otherwise:
2. If a **sub-ident-policy** is defined on the SAP, a lookup is done on its **sub-profile-map** with the sub-profile string from the script. The sub-profile-name is taken from the entry.
   If no entry was found, then:
3. If provisioned, the sub-profile-name is taken from the **def-sub-profile** attribute on the SAP.
   If not provisioned, then:
4. The **sub-profile** with the name “default” is selected (if provisioned). If this is not provisioned, there are no other alternatives, the ACK is dropped, and the host will not gain access.

Determining the SLA Profile

For each host that comes on-line, the router also needs to determine which SLA profile to use. The SLA profile will determine for this host:

- The QoS-policies to use:
  - → classification
  - → queues/policers
  - → queue mapping
- The egress scheduling policies to use:
  - → egress HQoS
- The IP filter to use.

The SLA profile also has a host-limit attribute which limits the number of hosts (belonging to the same subscriber) on a certain SAP that can be using this SLA profile.

The classification and the queue mapping are shared by all the hosts on the same forwarding complex that use the same QoS policy (by their SLA profile).

The queues/policers are shared by all the hosts (of the same subscriber) on the same SAP that are using the same SLA profile. In other words, queues/policers are instantiated when, on a given SAP, a host of a subscriber is the first to use a certain SLA profile. This instantiation is referred to as an SLA profile instance. Ingress queues can be parented to a scheduler referenced in the ingress of a subscriber profile. Egress queues can be parented to a scheduler referenced in the egress of a subscriber or SLA profile, or to a port scheduler.

A scheduler policy can be applied to the egress an SLA profile, allowing its schedulers to be the parent for its queues and for its tier 1 schedulers to be parented to a scheduler in a scheduler policy applied to the egress of a subscriber profile or a vport, or to a port scheduler applied to a port or vport. Configuring scheduler overrides is allowed for SLA profile egress schedulers. The configuration of a scheduler policy in the egress of an SLA profile is supported for all host types only on Ethernet interfaces on FP2 and higher hardware. It is not supported for ESM over MPLS pseudowires, nor is HQoS adjustment and host tracking supported on its schedulers.

The following show/monitor/clear commands are available related to the SLA profile scheduler:

```
show qos scheduler-hierarchy subscriber sub-ident-string sla-profile sla-profile-name sap
sap-id [scheduler scheduler-name] [detail]
```

The **show qos scheduler-hierarchy subscriber** command (shown above) displays the scheduler hierarchy with the SLA profile scheduler as the root. Note that if the SLA profile scheduler is orphaned (that is when the scheduler has a parent which does not exist) then the hierarchy is only shown when the **show** command includes the **sla-profile** and **sap** parameters.

Note: If the SLA profile scheduler is orphaned (that is when the scheduler has a parent which does not exist) then the hierarchy is only shown when the show command includes the sla-profile and SAP parameters.

```
monitor qos scheduler-stats subscriber sub-ident-string [interval seconds] [repeat repeat]
```

```
[absolute|rate] sap sap-id sla-profile sla-profile-name

show qos scheduler-stats subscriber sub-ident-string sap sap-id sla-profile sla-profile-
name [scheduler scheduler-name]

clear qos scheduler-stats subscriber subscriber sub-ident-string sap sap-id sla-profile
sla-profile-name [scheduler scheduler-name]
```

The figure below shows a graphical description of how the SLA profile is derived based on the subscriber identification string, the SLA profile string and the provisioned data structures. The numbers on the arrows towards the SLA profile indicate the *priority* of the provisioning (the lower number means the higher priority).

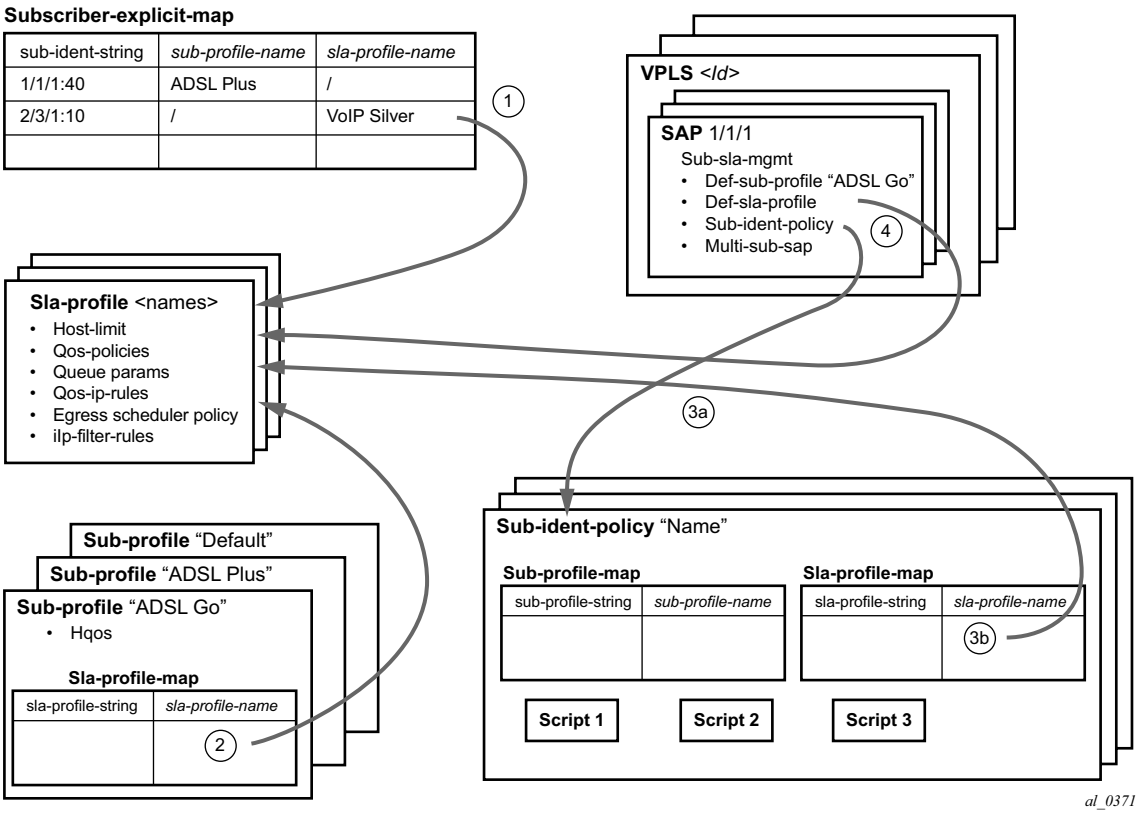


Figure 66: 7750 SR Determining the SLA Profile

1. A lookup is done with the sub-ident string returned by the script in the **explicit-subscriber-map**. If a matching entry is found, the sla-profile-name is taken from it – if defined. Otherwise:

2. A lookup with the sla-profile string from the script is done in the **sla-profile-map** of the sub-profile found earlier. The sla-profile-name from the found entry is taken. If no entry was found, then:
3. A lookup is done with the sla-profile string in the **sla-profile-map** of the **sub-ident-policy** configured on the SAP. The sla-profile-name from the found entry is taken. If no **sub-ident-policy** was configured on the SAP or no entry was found, then:
4. If provisioned, the sla-profile-name is taken from the **def-sla-profile** attribute on the SAP. If not provisioned, there are no more alternatives, the ACK is dropped, and the host will not gain access.

SLA-Based Egress QoS Marking

The egress QoS marking for subscriber-host traffic is derived from SAP-egress QoS policy associated with a corresponding SAP, rather than from the SLA profile associated with the corresponding subscriber-host. As a consequence, no egress QoS marking (or Dot1p marking is set to 0, the dscp/prec field is kept unchanged) is performed for traffic transmitted on a managed-SAP because per default, sap-egress policy 1 is attached to every managed-SAP.

The default value of the “qos-marking-from-sap” flag is enabled. This means that the qos-marking defined in the SAP egress QoS policy associated with the SAP will be used. The default setting of this flag in a combination with managed-SAP will result in the same behavior as in the current system (dot1p=0, dscp/prec is unchanged).

If “no qos-marking-from-sap” is executed, then both the Dot1p marking (all IOMs) and DSCP marking (IOM2/3 only) are derived from the sla-profile.

Changing the flag setting in the SLA profile being used by any subscriber-hosts (this includes subscriber-hosts on managed-SAPs as well) will be allowed.

The following MC traffic characteristics apply:

- On Layer 3 subscriber-interfaces, MC is not supported so it is impossible to enable it at the SAP level or at the sla-instance level.
- On Layer 2 SAPs IGMP snooping is supported while it is not supported on the sla-instance level. Therefore, any MC traffic transmitted at egress belongs to a SAP (meaning it will use SAP queues), rather than to sla-instance.
- The special case are SAPs with a profiled-traffic-only flag enabled. Although it is possible to define an sla-profile applicable to a Layer 2-host, this will not be taken as reference for marking mc-traffic, but rather SAP settings will be used.

Auto-Sub ID

The subscriber ID name (sub-id) is a mandatory object that binds all hosts of a given subscriber together. Briefly, the sub-id name represents a residential household. Many management/ troubleshooting and even billing operations rely on the sub-id name entity. The sub-id name is required for the host creation process, and it can be supplied by RADIUS or LUDB. It is derived from the sap-id or is statically provisioned in the form of a string.

In many ESM deployments with RADIUS, it is desirable that the sub-id is auto-generated within the 7x50 rather than burdening the OSS and the RADIUS server with this function. A typical application for auto sub-id is as follows:

- RADIUS server provides the sla-profile string and the sub-profile string but not the sub-id string.
- The sub-id name is auto-generated and formatted based on the configured options.

The following are the properties of auto sub-id generation:

- The auto-generation of the sub-id name can be based on any combination of the following fields:
  - → MAC address
  - → sap-id
  - → circuit-id
  - → remote-id
  - → session-id

There can be only a single set of subscriber identification fields defined per host type (IPoE or PPPoE) per chassis. If the combination of the fields must be modified, the existing subscribers with an auto-generated sub-id must be manually terminated. Considering that remote termination of the IPoE subscribers by a DHCP server is not supported by all DHCP client vendors through the FORCERENEW DHCP message (RFC 3203, *DHCP reconfigure extension*), changing the subscriber fields while subscribers with auto generated sub-id are active should be avoided.

The sub-id name generation will take place at the end of the host initiation process (as after the authentication phase is completed) and only in case whereby the sub-id had not been already provided by any other more specific means (RADIUS, LUDB). This means that if the sub-id is supplied by other means (RADIUS, LUDB), then the sub-id name will not be auto-generated.

The format of the sub-id name can be either a random 10 characters encoded string or a user-friendly string based on the subscriber identification fields. Note that the maximum length of the sub-id name is 32 characters.

The sub-id name will not be passed in the Access-Request to the RADIUS server since it is generated after the authentication phase.

The sub-id name can be auto-generated regardless of how the sla/sub-profile strings are obtained (RADIUS, LUDB or static).

The subscriber identification fields used in auto-generation of the sub-id name are enabled on the global level.

CLI Syntax: `configure`
`subscriber-mgmt`
`auto-sub-id-key`
`ppp-sub-id-key [mac] [sap-id] [circuit-id] [remote-id] [session-id]`
`ipoe-sub-id-key [mac] [sap-id] [circuit-id] [remote-id]`

If no sub-id-key per host type is configured, then the defaults are:

PPPoE host type: <mac, sap-id, session-id>

IPoE host type : <mac, sap-id>.

The order in which the fields are configured is important because the sub-id name will potentially become a concatenated string of the subscriber host identifiers in the order in which they are provisioned. Note that the sub-id cannot be longer than 32 characters.

- In case that the length of the concatenated fields for the sub-id name is larger than 32 characters, the host creation will fail.
- In case that the circuit-id/remote-id is in the key and they contain non-printable characters, their place in sub-id name will be formatted in hex instead of ASCII. ASCII printable characters contain byte values 0x20..0x7E. All other values are ASCII non-printable and thus are formatted in hex characters.

The following would generate a sub-id name: xx:xx:xx:xx:xx:xx|1/1/3:23|44. The length of such sub-id name would be 29B.

- mac: xx:xx:xx:xx:xx:xx
- sap: 1/1/3:23
- session-id: 44 (16bits length)

In case that the key contains the circuit-id as: 0x610163 (3 bytes), then the sub-id name will be formatted as ‘610161’ (hex) since ‘01’ hex is non printable in ASCII. In this case the sub-id name will be of length 6B.

However, if the circuit-id is 0x616263 (3 bytes), then the string will be formatted as ASCII string ‘abc’ (3 characters). The sub-id name is 3B long.

The assignment of the sub-id to dynamic hosts is as follows:

- From RADIUS (sub-ident-policy including use-direct-map-as-default)
- From LUDB (sub-ident-policy including use-direct-map-as-default)

- Configured (explicit) defaults:
  - → use-sap-id: sap-id
  - → auto-id: combination of sub-id identifiers specified in auto-sub-id-key. The sub-id name will be in a human friendly format, i.e. concatenation of the fields in the pppoe|ipoe-sub-id-key command separated by a "|" character.
  - → string: custom string
- Non-configured (implicit) defaults:

PPPoE host types: random 10 character string based on fields defined in the

- → **ppp-sub-id-key** command. If no such fields are explicitly defined, the default ones will be assumed: <mac, sap-id, session-id>.
- → IPoE host types: random 10 character string based on the **ipoe-sub-id-key** command. If no such fields are explicitly defined, the defaults will be assumed: <mac, sap-id >.

The way in which the default sub-id is generated is configured under the SAP level in the following manner:

CLI Syntax:
```
configure
service ies/vprn
   subscriber-interface <sub-if-name>
        group-interface <grp-if-name>
           sap <sap-id>
              sub-sla-mgmt
                 def-sub-id use-sap-id|use-auto-id|string
```

Under the msap-policy:

CLI Syntax:
```
configure
subscriber-mgmt
   msap-policy <name> (msap-policy referenced in msap-de-
      faults under the capture sap)
      sub-sla-mgmt
         def-sub-id <use-sap-id|use-auto-id|string <sub-
         id>
```

The **use-auto-id** keyword parameter of the def-sub-id string consists of concatenated auto-sub-id-keys separated by a '|' character. In the absence of the **use-auto-id** keyword, the sub-id name will be a random 10 characters encoded string based on the ipoe|ppp-sub-id-keys. This random encoded 10 character string is unique per chassis as well as in dual-homed environment.

This command will have no effect if it is configured directly under the capture SAPs in VPLS (in the **config>service>vpls>sap>sub-sla-mgmt** context). Managed SAPs in ESM are instantiated by a capture SAP and the msap-policy in this case is mandatory. An auto-id keyword in case of managed SAP will be looked only under the msap-policy.

Static subscribers are required to have the sub-id manually configured.

Sub-id Identifiers

The sub-id can be based on any combination of the following identifiers:

- The sap-id, in combination with any other allowable identifier, will be used as the search key. This assumes a 1:1 (subscriber per SAP) deployment model.
- The circuit-id, in combination with any other allowable identifier, will be used to identify subscribers. This can be used in 1:1 deployment model, or in service per SAP deployment model. Circuit-id is applicable to IPoE v4 type hosts (option 82), to IPoE v6 type hosts (option 18 – interface-id) and PPPoE hosts (remote agent option signaled by PPPoE tags). The format of circuit-id is identical for IPv4 and IPv6 hosts.
- The remote-id, in combination with any other allowable identifier, will be used to identify subscribers. This can be used in 1:1 deployment model, or in service per SAP deployment model. The remote-id is applicable to IPoE v4 type hosts (option 82), to IPoE v6 type hosts (option 37) and PPPoE hosts (remote agent option signaled via PPPoE tags).
- The mac address (in combination with any other allowable identifier will be used to identify subscribers. This assumes a 1:1 deployment model.
- The PPPoE session id, in combination with any other allowable identifier, is applicable only to PPPoE hosts. The session-id used will be of the first host that is instantiated for the subscriber.

Dual Stack Hosts

Autogeneration of sub-id names for subscribers with a single dual stack hosts (IPoE and PPPoE) is enabled by default by not explicitly provisioning anything for the def-sub-id. The sub-id name would be semi-randomly generated based on the <mac, sap-id, session-id> for PPPoE hosts and the <mac, sap-id> combination for IPoE host.

Mixing Hosts with Auto-Generated IDs and non Auto-Generated IDs

Hosts with different sub-id names but identical auto-sub-id keys are not linked into the same subscriber. Such scenarios can arise with hosts with the same auto-sub-id keys but different methods for obtaining the sub-id name. For example, one host relying on auto-generated sub-id name while the other is using explicit configuration methods (sap-id, string, RADIUS or LUDB). If the auto-generated sub-id name and explicit sub-id name are the same, the host will be tied into the same subscriber.

For example:

The default auto-sub-id for the following two hosts are <mac, sap-id>.

Host X on SAP 1/1/1:1 with MAC 00:00:00:00:00:01 obtains sub-id through RADIUS.

Host Y on SAP 1/1/1:1 with MAC 00:00:00:00:00:01 has sub-id auto-generated.

Regardless of which host comes up first, those two hosts at the end will belong two different subscribers as long as their sub-ids are different.

PPPoA/PPPoEoA Considerations

PPPoA/PPPoEoA hosts will adhere to the same rules as PPPoE. Fields that are supported in PPPoE but not PPPoA/PPPoEoA will be simply ignored.

Fields that are not supported in PPPoA are:

- Remote-id
- Circuit-id
- MAC address

Fields that are most likely not applicable to PPPoEoA are:

- Remote-id
- Circuit-id

Deployment Considerations

The following is a possible deployment example scenario.

CLI Syntax:
```
configure
    subscriber-mgmt
        auto-sub-id-key
            ppp-sub-id-key sap-id
            ipoe-sub-id-key mac circuit-id
```

CLI Syntax:
```
configure
    service vprn 10
        subscriber-interface <sub-if-name>
        authentication-policy <auth-pol-name>
        group-interface <grp-if-name>
            sap 1
                sub-sla-mgmt
                    def-sub-id use-sap-id
                    sub-ident-policy <ident-pol-name>
            sap 2
                sub-sla-mgmt
```

```
            def-sub-id auto-id
            sub-ident-policy <ident-pol-name>
      sap 3
         sub-sla-mgmt
            def-sub-id "sub3"
            sub-ident-policy <ident-pol-name>
      sap 4
         sub-sla-mgmt
               sub-ident-policy <ident-pol-name>
```

Assume the following cases:

1. RADIUS returns the sub-id on all four SAPs.
2. RADIUS does not return the sub-id string on any of the SAPs.

In the first case where RADIUS returns the sub-id string, the following will occur:

- On all 4 SAPs the sub-id string will be assigned by the RADIUS server. Defaults have no effect, and neither do identifiers specified under the auto-sub-id-key node.

In the second case, the effects are the following:

- On SAP1 the sub-id name will be the <sap-id> (1/1/1:3)
- On SAP 2 the sub-id name will be <sap-id> for PPPoE hosts and <mac>-<circuit-id> concatenation for IPoE type hosts.

Example:

1/1/1:100 for PPPoE

AC:AB:AA:AD:AE:AE-AN-id eth 1/1/1/1:2 for IPoE

(circuit-ID format is: Access-Node-Identifier atm slot/port:vpi.vci or Access-Node-Identifier eth slot/port:[vlan-id]).

Note that the circuit-ID can itself be 63B in length whereas the length of the sub-id name is limited to 32 Bytes. So in the above case, the sub-id name length would be 38 Bytes (>32B) and the host instantiation would fail.

- On SAP3 the sub-id name will be the literal ‘sub3’ for PPPoE and IPoE hosts.
- On SAP4 the sub-id name will be a semi-random value based on <sap-id> for PPPoE hosts and the <mac, circuit-id> combination for IPoE hosts.

Caveats

Only a single combination of the subscriber fields used to auto generate sub-id is allowed per host type (IPoE or PPPoE) and per chassis. In case that the combination of the fields needs to be changed, the existing subscribers with an auto-generated sub-id must be manually terminated. Considering that remote termination of the IPoE subscribers by DHCP server is not supported by all DHCP client vendors through FORCERENEW DHCP message (RFC 3203), changing the subscriber fields while subscribers with auto generated sub-id are active should be avoided.

Limiting Subscribers and Hosts on a SAP

A number of configuration parameters are available to control the maximum amount of subscribers and/or hosts that can be simultaneously active on a SAP:

- multi-sub-sap — Limits the number of subscribers (dynamic + static) on a SAP
- lease-populate — Limits the number of dynamic hosts on a SAP
- host-limit — Limits the number of hosts (dynamic + static) per SLA profile instance.

If any of these limits are reached, a new host will be denied access and the DHCP ACK will be dropped. The only exception is when **host-limit** command is configured with the keyword **remove-oldest** specified, then the oldest active host is dropped and the new host is granted access. The dynamic host with the least remaining lease time will be considered the oldest host.

Static Subscriber Hosts

While it is typically preferred to have all hosts provisioned dynamically through DHCP snooping, it may be needed to provide static access for specific hosts (those that do not support DHCP).

Since a subscriber identification policy is not applicable to static subscriber hosts, the subscriber identification string, subscriber profile and SLA profile must be explicitly defined with the host's IP address and MAC address (if Enhanced Subscriber Management is enabled).

If an SLA profile instance associated with the named SLA profile already exists on the SAP for the subscriber, the static subscriber host is placed into that SLA profile instance. If an SLA profile instance does not yet exist, one will be created if possible. If the SLA profile cannot be created, or the host cannot be placed in the existing SLA profile instance (the **host-limit** was exceeded), the static host definition will fail.

QoS for Subscribers and Hosts

QoS Parameters in Different Profiles

QoS aspects for subscribers and hosts can be defined statically on a SAP or dynamically using

Enhanced Subscriber Management. For example, in a VLAN-per-service model, different services belonging to a single subscriber are split over different SAPs, and thus the overall QoS (such as a scheduler policy) of this subscriber must be assigned using Enhanced Subscriber Management.

QoS parameters are shared among the subscriber profile and SLA profile as follows:

- The subscriber profile refers to HQoS ingress and egress scheduler policies which define the overall treatment for hosts of this subscriber when queues are used. If the subscriber is using policers, the subscriber profile also refers to CFHP ingress and egress policer-control-policies which define the overall treatment for hosts of this subscriber.
- The SLA profile refers to specific queue/policer settings for each host (BTV, VoIP, PC) using SAP ingress and SAP egress QoS policies. The SLA profile can also refer to an egress HQoS scheduler policy which defines the scheduling from the queues of the related host.

The primary use of the subscriber profile is to define the ingress and egress scheduler policies/ policer-control-policies used to govern the aggregate SLA for all hosts associated with a subscriber. To be effective, the queues/policers defined in the SLA profile's QoS policies will reference a scheduler/arbiter from the scheduler policy/policer-control-policy respectively as their parent.

QoS Policy Overrides

Generic QoS queue/policer parameters could be specified for the SAP in a QoS policy and overridden for some customers by queue/policer parameters defined in the SLA profile. This allows for a single SAP ingress and SAP egress QoS policy to be used for many subscribers, while providing individual subscriber parameters for queue/policer operation.

ESM Subscriber Hierarchical Traffic Control

ESM subscribers can make use of both queues and/or policers for both the ingress and egress traffic. The queue and policers are configured within SAP ingress/egress policies applied to the SLA profile. The queue can parent to different levels/cir-levels with different weights/cir weights of a virtual scheduler configured within a scheduler policy, and to an egress port scheduler configured in a port scheduler policy, to achieve hierarchical traffic control. The policers can parent to different levels with different weights of an arbiter configured within a policer control policies to achieve hierarchical traffic control.

Subscriber HQoS

Hierarchical QoS (HQoS) corresponds to scheduling bandwidth distribution to queues/schedulers and is applied using scheduler policies at ingress and egress of the subscriber profile for a subscriber, and at egress in the SLA profile for a host, together with a port scheduler at both the port and vport level.

Each scheduler policy can contain up to three tiers of schedulers with lower level schedulers being able to parent to higher level schedulers in the same scheduler policy.

Queues can parent to any scheduler in their related scheduler policy hierarchy (except vport at egress) and also at the egress to a port scheduler.

Schedulers can parent to any higher level scheduler in their related scheduler policy hierarchy and, at the egress to a port scheduler configured within the port or vport. When an egress port scheduler is used, an aggregate rate limit can be applied at the subscriber profile and vport levels instead of using a scheduler. To extend the hierarchy further at egress, a tier 1 scheduler within a scheduler policy can parent to any scheduler in a scheduler policy at a higher level.

The scheduling levels are comprised of:

- Ingress and egress queues
- Egress SLA-profile schedulers
- Ingress and egress subscriber profile schedulers
- Egress vport schedulers
- Port schedulers

The ingress hierarchical parenting relationship options are shown in Figure 67.

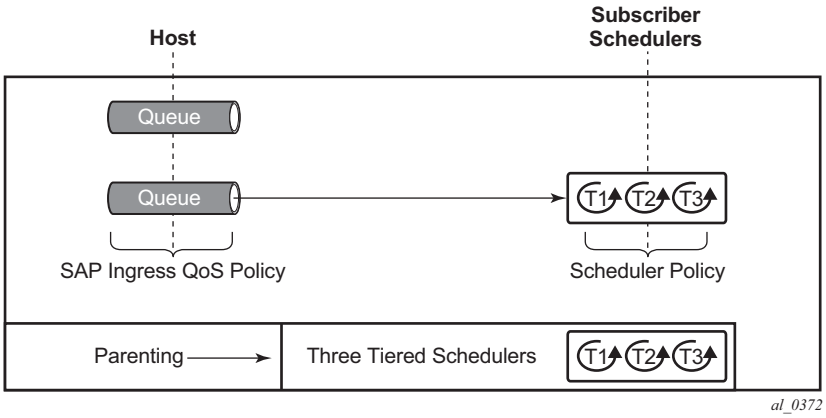


Figure 67: Ingress Scheduling Hierarchy Options

The egress hierarchical parenting relationship options are shown in Figure 68. Note that not all combinations can be configured concurrently, and some uses of port parent could be equally achieved using a scheduler parent and a child parent-location.

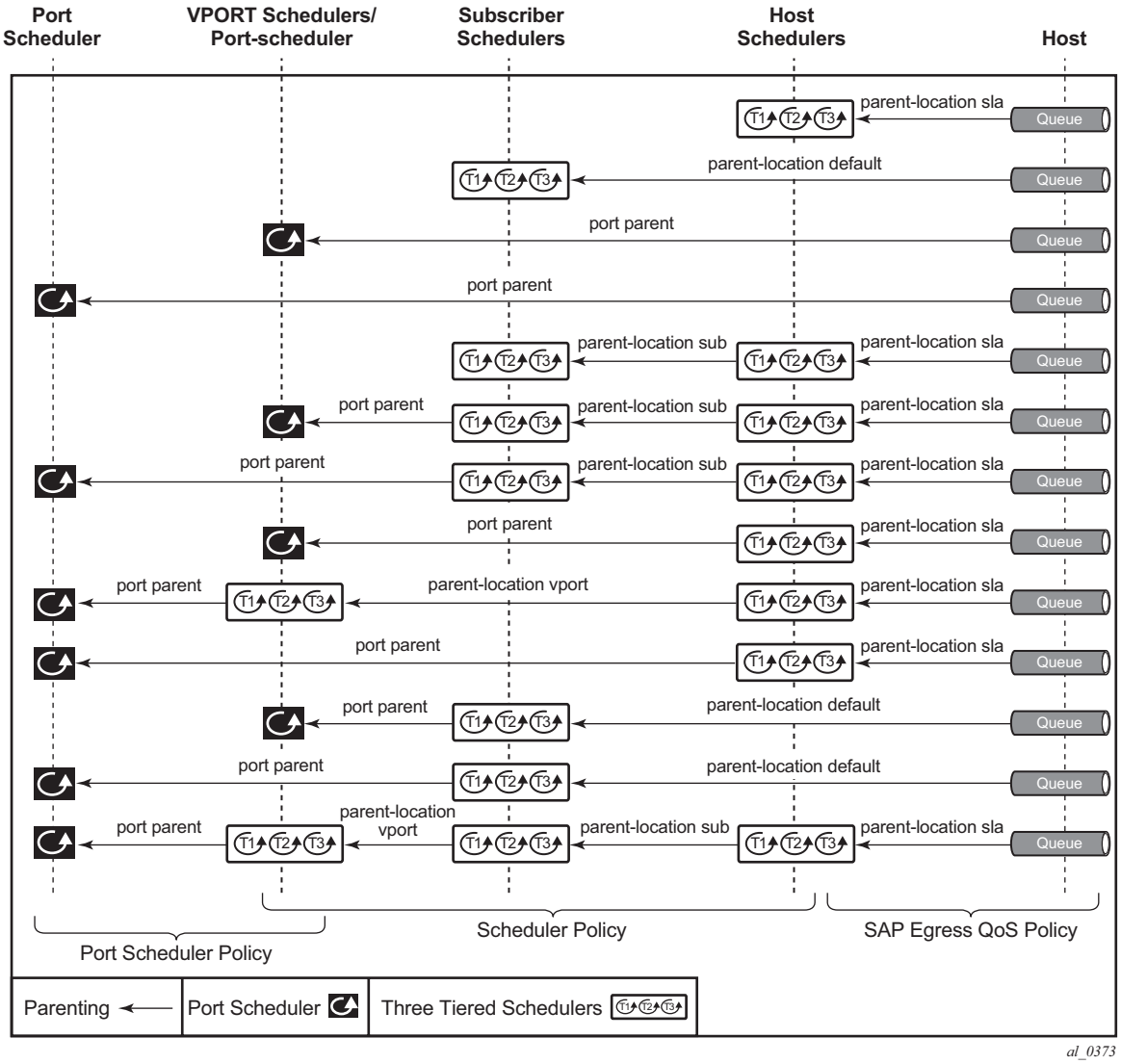


Figure 68: Egress Scheduling Hierarchy Options

The **parent** command is used to specify the name of the parent scheduler when parenting a queue or scheduler, together with the level/cir-level and weight/cir-weight at which to connect.

```
config>qos>sap-ingress>queue# parent
  - parent scheduler-name [weight weight] [level level]
                          [cir-weight cir-weight] [cir-level cir-level]

config>qos>sap-egress>queue# parent
- parent scheduler-name [weight weight] [level level]
                          [cir-weight cir-weight] [cir-level cir-level]
```

```
config>qos>scheduler-policy>tier>scheduler# parent
- parent scheduler-name [weight weight] [level level]
                        [cir-weight cir-weight] [cir-level cir-level]
```

The location of the parent scheduler (in which applied scheduler policy it exists) for a queue defaults to a scheduler in the subscriber ingress or egress scheduler policy. Parents of schedulers themselves must be explicitly configured and by default must be within the same scheduler policy.

At egress, the scheduler parenting relationship is determined using the parent-location command:

- By default, egress queues parent to any scheduler in subscriber egress scheduler policy.

  ```
  config>qos>sap-egress# parent-location default
  ```

- Egress queues can parent to any scheduler within the scheduler policy applied to the egress of an SLA profile.

  ```
  config>qos>sap-egress# parent-location sla
  ```

- By default, a tier 1 scheduler in the scheduler policy is not allowed to be parented to another scheduler.

  ```
  config>qos>scheduler-policy>tier# parent-location none
  ```

- A tier 1 scheduler in the scheduler policy applied to the egress of an SLA profile can parent to a scheduler applied to the egress of a subscriber profile.

  ```
  config>qos>scheduler-policy>tier# parent-location sub
  ```

- A tier 1 scheduler in the scheduler policy applied to the egress of a subscriber profile can parent to a scheduler applied to the egress of a Vport.

  ```
  config>qos>scheduler-policy>tier# parent-location vport
  ```

The configuration of a **parent-location** and frame-based accounting in a scheduler policy is mutually exclusive in order to ensure consistency between the different scheduling levels.

Note that the parent-location command is supported only on Ethernet interfaces on FP2 and higher hardware. It is not supported for ESM over MPLS pseudowires.

Both egress queues and egress schedulers can port parent using directly to different levels/cir-levels, with different weights/cir weights, to a port egress port scheduler. Egress schedulers can also port parent directly to different levels/cir-levels, with different weights/cir weights, to a vport egress port scheduler.

Subscriber CFHP

Class Fair Hierarchical Policing (CFHP) corresponds to the policing control of traffic by policers/arbiters. This uses policer control policies and can be applied for ingress and egress capacity control for the subscriber in the subscriber profile.

Each policer control policy can contain up to three tiers of arbiters with lower level arbiters being able to parent to higher level abiters in the same scheduler policy.

Policers can parent to any arbiter in their related policer control policy hierarchy.

The policing levels are comprised of:

- Ingress and egress policers
- Ingress and egress subscriber arbiters

Note that ingress policed traffic uses the shared policer-output-queues to access the switch fabric. At egress, the policed traffic accesses the egress port through a queue group queue (by default the policer-output-queues queue group, though user configurable queue groups can also be used) or a locally configured subscriber queue.

The ingress hierarchical parenting relationship options are shown in Figure 69.

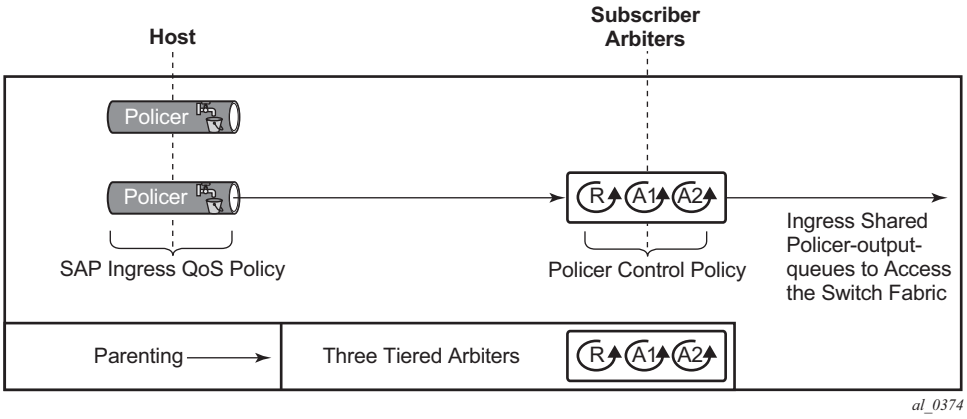


Figure 69: Ingress Policing Hierarchy Options

The egress hierarchical parenting relationship options are shown in Figure 70.

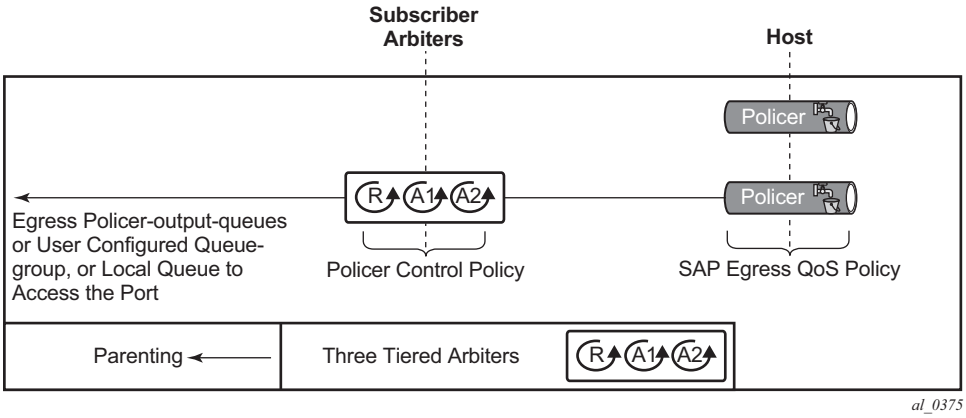


Figure 70: Egress Policing Hierarchy Options

The **parent** command is used to specify the name of the parent arbiter when parenting a policer or arbiter, together with the level and weight at which to connect.

```
config>qos>sap-ingress>policer$ parent
  - parent arbiter-name [weight weight-level] [level level]

config>qos>sap-egress>policer$ parent
- parent arbiter-name [weight weight-level] [level level]

config>qos>plcr-ctrl-plcy>tier>arbiter# parent
- parent arbiter-name [weight weight-level] [level level]
```

ATM/Ethernet Last-Mile Aware QoS for Broadband Network Gateway

This feature allows the user to perform hierarchical scheduling of subscriber host packets such that the packet encapsulation overhead and ATM bandwidth expansion (when applicable) due to the last mile for each type of broadband session, that is, PPPoEoA LLC/SNAP and VC-Mux, IPoE, IPoEoA LLC/SNAP and VC-Mux, etc., is accounted for by the 7x50 acting as the Broadband Network Gateway (BNG).

The intent is that the BNG distributes bandwidth among the subscriber host sessions fairly by accounting for the encapsulation overhead and bandwidth expansion of the last mile such that packets are less likely to be dropped downstream in the DSLAM DSL port.

The last mile encapsulation type can be configured by the user or signaled using the Access-loop-encapsulation sub-TLV in the Vendor-Specific PPPoE Tags or DHCP Relay Options as per RFC 4679.

Furthermore, this feature allows the BNG to shape the aggregate rate of each subscriber and the aggregate rate of all subscribers destined to a given DSLAM to prevent congestion of the DSLAM. The subscriber aggregate rate is adjusted for the last mile overhead. The shaping to the aggregate rate of all subscribers of a given destination DSLAM is achieved via a new scheduling object, referred to as Virtual Port or vport in CLI, which represents the DSLAM aggregation node in the BNG scheduling hierarchy

Broadband Network Gateway Application

An application of this feature in a BNG is shown in Figure 71.

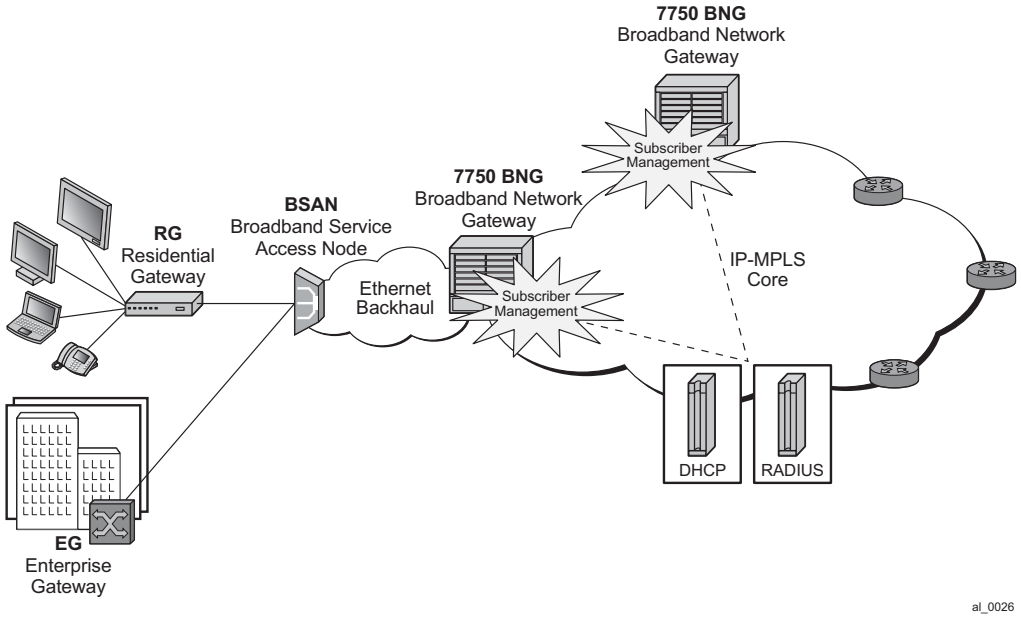


Figure 71: BNG Application

Residential and business subscribers use PPPoEoA, PPoA, IPoA, or IPoEoA based session over ATM/DSL lines. Each subscriber host can use a different type of session. Although Figure 1 illustrates ATM/DSL as the subscriber last mile, this feature supports both ATM and Ethernet in the last mile.

A subscriber SAP is auto-configured via DHCP or RADIUS authentication process, or is statically configured, and uses a Q-in-Q SAP with the inner C-VLAN identifying the subscriber while the outer S-VLAN identifies the Broadband Service Access Node (BSAN) which services the subscriber, i.e., the DSLAM. The SAP configuration is triggered by the first successfully validated subscriber host requesting a session. Within each subscriber SAP, there can be one or more hosts using any of the above session types. The subscriber SAP terminates on an IES or VPRN service on the BNG. It can also terminate on a VPLS instance.

When the 7750 BNG forwards IP packets from the IP-MPLS core network downstream towards the Residential Gateway (RG) or the Enterprise Gateway (EG), it adds the required PPP and Ethernet headers, including the SAP encapsulation with C-VLAN/S-VLAN. When the BSAN node receives the packet, it strips the S-VLAN tag, strips or overwrites the C-VLAN tag, and adds padding to minimum Ethernet size if required. It also adds the LLC/SNAP or VC-mux headers plus the fixed AAL5 trailer and variable AAL5 padding (to next multiple of 48 bytes) and then segments the resulting PDU into ATM cells when the last mile is ATM/DSL. Thus the packet size will undergo a fixed offset due to the encapsulation change and a variable expansion due to the AAL5 padding when applicable. Each type of subscriber host session will require a different amount of fixed offset and may require a per packet variable expansion depending of the encapsulation used by the session. The BNG node learns the encapsulation type of each subscriber host session by inspecting the Access-loop-encapsulation sub-TLV in the Vendor-Specific PPPoE Tags as specified in RFC 4679. The BNG node must account for this overhead when shaping packets destined to subscriber.

Queue Determination and Scheduling

Figure 72 illustrates the queuing and scheduling model for a BNG using the Ethernet/ATM last-mile aware QoS feature.

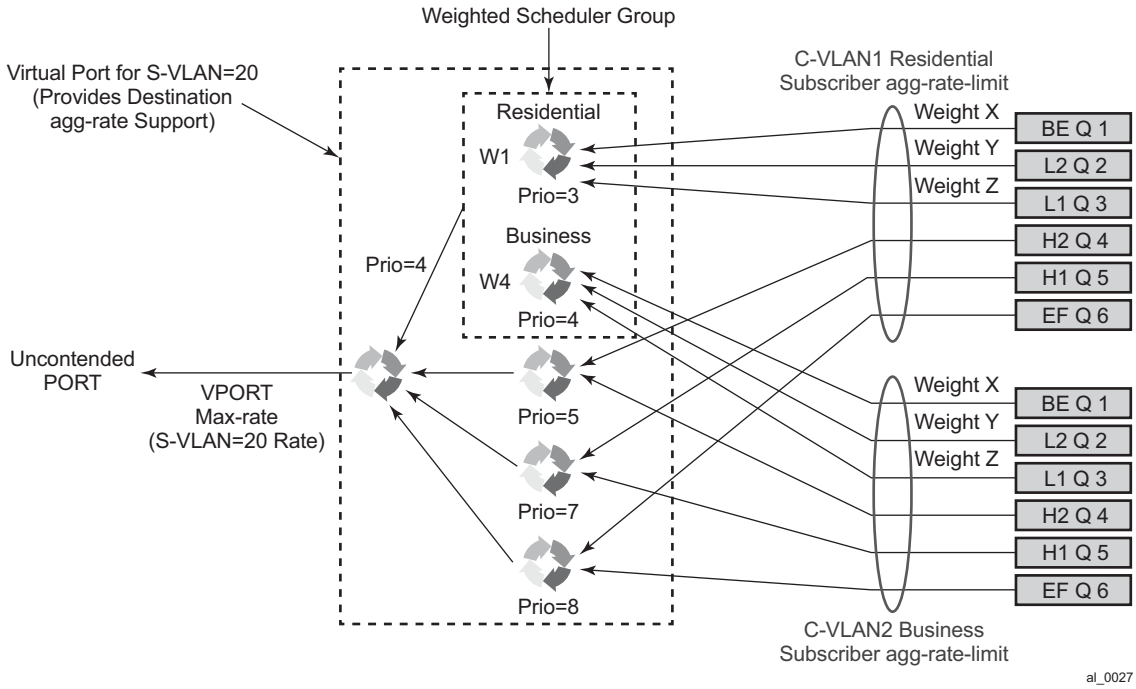


Figure 72: BNG Queuing and Scheduling Model

CLI Syntax: A set of per FC queues are applied to each subscriber host context to enforce the packet rate within each FC in the host session as specified in the subscriber's host SLA profile. A packet is stored in the queue corresponding the packet's FC as per the mapping of forwarding class to queue-id defined in the sap-egress QoS policy used by the host SLA profile. In the BNG application however, the host per FC queue packet rate is overridden by the rate provided in the RADIUS access-accept message. This rate represents the ATM rate that will be seen on the last mile, that is, it includes the encapsulation offset and the per packet expansion due to ATM segmentation into cells at the BSAN.

In order to enforce the aggregate rate of each destination BSAN, a scheduling node, referred to as virtual port, and vport is in the CLI. The vport operates exactly like a port scheduler with the difference that multiple vport objects can be configured on the egress context of an Ethernet port. The user adds a vport to an Ethernet port using the following command:

CLI Syntax: configure>port>ethernet>access>egress>vport *vport-name* **create**

The vport is always configured at the port level even when a port is a member of a LAG. The vport name is local to the port it is applied to but must be the same for all member ports of a LAG. It however does not need to be unique globally on a chassis.

CLI Syntax: configure>port>ethernet>access>egress>vport *vport-name* **create**

The vport is always configured at the port level even when a port is a member of a LAG. The vport name is local to the port it is applied to but must be the same for all member ports of a LAG. It however does not need to be unique globally on a chassis.

The user applies a port scheduler policy to a vport using the following command:

CLI Syntax: configure>port>ethernet>acess>egress>vport>port-scheduler-policy *port-scheduler-policy-name*

A vport cannot be parented to the port scheduler when it is using a port scheduler policy itself. It is thus important the user ensures that the sum of the **max-rate** parameter value in the port scheduler policies of all vport instances on a given egress Ethernet port does not oversubscribe the port's hardware rate. If it does, the scheduling behavior degenerates to that of the H/W scheduler on that port. A vport which uses an agg-rate can be parented to a port scheduler. This is explained in Applying Aggregate Rate Limit to a Vport on page 1043. Note that the application of the agg-rate rate, port-scheduler-policy and scheduler-policy commands under a vport are mutually exclusive.

Each subscriber host queue is port parented to the vport which corresponds to the destination BSAN using the existing port-parent command:

CLI Syntax: configure>qos>sap-egress>queue>port-parent [**weight** *weight*] [**level** *level*] [**cir-weight** *cir-weight*] [**cir-level** *cir-level*]

This command can parent the queue to either a port or to a vport. These operations are mutually exclusive in CLI as explained above. When parenting to a vport, the parent vport for a subscriber host queue is not explicitly indicated in the above command. It is determined indirectly. The determination of the parent vport for a given subscriber host queue is described in Vport Determination and Evaluation on page 1043.

Furthermore, the weight (cir-weight) of a queue is normalized to the sum of the weights (cir-weights) of all active subscriber host queues port-parented at the same priority level of the vport or the port scheduler policy. Since packets of ESM subscriber host queues are sprayed among the link of a LAG port based on the subscriber-id, it is required that all subscribers host queues mapping to the same vport, such as having the same destination BSAN, be on the same LAG link so that the aggregate rate towards the BSAN is enforced. The only way of achieving this is to operate the LAG port in active/standby mode with a single active link and a single standby link.

The aggregate rate of each subscriber must also be enforced. The user achieves this by applying the existing agg-rate-limit command to the egress context of the subscriber profile:

CLI Syntax: configure>subscriber-mgmt>sub-profile>egress>agg-rate-limit *agg-rate*

In the BNG application however, this rate is overridden by the rate provided in the RADIUS access-accept message. This rate represents the ATM rate that will be seen on the last mile, that is, it includes the encapsulation offset and the per packet expansion due to ATM segmentation into cells at the BSAN.

Weighted Scheduler Group

The existing port scheduler policy defines a set of eight priority levels with no ability of grouping levels within a single priority. In order to allow for the application of a scheduling weight to groups of subscriber host queues competing at the same priority level of the port scheduler policy applied to the vport, or to the Ethernet port, a new group object is defined under the port scheduler policy:

CLI Syntax: configure>qos>port-scheduler-policy>group group-name rate pir-rate [**cir** *cir-rate*]

Up to eight groups can be defined within each port scheduler policy. One or more levels can map to the same group. A group has a rate and optionally a cir-rate and inherits the highest scheduling priority of its member levels. For example, the scheduler group shown in the vport consists of level priority 3 and level priority 4. It thus inherits priority 4 when competing for bandwidth with the standalone priority levels 8, 7, and 5.

In essence, a group receives bandwidth from the port or from the vport and distributes it within the member levels of the group according to the weight of each level within the group. Each priority level will compete for bandwidth within the group based on its weight under congestion situation. If there is no congestion, a priority level can achieve up to its rate (cir-rate) worth of bandwidth.

The mapping of a level to a group is performed as follows:

CLI Syntax: configure>qos>port-scheduler-policy>level priority-level rate pir-rate [**cir** *cir-rate*] **group** *group-name* [**weight** *weight-in-group*]

Note that CLI will enforce that mapping of levels to a group are contiguous. In other words, a user would not be able to add priority level to group unless the resulting set of priority levels is contiguous.

When a level is not explicitly mapped to any group, it maps directly to the root of the port scheduler at its own priority like in existing behavior.

Queue and Subscriber Aggregate Rate Configuration and Adjustment

Software-Based Implementation (8.0R4)

The subscriber aggregate rate is adjusted and it will be based on an average frame size.

The user enables the use of this adjustment method by configuring the following option in the egress context of the subscriber profile:

CLI Syntax: configure>subscriber-management>sub-profile>egress>encap-offset [type *type***]**

This command allows the user to configure a default value to be used by all hosts of the subscriber in the absence of a valid signaled value. The following is a list of the configurable values:

Values pppoa-llc, pppoa-null, pppoeoa-llc, pppoeoa-llc-fcs, pppoeoa-llc-tagged, pppoeoa-llc-tagged-fcs, pppoeoa-null, pppoeoa-null-fcs, pppoeoa-null-tagged, pppoeoa-null-tagged-fcs
ipoa-llc, ipoa-null, ipoeoa-llc, ipoeoa-llc-fcs, ipoeoa-llc-tagged, ipoeoa-llc-tagged-fcs, ipoeoa-null, ipoeoa-null-fcs, ipoeoa-null-tagged, ipoeoa-null-tagged-fcs,
pppoe, pppoe-tagged,
ipoe, ipoe-tagged

Otherwise, the fixed packet offset will be derived from the encapsulation type value signaled in the Access-loop-encapsulation sub-TLV in the Vendor-Specific PPPoE Tags as explained in Section Signaling of Last Mile Encapsulation Type. Only signaling using PPPoE Tags is supported in the software based implementation. The last signaled valid value is then applied to all active hosts of this subscriber. If no value is signaled in the subscriber host session or the value in the fields of the Access-loop-encapsulation sub-TLV are invalid, then the offset applied to the aggregate rate of this subscriber will use the last valid value signaled by a host of this subscriber if it exists, or the user entered default type value if configured, or no offset is applied.

The user also configures the average frame size value to be used for this adjustment:

CLI Syntax: configure>subscriber-management>sub-profile>egress>avg-frame-size *bytes*

The value entered by the user must include the FCS but not the Inter-Frame Gap (IFG) or the preamble. If the user does not explicitly configure a value for the **avg-frame-size** parameter, then it will also be assumed the offset is zero regardless of the signaled or user-configured value.

The computation of the subscriber aggregate rate consists of taking the average frame size, adding the encapsulation fixed offset including the AAL5 trailer, and then adding the variable offset consisting of the AAL5 padding to next multiple of 48 bytes. The AverageFrameExpansionRatio is then derived as follows:

AverageFrameExpansionRatio = (53/48 x (AverageFrameSize + FixedEncapOffset + AAL5Padding)) / (AverageFrameSize + IFG + Preamble).

When the last mile is Ethernet, the formula simplifies to:

AverageFrameExpansionRatio = (AverageFrameSize + FixedEncapOffset + IFG + Preamble) / (AverageFrameSize + IFG + Preamble).

The following are the frame size and rate applied to the subscriber queue and scheduler:

Subscriber Host Queue (no change):

Size = ImmediateEgressEncap + Data

Rate = ImmediateEgressEncap + Data

Subscriber Aggregate Rate Scheduler:

Size = ImmediateEgressEncap + Data

Rate = sub-agg-rate / AverageFrameExpansionRatio

Note that the CPM applies the AverageFrameExpansionRatio adjustment to the various components used in the determination of the net subscriber operational aggregate rate. It then pushes these adjusted components to IOM which then makes the calculation of the net subscriber operational aggregate rate.

The formula used by the IOM for this determination is:

sub-oper-agg-rate = min(sub-policy-agg-rate/*AverageFrameExpansionRatio*, ancp_rate/*AverageFrameExpansionRatio*) + (igmp_rate_delta/*AverageFrameExpansionRatio*),

where *sub-policy-agg-rate* is either the value configured in the **agg-rate-limit** parameter in the subscriber profile or the resulting RADIUS override value. In both cases, the CPM uses an internal override to download the adjusted value to IOM.

The value of *sub-oper-agg-rate* is stored in the IOM's subscriber table.

The following are the procedures for handling signaling changes or configuration changes affecting the subscriber profile:

1. If a new RADIUS update comes in for the aggregate subscriber rate, then a new subscriber aggregate ATM adjusted rate is computed by CPM using the last configured **avg-frame-size** and then programmed to IOM.
2. If the user changes the value of the **avg-frame-size** parameter, enables/disables the **encap-offset** option, or changes the parameter value of the **encap-offset** option, the CPM will immediately trigger a re-evaluation of subscribers using the corresponding subscriber profile and an update the IOM with the new subscriber aggregate rate.
3. If the user changes the value of the **agg-rate-limit** parameter in a subscriber profile which has the **avg-frame-size** configured, this will immediately trigger a re-evaluation of subscribers using the corresponding subscriber profile. An update to the subscriber aggregate rate is performed for those subscribers which rate has not been previously overridden by RADIUS.
4. If the user changes the **type** value of the encap-offset command, this will immediately trigger a re-evaluation of subscribers using the corresponding subscriber profile. An update to the subscriber aggregate rate is performed for those subscribers which are currently using the default value.

5. If two hosts of the same subscriber signal two different encapsulation types, the last one signaled gets used at the next opportunity to re-evaluate the subscriber profile.
6. If a subscriber has a DHCP host, a static host or an ARP host, the subscriber aggregate rate will continue to use the user-configured default encapsulation type value or the last valid encapsulation value signaled in the PPPoE tags by other hosts of the same subscriber. If none was signaled or configured, then no rate adjustment is applied.

Hardware-Based Implementation

The data path will compute the adjusted frame size real-time for each serviced packet from a queue by adding the actual packet size to the fixed offset provided by CPM for this queue and variable AAL5 padding.

Like in the software based implementation, the user enables the use of the fixed offset and per packet variable expansion by configuring the following option in the egress context of the subscriber profile:

CLI Syntax: configure>subscriber-management>sub-profile>egress>encap-offset [**type** *type*]

When this command is enabled, the fixed packet offset will be derived from the encapsulation type value signaled in the Access-loop-encapsulation sub-TLV in the Vendor-Specific PPPoE Tags or DHCP Relay Options as explained in Section Signaling of Last Mile Encapsulation Type.

If the user specifies an encapsulation type with the command, this value will be used as the default value for all hosts of this subscriber until a host session signaled a valid value. The signaled value is applied to this host only and the remaining hosts of this subscriber continue to use the user entered default type value if configured, or no offset is applied. Note however that hosts of the same subscriber using the same SLA profile and which are on the same SAP will share the same instance of FC queues. In this case, the last valid encapsulation value signaled by a host of that same instance of the SAP egress QoS policy will override any previous signaled or configured value.

The procedures for handling signaling changes or configuration changes affecting the subscriber profile are the same as in the Software based implementation with except for the following:

1. The **avg-frame-size** parameter in the subscriber profile is ignored.
2. If the user specifies an encapsulation type with the command, this value will be used as the default value for all hosts of this subscriber until a host session signaled a valid value. The signaled value is applied to this host and other hosts of the same subscriber sharing the same SLA profile and which are on the same SAP. The remaining hosts of this subscriber continue to use the user entered default type value if configured, or no offset is applied.
3. If the user enables/disables the **encap-offset** option, or changes the parameter value of the **encap-offset** option, the CPM will immediately trigger a re-evaluation of subscribers hosts using the corresponding subscriber profile and an update the IOM with the new fixed offset value.
4. If subscriber host session signals an encapsulation type at the session establishment time and subsequently sends a DHCP renewal message using a Layer 2 DHCP relay which does not insert option82 in a unicast message, the encapsulation type for this host will not change. Note that TR-101 states that option82 is mandatory for DHCP broadcast messages).
5. If a subscriber has a static host or an ARP host, the subscriber host will continue to use the user-configured default encapsulation type value or the last valid encapsulation value signaled in the PPPoE tags or DHCP relay options by other hosts of the same subscriber which

use the same SLA profile instance. If none was signaled or configured, then no rate adjustment is applied.

6. The encapsulation type value signaled in DHCP relay options or PPPoE tags are not cross-checked against the host type. So, a host signaling PPPoA/LLC encapsulation type via DHCP relay options will be handled as if the packet included a PPPoE header when forwarded over the local Ethernet port. This results in applying an encap-offset in the data path which assumes the PPPoE header is added to forwarded packets over the local Ethernet port.

The **encap-offset** option forces all the rates to be either last-mile frame over the wire or local port frame over the wire, referred to as **LM-FoW** and **FoW** respectively. The system maintains a running average frame expansion ratio for each queue to convert queue rates between these two formats as explained in Frame Size, Rates, and Running Average Frame Expansion Ratio on page 1042. Here are the details of the queue and scheduler operation:

1. When the **encap-offset** option is configured in the subscriber profile, the subscriber host queue rates, that is, CLI and operational PIR and CIR as well as queue bucket updates, the queue statistics, that is, forwarded, dropped, and HQoS offered counters use the **LM-FoW** format. The scheduler policy CLI and operational rates also use **LM-FoW** format. The port scheduler **max-rate** and the priority level rates and weights, if a Weighted Scheduler Group is used, are always entered in CLI and interpreted as **FoW** rates. The same is true for an **agg-rate-limit** applied to a vport. Finally the subscriber **agg-rate-limit** is entered in CLI as **LM-FoW** rate. When converting between **LM-FoW** and **FoW** rates, the queue running average frame expansion ratio value is used.
   - If the user enabled **frame-based-accounting** in a scheduler policy or **queue-frame-based-accounting** with subscriber **agg-rate-limit** and a port scheduler policy, the queue operational rate will be capped to a user configured **FoW** rate. The scheduler policy operational rates will also be in the **FoW** format. Note that a user configured queue **avg-frame-overhead** value is ignored since the running average frame expansion ratio is what is used when the **encap-offset** option is enabled.
   - If the user configured queue **packet-byte-offset** value, it is ignored and is not accounted for in the net packet offset calculation.
2. When **no encap-offset** is configured in the subscriber profile, that is, default and pre-R9.0 behavior, queue CLI and operational PIR and CIR rates, as well as queue bucket updates, the queue statistics, use data format. The scheduler policy CLI and operational rates also use data format. The port scheduler **max-rate** and the priority level rates and weights, if a Weighted Scheduler Group is used, and the subscriber **agg-rate-limit** are entered in CLI and interpreted as **FoW** rates. When converting between **FoW** and data rates, the queue a**vg-frame-overhead** value is used and since this an Ethernet port, it is not user-configurable but constant and is equal to +20 bytes (IFG and preamble).
   - If the user enabled **frame-based-accounting** in a scheduler policy or **queue-frame-based-accounting** with subscriber **agg-rate-limit** and a port scheduler policy, the queue operational rate will be capped to a user configured FoW rate in

CLI which is then converted into a data rate using the queue **avg-frame-overhead** constant value of +20 bytes. The scheduler policy operational rates will also be in the **FoW** format.

– If the user configured queue **packet-byte-offset** value, it adjusts the immediate packet size. This means that the queue rates, that is, operational PIR and CIR, and queue bucket updates use the adjusted packet size. In addition, the queue statistics will also reflect the adjusted packet size. Scheduler policy rates, which are data rates, will use the adjusted packet size. The port scheduler **max-rate** and the priority level rates and weights, if a Weighted Scheduler Group is used, as well as the subscriber **agg-rate-limit** are always **FoW** rates and thus use the actual frame size

Frame Size, Rates, and Running Average Frame Expansion Ratio

The following are the details of the rates and frame sizes applied to the subscriber host queues, the subscriber aggregate rate, and the vport root scheduler for the scheduling model and when the **encap-offset** option is enabled in the subscriber profile.

Subscriber Host Queue:

Size = LastMileFrameOverWireEncap + Data

Rate = (48/53)* x (LastMileFrameOverWireEncap + Data)

*Applicable to ATM last-mile only.

Subscriber Aggregate Rate:

Size = LastMileFrameOverWireEncap + Data

Rate = (48/53)* x (LastMileFrameOverWireEncap + Data)

*Applicable to ATM last-mile only.

Vport/Port Port Scheduler and Weighted Scheduler Group

Size = FrameOverWireEncap + Data

Rate = FrameOverWireEncap + Data

When a frame arrives at the queue, it size will be *ImmediateEgressEncap*+*Data*. This size is stored as the *OfferedFrameSize* so that the queue offered stats used in HQoS calculations are correct. Let us refer to the HQoS offered statistics as Offered.

This size is then adjusted by removing the *ImmediateEgressEncap* and adding the *LastMileFrameOverWireEncap*. This new adjusted frame size, let us refer to it as *LastMileOfferedFrameSize*, is then used for checking compliance of the frame against the queue PIR and CIR bucket sizes and for updating the queue forwarded and dropped stats.

The *LastMileOfferedFrameSize* value is computed dynamically for each packet serviced by the queue.

A new HQoS stat counter *OfferedLastMileAdjusted* is maintained for the purpose of calculating the running average frame expansion ratio, which is the ratio of the accumulated *OfferedLastMileAdjusted* and Offered of each queue:

RunningAverageFrameExpansionRatio = OfferedLastMileAdjusted / Offered

The vport/port port scheduler will hand out its **FoW** bandwidth in terms of Fair Information Rate (FIR) bandwidth to each subscriber queue. This queue FIR must be converted into **LM-FoW** format to cap it by the queue PIR (*adminPIR*) and to make sure the sum of *FIRs* of all queues of the same subscriber does not exceed the subscriber **agg-rate-limit** which is also expressed in **LM-FoW** format. The conversion between these two rates makes use of the cumulative *RunningAverageFrameExpansionRatio* value.

Note that a queue **LM-foW** AdminPIR value will always be capped to the value of the local port **FoW** rate even if the conversion based on the current *RunningAverageFrameExpansionRatio* value indicates that a higher AdminPIR may be able to fill in the full line rate of the local port.

Vport Determination and Evaluation

In the BNG application, host queues of all subscribers destined to the same downstream BSAN, for example, all SAPs on the egress port matching the same S-VLAN tag value, are parented to the same vport which matches the destination ID of the BSAN.

The BNG determines the parent vport of a subscriber host queue, which has the **port-parent** option enabled, by matching the destination string **dest** string associated with the subscriber with the string defined under a vport on the port associated with the subscriber.

The user configures the dest string match under the egress context of the Ethernet port associated with the subscriber:

CLI Syntax: configure>port>ethernet>acess>egress>vport>host-match dest *string* **create**

If a given subscriber host queue does not have the **port-parent** option enabled, it will be foster-parented to the vport used by this subscriber and which is based on matching the **dest** string. If the subscriber could not be matched with a vport on the egress port, the host queue will not be bandwidth controlled and will compete for bandwidth directly based on its own PIR and CIR parameters.

By default, a subscriber host queue with the **port-parent** option enabled is scheduled within the context of the port's port scheduler policy. In order to indicate the option to schedule the queue in the context of a port scheduler policy associated with a vport, the user enters the following command in SLA profile used by the subscriber host:

CLI Syntax: configure>subscriber-mgmt>sla-profile>egress>qos *sap-egress-qos-policy-id* **vport-scheduler**

This command is persistent meaning that the user can re-enter the **qos** node without specifying the **vport-scheduler** argument each time and the system will remember it. The user can revert to the default setting without deleting the association of the SLA profile with the SAP egress QoS policy by explicitly re-entering the command with the following new argument:

CLI Syntax: configure>subscriber-mgmt>sla-profile>egress>qos *sap-egress-qos-policy-id* **port-scheduler**

Applying Aggregate Rate Limit to a Vport

The user can apply an aggregate rate limit to the vport and apply a port scheduler policy to the port.

This model allows the user to oversubscribe the Ethernet port. The application of the **agg-rate** option is mutually exclusive with the application of a port scheduler policy, or a scheduler policy to a vport.

When using this model, a subscriber host queue with the **port-parent** option enabled is scheduled within the context of the port's port scheduler policy. However, the user must still indicate to the

system that the queues are managed by the aggregate rate limit instance of a vport by enabling the **vport-scheduler** option in the subscriber host SLA profile:

CLI Syntax: configure>subscriber-mgmt>sla-profile>egress>qos *sap-egress-qos-policy-id* **vport-scheduler**

A subscriber host-queue which is port-parented will be parented to the port scheduler policy of the port used by the subscriber and aggregate rate limited within the instance of the vport used by this subscriber and which is based on matching the **dest** string and **org** string. If the vport exists but the port does not have a port scheduler policy applied, then the host queue will be orphaned and no aggregate rate limit can be enforced.

If a given subscriber host queue does not have the port-parent option enabled, it will be foster-parented to the port used by this subscriber and aggregate rate limited within the instance of the vport used by this subscriber. If the vport exists but the port does not have a port scheduler policy applied, then the host queue will be orphaned and no aggregate rate limit can be enforced.

Applying a Scheduler Policy to a Vport

The user can apply a scheduler policy to the vport. This is allows scheduling control of subscriber tier 1 schedulers in a scheduler policy applied to the egress of a subscriber or SLA profile, or to a PW SAP in an IES or VPRN service.

The advantage of using a scheduler policy under a vport, compared to the use of a port scheduler (with or without an agg-rate rate), is that it allows a port parent to be configured at the vport level.

Bandwidth distribution from an egress port scheduler to a vport configured with a scheduler policy can be performed based on the level/cir-level and weight/cir-weight configured under the scheduler's port parent. The result is in allowing multiple vports, for example representing different DSLAMs, to share the port bandwidth capacity in a flexible way that is under the control of the user.

The configuration of a scheduler policy under a vport is mutually exclusive with the configuration of a port scheduler policy or an aggregate rate limit.

A scheduler policy is configured under a vport as follows:

CLI Syntax: config>port>ethernet>access>egress>vport# scheduler-policy *scheduler-policy-name*

When using this model, a tier 1 scheduler in a scheduling policy applied to a subscriber profile or SLA profiles must be configured as follows:

CLI Syntax: config>qos>scheduler-policy>tier# parent-location vport

If the vport exists, but port does not have a scheduler policy applied, then its schedulers will be orphaned and no port level QOS control can be enforced.

The following **show**/**monitor**/**clear** commands are available related to the vport scheduler:

```
show qos scheduler-hierarchy port port-id vport name [scheduler scheduler-name] [detail]

show qos scheduler-stats port port-id vport name [scheduler scheduler-name] [detail]

monitor qos scheduler-stats port port-id vport name [interval seconds ] [repeat repeat ]
[absolute|rate]

clear qos scheduler-stats port port-id vport name [scheduler scheduler-name] [detail]
```

HQoS adjustment and host tracking are not supported on schedulers that are configured in a scheduler policy on a vport, so the configuration of a scheduler policy under a vport is mutually exclusive with the configuration of the egress-rate-modify parameter.

ESM over MPLS pseudowires are not supported when a scheduler policy is configured on a vport.

Signaling of Last Mile Encapsulation Type

A subscriber host session can signal one of many encapsulation types each with a different fixed offset in the last mile. These encapsulation types are described in RFC 4679 and are illustrated in Figure 73 and Figure 74. The BNG node learns the encapsulation type of each subscriber host session by inspecting the Access-loop-encapsulation sub-TLV in the Vendor-Specific PPPoE Tags as specified in RFC 4679.When Ethernet is the last mile, the encapsulation type will result in a fixed offset for all packet sizes. When ATM/DSL is the last mile, there will be an additional expansion due to AAL5 padding to next multiple of 48 bytes and which varies depending on the packet size.

Both ATM and Ethernet access using PPP encapsulation options are supported in the software and hardware based implementations. Thus both provide support for the Access-loop-encapsulation sub-TLV in the Vendor-Specific PPPoEv4/PPPoEv6 Tags with the ATM encapsulation values and Ethernet encapsulation values.

ATM and Ethernet access using IP encapsulation are only supported using default encapsulation offset configuration in the subscriber profile in the software based implementation. Support for signaling the Access-loop-encapsulation sub-TLV in the DHCPv4/DHCPv6 Relay Options is included in the hardware based implementation. There is no support for DHCPv6 relay options.

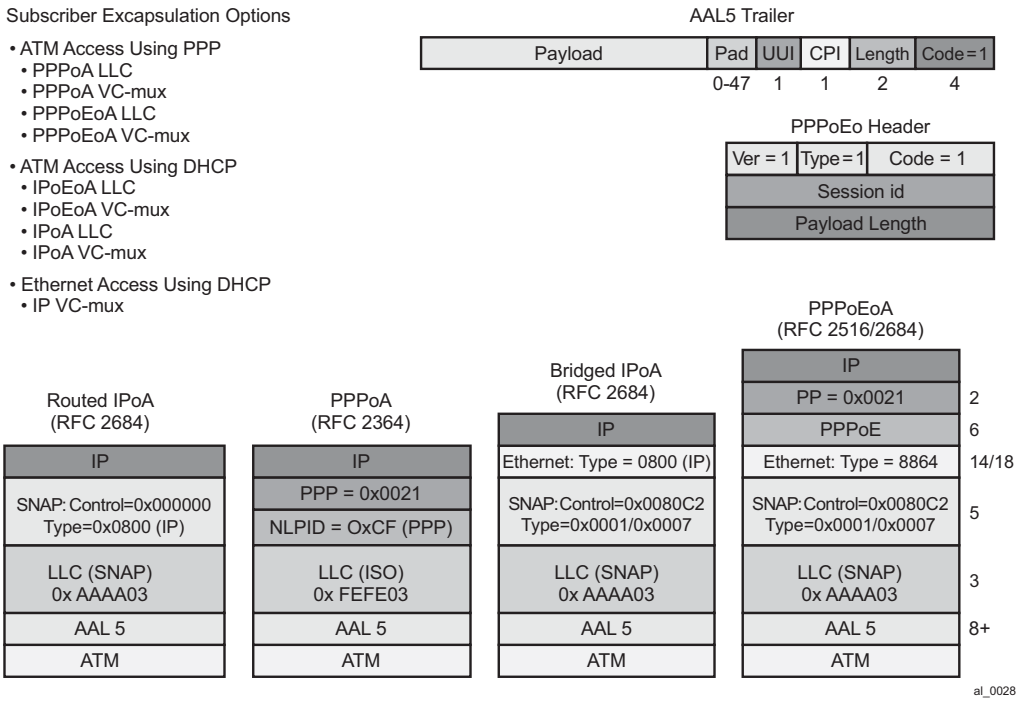


Figure 73: Subscriber Host Session Encapsulation Types

Encapsulation combinations (RFC 4679)

```
            Access-loop-encapsulation
0                   1                   2
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Data Link   |    Encaps 1   |    Encaps 2   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

  Valid values for the sub-fields are as follows:

     Data Link

        0x00 AAL5
        0x01 Ethernet

     Encaps 1

        0x00 NA - Not Available
        0x01 Untagged Ethernet
        0x02 Single-Tagged Ethernet

     Encaps 2

        0x00 NA - Not Available
        0x01 PPPoA LLC
        0x02 PPPoA Null
        0x03 IPoA LLC
        0x04 IPoA Null
        0x05 Ethernet over AAL5 LLC with FCS
        0x06 Ethernet over AAL5 LLC without FCS
        0x07 Ethernet over AAL5 Null with FCS
        0x08 Ethernet over AAL5 Null without FCS
```

Encapsulation combinations

- AAL5
  - PPPoA LLC/Null
  - IPoA LLC/Null
  - Ethernet over ATM x 4
    - Tagged/Untagged PPP
    - Tagged/Untagged DHCP
  - Total of 20 AAL5combinations
- Ethernet
  - Tagged/Untagged PPP
  - Tagged/Untagged DHCP
  - Total of four Ethernet combinations
- *Total of 24 access combinations*

Figure 74: Access-Loop-Encapsulation Sub-TLV

The operational last-mile values for hosts on the same sap, having the same SLA profile are displayed in following the show-command:

CLI Syntax: show>service active-subscribers>ale-adjust

The data-link can have values: atm, other and unknown. If no offset is supplied it will be set to unknown. Other is used when the data-link is non-atm, otherwise it will state atm.

Operational per-queue values can also be found in the show-command:

CLI Syntax: show>qos>scheduler-hierarchy

Here, one can see whether the queue is operating in last-mile mode. Note that this command is not available on HSMDAv2,

Last Mile ATM

```
*A:Dut-C# /show service active-subscribers ale-adjust
===============================================================================
Active Subscriber Access Loop Encapsulation adjustment
===============================================================================
Subscriber
   SAP                                          SLA profile
   Data-link Offset(bytes)
```

```
-------------------------------------------------------------------------------
hpolSub81
   1/1/11:2000.1                                hpolSlaProf1
   atm       -10
-------------------------------------------------------------------------------
No. of Access Loop Encapsulation adjustments: 1
===============================================================================

*A:Dut-C# show qos scheduler-hierarchy subscriber "hpolSub81"
===============================================================================
Scheduler Hierarchy - Subscriber hpolSub81
===============================================================================
Ingress Scheduler Policy:
Egress Scheduler Policy :
-------------------------------------------------------------------------------
Root (Ing)
|
No Active Members Found on slot 1


Root (Egr)
| slot(1)
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->8->ATM  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->7->ATM  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->6->ATM  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->5->ATM  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->4->ATM  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->3->ATM  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->2->ATM  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->1->ATM  (Port 1/1/11)
|
```

Last Mile Ethernet

```
*A:Dut-C# show service active-subscribers ale-adjust
===============================================================================
Active Subscriber Access Loop Encapsulation adjustment
===============================================================================
Subscriber
   SAP                                          SLA profile
   Data-link Offset(bytes)
-------------------------------------------------------------------------------
hpolSub81
   1/1/11:2000.1                                hpolSlaProf1
   other     +12
-------------------------------------------------------------------------------
No. of Access Loop Encapsulation adjustments: 1
===============================================================================

*A:Dut-C# show qos scheduler-hierarchy subscriber "hpolSub81"
```

```
===============================================================================
Scheduler Hierarchy - Subscriber hpolSub81
===============================================================================
Ingress Scheduler Policy:
Egress Scheduler Policy :
-------------------------------------------------------------------------------
Root (Ing)
|
No Active Members Found on slot 1


Root (Egr)
| slot(1)
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->8->Eth  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->7->Eth  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->6->Eth  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->5->Eth  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->4->Eth  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->3->Eth  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->2->Eth  (Port 1/1/11)
|
|--(Q) : Sub=hpolSub81:hpolSlaProf1 2000->1/1/11:2000.1->1->Eth  (Port 1/1/11)
|
```

Next Mile ATM

```
*A:Dut-C# show service active-subscribers ale-adjust subscriber "hpolSub321"
===============================================================================
Active Subscriber Access Loop Encapsulation adjustment
===============================================================================
Subscriber
   SAP                                          SLA profile
   Data-link Offset(bytes)
-------------------------------------------------------------------------------
hpolSub321
   5/1/1:100/1                                  hpolSlaProf1
   atm       +8
-------------------------------------------------------------------------------
No. of Access Loop Encapsulation adjustments: 1
===============================================================================

*A:Dut-C# show qos scheduler-hierarchy subscriber "hpolSub321"
===============================================================================
Scheduler Hierarchy - Subscriber hpolSub321
===============================================================================
Ingress Scheduler Policy:
Egress Scheduler Policy :
-------------------------------------------------------------------------------
Root (Ing)
|
No Active Members Found on slot 5
```

```
Root (Egr)
| slot(5)
|--(Q) : Sub=hpolSub321:hpolSlaProf1 2000->5/1/1:100/1->8:ATM  (Port 5/1/1)
|
|--(Q) : Sub=hpolSub321:hpolSlaProf1 2000->5/1/1:100/1->7:ATM  (Port 5/1/1)
|
|--(Q) : Sub=hpolSub321:hpolSlaProf1 2000->5/1/1:100/1->6:ATM  (Port 5/1/1)
|
|--(Q) : Sub=hpolSub321:hpolSlaProf1 2000->5/1/1:100/1->5:ATM  (Port 5/1/1)
|
|--(Q) : Sub=hpolSub321:hpolSlaProf1 2000->5/1/1:100/1->4:ATM  (Port 5/1/1)
|
|--(Q) : Sub=hpolSub321:hpolSlaProf1 2000->5/1/1:100/1->3:ATM  (Port 5/1/1)
|
|--(Q) : Sub=hpolSub321:hpolSlaProf1 2000->5/1/1:100/1->2:ATM  (Port 5/1/1)
|
|--(Q) : Sub=hpolSub321:hpolSlaProf1 2000->5/1/1:100/1->1:ATM  (Port 5/1/1)
|
===============================================================================
```

Configuration Example

The following CLI configuration achieves the specific use case shown in Figure 72.

```
config
    qos
       port-scheduler-policy "dslam-vport-scheduler"
         group res-bus-be create
              rate 1000
         level 3 rate 1000 group res-bus-be weight w1
         level 4 rate 1000 group res-bus-be weight w4
         level 5 rate 1000 cir-rate 100
         level 7 rate 5000 cir-rate 5000
         level 8 rate 500 cir-rate 500
         max-rate 5000

       sap-egress 100                // residential policy
            queue 1                 // be-res
            port-parent weight x level 3
            queue 2                 // l2-res
            port-parent weight y level 3
            queue 3                 // l1-res
            port-parent weight z level 3
            queue 4                 // h2-res
            port-parent level 5
            queue 5                 // h1-res
            port-parent level 7
            queue 6                 // ef-res
            port-parent level 8
            fc be queue 1
            fc l2 queue 2
            fc l1 queue 3
            fc h2 queue 4
            fc h1 queue 5
            fc ef queue 6
        exit
        sap-egress 200               // business policy
            queue 1                 // be-bus
              port-parent weight x level 4
            queue 2                 // l2-bus
              port-parent weight y level 4
            queue 3                 // l1-bus
              port-parent weight z level 4
            queue 4                 // h2-bus
              port-parent level 5
            queue 5                 // h1-bus
              port-parent level 7
            queue 6                 // ef-bus
              port-parent level 8
            fc be queue 1
            fc l2 queue 2
            fc l1 queue 3
            fc h2 queue 4
            fc h1 queue 5
            fc ef queue 6
        exit
    exit
```

```
config
    sub-mgmt
        sla-profile "residential"
            egress
                qos 100 vport-scheduler
            exit
        exit
        sla-profile "business"
            egress
                qos 200 vport-scheduler
            exit
        exit
        sub-profile "residential"
            egress
               encap-offset
               avg-frame-size 1500
               agg-rate-limit 100
               exit
            exit
        exit
        sub-profile "business"
            egress
               encap-offset type pppoeoa-llc-tagged-fcs
               avg-frame-size 500
               agg-rate-limit 200
               exit
            exit
        exit
    exit

config
    port 1/1/1
        ethernet
            access
                egress
                    vport "dslam-1" create
                       port-scheduler-policy "dslam-vport-scheduler"
                        host-match dest “20” create
                        exit
                    exit
                exit
            exit
        exit
    exit
exit
```

Subscriber Volume Statistics

Subscriber volume statistics or octet and packet counters are available through the queues and policers that are instantiated for the subscriber. The queue and policer configuration is defined in the SLA profile via ingress and egress qos policy associations with optional overrides. Subscriber hosts that belong to the same subscriber, that are active on the same SAP and that have the same sla-profile will share the set of queues and policers defined by that SLA profile instance. For HSMDA hardware, the ingress policer/queue and egress queue configuration is defined in the subscriber profile via ingress and egress qos policy associations with optional overrides. All hosts belonging to the subscriber share the same set of queues and policers.

IP (Layer 3) Volume Accounting

Subscriber volume statistics by default count Layer 2 frame sizes optionally modified by configuration such as packet-byte-offset, last mile aware shaping, etc.

To report subscriber volume statistics as Layer 3 (IP) packet sizes, the volume-stats-type can be configured to **ip** in the subscriber profile:

```
configure
    subscriber-mgmt
        sub-profile <subscriber-profile-name>
            volume-stats-type ip
```

volume-stats-type ip affects the subscriber statistics in SNMP, CLI, RADIUS accounting, XML accounting and Diameter Gx usage monitoring. Volume quota for RADIUS or Diameter Credit Control applications are interpreted as Layer 3 quota.

The following restrictions apply for **volume-stats-type ip**:

- Layer-3/IP accounting is not supported in combination with last-mile-aware shaping on HSMDA
- Layer-3/IP accounting is not supported in combination with ESMoPW on HSMDA
- Layer-3/IP accounting is not supported in combination with MLPPP
- Layer-3/IP accounting in combination with ESMoPW and last-mile-aware shaping may be inaccurate if the MPLS encapsulation overhead changes during the lifetime of a subscriber.
- Layer-3/IP accounting is restricted to a single encap per sla-profile instance (queue instance). The first host associated with the sla-profile instance (queue instance) determines the allowed encap. Conflicting encaps are:
  - → PPPoE and IPoE on regular Ethernet SAPs
  - → PPPoE and IPoE on PW-SAPs
  - → PPPoA and PPPoEoA on ATM ports

- PPPoE keep alive packets do not contain IP payload and introduce an error in Layer-3/IP accounting when enabled in combination with L2TP-LAC. A workaround is to isolate the keep alives in a separate queue/policer.
- Padding of frames smaller than the Ethernet minimum frame size (64B) may introduce an inaccuracy in Layer-3/IP accounting.
- With ATM in the last mile, last-mile-aware shaping may introduce an inaccuracy in Layer-3/IP accounting.
- Packet-Byte-Offset (PBO) changes during the lifetime of a subscriber introduces an inaccuracy in Layer-3/IP accounting.

Separate IPv4 and IPv6 Counters

IPv4 and IPv6 forwarded and dropped subscriber traffic can be counted separately via a **stat-mode v4-v6** command that is configured as a policer or queue qos override in the sla-profile. The **stat-mode v4-v6** command is only applicable for Enhanced Subscriber Management (ESM).

```
configure subscriber-mgmt
        sla-profile "sla-profile-1" create
            ingress
                qos 10
                    queue 1
                        stat-mode v4-v6
                    exit
                    policer 1
                        stat-mode v4-v6
                    exit
                exit
            exit
            egress
                qos 10
                    queue 1
                        stat-mode v4-v6
                    exit
                    policer 1
                        stat-mode v4-v6
                    exit
                exit
            exit
        exit
```

For policers, the stat-mode command overrides the policer stat-mode configuration as defined in the sap-ingress or sap-egress qos policy. For details on sap-ingress and sap-egress policer stat-mode, refer to the 7750 SR OS Quality of Service Guide. For a policer in stat-mode v4-v6, following counters are available:

- Offered IPv4 octets and packets
- Offered IPv6 octets and packets
- Dropped IPv4 octets and packets

- Dropped IPv6 octets and packets
- Forwarded IPv4 octets and packets
- Forwarded IPv6 octets and packets

When a policer's stat-mode is changed while the sla profile is in use, any previous counter values are lost and any new counters are set to zero.

For queues, a stat-mode is only available for use in Enhanced Subscriber Management (ESM) context to enable separate IPv4/IPv6 counters. For a queue in stat-mode v4-v6, following counters are available:

- Offered High Priority, Low Priority, Uncolored, Managed octets and packets
- Dropped IPv4 octets and packets
- Dropped IPv6 octets and packets
- Forwarded IPv4 octets and packets
- Forwarded IPv6 octets and packets

A queue's stat-mode cannot be changed while the sla profile is in use.

Note that there will be no in-profile/out-of-profile forwarded and dropped counters for policers and queues in **stat-mode v4-v6**.

Non IP traffic (for example PPPoE LCP frames) is counted against the IPv4 counters.

The separate IPv4 and IPv6 forwarded and dropped counters are reported in

- SNMP
- CLI

```
show service active-subscribers detail
- - - snip - - -
-------------------------------------------------------------------------------
SLA Profile Instance statistics
-------------------------------------------------------------------------------
                        Packets                 Octets

Off. HiPrio           : 0                       0
Off. LowPrio          : 1102685                 1102685000
Off. Uncolor          : 0                       0
Off. Managed          : 0                       0

Queueing Stats (Ingress QoS Policy 10)
Dro. HiPrio           : 0                       0
Dro. LowPrio          : 0                       0
For. InProf           : 0                       0
For. OutProf          : 0                       0
Dro. V4               : 0                       0
Dro. V6               : 0                       0
For. V4               : 367543                  367543000
For. V6               : 735142                  735142000

Queueing Stats (Egress QoS Policy 10)
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
```

```
For. InProf           : 0                      0
For. OutProf          : 0                      0
Dro. V4               : 0                      0
Dro. V6               : 0                      0
For. V4               : 367543                 367543000
For. V6               : 735088                 735088000

-------------------------------------------------------------------------------
SLA Profile Instance per Queue statistics
-------------------------------------------------------------------------------
                        Packets                Octets

Ingress Queue 1 (Unicast) (Priority) (Stats mode: v4-v6)
Off. HiPrio           : 0                      0
Off. LowPrio          : 1102685                1102685000
Dro. V4               : 0                      0
Dro. V6               : 0                      0
For. V4               : 367545                 367545000
For. V6               : 735146                 735146000

Egress Queue 1 (Stats mode: v4-v6)
Dro. V4               : 0                      0
Dro. V6               : 0                      0
For. V4               : 367547                 367547000
For. V6               : 735096                 735096000

-------------------------------------------------------------------------------
SLA Profile Instance per Policer statistics
-------------------------------------------------------------------------------
                        Packets                Octets

Ingress Policer 1 (Stats mode: v4-v6)
Off. V4               : 0                      0
Off. V6               : 0                      0
Dro. V4               : 0                      0
Dro. V6               : 0                      0
For. V4               : 0                      0
For. V6               : 0                      0

Egress Policer 1 (Stats mode: v4-v6)
Off. V4               : 0                      0
Off. V6               : 0                      0
Dro. V4               : 0                      0
Dro. V6               : 0                      0
For. V4               : 0                      0
For. V6               : 0                      0
```

- RADIUS accounting

When a queue or policer is configured in stat-mode v4-v6, existing VSA's are re-used in RADIUS detailed per queue / per policer accounting (**configure subscriber-mgmt radius-accounting-policy** <*name*> **include-radius-attribute detailed-acct-attributes**):

- in-profile counter VSA's map to IPv4 octets/packets
- ingress queue high priority dropped counter VSA's map to IPv4 octets/packets
- out-of-profile counter VSA's map to IPv6 octets/packets
- ingress queue low priority dropped counter VSA's map to IPv6 octets/packets

In addition the [26-6527-107] Alc-Acct-I-statmode / [26-6527-127] Alc-Acct-O-statmode is sent with value set to "v4-v6".

Optionally a set of VSA's can be included in RADIUS accounting to report the aggregate IPv6 forwarded octets and packets of queues and policers with stat-mode v4-v6 enabled (configure subscriber-mgmt radius-accounting-policy <name> include-radius-attribute detailed-acct-attributes v6-aggregate-stats):

```
[26-6527-194] Alc-IPv6-Acct-Input-Packets
[26-6527-195] Alc-IPv6-Acct-Input-Octets
[26-6527-196] Alc-IPv6-Acct-Input-GigaWords
[26-6527-197] Alc-IPv6-Acct-Output-Packets
[26-6527-198] Alc-IPv6-Acct-Output-Octets
[26-6527-199] Alc-IPv6-Acct-Output-Gigawords
```

Refer to the 7750 SR-OS RADIUS Attributes Reference Guide for a detailed description of all counter attributes.

- XML accounting

The complete-subscriber-ingress-egress and custom-record-subscriber XML records use following fields to represent IPv4 and IPv6 forwarded/dropped octets and packets for queues or policers with sta**t-mode v4-v**6 enabled:

```
v4po   -  IPv4PktsOffered (policer only)
v4oo   -  IPv4OctetsOffered (policer only)
v6po   -  IPv6PktsOffered (policer only)
v6oo   -  IPv6OctetsOffered (policer only)
v4pf   -  IPv4PktsForwarded
v6pf   -  IPv6PktsForwarded
v4pd   -  IPv4PktsDropped
v6pd   -  IPv4PktsDropped
v4of   -  IPv4OctetsForwarded
v6of   -  IPv6OctetsForwarded
v4od   -  IPv4OctetsDropped
v6od   -  IPv4OctetsDropped
```

For custom records, the following CLI is re-used to include v4/v6 counters if the queue is configured in **stat-mode v4-v6**:

```
i-counters
            all-packets-offered-count           # n/a
            all-octets-offered-count            # n/a
            high-packets-offered-count          # n/a
            low-packets-offered-count           # n/a
            uncoloured-packets-offered-count    # n/a
            high-octets-offered-count           # n/a
            low-octets-offered-count            # n/a
            uncoloured-octets-offered-count     # n/a
            all-packets-offered-count           # n/a
            all-octets-offered-count            # n/a
            high-packets-discarded-count        # IPv4
            low-packets-discarded-count         # IPv6
            high-octets-discarded-count         # IPv4
            low-octets-discarded-count          # IPv6
            in-profile-packets-forwarded-count  # IPv4
            out-profile-packets-forwarded-count # IPv6
            in-profile-octets-forwarded-count   # IPv4
            out-profile-octets-forwarded-count  # IPv6

        e-counters
            in-profile-packets-forwarded-count  # IPv4
            in-profile-packets-discarded-count  # IPv4
            out-profile-packets-forwarded-count # IPv6
            out-profile-packets-discarded-count # IPv6
            in-profile-octets-forwarded-count   # IPv4
            in-profile-octets-discarded-count   # IPv4
            out-profile-octets-forwarded-count  # IPv6
            out-profile-octets-discarded-count  # IPv6
```

On HSMDA, **stat-mode v4-v6** is configured as a policer or queue qos override in the subscriber profile:

```
configure subscriber-mgmt
        sub-profile "sub-profile-2" create
            hsmda
                egress-qos
                    qos 10
                        queue 1
                            stat-mode v4-v6
                        exit
                    exit
                exit
                ingress-qos
```

```
                qos 10
                    policer 1
                        stat-mode v4-v6
                    exit
                    queue 1
                        stat-mode v4-v6
                    exit
                exit
            exit
        exit
    exit
```

The stat-mode on egress hsmda queues is always enabled per subscriber: when enabling **stat-mode v4-v6** for one hsmda queue, it is automatically enabled for all hsmda queues for that subscriber profile.

Configuring IP and IPv6 Filter Policies for Subscriber Hosts

This section applies to the 7750 SR and 7450 ESS.

Access Control Lists (ACLs) for subscriber traffic are defined as IP and IPv6 filter policies and are configured in the SLA-profile associated with the subscriber. For information about IP and IPv6 filter policy configurations, refer to the 7750 SR-OS Router Configuration Guide.

CLI Syntax:

```
config>subscr-mgmt>sla-prof
    sla-profile sla-profile-1 create
        ingress
            ip-filter 100
            ipv6-filter 300
        exit
        egress
            ip-filter 200
            ipv6-filter 400
        exit
    exit
```

Traffic from different hosts of a single subscriber and associated with the same sla-profile instance, is subject to the filter policies defined in the SLA profile.

The IP or IPv6 filter policy configuration of subscriber hosts can be dynamically updated using different mechanisms:

1. Assign a new SLA profile.

   This can be done dynamically by, for example, a RADIUS CoA message. As the SLA profile also defines the QoS configuration for the subscriber hosts, this change may result in a discontinuity in accounting.

   Note: changing the ip-filter policy in an SLA profile in use by an active subscriber is allowed in the CLI, but not recommended. Changing the IPv6 filter policy in an SLA profile in use by an active subscriber is prevented in the CLI.
2. Override the IP and IPv6 filter policies

   Alternatively, it is also possible to dynamically override the IP and IPv6 filter policies per subscriber-host through a RADIUS Access-Accept or CoA message. Following VSA should be included in the RADIUS message:
3. Insert subscriber host specific filter entries

   A subscriber host specific entry is dynamically created from a RADIUS access accept or CoA message using the NAS-Filter-Rule or Alc-Ascend-Data-Filter-Host-Spec attribute (see also IP Filter Attribute Format Details on page 1067 for a detailed description of the attribute format):

Attribute ID	Attribute Name	Type	Limits	SR OS Format
92	NAS-Filter-Rule	String	max. 10 attributes per message or max. 10 filter entries per message	The format of a NAS-Filter-Rule is defined in rfc-3588 section-4.3. A single filter rule is a string of format "<action> <direction> <protocol> from <source> to <destination> <options>". Multiple rules should be separated by a NUL (0x00). A NAS-Filter-Rule attribute may contain a partial rule, one rule, or more than one rule. Filter rules may be continued across attribute boundaries. A RADIUS message with NAS-Filter-Rule attribute value equal to 0x00 or " " (a space) removes all host specific filter entries for that host. See also IP Filter Attribute Format Details on page 1067. For example: Nas-Filter-Rule = "permit in ip from any to 10.1.1.1/32"
26-6527-159	Alc-Ascend-Data-Filter-Host-Spec	octets	max. 10 attributes per message or max. 10 filter entries per message. min. length 22 bytes (IPv4), 46 bytes (IPv6) max. length: 110 bytes (IPv4), 140 bytes (IPv6)	a string of octets with fixed field length (type (ipv4/ipv6), direction (ingress/egress), src-ip, dst-ip, ...). Each attribute represents a single filter entry. See IP Filter Attribute Format Details on page 1067 for a description of the format. For example: # "permit in ip from any to 10.1.1.1/32" Alc-Ascend-Data-Filter-Host-Spec = 0x01010100000000000a010101002000000000000000000

The Alc-Subscriber-Filter VSA is a comma separated list of strings:

Field	Use
Ingr-v4:<number>	Ingress ipv4 filter

Field	Use
Egr-v4:<number>	Egress ipv4 filter
Ingr-v6:<number>	Ingress ipv6 filter
Egr-v6:<number>	Egress ipv6 filter

The filter number can have following values:

<number>	Result
1..65535	Ignore filter from sla-profile configuration and assign corresponding pre-configured filter
0	Ignore filter from sla-profile configuration and do not assign a new filter (only allowed if no dynamic subscriber host specific rules are present)
-1	No change in filter configuration
-2	Restore filter from sla-profile configuration

Notes:

- Not relevant fields (IPv4 filters for an IPv6 host) will be ignored.
- RADIUS CoA message: if the ingress or egress field is missing in the VSA, there will be no change for that direction.
- RADIUS Access-Accept message: if the ingress or egress field is missing in the VSA, then the IP filters as specified in the SLA profile will be active for that direction.

An SLA profile IP filter override is applicable to all dynamic host types, including L2TP LNS but excluding L2TP LAC.

4. Insert subscriber host specific filter entries

   A subscriber host specific entry is a filter entry where the match criteria is automatically extended with the subscriber host IP or IPv6 address as source (ingress) or destination (egress) IP. They represent a per host customization of a generic filter policy: only traffic to/from the subscriber host will match against these entries.

   A subscriber host specific entry is dynamically created from a RADIUS access accept or CoA message using the NAS-Filter-Rule attribute:

The format used to specify host specific filter entries (NAS-Filter-Rule format or Alc-Ascend-Data-Filter-Host-Spec format) cannot change during the lifetime of the subscriber host. A RADIUS message can only contain a single format for host specific filter entries.

Up to 10 host specific filter rules can be specified in a single RADIUS message. Each new RADIUS CoA message containing host specific filter attributes overwrites the previous subscriber host-specific filter entries for that host provided that there are enough free entries in the reserved range.

Subscriber host specific filter entries can be removed with a RADIUS CoA message with NAS-Filter-Rule attribute value equal to 0x00 or " " (a space).

When the subscriber host session terminates or is disconnected the corresponding subscriber host specific filter entries are also deleted.

Note that subscriber host-specific filter entries are moved if the subscriber host filter policy is changed (new SLA profile or ip filter policy override) and the new filter policy contains enough free reserved entries (sub-insert-RADIUS).

A range of entries must be reserved for subscriber host specific entries in a filter policy:

CLI Syntax: **config>filter**
ip-filter 100 create
sub-insert-radius start-entry 1000 count 100

High and low watermarks can be configured to raise an event when the thresholds of free entries in the reserved range are reached:

CLI Syntax: **config>filter>ip-filter# sub-insert-wmark ?**
- no sub-insert-wmark
- sub-insert-wmark low <low-watermark> high <high-watermark>

<low-watermark> : [0..100]
<high-watermark> : [0..100]

Use following show commands to check filter policy details and the filter configuration for a subscriber host:

```
# show filter ip <ip-filter-id> type <entry-type>
# show filter ipv6 <ipv6-filter-id> type <entry-type>
     <entry-type>        : fixed|radius-insert|credit-control-insert

# show service active-subscribers filter [subscriber <sub-ident-string>] [origin <origin>]
     <sub-ident-string>   : [32 chars max]
     <origin>             : radius|credit-control
```

5. Insert shared filter entries

   The target application for RADIUS shared filter entries is operators that have a predefined limited number of different filter lists that each are shared with multiple subscriber hosts and that are to be managed and activated from RADIUS at authentication.

   A local configured ip or ipv6 filter associated with a host (sla-profile or host filter override) can be enhanced with dynamic filter entries that can be shared with multiple subscriber hosts. The shared dynamic filter entries are inserted with a set of RADIUS attributes "[242]

Ascend-Data-Filter" or "[26-6527-158] Alc-Nas-Filter-Rule-Shared" received in a RADIUS Access-Accept or CoA message. A CoA message containing a set of one of those attributes overrides the previous set of shared filter entries active for that subscriber host.

For each unique set of dynamic filter entries received per type (ipv4/ipv6) and direction (ingress/egress), a copy is made of the local filter with the dynamic entries included at a preconfigured insert point. If the same set of dynamic filter entries is sent to subscriber hosts that have the same associated local filter, then they will share the same filter copy. When there are no more subscriber hosts associated with a filter copy, then the filter copy is deleted. A filter copy is identified as *local filter id*:*number*. For example: show filter ip 10:2

Shared filter entries are moved if the subscriber host filter policy is changed (new SLA profile or ip filter policy override) and if the new filter policy contains enough free reserved entries.

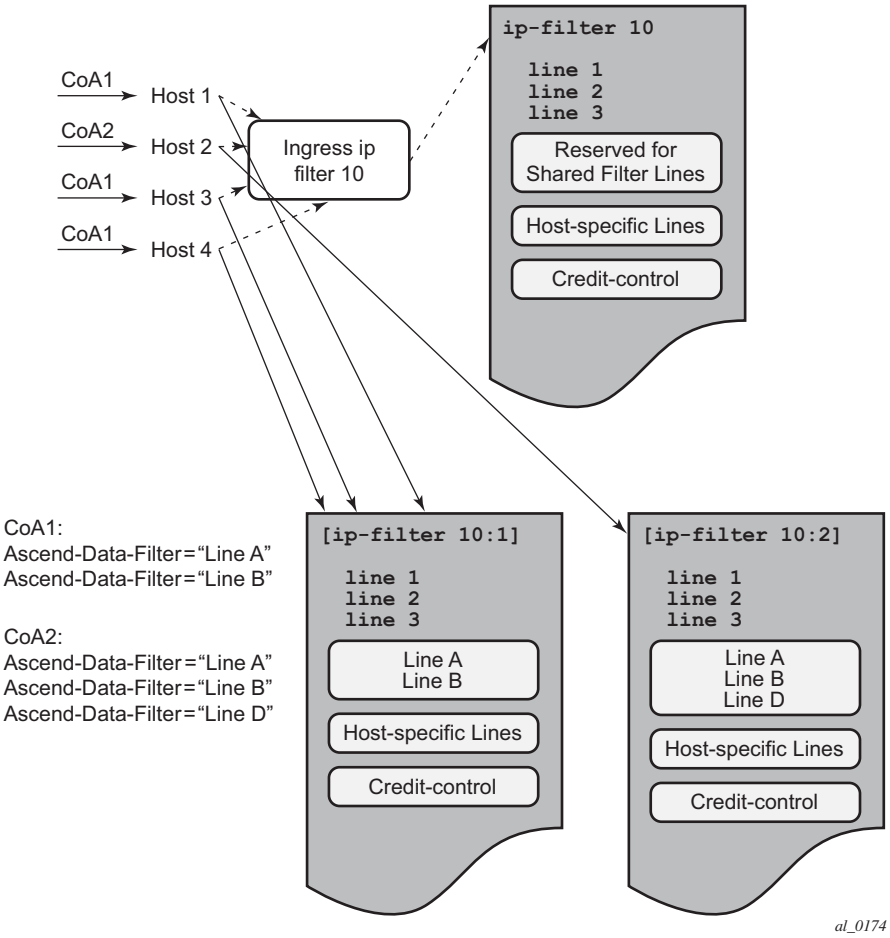


Figure 75: Insert Shared Filters

A range of entries must be reserved for shared entries in a filter policy:

CLI Syntax: config>filter
ip-filter 10 create
sub-insert-shared-radius start-entry 100 count 10

High and low watermarks can be configured to raise an event when the thresholds of dynamic filter copies are reached:

CLI Syntax: config>filter>ip-filter# shared-radius-filter-wmark ?
- no shared-radius-filter-wmark
- shared-radius-filter-wmark low *low-watermark* high *high-watermark*
low-watermark : [0..8000]
high-watermark : [0..8000]

The format used to specify shared filter entries (Alc-Nas-Filter-Rule-Shared format or Ascend-Data-Filter format) cannot change during the lifetime of the subscriber host. A RADIUS message can only contain a single format for shared filter entries.

Shared filter entries can be removed with a RADIUS CoA message with Alc-Nas-Filter-Rule-Shared attribute value equal to 0x00 or " " (a space).

Attribute ID	Attribute Name	Type	Limits	SR OS Format
242	Ascend-Data-Filter	Octets	multiple attributes per RADIUS message allowed. min. length 22 bytes (IPv4), 46 bytes (IPv6) max. length: 110 bytes (IPv4), 140 bytes (IPv6)	a string of octets with fixed field length (type (ipv4/ipv6), direction (ingress/egress), src-ip, dst-ip, ...). Each attribute represents a single filter entry. See IP Filter Attribute Format Details on page 1067 for a description of the format. For example: # "permit in ip from any to 10.1.1.1/32" Ascend-Data-Filter = 0x01010100000000000a010101002000000000000000000
26-6527-158	Alc-Nas-Filter-Rule-Shared	string	Multiple attributes per RADIUS message allowed.	The format is identical to [92] NAS-Filter-Rule and is defined in rfc-3588 section-4.3. A single filter rule is a string of format "<action> <direction> <protocol> from <source> to <destination> <options>". Multiple rules should be separated by a NUL (0x00). An Alc-Nas-Filter-Rule-Shared attribute may contain a partial rule, one rule, or more than one rule. Filter rules may be continued across attribute boundaries. A RADIUS message with Alc-Nas-Filter-Rule-Shared attribute value equal to 0x00 or " " (a space) removes the shared filter entries for that host. See also IP Filter Attribute Format Details on page 1067. For example: Alc-Nas-Filter-Rule-Shared = "permit in ip from any to 10.1.1.1/32"

IP Filter Attribute Format Details

The format for [92] Nas-Filter-Rule and [26-6527-158] Alc-Nas-Filter-Rule-Shared is a string formatted as: "*action direction protocol* from *source* to *destination options*". Refer to the table below for details on the respective fields.

Action or Classifier	Value		Corresponding SR-OS Filter Function
<direction>	in		ingress
	out		egress
<protocol>	ip		
	any number [0..255]		
	ip		
	any number [1..42]		
	any number [45..49]		
	any number [52..59]		
	any number [61..255]		
	any number 43|44|50|51|60		
from <source>	any	100	ingress: src-ip = host-ip-address; src-port eq 100 egress: src-ip = 0.0.0.0/0 | ::/0; src-port eq 100
		200-65535	ingress: src-ip = host-ip-address; src-port range 200 65535 egress: src-ip = 0.0.0.0/0 | ::/0; src-port range 200 65535
	ip-prefix/ length	100	ingress: src-ip = host-ip-address; src-port eq 100 egress: src-ip = ip-prefix/length; src-port eq 100
		200-65535	ingress: src-ip = host-ip-address; src-port range 200 65535 egress: src-ip = ip-prefix/length; src-port range 200 65535
	any	100	ingress: dst-ip = 0.0.0.0/0 | ::/0; dst-port eq 100 egress: dst-ip = host-ip-address; dst-port eq 100
		200-65535	ingress: dst-ip = 0.0.0.0/0 | ::/0; dst-port range 200 65535 egress: dst-ip = host-ip-address; dst-port range 200 65535

Action or Classifier	Value		Corresponding SR-OS Filter Function
	ip-prefix/ length	100	ingress: dst-ip = ip-prefix/length; dst-port eq 100 egress: dst-ip = host-ip-address; dst-port eq 100
		200-65535	ingress: dst-ip = ip-prefix/length; dst-port range 200 65535 egress: dst-ip = host-ip-address; dst-port range 200 65535
<options: frag>	frag		fragment true (ipv4 only)
<options: ipoptions>	ssrr		ip-option 9 / ip-mask 255
	lsrr		ip-option 3/ ip-mask 255
	rr		ip-option 7/ ip-mask 255
	ts		ip-option 4/ ip-mask 255
	!ssrr		not supported
	!lsrr		not supported
	!rr		not supported
	!ts		not supported
	ssrr,lsrr,rr, ts		not supported
<options: tcpoptions>	mss		not supported
	window		not supported
	sack		not supported
	ts		not supported
	!mss		not supported
	!window		not supported
	!sack		not supported
	!ts		not supported
	mss,window,sack,ts		not supported
<options: established>	established		not supported
			not supported
			not supported

Action or Classifier	Value		Corresponding SR-OS Filter Function
<options: setup>	setup		tcp-syn true
			tcp-ack false
			protocol tcp
<options: tcpflags>	syn		tcp-syn true
	!syn		tcp-syn false
	ack		tcp-ack true
	!ack		tcp-ack false
	fin		not supported
	rst		not supported
	psh		not supported
	urg		not supported
<options: icmptypesv4>	echo reply		protocol 1 / icmp-type 0
	destination unreachable		protocol 1 / icmp-type 3
	source quench		protocol 1 / icmp-type 4
	redirect		protocol 1 / icmp-type 5
	echo request		protocol 1 / icmp-type 8
	router advertisement		protocol 1 / icmp-type 9
	router solicitation		protocol 1 / icmp-type 10
	time-to-live exceeded		protocol 1 / icmp-type 11
	IP header bad		protocol 1 / icmp-type 12
	timestamp request		protocol 1 / icmp-type 13
	timestamp reply		protocol 1 / icmp-type 14
	information request		protocol 1 / icmp-type 15
	information reply		protocol 1 / icmp-type 16
	address mask request		protocol 1 / icmp-type 17
	address mask reply		protocol 1 / icmp-type 18

Action or Classifier	Value	Corresponding SR-OS Filter Function
	-	protocol 1 / icmp-type [0..255]
	3-9 (range)	not supported
	3,5,8,9 (comma seper-ated)	not supported
<options: icmptypesv6>	destination unreachable	icmp-type 1
	time-to-live exceeded	icmp-type 3
	IP header bad	icmp-type 4
	echo request	icmp-type 128
	echo reply	icmp-type129
	router solicitation	icmp-type 133
	router advertisement	icmp-type 134
	redirect	icmp-type 137

The format for [242] Ascend-Data-Filter and [26-6527-159] Alc-Ascend-Data-Filter-Host-Spec is an octet string with fixed length fields. Refer to the table below for details on the respective fields.

Field	Length	Value
Type	byte	1 = IPv4
		3 = IPv6
Filter or forward	1 byte	0 = drop
		1 = accept
Indirection	1 byte	0 = egress
		1 = ingress
Spare	1 byte	ignored
Source IP address	IPv4 = 4 bytes	IP address of the source interface
	IPv6 = 16 bytes	
Destination IP address	IPv4 = 4 bytes	IP address of the destination interface
	IPv6 = 16 bytes	

Field	Length	Value
Source IP prefix	1 byte	Number of bits in the network portion
Destination IP prefix	1 byte	Number of bits in the network portion
Protocol	1 byte	Protocol number. Note: match the inner most header only for IPv6
Established	1 byte	ignored (not implemented)
Source port	2 bytes	Port number of the source port
Destination port	2 bytes	Port number of the destination port
Source port qualifier	1 byte	0 = no compare
		1 = less than
		2 = equal to
		3 = greater than
		4 = not equal to (not supported)
destination port qualifier	1 byte	0 = no compare
		1 = less than
		2 = equal to
		3 = greater than
		4 = not equal to (not supported)
Reserved	2 bytes	ignored

Checking Filter Policy Details

Use following show commands to check filter policy details and the filter configuration for a subscriber host:

CLI Syntax:

show filter ip *ip-filter-id* detail
show filter ipv6 *ip-filter-id* detail
show filter ip *ip-filter-id* type entry-type
show filter ipv6 *ipv6-filter-id* type *entry-type*
entry-type : fixed | radius-insert | credit-control-insert | radius-shared
show service active-subscribers filter [subscriber *sub-ident-string*] [origin *origin*]
sub-ident-string : [32 chars max]
origin : radius | credit-control”

ESM PPPoA/PPPoEoA

This section applies to the 7750 SR and 7450 ESS.

The main goal of PPP in the subscriber context is to provide authentication, to negotiate link layer parameters (such as MTU) and to negotiate IP parameters (IP address, WINS, DNS, Default Gateway, etc.).

Each PPP session is carried over a single ATM VC over to the BNG. In PPPoA environment, PPP session is directly encapsulated over ATM transport on a DSL Customer Premise Equipment (CPE).

In the PPPoEoA environment, an additional layer is added to accommodate Ethernet medium. In this fashion, a PPP session can be directly terminated on any host within the customer Ethernet network and then transported over an ATM network to the BNG. Multiple PPPoE sessions can be carried over a single ATM PVC.

However, the majority of current implementations in ATM transport networks have PPPoE session terminated at the DSL CPE and not on a host within the customer network. This PPPoE session is then transported over ATM to the BNG. Although it seems unnecessary to add the overhead associated with Ethernet on an ATM-equiped DSL CPE, mainly for historical reasons PPPoE became engrained in the home network and as such has moved into DSL CPE.

PPPoA

In a PPPoA environment, services are offered to residential and business customers. DSL CPE and BNG are the originating and terminating points of a PPP connection. In a residential example, a DSL CPE is a Home Gateway (HG) as shown in Figure 76.

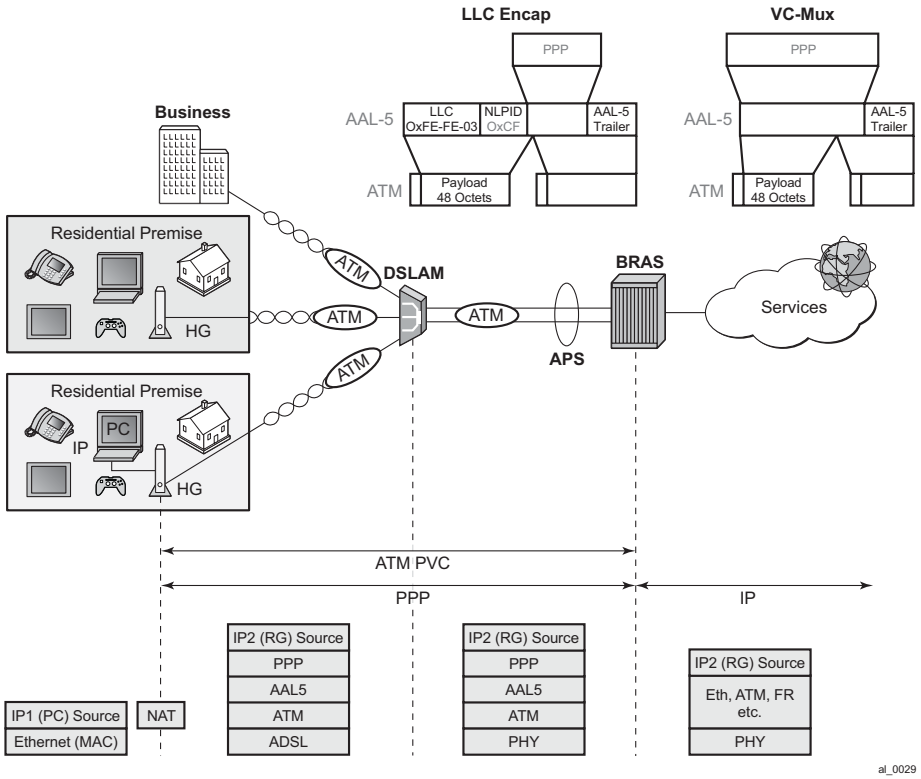


Figure 76: PPPoA Architecture and Packet Encapsulation

An ATM VC must exist between a CPE and a BNG before a PPP session can be established. From a QoS perspective, this VC is one of the following service categories: CBR, rt-VBR, nrt-VBR or UBR(+). CPE starts negotiating PPP link/session parameters over the VC. Once the IP address is obtained from the Service Provider (SP) side, the customer is ready for data transfer. There is a 1:1 mapping between a PPPoA session and a VC.

There is no need for the customer to run PPP within its own network. CPE, as a default gateway, accepts Ethernet IP packets, strips off the Ethernet header, performs a NAT function, and encapsulates the IP packets into PPPoA before it sends them on to the BNG.

In most residential cases, this PPPoA session is used for pure data transport (Internet access). As such, the BNG side would require a single service queue per VC.

In certain cases, customers use PPPoA for VoIP. In this case, they use an IAD (Integrated Access Device) to gain access to the ATM network.

It must be noted here that nothing in this architecture precludes customers from using multiple services over a single PPPoA session. Services would be differentiated through DSCP bits and each service in this case would require a separate queue. This is most likely a scenario with business customers where a customer runs multiple services over a PPPoA session. DSL CPE

would play a role here in differentiating and appropriately marking the services, either through a separate physical port per service or through some other means.

PPPoEoA

In the PPPoE model the originating PPP point could extends beyond the DSL CPE and into the customer Ethernet network where any host can originate a PPP session. In such case, ATM is generally used as a transport to carry PPPoE sessions that are originated by hosts within the customer network (beyond DSL CPE). The DSL CPE would operate in a bridged mode. This is shown in Figure 77.

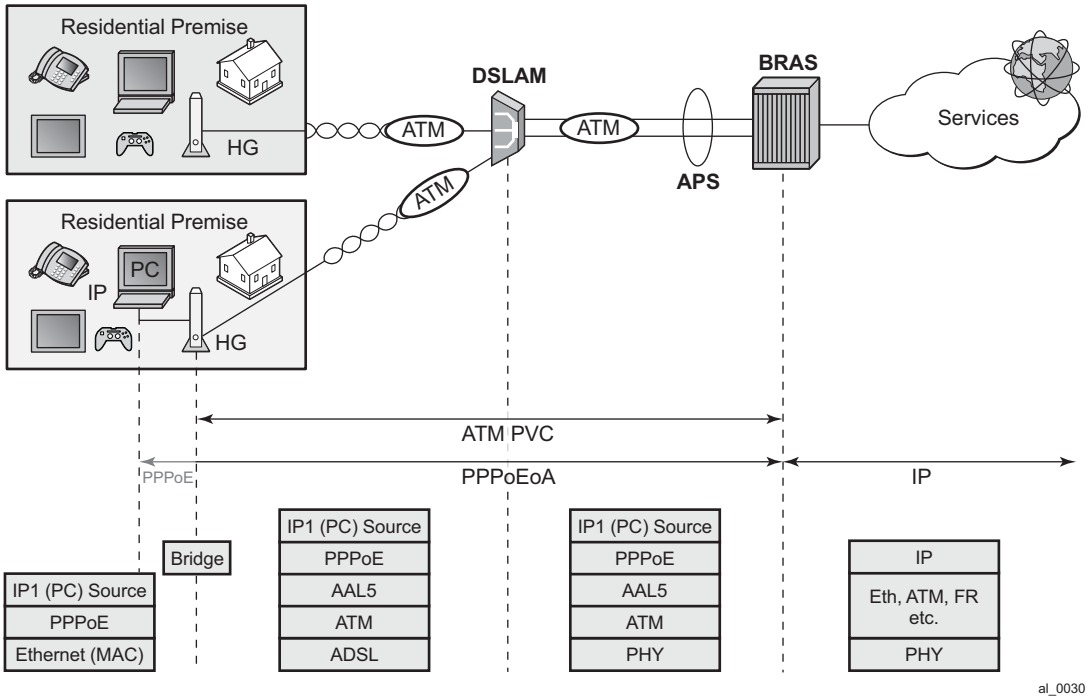


Figure 77: PPoEoA Host Terminated Session

However, the majority of deployments have PPPoE sessions terminated in DSL CPE. Although it is inefficient to add an extra Ethernet encapsulation layer over ATM-equiped DSL CPE, the evolution of PPP in broadband is the chief reason for this deployment scenario as shown in Figure 78.

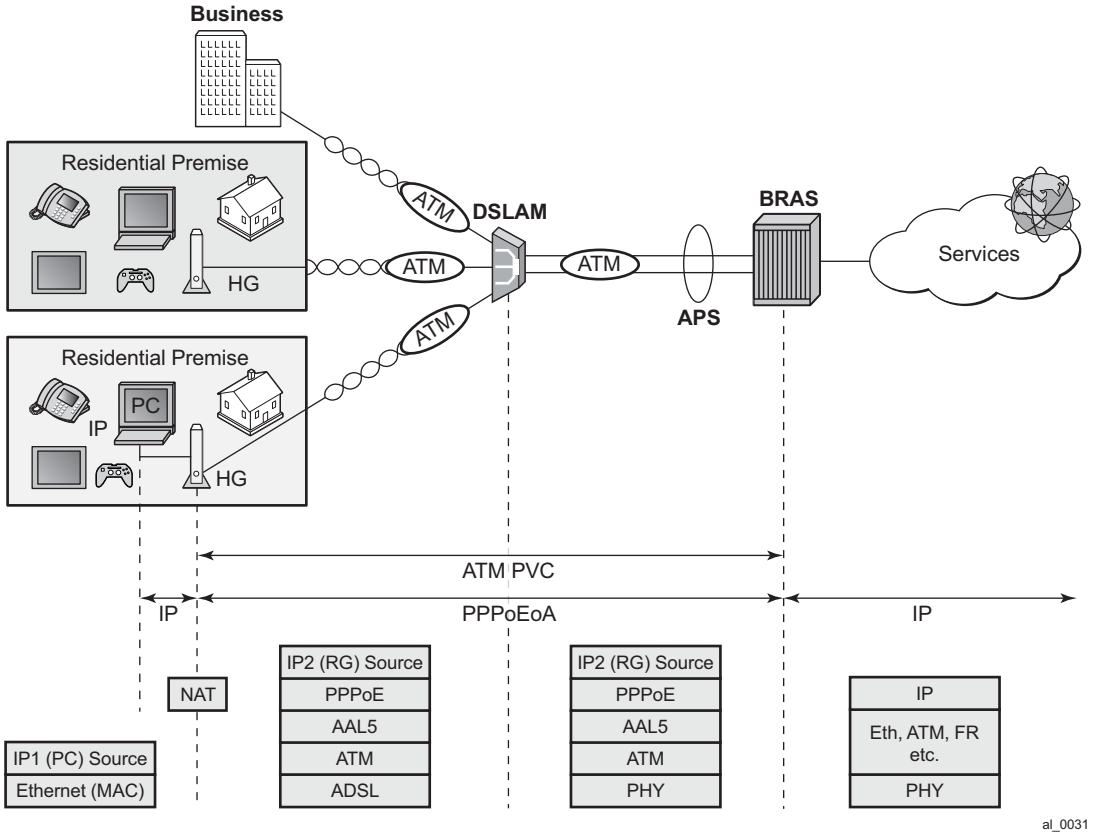


Figure 78: PPPoEoA DSL CPE Terminated Session

PPPoEoA implementation must allow multiple PPPoE sessions of the same subscriber to be carried over a single ATM PVC.

Hardware Support

This feature is supported on ATM MDA on:

- 7750SR (SR-12, SR-7) platforms
- 7750 SR-c4/12 platforms
- 7450 platforms in Mixed Mode.

This feature is implemented only on IOM3 based hardware.

ATM MDAs:

- 16 port ATM OC-3/STM-1 (single rate) –
- 4 port ATM OC-3/12c/STM-1/4c (dual rate on a per port basis; oc3/stm1 or oc12/stm4; port speed can only be changed in groups of four ports).

Chassis modes B,C and D are supported.

PPPoEoA/PPPoA will NOT be supported on the following modules:

ASAP MDAs:

- 4 port channelized OC-3/STM-1 (IOM2-20G and IOM3-XP)
- 1 port channelized OC-12/STM-4
- 12 port channelized DS3/E3 (coax)
- 4 port channelized DS3/E3 (coax)

ATM CMA:

- 8 port T1/E1 ATM (RJ-48)

The 7750-c4/12 currently supports only the four port ATM MDA.

Termination Points within 7x50

PPPoA/PPPoEoA sessions are terminated on the access ATM SAP in IES and IP-VPN service context through subscriber/group interfaces.

However, for the wholesale/retail deployment scenarios, the ATM VCs are terminated on the LAC while the PPP(oE) sessions will be terminated on the LNS.

PPPoA/PPPoEoA is not supported in the wholesale/retail VRF model (wholesale VRF + retailer VRF). However it is supported in wholesale/retail MSAP model (capture SAP in VPLS that is mapped into a VRF).

PPPoA Encapsulation

PPP frames are transported over ATM using ATM AAL5 framing mechanism. This is defined in RFC 2364. In short, each PPP packet is appended by an 8-octet AAL5 trailer with some control information (16-bit length field and a 32-bit CRC being the most important). This new frame is not self-identifying, in other words, kind of payload it carries (PPP, IPv4, IPv6, ARP, MPLS, etc.) can not be identified. This means that if you want to send it as such, it can carry only a single protocol type which must be agreed upon in advance by configuration at each side of a PVC connection. Only then will both ends of the connection be able to recognize the payload type inside of it.

To add more flexibility to the payload type and allow multiple protocol types to be multiplexed within a single VC session, an additional header must be defined in the AAL-5 packet. This header which allows protocol multiplexing over ATM VC is called Link Layer Control (LLC) header. PPP transport over ATM using LLC is defined in RFC 2364, *PPP over AAL5*. A more extensive version for multiplexing protocols over VC is defined in RFC 2684 “Multiprotocol Encapsulation over ATM AAL5” (LLC/SNAP encap).

7x50 supports these two types of PPPoA encapsulation:

1. LLC (RFC 2364)

   LLC header is extended with a NLPID (Network Layer Protocol Identifier) which identifies the protocol type inside of the AAL5 frame. NLPID for PPP in LLC is 0xCF.

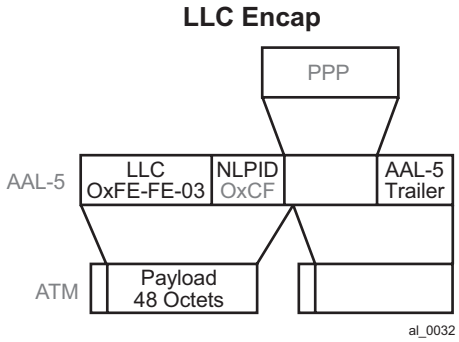


Figure 79: PPPoA LLC Encapsulation

Possible CLI syntax:

```
encapsulation aal5nlpid-ppp
```

The **ppp** keyword in the **aal5nlpid-ppp** command is used to indicate that ppp is the only encapsulation that currently supported in NLPID.

SNAP is an extension to LLC for protocols that are not defined in LLC NLPID. PPP protocol identifier is defined within NLPID and therefore it does not need additional SNAP header (this reduces the overall AAL5 header overhead).

LLC/SNAP encapsulation is defined in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*, and it is needed for PPPoEoA encapsulation.

2. VC-MUX

In VC-MUX mode there is no additional (LLC/SNAP) header used for protocol multiplexing. Instead, VC endpoints must agree before hand on the payload type that they will transport. For PVCs this is done during the provisioning phase on each side of the connection. For example:

encapsulation aal5mux-ppp

aal5mux-ppp will tell each end of the VC in advance that the payload inside of the AAL5 frame is PPP.

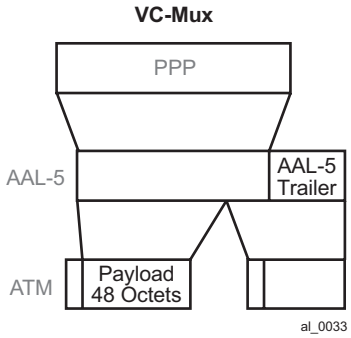


Figure 80: PPPoA AAL5MUX Encapsulation

PPPoEoA Encapsulation

Similar to PPPoA, two types of encapsulation are defined for PPPoEoA:

- Protocol multiplexing (Layer 2 bridging defined by additional headers - LLC/SNAP).
- VC-Multiplexing where payload type within a VC is agreed upon in advance by static configuration.

Both types are supported in our implementation:

1. "Multiprotocol Encapsulation over ATM AAL5" (LLC/SNAP) defined in RFC 2684.

   This encapsulation adds support for protocols that are currently not defined in the LLC header. There are two basic types of encapsulations defined under this RFC:

   – Routed

   – Bridged

   PPPoEoA encapsulation is defined as 'Bridged' where Layer 2 information is preserved through transitioning between two different Layer 2 network types (Ethernet -> ATM) which is shown in Figure 81.

   0xAA-AA-03 in the LLC header indicates the presence of the SNAP header.

   0x00-80-C2 in the OUI indicates that a bridged PDU is encapsulated.

   0x00-01 or 0x00-07 in PID indicates that the encapsulated Layer 2 network type is 802.3 Ethernet with or without preserved FCS.

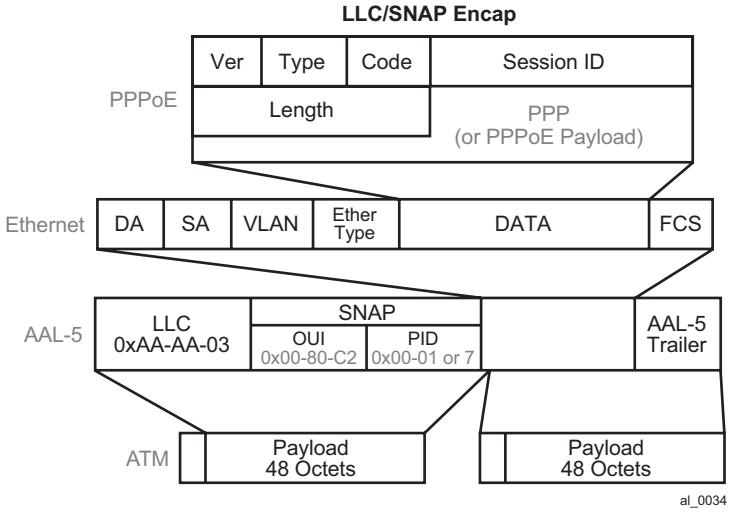


Figure 81: PPPoEoA Bridged LLC/SNAP Encapsulation

The CLI syntax is:

```
encapsulation aal5snap-bridged
```

2. VC-MUX

   In the VC-MUX mode there is no additional (LLC/SNAP) header used for protocol multiplexing. Instead, the VC endpoints must agree before hand on the payload type that they will transport. For PVCs this is done during the provisioning phase on each side of the connection. For example:

   ```
   encapsulation aal5mux-bridged-eth-nofcs
   ```

   `aal5mux-bridged-eth-nofcs` tells each end of the VC in advance that the payload inside of the AAL5 frame is an Ethernet frame. In this case, it accepts the frame and treat it as an Ethernet frame inside AAL5. The EtherType within the frame must be set to 0x8863 (PPPoE Discovey Phase) or 0x8864 (PPPoE Session Phase).

   The '-nofcs' portion indicates that the FCS is not supported on those Ethernet frames.

   PPPoEoA encapsulation is shown in Figure 82.

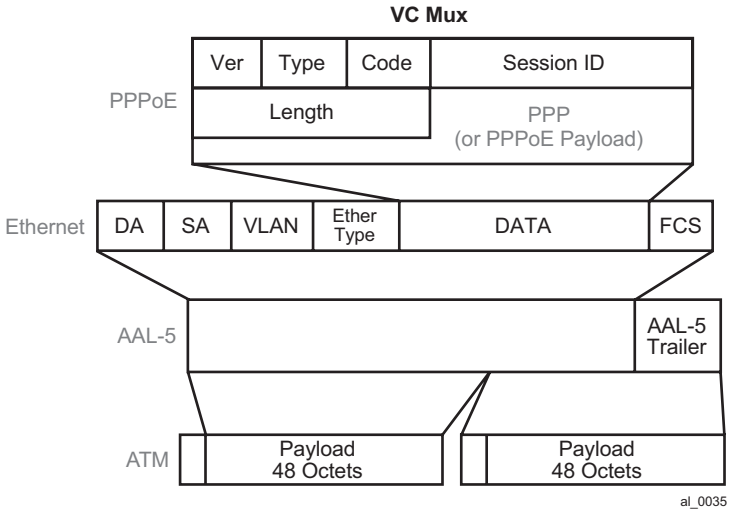


Figure 82: PPPoA AAL5MUX Encapsulation

Encapsulation Summary

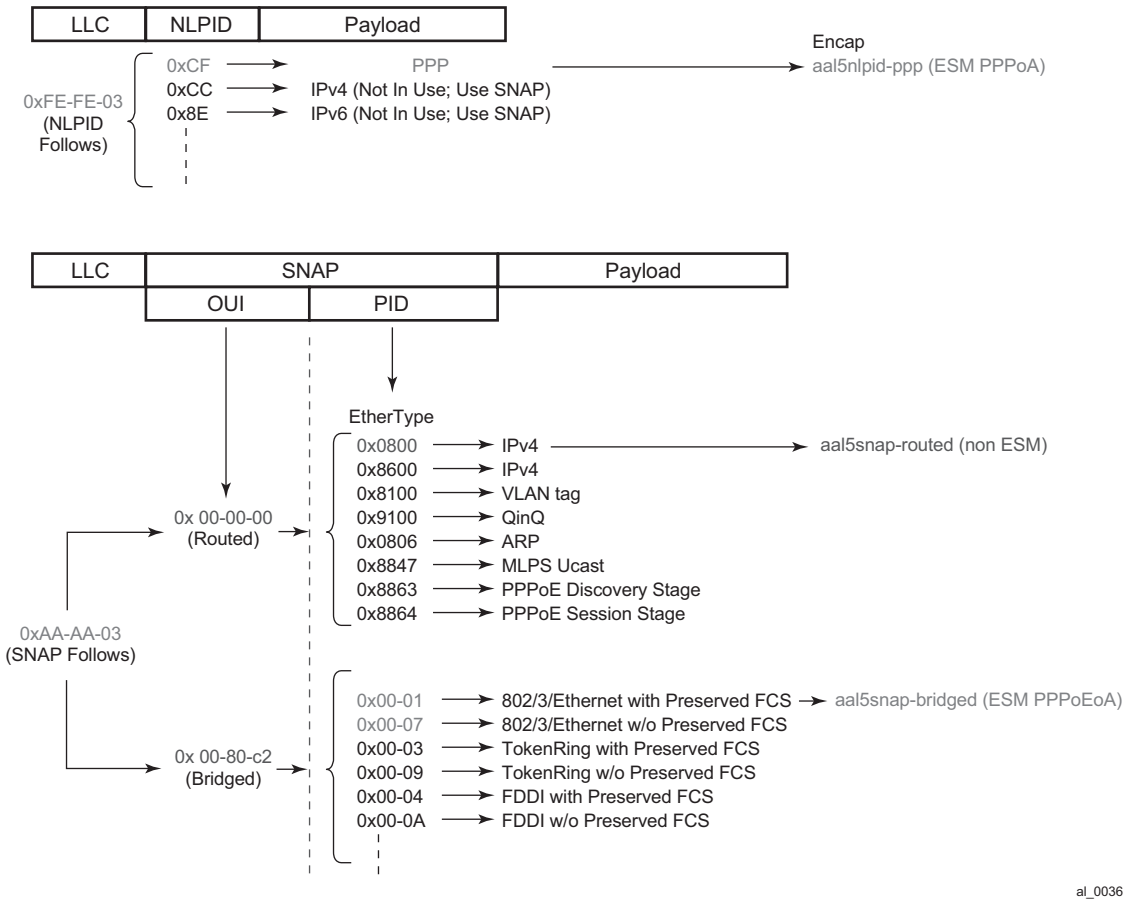


Figure 83: LLC/SNAP Encapsulation

There is a 0-2Byte additional padding (optional) in the SNAP Bridged encapsulation header that is not shown in Figure 83. This padding, according to RFC 2684, is necessary to align the info field (payload of the Layer 2 encapsulated frame) on a 4-Byte boundary.

At the end the following types of ATM encapsulation are supported on 7x50 in ESM:

`aal5snap-bridged`

This encapsulation type is used for PPPoEoA encapsulation with FCS or without FCS on ingress. On egress only frames without MAC FCS can be sent. PPPoE session type will be determined based on the EtherType in the Ethernet frame.

`aal5mux-bridged-eth-nofcs`

This encapsulation type is used for mux PPPoEoA sessions without MAC FCS.

`aal5nlpid-ppp`

This encapsulation type is used for LLC/NLPID PPPoA encapsulated packets.

`aal5mux-ppp`

This type encapsulation is used for PPPoA traffic without LLC/SNAP header (VC-MUX).

`aal5auto` (new command)

This encapsulation type is supported in ESM and it is used for auto detecting the encapsulation type. This is also called autosensing.

All hosts for the same subscriber will use the same encapsulation type.

Concurrent Support for Different Service Types on the Same Port

An ATM port on 7x50 can concurrently support various service types. One service type can be mapped only to one VC. This would normally be the case if there is an aggregation network in front of 7x50. A Service Provider could run a variety of services over this aggregation network (ATM switches) connected on the same physical port within the 7x50.

For example, the following services can be run on the same physical port:

- PPPoA/PPPoEoA sessions connecting residential/business customers through a DSLAM to 7x50
- Providing access for xPIPE services
- Plain aal5snap-ip or vc-mux-ip PVC for Internet access, etc.

Restrictions in Scaled ATM MDA Mode

Note: ATM concatenation mode for Apipe is not supported in the 16K VC mode.

In the concatenated mode, cells are delayed so that they can be concatenated and delivered in a single packet over to pseudowires to the other side. Without concatenation, each cell is transported individually. The implication is that each cell is individually encapsulated into Eth/MPLS which results in wasted bandwidth on the link.

Support for the concatenated ATM pseudowires is not removed from the CLI in the 16K mode of operation:

```
configure
    service apipe <id> [vc-type <cell-type>]
         spoke-sdp <sdp:pw> cell-concatenation
              [no] aal5-frame-aware
              [no] clp-change
              [no] max-cells
              [no] max-delay
```

Instead:

- Adding an ATM port or a connection profile on an MDA in 16-VC mode to an APIPE is disabled if the vc-type is set to atm-cell AND cell-concatenation is enabled.

  ```
  A:BNG>config>service>apipe# sap x/y/z:cp.w create
  MINOR: SVCMGR #2603 Cell-concatenation is not allowed on 16k VC-mode ATM MDAs
  ```

- cell-concatenation on an APIPE of the vc-type atm-cell is disabled if it already contains an ATM port or a connection profile.

  ```
  A:BNG>config>service>apipe>spoke-sdp>cell-concat# max-delay X
  MINOR: SVCMGR #2603 Cell-concatenation is not allowed on 16k VC-mode ATM MDAs
  ```

Note that regular VPI/VCI SAPs (sap:vpi/vci) are not allowed to be configured on an Apipe of vc-type atm-cell.

Cell-concatenation is supported on Apipe services with a VC on an ATM MDA in the 8-VC mode.

AAL5 SDU mode is continued to be supported.

QoS Implementation

In addition to our system QoS that is provided in the “Q” chip on IOM, the ATM MDA offers QoS capabilities at the ATM cell level. In the context of this document, the system QoS is referred to as ‘IOM QoS’ and to ATM MDA provided QoS simply as ‘ATM QoS’.

Both, IOM QoS as well as ATM QoS defined by Traffic Descriptors working at the cell level, play a role in the overall QoS for the SAP (or virtual circuit). ATM QoS defines rates of each VC stream and defines the behavior under port congestion. IOM QoS defines bandwidth allotment and the scheduling scheme for each service within a VC stream.

In general, both MDAs, ATM and ASAP, support four traffic categories:

- CBR
- Rt-VBR
- Nrt-VBR
- UBR

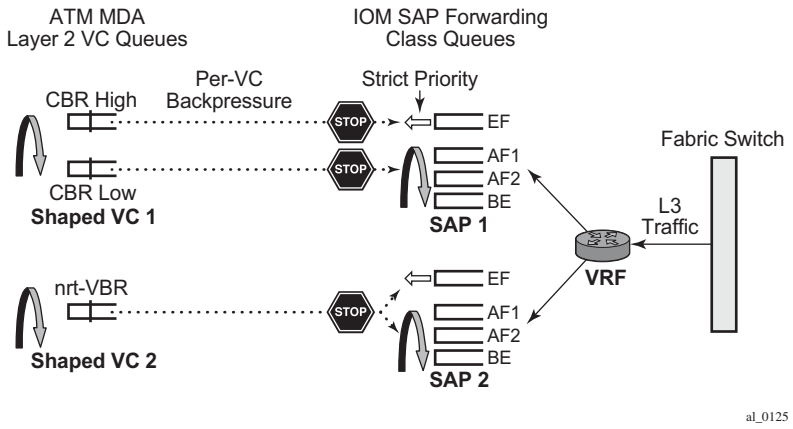


Figure 84: Scheduling on ATM MDA

Each ATM traffic category is defined by a set of parameters, such as PIR, SIR, MIR, MBS and CDTV.

Currently, policing is supported only on ingress for CBR and VBR traffic classes. CBR traffic class police at PIR, while rt/nrt-VBR police at SIR.

Shaping is supported only on egress for CBR and rt/nrt-VBR traffic classes. CBR shapes traffic at PIR, while rt/nrt-VBR shape traffic at SIR. Egress shaping can be disabled only for nrt-VBR traffic class.

Scheduling at the ATM layer is shown in Figure 84. Shaped CBR and VBR traffic classes have two queues, an HP and an LP queue. Packets from IOM are marked according to scheduling priority of the Forwarding Class (expedited or best-effort) from which they were sent and are accepted into the ATM VC queue (HP | LP) accordingly. For example, at the IOM level packets from an expedited FC (queue) are marked as HP, and the packets from a best-effort FC (queue) are marked as LP. When these packets arrive to MDA, they will be admitted into appropriate queues, pending VC (or port) buffer availability.

Non-shaped VBR and UBR have only one queue at the MDA level.

In terms of the ATM QoS scheduling, CBR has the highest scheduling priority (strict priority) followed by rt-VBR (also strict priority). The remaining traffic classes (non-shaped VBR and UBR) are serviced in WRR fashion, the weight being their configured SIR (non shaped nrt-VBR) or MIR (UBR) rate.

There are several areas of QoS that are addressed in relation to integration of IOM QoS and ATM QoS:

- Association between the subscriber and ATM VC traffic descriptor.
- Rate adjustments between Layer 3 and ATM QoS rates due to difference in frame/cell sizes on which they operate.
- Per VP shaping.

Association Between the Subscriber and ATM VC Traffic Descriptor (QoS)

Each PPPoA PVC is of a certain traffic class – CBR, rt/nrt-VBR or UBR/UBR+MIR which along with other parameters is defined in the ATM traffic descriptor profile. For ATM service categories and traffic descriptors. There should be a uniform mapping between service offered and L3 and ATM QoS.

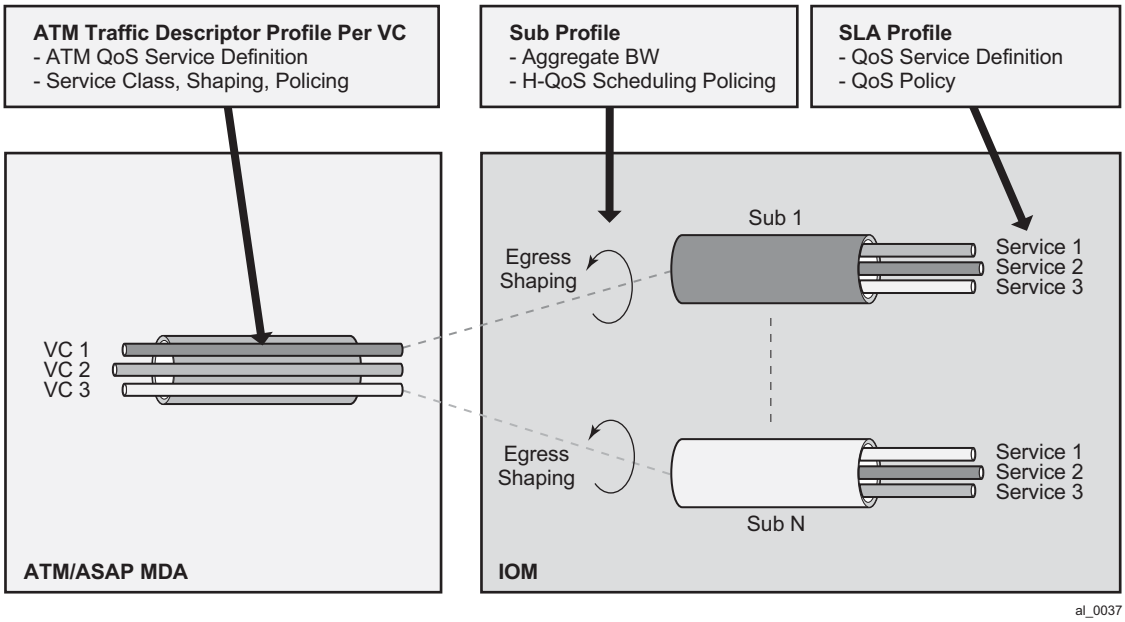


Figure 85: ATM Traffic Descriptor Association with Subscriber

The ATM traffic descriptor (atm-td) is applied to a VC under the SAP CLI hierarchy. In this fashion, MDA related QoS (ATM QoS) is referenced outside of the subscriber context (SUB/SLA-profiles).

The following describes the operability:

atm-td for the VC is applied under the SAP:

```
configure
         services ies/vprn
              subscriber-interface <sub-if-name>
                   group-interface <grp-if-name>
                        sap <sap-id>
                             atm
                                  ingress
                                       traffic-desc <id>
                                  egress
                                       traffic-desc <id>
```

and for MSAP:

```
con  figure
          subscriber-management
               msap-policy <name>
                    atm
                         ingress
                              traffic-desc <id>
                         egress
                              traffic-desc <id>
```

msap-policy is then invoked via LUDB, RADIUS or the default-msap-policy under the capture SAP.

This allows 7x50 to have preconfigured MSAP policies, each corresponding to a specific VC type with its own traffic-class parameters (CBR/rt-nrt-VBR/UBR.). Each subscriber with corresponding hosts is then associated with a msap-policy that determines the VC type.

A more flexible way to go about this would be to allow the subscriber to reference the atm-td directly by the sub-host at the host creation time, independently of the msap-policy. This is supported in the following manner:

- atm-td is referenced via a RADIUS VSA in the Access-Accept message.
- There are two VSAs, one for ingress and one for egress atm-td:
  - alc-ingress-atm-td
    (ATTRIBUTE Alc-ATM-Ingress-TD-Profile 128 integer)
  - alc-egress-atm-td
    (ATTRIBUTE Alc-ATM-Egress-TD-Profile 129 integer)
- Only the first host of the subscriber can overwrite the atm-td that is defined under the msap-policy or under the static SAP.
- Consecutive hosts (second, third, etc.) of the same subscriber will not have any effect on the atm-td of the VC. For example, if the second host tries to overwrite the existing atm-td with a different atm-td, it will fail. Once the atm-td is set via the Access-Accept message for the first host, it cannot be changed as long as the subscriber is active in the system. This implies that all hosts of the same subscriber will have the same atm-td.

- If another hosts of the same subscriber initiates a session with a different atm-td name in the Access-Accept message, the host will be created but the atm-td for the VC will not be changed. A trap/syslog will be generated with a 'VC-parameter-mismatch:VSA ignored' info message.
- atm-td change will not be supported through CoA.

The following guidelines should be followed in configuring ATM traffic descriptors:

- ATM policing is the only function that can discard ATM cells on an ATM MDA
- Ingress:
  - ATM policing can only be enabled on ingress.
  - Policing is disabled by default.
  - Policing can only be enabled for the following traffic categories: CBT, rt-VBR and nrt-VBR.
  - CBR police at PIR. CBR is CLP transparent (it does not look at the CLP bit – aggregate traffic policing).
  - rt-VBR and nrt-VBR police at SIR and can operate either in CLP Significant (CLP marking) or CLP transparent mode (only relevant for Apipes and not for ESM).
  - In CLP significant mode with policing enabled, traffic is policed at the PIR value, but it can be marked with CLP 1 if it exceeds the SIR rate (only relevant for Apipes and not for ESM).
  - Ingress classification: the service category and CLP bits only affect Apipe traffic. If ATM traffic is terminated in the BNG, rely on the existing QoS classification implemented in the IOM.
- Egress:
  - Shaping is supported only on egress. Traffic shaping is supported for CBR, rt/nrt-VBR service categories.
  - ATM MDA is cell "lossless" – It sends backpressure to IOM which drops packets.

Per VP Shaping

VCs traversing the same DSLAMs will typically use the same VPI. To prevent overrunning DSLAM capacity (intermediate destinations) in case an aggregation network is in place (between BNG and a DSLAM), per VP shaping will be implemented.

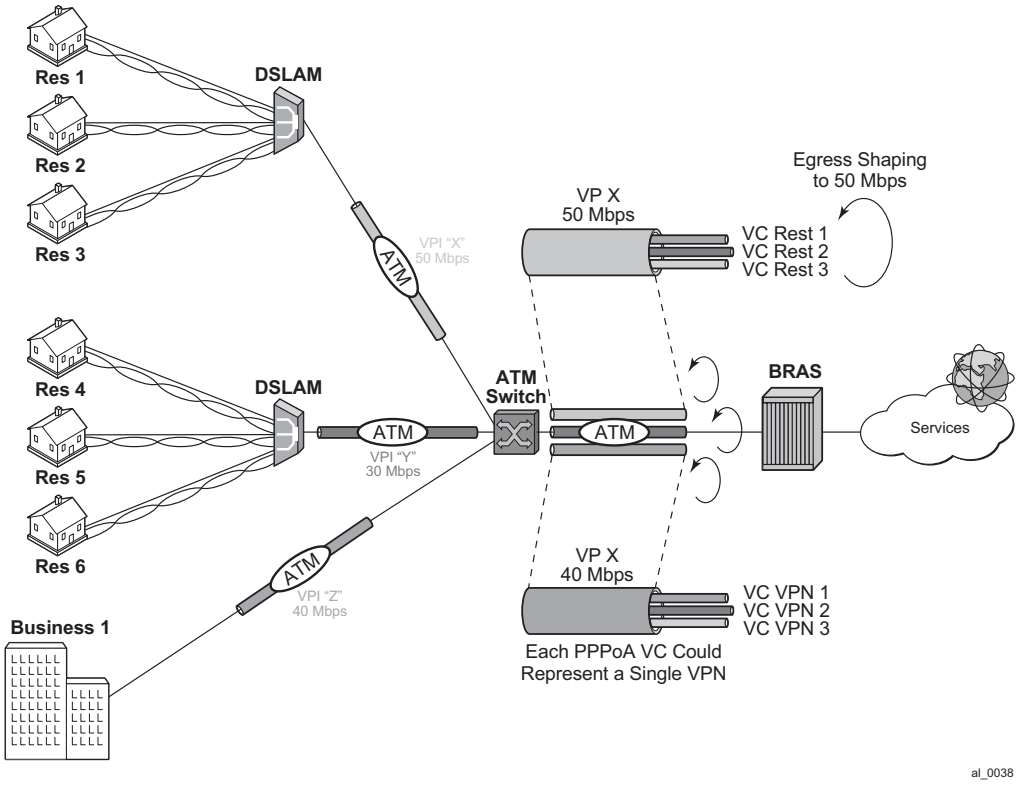


Figure 86: VP Shaper

The shaping rate per VP and the VP service type is provisioned manually via a traffic descriptor on a per port level. The cli syntax is:

```
config
    port <port-id>
        sonet-sdh
            path
              atm
                vp <vpi> egress-traffic-desc <atm-td-profile-id>
```

Where the vpi is a VPI identifier and the egress-traffic-desc is the traffic descriptor id. Only traffic descriptors with service-category of cbr, rt-vbr and nrt-vbr can be used in VP Shapers. However, only the rate in the traffic descriptor can be changed on-the-fly, and not the service category (nrtVBR, rtVBR, CBR). A VP shaper can be added to or removed from active VCs.

CBR VP Shaper shapes cells at the exact PCR rate. There is no burst concept in CBR shaping. Excessive traffic is back-pressured towards the IOM (Q-chip).

The IOM will never send more frames to the ATM MDA than the MDA cannot buffer. This is implemented through a combination of software and hardware backpressure mechanisms. This backpressure mechanism utilizes a combination of hardware and software. Software backpressure aims to have around 100ms of traffic queued against a VC based on its configured shaping/ scheduling rate, but being a software mechanism that is only a guideline. As ATM MDA detects more traffic that it can accept, a hardware backpressure is exerted.

A rt/nrt-VBR type VP Shaper has three parameters associated with it: PCR (peak cell rate), SCR (sustained cell rate) and MBS (maximum burst size at a peak rate). As long as there is enough MBR credit, traffic will be shaped at the PCR rate. Once all MBR credit (burst) is exhausted, traffic will be shaped at the SCR rate. Bursting above the SCR is configurable via the MBS parameter.

In both cases cells will be spaced at 1/PCR or 1/SCR as perfectly as possible with minimum jitter.

VP shaping is supported only when the ATM MDA is in max16k-vc mode. The maximum number of VP shapers per MDA to 128.

The maximum number of VCs that can feed into a single VP shaper is 16K. This includes the sum of all VC-ranges on the VP plus any statically configured VC on that VP.

VCs within the VP tunnel is serviced by a single scheduler assigned to each VP tunnel. The ATM VP shaper will condition the aggregate traffic for all ATM VCs within the VP tunnel. VCs within the shaped VP tunnel are degraded from the originally assigned service category to a common UBR service category (default traffic descriptor). If the VP shaper is removed from the VCs, the VCs will be reverted to their original service category. Scheduling between VCs will be WRR based with a weight parameter that is explicitly configured. The weights assigned to VCs within the VP tunnel are in range 1-255. By default, VCs are assigned a priority based on the originally assigned service category:

- VC degraded from CBR = wight 10
- VC degraded from rt-VBR = weight 7
- VC degraded from nrt-VBR = weight 5
- VC degraded from UBR+ = weight 2
- VC degraded from UBR = weight 1

The weight parameter is user configurable under the traffic descriptor hierarchy.

```
configure
     qos
          atm-td-profile <td-profile-id> [create]
               weight <weight>

<weight> : 1-255.
```

If weight is not specifically configured, the defaults are taken as described above.

The explicitly configured weight parameter is honored only on ATM MDA in the max16k-vc mode. On all other ATM capable MDAs (ASAP or ATM MDA in max8K-VC mode), the weight parameter is ignored.

Note that in the current ATM implementation there is already a WRR scheme in place based on internally calculated weights. This WRR scheme is used to service traffic from the VC queues of equal priority (where there are two queues per VC - a HiPrio and a LowPrio queue). Weights are assigned to VCs automatically based on the rate of the VC,

ATM/IOM QoS Integration

There are major differences between the QoS mode of operation at the ATM MDA level and the IOM level.

ATM QoS operates on fixed size cells that contain additional transport overhead. In addition, ATM shaping is very accurate so that traffic is paced into the ATM network with nodes that are sensitive to bursts (ingress policing). Buffering and service differentiation (number of queues) at the ATM layer is not as flexible as it is on the IOM level.

On the other hand, HQoS in the IOM is less accurate and less responsive to sudden traffic fluctuations (bursts). It operates on Layer 2 frame lengths. Bursts of traffic are usually let into the network more freely than the ATM network would like to accept.

To combine the extensibility of IOM HQoS with the stringent ATM QoS requirements, the two modes of operation are integrated.

The congestion in the ATM network is treated by using extensive IOM HQoS.

When the VC ATM queue becomes congested, it exerts backpressure to the subscriber queues in the IOM on the corresponding VC.

To avoid the condition where a VC becomes overly oversubscribed and excessive in exserting the backpressure, our HQoS in IOM has to be proactive and has to be able to detect congestion on the IOM level based on the ATM VC configured rate or the VP configured rate. IOM HQoS must deal with this congestion before it actually becomes the problem in the ATM layer. Occasional and short-lived backpressure from VCs, but persistent QoS backpressure and congestion at the ATM layer is avoided. A prerequisite for treating ATM congestion at the IOM level is to adjust the frame size in HQoS calculations (on all levels - including queues and aggregate rate limits) so that it reflects the ATM overhead associated with ATM transport (AAL5 encap, cellification).

Intermediate Node Rate Limit/Shaper

In many cases it is desired or even necessary to shape traffic per DSLAM. In the ATM network, a DSLAM corresponds to a VP (Virtual Path) which is at the ATM cell level identified by a VPI (Virtual Path Identifier). The VPI/VCI pair represents the addressing mechanism in the ATM network.

Another level of hierarchy is introduced into our HQoS model - an aggregate rate limit in the IOM that will correspond to the ATM VP shaper. The purpose of this new construct in the IOM is to help detect congestion at the IOM level before it becomes a severe problem at the ATM layer.

As a final solution, our HQoS hierarchy in IOM is a 4 tier hierarchy consisting of:

- subscriber queues that are parented to the port scheduler
- egress agg-rate-limit that represents the egress aggregate subscriber rate
- tier-2 aggregate-rate-limit that represents the ATM VP rate limiter (related to DSLAM). This is a pure rate limiter and not a scheduler (it does not receive any scheduling opportunity).
- port-scheduler to which are subscriber queues parented. The port-scheduler delegates bandwidth to its children based on the priority levels associated with the children queues.

The four tiered hierarchy is needed to deal with:

- port congestion. The port bandwidth can be overbooked the desired service levels can still be ensured.
- ATM VP congestion. An ATM VP can be effectively protected from prolonged congestion that would result into significant backpressure to the IOM queues.
- subscriber congestion. Within the subscriber, bandwidth is managed within the subscriber bandwidth limit.

The four-tiered hierarchy looks like Figure 87.

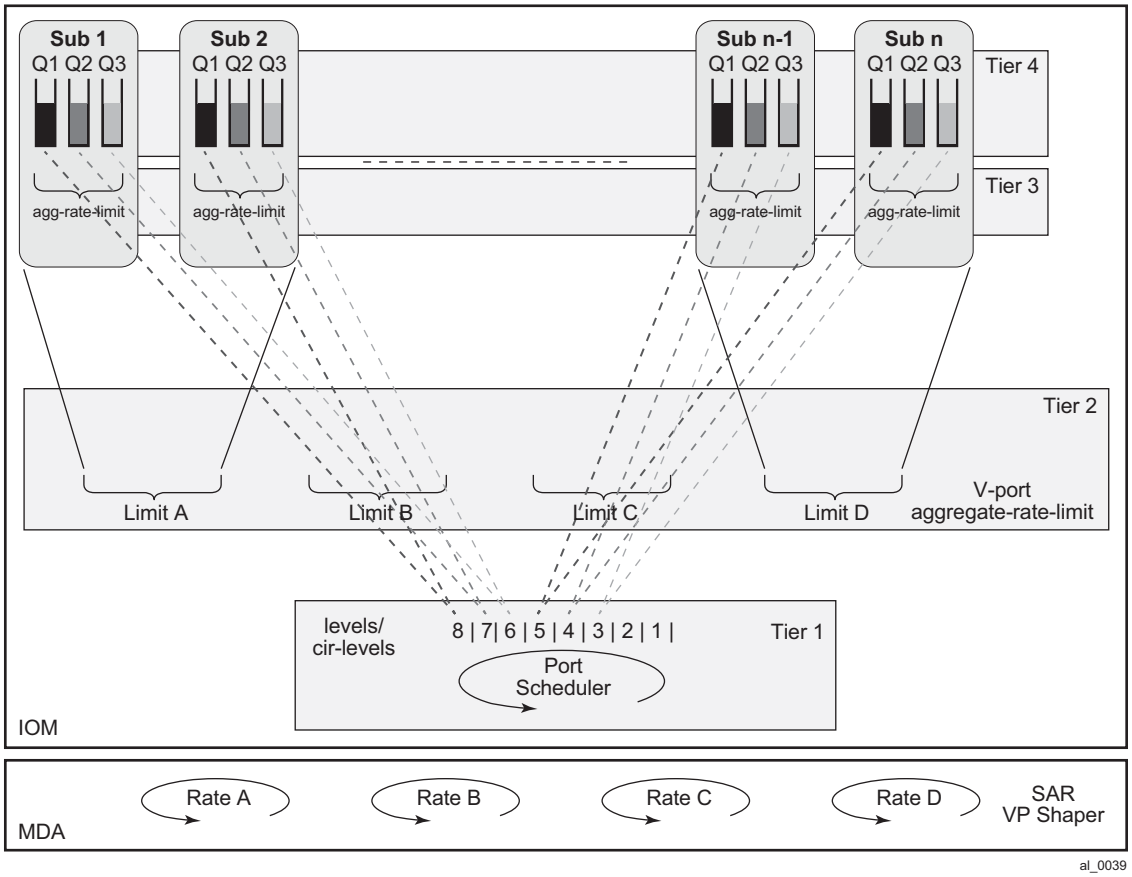


Figure 87: Tier HQoS

The key point in such HQoS model is that the port-scheduler delegates its available bandwidth to the subscriber queues directly according to the queue priority on a configured level. Higher priority queue are served over all subscribers before any lower priority queues, up to the limits imposed by the tier 1 and tier 2 aggregate rate limits.

Provisioning Aspects

The tier 2 aggregate rate limit that corresponds to the VP shaper on the IOM level is provisioned in the context of a vport. The vport is a container that is configured directly under the port and it can contain either an aggregate rate limit or another port scheduling policy (port scheduler). These two constructs (vport aggregate and V-port port scheduling policy) are mutually exclusive. In addition, if a V-port port scheduling policy is configured instead of the V-port aggregate, then the port scheduler cannot be used (currently two port schedulers applied under the same port cannot be used in a parent/children relationship).

The V-port aggregate have to have the agg-rate-limit defined explicitly. In other words, the rate can NOT be implicitly inherited by configuration from the VP shaper traffic descriptor.

Example:

```
config
    port <port-id>
        sonet-sdh
            path
                egress-scheduler-policy <port-scheduler-policy-name>
                access
                    egress
                        vport <vport-name>
                            description <description-string>
                            host-match dest <dest-string>
                            agg-rate-limit <agg-rate>
                            port-scheduler-policy <port-scheduler-policy-name>

                atm
                    vp <vpi> egress-traffic-desc <atm-td-profile-id>
```

The association between the vport aggregate and the subscriber host is done in three ways:

- RADIUS attribute — a dest-string VSA that is matched against the string defined under the corresponding vport. This dest string VSA is returned via RADIUS at the subhost instantiation time.
- LUDB – similar to the RADIUS method. The dest-string comes from the LUDB instead from RADIUS.
- VP identifier (VPI) - The VPI is known to the CPM from the beginning of the session initiation process – raw (unknown encapsulation) packets and passed to the CPM. These raw packets contain VPI,VCI identifiers. The vport container for the subscriber is referenced implicitly via the VPI in the following fashion (Figure 88):
  - CPM determines the VPI from the first packet for the session.
  - ATM VP Shaper mapping: The VPI is used to make the subscriber association with the VP Shaper which is defined under the VP Shaping node: **port>sonet-sdh>path>atm>vp**. The VP Shaping node name must be the VPI number.
  - Vport mapping: The vport-name in the **port>sonet-sdh>path>access>egress>vport <vport-name>** hierarchy is matched against the VPI number.

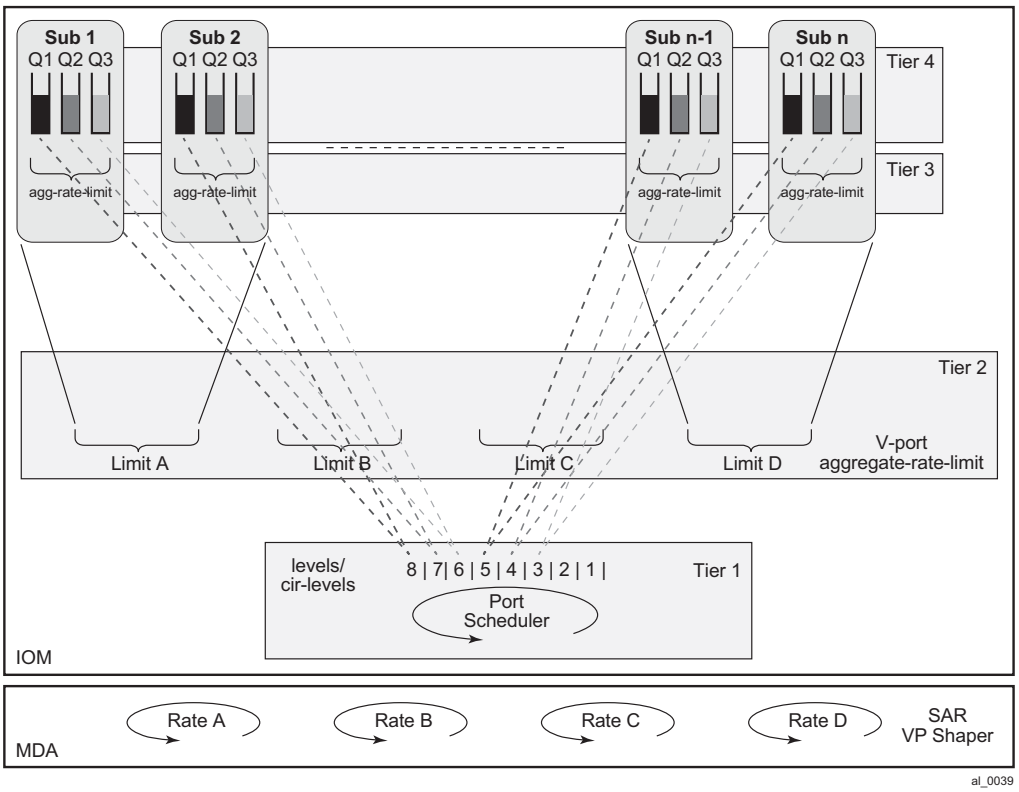


Figure 88: VPI Based V-Port <-> Subscriber Association

The association method (automatic via VPI or based on RADIUS/LUDB) between the subscriber host and the vport is defined under the SAP (or MSAP) where the subscriber resides. In most cases subscriber management is used with MSAPs.

This is the syntax:

```
configure
subscriber-mgmt
msap-policy <name>
sub-sla-mgmt
def-inter-dest-id string <inter-dest-string>
def-inter-dest-id {use-top-q  | use-vpi}

configure
     services ies/vprn
          subscriber-interface <sub-if-name>
               group-interface <grp-if-name>
                    sap <sap-id>
                         sub-sla-mgmt
                              def-inter-dest-id string <inter-dest-string>
def-inter-dest-id {use-top-q | use-vpi}
```

The **def-inter-dest-id** stand for a ‘default inter-destination identifier’.

If the use-vpi method is used and the VPI derived from the incoming traffic points to a non-existing VP container, the association between the subhost and the V-port container will fail and a message/trap is logged. This however will not prevent the creation of the subhost that can be parented to the port-scheduler.

If the use-vpi is used on an Ethernet port where this parameter is not applicable, the parameter is ignored and defaulted to ‘string’. A message/trap is logged.

Note that if the vport contains an aggregate-rate-limit, then there is no need for the indication of a vport construct in the sub-profile or sla-profile of the subscriber. On the contrary, in case that the vport contains a port-scheduling-policy, the sla-profile template must contain the indication that the subscriber is tied to a vport (**configure>subscriber-mgmt>sla-profile>egress>qos sap-egress-qos-policy-id vport-scheduler**.)

HQoS Combinations

These are the possible HQoS combinations that are supported:

- port-scheduler assigned to path, agg-rate-limit assigned to vport, agg-rate-limit assigned to subscriber.
- port-scheduler assigned to path, no vport, agg-rate-limit or scheduler-policy assigned to subscriber.
- no port-scheduler assigned to path, port-scheduler assigned to V-port, agg-rate-limit or scheduler-policy assigned to subscriber.
- no port-scheduler assigned to path, no vport, scheduler-policy assigned to subscriber.

In case that the vport contains the agg-rate-limit, any subscriber host queue that is parented to a virtual scheduler will not be rate-limited by the vport aggregate rate. The queue will compete for bandwidth directly on the port's port scheduler, at the priority level and weighted scheduler group the virtual scheduler is port-parented to. If the virtual scheduler is not port-parented or if there is no port scheduler policy on the port, the host queue will be orphaned and will compete for bandwidth directly based on its own PIR and CIR parameters.

ATM Rate Adjustment

The difference in cell/frame overhead on the ATM level and IOM Level (Layer 2) lead to inconsistent behavior in integrated QoS. For example, IOM based QoS operates on Layer 2 frames (PPP header is included in rate calculations). On the other hand, ATM QoS operates on ATM 53byte cells. Each PPP frame with AAL5 overhead is segmented into 48-byte chunk cells prepended by a 5 byte ATM header. Assuming that ATM QoS operates on 53-octet cells, a significant rate discrepancy might arise from this difference.

For example, consider two flows:

Flow 1, 1000pps, PPP+IP packet size 190Bytes => L2 (IOM) QoS rate is 1520 kbps

Flow 2, 1000pps, PPP+IP Packet size 232Bytes => L2 (IOM) QoS rate is 1856 kbps

Assuming that VC MUX encap is used, and that AAL5 trailer (8 octets + padding) is used:

Flow 1 = AAL5 length is 190+8+48B_boundary_padding= 240Bytes => 5 ATM cells

Flow 2 = AAL5 length is 232+8+48B_boundary_padding= 240Bytes=>5 ATM cells

Each cell has a 5 byte header which translates into a 2120 kbps rate for each flow.

As a result, more bandwidth is required at the ATM layer than the QoS on the IOM level has budgeted. Moreover, the two flows appear to be of the same rate at the ATM layer, even though the IP rate of flow 1 is ~20% less than the flow 2.

From the example above, Flow 1 consumes 40% more bandwidth configured at the ATM layer than it is given in IOM QoS. The rate adjustment depends on the packet size which additionally complicates conversion. This issue is more pronounced with smaller packet sizes.

An example is shown in Figure 89.

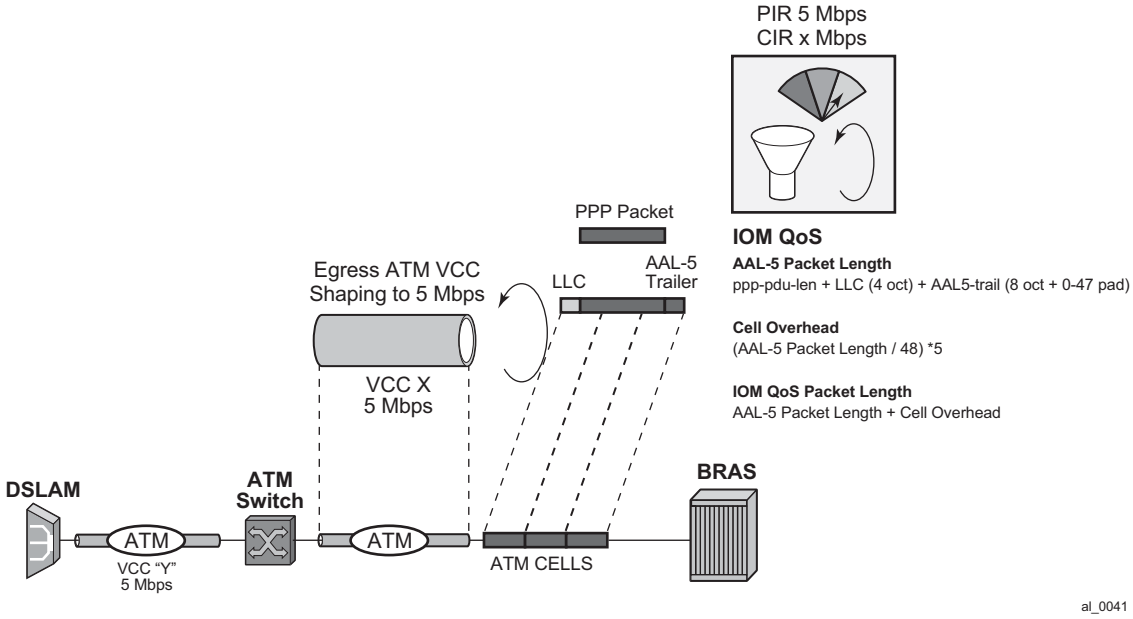


Figure 89: QoS Adjustment

Depending on the session encapsulation (VC-MUX, LLC/SNAP) the packet length on which IOM QoS operates is adjusted.

The rates are adjusted on a per queue level, per subscriber egress agg-rate-limit level, per V-port aggregate level and on per port-scheduler level. Because the ATM termination points are on the

BNG, there is a direct view of the encapsulation. The encapsulation information is supplied to the forwarding plane via the control plane.

The rate adjustment are examined in the following commands:

- **frame-based-accounting** under the qos>scheduler-policy hierarchy
- **queue-frame-based-accounting** under the sub-profile>agg-rate-limit hierarchy
- **avg-frame-overhead** under the queue hierarchy
- **encap-offset** under the sub-profile hierarchy

In PPPoA/PPPoEoA scenario there is no last mile rate adjustment (due to the difference in encapsulation) performed. It is assumed that the encapsulation in the last mile and in the intermediate mile is the same. In other words, it is assumed that the DSLAM does not add/change any encapsulation but instead it only acts as a VPI/VCI cross-connect. If the last mile encapsulation is PPPoA, then the intermediate encapsulation is considered to be PPPoA as well. Similar is valid for PPPoEoA encapsulation.

There are two configuration scenarios possible:

1. The **encap-offset** command in the sub-profile is configured. This command overwrites any other command related to rate conversion that might be configured (**frame-based-accounting**, **queue-frame-based-accounting**, **avg-frame-overhead**, or **avg-frame-size**).
   The *encap-offset* command forces dynamic wire rates calculation in the intermediate mile (directly connected ports) on all levels in the QoS hierarchy. The wire overhead in the intermediate mile takes into account the length of the fixed ATM encapsulation, the variable length of AAL5 encapsulation (including AAL5 48bit boundary padding) and the ATM cellification overhead. The queue stats are also wire based. All calculations are performed in the data plane using the actual packet size. In other words, this command will ensure that the rates on the queue level and the subscriber aggregate level (either through virtual schedulers or egress aggregate-rate limits) are wire based. Port-scheduler and V-port rates are already by default wire based rates and this cannot be changed.
2. The **encap-offset** command is not configured by default. In this case the other rate conversion related commands are in effect (**frame-based-accounting**, **queue-frame-based-accounting**, **avg-frame-overhead**, or **avg-frame-size**). The behavior is the following:
   - Wire rates in the intermediate mile (directly connected ports) are based on the **avg-frame-overhead** command which is provisioned via CLI. If avg-frame-overhead is not provisioned via CLI, by default it is assumed to be 0[%] and the wire rates effectively become data rates (IP payload + IP header + PPP(oE) header + fixed ATM encapsulation).
   - Queue stats (used in accounting) are always ‘data’ stats. This includes the IP Payload + IP header + PPP(oE) header + fixed ATM encapsulation.
   - *agg-rate-limit* (subscriber or vport) rates are always wire rates (as defined in the first bullet – based on the avg-frame-overhead).
   - Rates in the *port-scheduler-policy* (vport or physical port) are always wire based (rates (as defined in the first bullet – based on the avg-frame-overhead).
   - The **frame-based-accounting** command under the scheduler-policy will affect rate calculation for virtual schedulers and queues:

- If this option is configured, the virtual scheduler and queue rates will be wire based.
- if this option is NOT configured, the virtual scheduler and queue rates will be data rates

→ *queue-frame-based-accounting* configuration option under the subscriber agg-rate-limit command (in sub-profile) will affect rate calculations for queues. If this command is configured, the queue rates will be wire rates, otherwise they will be data rates

Avg-frame-size command in PPPoA/PPPoEoA is ignored.

Currently queue rates and subscriber virtual scheduler rates are allowed to be either data rates (one in Figure 90) or *on-the-wire-rates* (three in Figure 90). *Port-scheduler* rates, vport rates and the subscriber *agg-rate-limit* (in sub-profile) are always on *on-the-wire* rates.

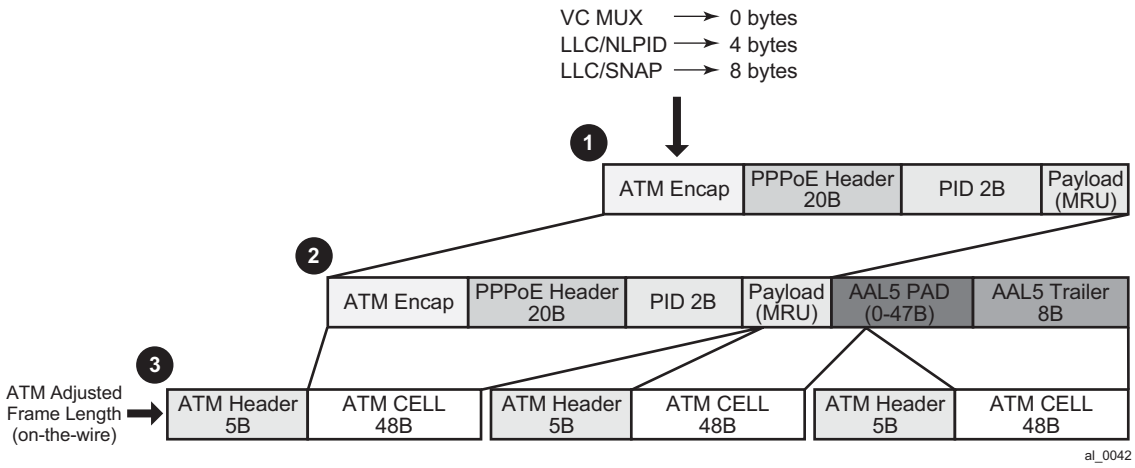


Figure 90: ATM Wire Overhead

Subscriber Instantiation Use Cases

Note that multiple subscribers per single VC are not supported. However, multiple VCs per subscriber are supported.

The following displays examples of how subscriber hosts could be instantiated in PPPoA/PPPoEoA environment.

Case 1

- One host per subscriber.
- One ATM VC per subscriber.
- Authentication is done via RADIUS or LUDB.
- Authentication methods: PAP/CHAP or PADI for PPPoE.
- If there is no RADIUS/LUDB authentication, the subscriber-id should be by default the SAP (with VPI:VCI) with default sub-strings. For MSAP this would be configured under the msap-policy – all subs would have the same service in this case (SLA/SUB profiles).

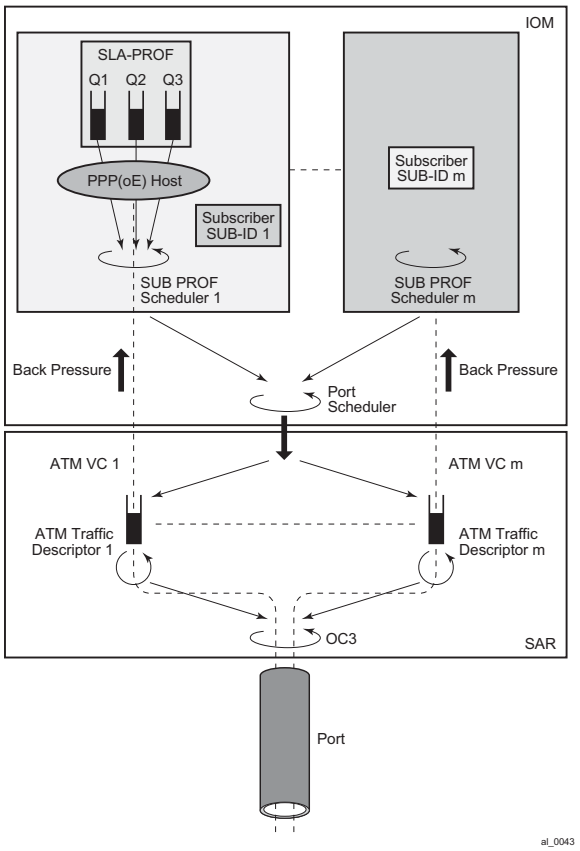


Figure 91: Subhost per VC

Case 2

- Multiple hosts per subscriber
- Single VC per host
- Multiple VCs per subscriber
- PPPoA or PPPoEoA
- Subhosts for the same subscriber can authenticate using a unique username or the same username

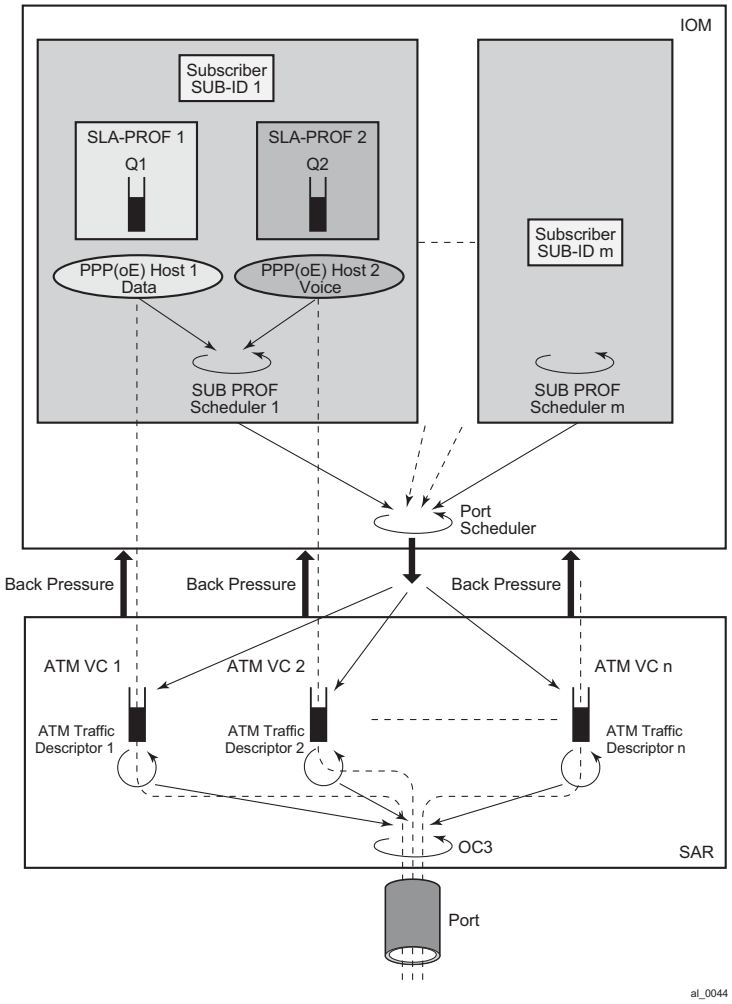


Figure 92: Multiple VCs per Subscriber

Case 3

- Multiple hosts per subscriber
- Singe VC
- PPPoEoA only
- Per host SLA-PROFILE instantiation

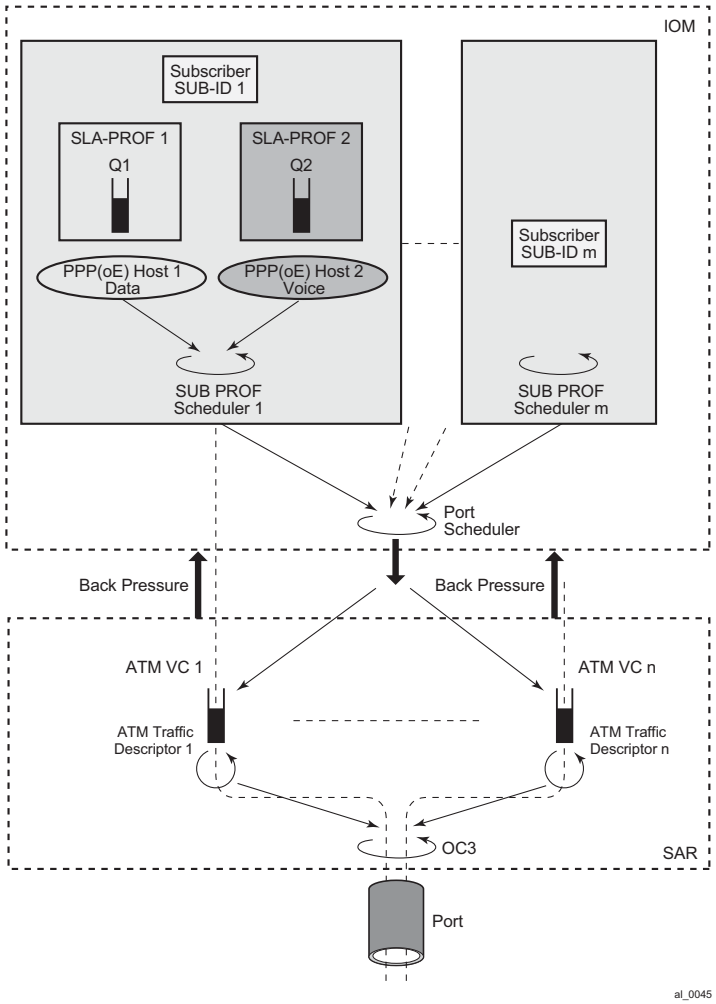


Figure 93: Multiple Hosts per Subscriber, Single VC

Case 4

- VP Shaping

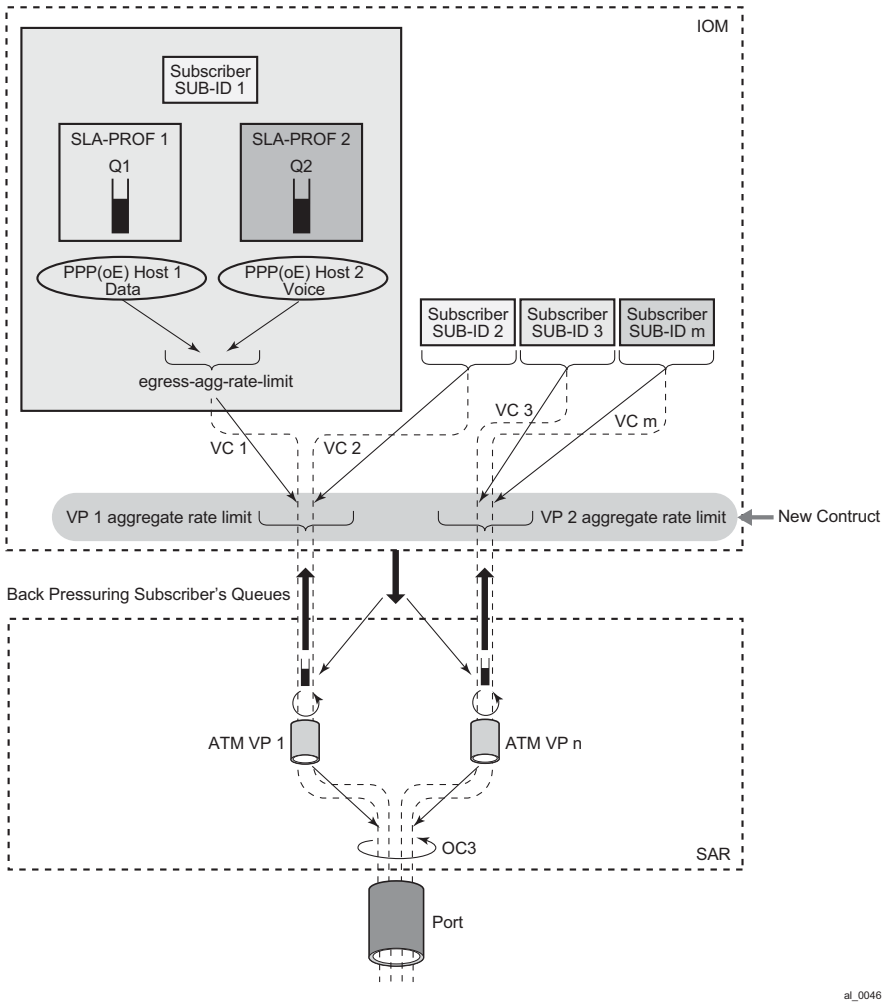


Figure 94: VP Shaping

Authentication

Authentication for PPPoEoA is the same as in PPPoE:

- based on PADI
- based on PAP/CHAP
- No authentication

Authentication in PPPoA is based on:

- PAP/CHAP
- No Authentication — There is a small percentage of cases where this might be required.

An example of no authentication configuration for PPPoEoA would be:

```
configure
     service ies/vprn
          subscriber-interface <sub-if-name>
               group-interface <grp-if-name>
                    dhcp
                         server <ip-address>
                         client-application pppoe  => make PPPoE session the client of DHCP
server
                         local-dhcp-server <dhcp-server-name>
                              user-db <ludb-name>       => allow DHCP server to query LUDB
     subscriber-management
          local-user-db <ludb-name>
               pppoe
                    host <host-name>
                         host-identification [circuit-id | mac | remote-id | service-name |
username]
                    options
                    address
                    identification-strings
```

In the case that there is no PAP/CHAP authentication, a PPPoE host can be identified by a MAC address, circuit/remote-id (inserted by the BNG) or service-name in PPPoE.

LUDB Access via Capture SAP

Access to LUDB via a capture SAP is enabled for this feature:

```
configure
     service vpls <id>
          sap <sap-id> capture-sap
               pppoe-user-db <ludb-name>
               ppp-user-db <ludb-name>
```

Note that if the authentication-policy (RADIUS authentication) is specified under the capture SAP, it (the RADIUS authentication) will take precedence over LUDB.

Encapsulation Autosensing

As previously discussed, these four static encapsulation types will be supported:

1. aal5nlpid-ppp (LLC/SNAP for PPPoA)
2. aal5snap-bridged (LLC/SNAP for PPPoEoA)
3. aal5mux-ppp (mux PPPoA)
4. aal5-mux-bridged-eth-nofcs (mux PPPoEoA)

These four types of encapsulation are supported for ATM MSAPs as well as for fixed configuration ATM SAPs.

In addition, the LLC/SNAP encapsulation type can be autosensed. This is called autosensing. The keyword for autosensing is **aal5auto**. An option is given to provision encapsulation statically, if needed.

```
sap x/y/z:* capture-sap
atm
encapsulation aal5auto | aal5mux-ppp | aal5nlpid-ppp | aal5mux-pppoe | aal5snap-bridged-
eth-nofcs

sap x/y/z:w/z
atm
encapsulation aal5auto | aal5mux-ppp | aal5nlpid-ppp | aal5mux-pppoe | aal5snap-bridged-
eth-nofcs
```

The aforementioned encapsulation options (including autosensing) is visible only under the SAP hierarchy on group-interfaces and on capture SAPs in VPLS. This is allowed only in 16K-VP mode ATM MDA.

SAP Autoprovisioning

In order to simplify the provisioning of the subscriber access ports in the ESM context, a concept similar to managed SAP(MSAP) on Ethernet is introduced. In Ethernet MSAP, an ingress access SAP is automatically created upon receipt of the first (VLAN) tagged packet from the customer side (pending the authentication process).

In our ESM over PPPoA/PPPoEoA case, a number of PVCs is pre-provisioned that will initially be only in a provisioned (or listening, passive) state. This is sometimes referred as a bulk configuration of VC ranges. Once the initial ESM processing in the CPM is completed (for example, the user is authenticated), the ATM SAP is created in the appropriate context (VRF or GRT) and the ATM VC is activated. ATM VC activation means that the ATM VC is associated with a SAP.

The ratio between the maximum number of provisioned VCs vs the maximum number of active VCs on an MDA supporting PPPoA/PPPoEoA is 2:1. This amounts to 32K ATM VCs in the listening state. Out of the total 32K ATM VCs, 16K ATM VCs can be active simultaneously.

Obviously, there are some differences between the Ethernet MSAP processing and the ATM MSAP processing. On Ethernet there is not need to pre-configure VCs, while on ATM this is necessary due to complexity of ATM layer comparing to Ethernet.

Our current Ethernet based MSAP is configured under VPLS. The same approach is adopted for ATM capture SAP.

Since a combination of ESM over PPPoA/PPPoEoA VCs and other non PPPoA/PPPoEoA VCs on a single physical port is supported, ranges of VCs that will be supported in autoconfiguration are defined. ATM VCs outside this range are available for manual creation. Multiple ranges are necessary in order to address non-contiguous sets of VPI/VCIs.

The following is the CLI syntax:

```
configure
    service vpls <id> customer <customer-id> [create]
        sap x/y/x:*/* capture-sap [create]
            atm
                vc-range <num> vpi-range <vpi-range> vci-range <vci-range>
```

Note that the capture SAP must be configured as '*/*' in place of the VPI/VCI identifiers. Any other combination for the VPI/VCI identifiers is not allowed.

Up to 5 ranges are allowed per capture SAP. VCs configured in this way can carry a single PPP session per VC or multiple PPPoE sessions per VC. Ranges are not allowed unless the ATM MDA is in the 16K-VCs mode.

The total number of VCs that can be fed into a VP is 16K. This includes all VC ranges associated with the VP plus any statically configured VC on the VP.

PPP Nodes and ppp-policy

Differences in operation between PPP and PPPoE warrant creation of a new ppp node under the *group-interface* in the CLI that will cover PPP aspects of operation. The existing pppoe node under the *group-interface* is preserved in the CLI. This allows referencing different *user-dbs* for authentication purposes and different session parameters defined in the *ppp-policy* for each session type (pppoe or plain ppp).

PPP node under the *group-interface* is used to cover PPPoA operation while PPPoE node is used to cover PPPoE and PPPoEoA operation. ATM in PPPoEoA is just a transport and as such does not carry any information relevant to PPP operation (like PADx does in PPPoE).

For dynamic SAPs (managed SAPs), the same PPP(oE) related structures are referenced under the capture SAP hierarchy. Under the capture SAP there are no ppp/pppoe nodes (like they are under the group-interface hierarchy). In order to differentiate between *ppp* and *pppoe* clients, a new ppp-policy command is introduced in addition to the *pppoe-policy* command. The *ppp-policy* under the

capture SAP is needed for the definition of session parameters before the *group-interface* (where normally session parameters are referenced) is determined.

Two commands for LUDB access are available under the same *capture-sap* hierarchy (*pppoe-user-db* and *ppp-user-db*).

The *ppp-policy* under the *subscr-mgmt* hierarchy contains PPP and PPPoE session parameters. PPP parameters are applicable to both session types (PPP and PPPoE) while PPPoE parameters are applicable only to PPPoE session type. The PPPoE parameters are ignored for PPP sessions.

MTU Considerations

MRU configuration option negotiated during the LCP phase in PPPoA is based on the following command:

```
configure>subscr-mgmt>ppp-policy#
     ppp-mtu
```

By default, this command is disabled and consequently will negotiate the default MRU of 1500B, as long as the ATM port's MTU can accommodate at least 1500B:

```
configure>port>sonnet-sdh>path#
     mtu
```

The MRU option in PPPoA refers to the PPP packet length (PID+Information+Padding) that is ATM encapsulated.

PPP(oE) Session Antispoofing

Antispoofing filters need to be in place in order to prevent the hijacking of a PPPoA/PPPoEoA session. For successful anti-spoofing, the following fields are accessible:

- Source IP address (PPPoA and PPPoEoA)
- VPI/VCI pair which is equivalent to the SAP (PPPoA/PPPoEoA)
- Source MAC Address (PPPoEoA only)
- session-ID (PPPoEoA only)

1. For locally terminated PPPoEoA subscriber hosts, access to all fields are required (a, b, c and d). Antispoofing is defined under the following hierarchy:

```
configure
service <svc-name>
subscriber-interface <sub-if-name>
group-interface <grp-if-name>
          pppoe
anti-spoof [mac-sid | mac-sid-ip]
```

   This behavior matches our current PPPoE behavior. The default antispoofing option is set to mac-sid, which means that the incoming traffic is checked against the source MAC address and the session-ID. Antispoofing under this hierarchy cannot be disabled.

   The source IP address can be added to the source MAC and session-ID (mac-sid-ip).

   Note that the group-interface is the lowest granularity at which options can be anabled. In other words, these two options (mac+sid or mac+sid+ip) cannot be changed at the SAP level.

   The VPI/VCI pair is always be checked against the incoming traffic, regardless of the configuration option as the VPI/VCI pair is an intrinsic part of the SAP (similar to VLAN tags on Ethernet).

   In case that a subscriber host is a routed host (managed routes), the nh-mac antispoofing option must be enabled under the managed sap (msap-policy) or group-interface->sap level. Otherwise, managed routes for the host would NOT be installed. The nh-mac option forces a lookup of the incoming packet based on the mac+sid of the originally created host (CPE device). Note that only the group-interface->sap>anti-spoof and msap-policy hierarchies contain the nh-mac option, and NOT the pppoe->anti-spoof hierarchy.

   For locally terminated PPPoA subscriber hosts, only access to source IP address is available (src MAC and session-ID fields are non-existent in PPP).

   The default antispoofing is based on the VPI/VCI pair + IP. This cannot be changed by configuration, except when the session has managed routes or is a LAC session. In the case of managed routes (routed host) a lookup will be done based on the SAP (VPI/VCI) only. The antispoofing for PPPoA should be set to antispoof nh-mac, under msap-policy or grp-if>sap hierarchy even though PPPoA has no MAC address.

For LAC, the behavior is the following:

- For PPPoE traffic, antispoofing is always done based only on the SAP+mac+session-id.
- For PPP traffic, antispoofing is always based on VPI/VCI pair (SAP only). The IOM automatically determines whether IP based antispoofing can be done (e.g. no IP based antispoofing for LAC and managed routes).

There are two other nodes on which antispoofing can be configured:

```
configure
     service ies/vprn
          subscriber-interface <sub-if-name>
               group-interface <grp-if-name>
                    sap <sap-id>
                         anti-spoofing [ip|ip-mac|nh-mac]
```

A few points in regards to the above hierarchy:

- **ip** - This option can be only used in BSM mode. This is used only for IPoE.
- **ip-mac** – Lookup is performed based on the combination of the IP address and MAC address (incipient host). This is used for IPoE. For PPPoE, it will be overwritten by the configuration option under the group-interface-> ppp node (mac+sid or mac-sid+ip).
- **nh-mac** – Lookup is based on the MAC only for IPoE or mac+sid for PPPoE.

```
configure
     subscriber-managemnt
          msap-policy <msap-pol-name>
               ies-vprn-only-sap-parameters
                    anti-spoof [ip-mac|nh-mac]
```

This is similar to the previous case (under the group-interface>sap hierarchy) with the exception that the pure IP option is not supported under the MSAP. The reason is that the IP option can only be used in BSM (under the SAP node) whereas MSAP can only be used in ESM (PPPoX).

Note that for IPoE, the entire control over antispoofing under the (M)SAP node, while for PPPoE, the anti-spoofing control is distributed between the (M)SAP node and the *group-interface->ppp* node.

Multi-Chassis Synchronization

Figure 95 shows the configuration under which synchronization of subscriber management information is performed. As depicted, a single access node aggregating several subscriber lines is dual- homed to redundant-pair of nodes.

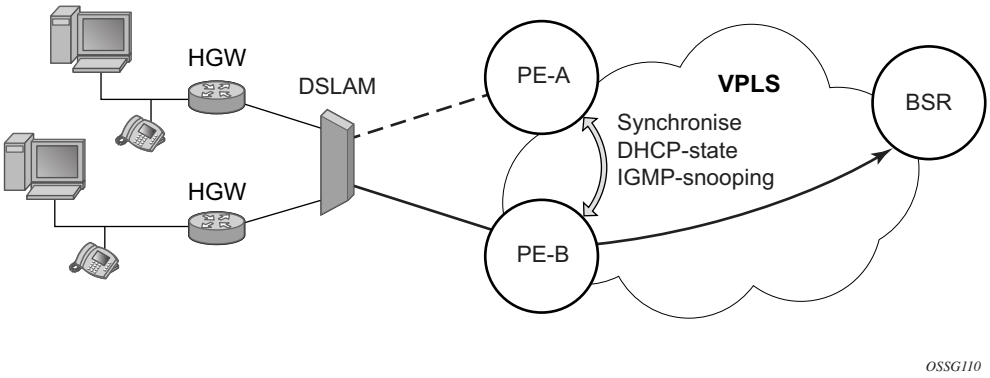


Figure 95: Dual-Homing Configuration

Enabling subscriber management features (whether basic subscriber-management (BSM) or enhanced subscriber management (ESM)) causes the node to create and maintain state information related to a given subscriber-host. This information is synchronized between redundant-pair nodes to secure non-stop service delivery in case of the switchover.

Overview

The synchronization process provides the means to manage distributed database (the Multi-Chassis Synchronization (MCS) database), which contains the dynamic state information created on any of the nodes by any application using its services. The individual entries in the MCS database are always paired by peering-relation, sync-tag and application-id. At any time the given entry is related two the single redundant-pair objects (two SAPs on two different nodes) and hence stored in a local MCS database of the respective nodes.

Internally, peering-relation and sync-tag are translated into a port and encapsulation value identifying the object (SAP) that the given entry is associated with. The application-id then identifies the application which created the entry on one of the nodes. There are three basic operations that the application can perform on MCS database. The MCS database will always synchronize these operations with its respective peer for the given entry.

The following principles apply:

- add-operation — Any dynamic-state created in the application is pushed to the MCS database. MCS then creates and synchronizes with the corresponding peer provided (if configured). The application in the peer node is then notified as soon as the entry has been created. Similarly, the application in the local node (the node where the state has been created) is notified that entry has been synchronized (MCS is “in-sync” state). This operation will be also used to modify existing MCS database entry.
- local-delete — The MCS database entry is marked as no longer in use locally and this information is sent to the peer node. If the information is no longer used by applications on both nodes (the application in remote-node has already issued local-delete before), it is removed from database.
- global-delete — The MCS database entry is removed from both nodes and from the application in the remote node.

The choice of the operation in corresponding situation is driven by the application. The following general guidelines are observed:

- An event which leads to a dynamic-state deletion on a standby chassis will be handled as “local-delete”.
- An event which leads to a dynamic-state deletion on an active chassis will be handled as “global-delete”.
- An exception to above the rules is an explicit “clear” command which will be handled as “global-delete” regardless of where the command was executed.

As previously stated, the MCS process automatically synchronizes any database operation with the corresponding peer. During this time, the MCS process maintains state per peer indicating to the applications (and network operator) the current status, such as in-sync, synchronizing or sync_down. These states are indicated by corresponding traps.

Loss of Synchronization and Reconciliation

Each time the connection between the redundant pair nodes is (re)established the MCS database will be re-synchronized. There are several levels of connectivity loss which may have different effect on amount of data being lost. To prevent massive retransmissions when the synchronization connection experiences loss or excessive delay, the MCS process implementation will take provisions to ensure following:

- In the case of a reboot of one or both nodes or establishing the peering for the first time, the full MCS database will be reconciled.
- In the case that the MCS communication is lost and then re-established but neither node rebooted during the connection loss, only the information not synchronized during this time will be reconciled (using sequence numbers helps identify information which was not synchronized).
- In the case that MCS communication is lost because of excessive delay in ACK messages but no information has been effectively lost, the MCS process indicates a loss of synchronization but no reconciliation is performed.

Subscriber Routed Redundancy Protocol (SRRP)

Subscriber Routed Redundancy Protocol (SRRP) is closely tied to the multi-chassis synchronization protocol used to synchronize information between redundant nodes. An MCS peer must be configured and operational when subscriber hosts have a redundant connection to two nodes. Subscriber hosts are identified by the ingress SAP, the hosts IP and MAC addresses. Once a host is identified on one node, the MCS peering is used to inform the other node that the host exists and conveys the dynamic DHCP lease state information of the host. MCS creates a common association between the virtual ports (SAPs) shared by a subscriber. This association is configured at the MCS peering level by defining a tag for a port and range of SAPs. The same tag is defined on the other nodes peering context for another port (does not need to be the same port-ID) with the same SAP range. In this manner, a subscriber host and Dot1Q tag sent across the peering with the appropriate tag will be mapped to the redundant SAP on the other node.

Once SRRP is active on the group IP interface, the SRRP instance will attempt to communicate through in-band (over the group IP interfaces SAPs) and out-of-band (over the group IP interfaces redundant IP interface) messages to a remote router. If the remote router is also running SRRP with the same SRRP instance ID, one router will enter a master state while the other router will enter a backup state. Since both routers are sharing a common SRRP gateway MAC address that is used for the SRRP gateway IP addresses and for proxy ARP functions, either node may act as the default gateway for the attached subscriber hosts.

For proper operation, each subscriber subnet associated with the SRRP instance must have a gw-address defined. The SRRP instance cannot be activated (no shutdown) unless each subscriber subnet associated with the group IP interface has an SRRP gateway IP address. Once the SRRP instance is activated, new subscriber subnets cannot be added without a corresponding SRRP gateway IP address. Table 16 describes how the SRRP instance state is used to manage access to subscriber hosts associated with the group IP interface.

SRRP instances are created in the disabled state (shutdown). To activate SRRP the no shutdown command in the SRRP context must be executed.

Before activating an SRRP instance on a group IP interface, the following actions are required:

- Add SRRP gateway IP addresses to all subscriber subnets associated with the group IP interface, including subnets on subscriber IP interfaces associated as retail routing contexts (at least one subnet must be on the subscriber IP interface containing the group IP interface and its SRRP instance).
- Create a redundant IP interface and associate it with the SRRP instances group IP interface for shunting traffic to the remote router when master.
- Specify the group IP interface SAP used for SRRP advertisement and Information messaging.

Before activating an SRRP instance on a group IP interface, the following actions should be considered:

- Associate the SRRP instance to a Multi-Chassis Synchronization (MCS) peering terminating on the neighboring router (the MCS peering should exist as the peering is required for redundant subscriber host management)
- Define a description string for the SRRP instance
- Specify the SRRP gateway MAC address used by the SRRP instance (must be the same on both the local and remote SRRP instance participating in the same SRRP context)
- Change the base priority for the SRRP instance
- Specify one or more VRRP policies to dynamically manage the SRRP instance base priority
- Specify a new keep alive interval for the SRRP instance

Table 16 lists the SRRP's state effect on subscriber hosts associated with group IP interfaces.

Table 16: SRRP State Effect on Subscriber Hosts Associated with Group IP Interface

SRRP State	ARP	Local Proxy ARP Enabled	Remote Proxy ARP Enabled	Subscriber Host Routing
Disabled	• Will respond to ARP for all owned subscriber subnet IP addresses. • Will not respond to ARP for subscriber subnet SRRP gateway IP addresses. • All ARP responses will contain the native MAC of the group IP interface (not the SRRP gateway MAC).	• Will respond to ARP for all subscriber hosts on the subscriber subnet.	• Will respond to ARP for all reachable remote IP hosts.	• All routing out the group IP interface will use the native group IP interface MAC address. • The group IP interface redundant IP interface will not be used. • Will not accept packets destined to the SRRP gateway MAC received on the group IP interface.
Becoming Master (In order to enter becoming master state, a master must currently exist)	• Will respond to ARP for all owned subscriber subnet IP addresses (hardware address and source MAC = group IP interface native MAC). • Will respond to ARP for subscriber subnet SRRP gateway IP addresses (hardware address = SRRP gateway IP address, source MAC = group IP interface native MAC).	• Will respond to ARP for all subscriber hosts on the subscriber subnet (hardware address = SRRP gateway MAC address, source MAC = group IP interface native MAC).	• Will respond to ARP for all reachable remote IP hosts (hardware address = SRRP gateway MAC address, source MAC = group IP interface native MAC).	• All routing out the group IP interface will use the native group IP interface MAC address. • Subscriber hosts mapped to the redundant IP interface are remapped to the group IP interface. • Will not accept packets destined to the SRRP gateway MAC received on the group IP interface.

Table 16: SRRP State Effect on Subscriber Hosts Associated with Group IP Interface (Continued)

SRRP State	ARP	Local Proxy ARP Enabled	Remote Proxy ARP Enabled	Subscriber Host Routing
Master	• Will respond to ARP for all owned subscriber subnet IP addresses (hardware address and source MAC = group IP interface native MAC). • Will respond to ARP for subscriber subnet SRRP gateway IP addresses (hardware address = SRRP gateway IP address, source MAC = group IP interface native MAC).	• Will respond to ARP for all subscriber hosts on the subscriber subnet (hardware address = SRRP gateway MAC address, source MAC = group IP interface native MAC).	• Will respond to ARP for all reachable remote IP hosts (hardware address = SRRP gateway MAC address, source MAC = group IP interface native MAC).	• All routing out the group IP interface will use the SRRP gateway MAC address. • Subscriber hosts mapped to the redundant IP interface are remapped to the group IP interface. • Will accept packets destined to the SRRP gateway MAC received on the group IP interface.
Becoming Backup (redundant IP interface operational)	• Will respond to ARP for all owned subscriber subnet IP addresses (hardware address and source MAC = group IP interface native MAC). • Will not respond to ARP for subscriber subnet SRRP gateway IP addresses	• Will not respond to ARP for any subscriber hosts on the subscriber subnet.	• Will not respond to ARP for any remote IP hosts.	• Will not route out the group IP interface for subscriber hosts associated with the subscriber subnet. • Subscriber hosts mapped to the group IP interface are remapped to the redundant IP interface. • Will accept packets destined to the SRRP gateway MAC received on the group IP interface.

Table 16: SRRP State Effect on Subscriber Hosts Associated with Group IP Interface (Continued)

SRRP State	ARP	Local Proxy ARP Enabled	Remote Proxy ARP Enabled	Subscriber Host Routing
Becoming Backup (redundant IP interface not available)	• Will respond to ARP for all owned subscriber subnet IP addresses (hardware address and source MAC = group IP interface native MAC). • Will not respond to ARP for subscriber subnet SRRP gateway IP addresses.	• Will not respond to ARP for any subscriber hosts on the subscriber subnet.	• Will not respond to ARP for any remote IP hosts.	• Will route out the group IP interface for subscriber hosts associated with the subscriber subnet using the group IP interface native MAC address. • Subscriber hosts mapped to the redundant IP interface are remapped to the group IP interface. • Will accept packets destined to the SRRP gateway MAC received on the group IP interface
Backup (redundant IP interface operational)	• Will respond to ARP for all owned subscriber subnet IP addresses (hardware address and source MAC = group IP interface native MAC). • Will not respond to ARP for subscriber subnet SRRP gateway IP addresses.	• Will not respond to ARP for any subscriber hosts on the subscriber subnet	• Will not respond to ARP for any remote IP hosts	• Will not route out the group IP interface for subscriber hosts associated with the subscriber subnet. • Subscriber hosts mapped to the group IP interface are remapped to the redundant IP interface. • Will not accept packets destined to the SRRP gateway MAC received on the group IP interface.

Table 16: SRRP State Effect on Subscriber Hosts Associated with Group IP Interface (Continued)

SRRP State	ARP	Local Proxy ARP Enabled	Remote Proxy ARP Enabled	Subscriber Host Routing
Backup (redundant IP interface not available)	• Will respond to ARP for all owned subscriber subnet IP addresses (hardware address and source MAC = group IP interface native MAC). • Will not respond to ARP for subscriber subnet SRRP gateway IP addresses.	• Will not respond to ARP for any subscriber hosts on the subscriber subnet.	• Will not respond to ARP for any remote IP hosts.	• Will route out the group IP interface for subscriber hosts associated with the subscriber subnet using the group IP interface native MAC address. • Subscriber hosts mapped to the redundant IP interface are remapped to the group IP interface. • Will not accept packets destined to the SRRP gateway MAC received on the group IP interface.

SRRP Messaging

SRRP uses the same messaging format as VRRP with slight modifications. The source IP address is derived from the system IP address assigned to the local router. The destination IP address and IP protocol are the same as VRRP (224.0.0.18 and 112, respectively).

The message type field is set to 1 (advertisement) and the protocol version is set to 8 to differentiate SRRP message processing from VRRP message processing.

The vr-id field has been expanded to support an SRRP instance ID of 32 bits.

Due to the large number of subnets backed up by SRRP, only one message every minute carries the gateway IP addresses associated with the SRRP instance. These gateway addresses are stored by the local SRRP instance and are compared with the gateway addresses associated with the local subscriber IP interface.

Unlike VRRP, only two nodes may participate in an SRRP instance due the explicit association between the SRRP instance group IP interface, the associated redundant IP interface and the multi-chassis synchronization (MCS) peering. Since only two nodes are participating, the VRRP skew timer is not utilized when waiting to enter the master state. Also, SRRP always preempts when the local priority is better than the current master and the backup SRRP instance always inherits the master's advertisement interval from the SRRP advertisement messaging.

SRRP advertisement messages carry a *becoming-master* indicator flag. The *becoming-master* flag is set by a node that is attempting to usurp the master state from an existing SRRP master router. When receiving an SRRP advertisement message with a better priority and with the *becoming-master* flag set, the local master initiates its *becoming-backup* state, stops routing with the SRRP gateway MAC and sends an SRRP advertisement message with a priority set to zero. The new master continues to send SRRP advertisement messages with the *becoming-master* flag set until it either receives a return priority zero SRRP advertisement message from the previous master or its *becoming-master* state timer expires. The new backup node continues to send zero priority SRRP advertisement messages every time it receives an SRRP advertisement message with the *becoming-master* flag set. After the new master either receives the old master's priority zero SRRP advertisement message or the *become-master* state timer expires, it enters the *master* state. The *become-master* state timer is set to 10 seconds upon entering the *become-master* state.

The SRRP advertisement message is always evaluated to see if it has higher priority than the SRRP advertisement that would be sent by the local node. If the advertised priority is equal to the current local priority, the source IP address of the received SRRP advertisement is used as a tie breaker. The node with the lowest IP address is considered to have the highest priority.

The SRRP instance maintains the source IP address of the current master. If an advertisement is received with the current masters source IP address and the local priority is higher priority than the masters advertised priority, the local node immediately enters the *becoming-master* state unless the advertised priority is zero. If the advertised priority is zero, the local node bypasses the *becoming-master* state and immediately enters the *master* state. Priority zero is a special case and is sent when an SRRP instance is relinquishing the master state.

SRRP and Multi-Chassis Synchronization

In order to take full advantage of SRRP resiliency and diagnostic capabilities, the SRRP instance should be tied to a MCS peering that terminates on the redundant node. The SRRP instance is tied to the peering using the **srrp** *srrp-id* command within the appropriate MCS peering configuration. Once the peering is associated with the SRRP instance, MCS will synchronize the local information about the SRRP instance with the neighbor router. MCS automatically derives the MCS key for the SRRP instance based on the SRRP instance ID. For example, an SRRP instance ID of 1 would appear in the MCS peering database with a MCS-key srrp-0000000001.

The SRRP instance information stored and sent to the neighbor router consists of:

- The SRRP instance MCS key
- Containing service type and ID
- Containing subscriber IP interface name
- Subscriber subnet information
- Containing group IP interface information
- The SRRP group IP interface redundant IP interface name, IP address and mask
- The SRRP advertisement message SAP
- The local system IP address (SRRP advertisement message source IP address)
- The Group IP interface MAC address
- The SRRP gateway MAC address
- The SRRP instance administration state (up / down)
- The SRRP instance operational state (disabled / becoming-backup / becoming-master / master)
- The current SRRP priority
- Remote redundant IP interface availability (available / unavailable)
- Local receive SRRP advertisement SAP availability (available / unavailable)

SRRP Instance

The SRRP instance uses the received information to verify provisioning and obtain operational status of the SRRP instance on the neighboring router.

SRRP Instance MCS Key

The SRRP instance MCS key ties the received MCS information to the local SRRP instance with the same MCS key. If the received key does not match an existing SRRP instance, the MCS information associated with the key is ignored. Once an SRRP instance is created and mapped to an MCS peering, the SRRP instance evaluates received information with the same MCS key to verify it corresponds to the same peering. If the received MCS key is on a different peering than the local MCS key an SRRP peering mismatch event is generated detailing the SRRP instance ID, the IP address of the peering the MCS key is received on and the IP address to which the local MCS key is mapped. If the peering association mismatch is corrected, an SRRP peering mismatch clear event is generated.

Containing Service Type and ID

The Containing Service Type is the service type (IES or VPRN) that contains the local SRRP instance. The Containing Service ID is the service ID of that service. This information is supplied for troubleshooting purposes only and is not required to be the same on both nodes.

Containing Subscriber IP Interface Name

The containing subscriber IP interface name is the subscriber IP interface name that contains the SRRP instance and its group IP interface. This information is supplied for troubleshooting purposes only and is not required to be the same on both nodes.

Subscriber Subnet Information

The subscriber subnet information includes all subscriber subnets backed up by the SRRP instance. The information for each subnet includes the Owned IP address, the mask and the gateway IP address. If the received subscriber subnet information does not match the local subscriber subnet information, an SRRP Subscriber Subnet Mismatch event is generated describing the SRRP instance ID and the local and remote node IP addresses. Once the subscriber subnet information matches, an SRRP Subscriber Subnet Mismatch Clear event is generated.

Containing Group IP Interface Information

The containing group IP interface information is the information about the group IP interface that contains the SRRP instance. The information includes the name of the group IP interface, the list of all SAPs created on the group IP interface, the administrative and operational state of each SAP and the MCS key and the peering destination IP address associated with each SAP. To obtain the MCS information, the SRRP instance queries MCS to determine the peering association of the SRRP instance and then queries MCS for each SAP on the group IP interface. If the local SRRP instance is associated with a different MCS peering than any of the SAPs or if one or more SAPs are not tied to an MCS peering, an SRRP group interface SAP peering mismatch event is generated detailing the SRRP instance ID, and the group IP interface name.

When receiving the remote containing group IP interface information, the local node compares the received SAP information with the local group IP interface SAP information. If a local SAP is not included in the SAP information or a remote SAP is not included in the local group IP interface, an SRRP Remote SAP mismatch event is generated detailing the SRRP instance ID and the local and remote group IP interface names. If a received SAP’s MCS key does not match a local SAP's MCS Key, an SRRP SAP MCS key mismatch event is generated detailing the SRRP instance ID, the local and remote group IP interface names, the SAP-ID and the local and remote MCS keys.

Remote Redundant IP Interface Mismatch

If the group IP remote redundant IP interface address space does not exist, is not within the local routing context for the SRRP instances group IP interface or is not on a redundant IP interface, the local node sends redundant IP interface unavailable to prevent the remote neighbor from using its redundant IP interface. An SRRP redundant IP interface mismatch event is generated for the SRRP instance detailing the SRRP instance, the local and remote system IP addresses, the local and remote group IP interface names and the local and remote redundant IP interface names and IP addresses and masks. The local redundant IP interface may still be used if the remote node is not sending redundant IP interface unavailable.

Remote Sending Redundant IP Interface Unavailable

If the remote node is sending redundant IP interface unavailable, the local node will treat the local redundant IP interface associated with the SRRP instances group IP interface as down. A Local Redundant IP Interface Unavailable event is generated detailing the SRRP instance ID, the local and remote system IP addresses, the local group IP interface name, the local redundant IP interface name and the redundant IP interface IP address and mask.

Remote SRRP Advertisement SAP Non-existent

If the remote node's SRRP advertisement SAP does not exist on the local SRRP instances group IP interface, the local node sends local receive SRRP advertisement SAP unavailable to the remote node. An SRRP receive advertisement SAP non-existent event is generated detailing the SRRP instance ID, the local and remote system IP addresses, the local group IP interface name and the received remote SRRP advertisement SAP. Since SRRP advertisement messages cannot be received, the local node will immediately become master if it has the lower system IP address.

Remote Sending Local Receive SRRP Advertisement SAP Unavailable

If the local node is receiving local receive SRRP advertisements stating that the SAP is unavailable from the remote node, an SRRP Remote Receive advertisement SAP Unavailable event will be generated. This details the SRRP instance ID, the local and remote system IP addresses, the remote group IP interface name and the local SRRP advertisement SAP. Since the remote node cannot receive SRRP advertisement messages, the local node will immediately become master if it has the lower system IP address.

Local and Remote Dual Master Detected

If the local SRRP state is master and the remote SRRP state is master, an SRRP dual master event is generated detailing the SRRP instance ID and the local, remote system IP addresses and the local and remote group IP interface names and port numbers.

Subscriber Subnet Owned IP Address Connectivity

In order for the network to reliably reach the owned IP addresses on a subscriber subnet, the owning node must advertise the IP addresses as /32 host routes into the core. This is important since the subscriber subnet is advertised into the core by multiple routers and the network will follow the shortest path to the closest available router which may not own the IP address if the /32 is not advertised within the IGP.

Subscriber Subnet SRRP Gateway IP Address Connectivity

The SRRP gateway IP addresses on the subscriber subnets cannot be advertised as /32 host routes since they may be active (master) on multiple group IP interfaces on multiple SRRP routers. Without a /32 host route path, the network will forward any packet destined to an SRRP gateway IP address to the closest router advertising the subscriber subnet. While a case may be made that only a node that is currently forwarding for the gateway IP address in a master state should respond to ping or other diagnostic messages, the distribution of the subnet and the case of multiple masters make any resulting response or non-response inconclusive at best. To provide some ability to ping the SRRP gateway address from the network side reliably, any node receiving the ICMP ping request will respond if the gateway IP address is defined on its subscriber subnet.

Receive SRRP Advertisement SAP and Anti-Spoof

The group IP interface SAPs are designed to support subscriber hosts and perform an ingress anti-spoof function that ensures that any IP packet received on the group IP interface is coming in the correct SAP with the correct MAC address. If the IP and MAC are not registered as valid subscriber hosts on the SAP, the packet is silently discarded. Since the SRRP advertisement source IP addresses are not subscriber hosts, an anti-spoof entry will not exist and SRRP advertisement messages would normally be silently discarded. To avoid this issue, when a group IP interface SAP is configured to send and receive SRRP advertisement messages, anti-spoof processing on the SAP is disabled. This precludes subscriber host management on the SRRP messaging SAP.

PPPoE MC Redundancy

This feature minimizes the downtime for PPPoE clients in an ESM environment when a single node fails.

But it is not necessary that an entire BNG fails before it triggers the corrective action. The solution outlined in this document will natively include protection against interfaces and line card failures within the BNG. The redundant (protective) entity, however, does not reside within the same BNG on which the failure occurs but instead it is on a separate BNG node.

The PPPoE MC Redundancy is based on SRRP and MC-LAG because SRRP is already established in ESM providing IPoE MC Redundancy. With some modifications, SRRP approach is adopted to PPPoE deployments.

Hardware Support

This feature is supported on the following platforms:

- 7750 SR-7/12
- 7750-c4/12
- 7450 in mixed chassis mode.

MCS across different platform types (7750 SR-7/12, 7750-c4/12, 7450) is not supported. For example, MCS between 7750 SR-7/12 and 7750-c12 is not supported.

This feature is supported in the following chassis modes: B, C, D and SR Mixed Mode (IPv6 on IOM3 while IOM1 cards can be present in the same system).

IPv4 functionality is supported on IOM2 cards and IPv4/IPv6 on IOM3 cards.

Note: ESM v6 is supported only on IOM3 cards. IPv6 forwarding in ESM between IOM3 and IOM2 cards is not supported – for example, if the access side is IOM3 and the network side is IOM2. However, plain routing (non-ESM related) is supported between these two cards.

SRRP Considerations for PPPoE

SRRP is based on VRRP whose purpose is to provide a default gateway redundancy for clients sharing the transport medium such as Ethernet. IPoE would be a typical example of this where IPoE clients use a virtual IP and MAC address that is shared between two default gateway nodes in the Master/Backup configuration. SRRP supports only two nodes in a cluster but VRRP allows multiple nodes to be configured in a cluster with a priority that will determine which node will assume Mastership. Although it is mandatory for the proper operation of IPoE clients that the same SRRP IP address is shared between the two BNG nodes providing redundancy, having the same SRRP IP address is not necessary for the operation of SRRP itself. In other words, SRRP itself (Master/Backup states) will work with different SRRP IP addresses on each node. Same is valid for MAC addressing. It is possible by configuration that the redundant BNG nodes use different IP/MAC addresses on a pair of SRRP instances.

Upon a switchover, a gratuitous ARP is sent from a newly selected active node so that each IPoE client can update the ARP table, if the MAC address has indeed changed (it does not have to). More importantly, if an Layer 2 aggregation network is in place between the BNG and the IPoE client, all intermediate Layer 2 devices will have to update their port-to-mac mappings (Layer 2 FIB). The above described process will ensure proper packet addressing on the IPoE client side as well as the proper forwarding path through Layer 2 aggregation network to the newly activated BNG.

When considering PPPoE in conjunction with SRRP, keep in mind that PPP protocol (point-to-point protocol) is adopted for the Ethernet (shared medium) by enabling an extra Ethernet related layer in PPP that allows sharing of point-to-point sessions over Ethernet (shared medium). The result is a PPPoE protocol designed to ‘tunnel’ each PPP session over Ethernet.

PPPoE is not aware of ARP (Address Resolution Protocol) and it will not react to gratuitous ARP packets sent by a newly active BNG. The destination MAC address that PPPoE clients will use when sending traffic is determined not by ARP but by the PPPoE Discovery phase at the beginning of the session establishment. This originally discovered destination MAC is used throughout the lifetime of the session. This has a couple of consequences:

1. If SRRP is used for PPPoE then the ‘SRRP’ MAC address between the redundant BNG nodes must be shared. It is not allowed to use a unique ‘SRRP’ MAC address per BNG in the redundant pair of BNG nodes (as it is allowed today for IPoE). Every PADx conversation is based on the SRRP shared MAC address, that is, the PADO reply must have the shared SRRP MAC address as the source MAC. This has a significant impact on the operation of MSAP in conjunction with this feature.
2. Since PPPoE sessions are not ARP aware, the only purpose of the gratuitous ARP would be to update the Layer 2 FIB in the aggregation network (and not the PPPoE client destination MAC address). For IPoE, the gratuitous ARP is sent for ALL subnet gateway IP addresses found under the subscriber interface over either all SAPs (default) or top-tags only. For PPPoE, the gratuitous ARP is sent only for the system IP address. The purpose of the gratuitous ARP in PPPoE scenario is only to update Layer 2 network path which is otherwise IP unaware. It is not necessary to send the gratuitous ARP for every default-gateway address found under the subscriber-interface. Since this feature is only applicable to PPPoE deploy-

ments, therefore, only PPPoE is present under the group interface. This is indicated by the following command under the SRRP node:

```
group-interface <name>
srrp <id>
     one-garp-per-sap
```

SRRP Fact-Checks

1. Once Multi-chassis Synchronization (MCS) for subscriber management and SRRP is enabled, both BNG nodes, Master and Backup will in general forward packets (for subscribers) in both directions.
2. Traffic flows through an SRRP enabled node according to the entries in the SRRP sync database and the SRRP state of the node:
   - Backup SRRP directs downstream traffic over the redundant-interface towards the Master SRRP node. If the redundant interface is unavailable, traffic is sent directly to the subscriber.
   - Master SRRP always directly forwards the downstream traffic towards the subscriber.
   - In the upstream direction, the active SRRP node accepts subscriber traffic addressed either to the MAC address of the SRRP active group OR the native interface MAC address.
   - The standby node accepts in the upstream direction only packets addressed to its native interface MAC address.
3. If both SRRP nodes become Masters then both forward traffic to/from subscribers unaware of the link failure somewhere in the Layer 2 network. As a result, downstream traffic can be blackholed. Whether downstream traffic will be lost depends on the native routing on the network side, which is unaware of the failures in the aggregation network.

State Synchronization

PPPoE sessions are synchronized between the redundant BNG nodes. The subscriber synchronization is achieved through Multichasiss Synchronization (MCS) protocol in a similar way it is performed for IPoE.

```
multi-chassis
           peer <IP@>create
                sync
                    local-dhcp-server
                    SRRP
                    sub-mgmt [ipoe | pppoe]
                 :
                                                :
                    no shutdown
                exit
                no shutdown
           exit
```

A two keywords, **ipoe** and **pppoe** enable a more granular control over which type of subscribers the MCS should be enabled.

Subscriber synchronization is important for following reasons:

1. Forwarding of downstream traffic between the redundant BNG nodes through a redundant interface is an artifact of how natural routing steers traffic through the network.
2. Subscriber instantiation on the node which did not originally create subscriber session. This drastically reduces downtime during the SRRP switchover.
3. Monitors operational aspects of the subscriber management through show commands.

PPPoE Multi-chassis Synchronization (MCS) Model

PPPoE MCS model is based on SRRP synchronization and can be used in a centralized or distributed environment with or without Layer 2 aggregation network in-between DSLAMs and BNG nodes. The failure detection speed is dependent on SRRP timers. Traffic load can be balanced per SRRP group over the two links. In this model (Figure 96), PPPoE states are synchronized between the redundant BNG nodes. If one BNG fails, the newly activated BNG sends out a 'MAC update' (gratuitous ARP) message prompting the intermediate Layer 2 nodes to update their forwarding tables so that forwarding can resume. The SRRP timers can be configured in the sub-second range. In reality, the limiting factor for timer values is the scale of the deployment, in particular the number of SRRP groups per node.

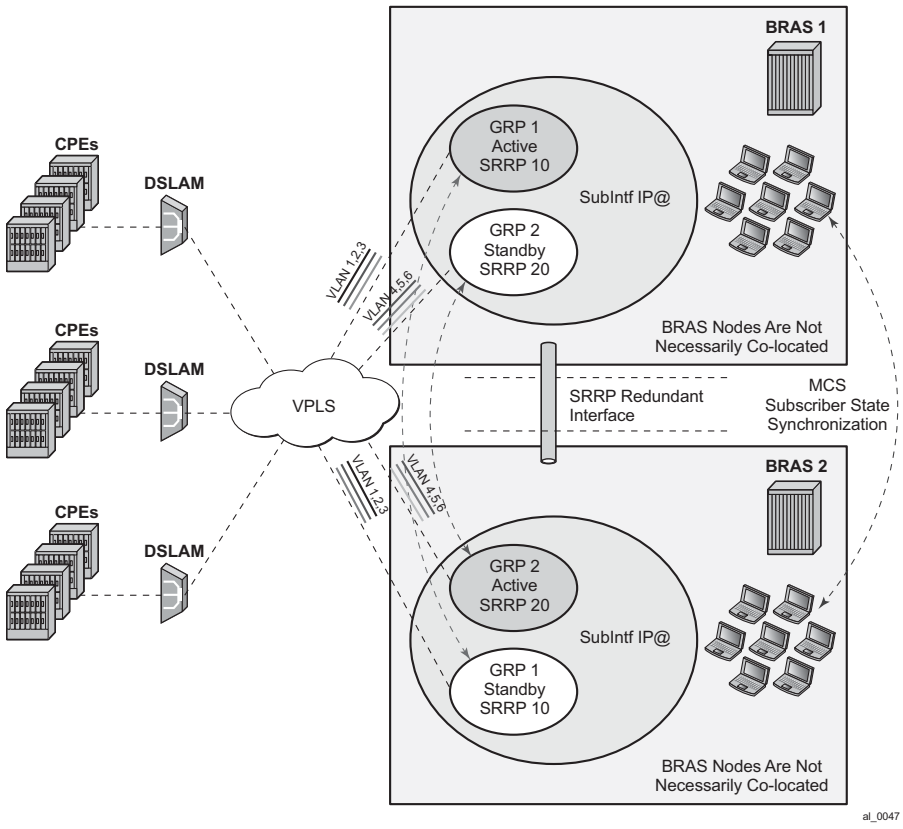


Figure 96: Fully Redundant "Statefull 1:1" Model

Traffic Control and Redundant Interface

To preserve QoS and Accounting, subscriber's traffic must flow in both directions through the Master BNG node.

In the upstream direction, this is always true as traffic is steered to the master SRRP node just by the virtue of SRRP operation.

In the downstream direction which represents bulk of traffic, SRRP can not be relied up on to steer traffic through the Master node. This poses a problem in a very common environment where IP subnets are shared over multiple group-interfaces with SRRP enabled. A particular subnet will be advertised to the network side from both BNG nodes, Master and Backup. Natural routing on the network side will determine which BNG node will receive subscriber's traffic in the downstream direction. If the Backup SRRP node receives the traffic, it cannot simply send the traffic directly to the access network where the subscriber resides by just inserting the source MAC address of the SRRP instance in the outgoing packet. This would break the operation of SRRP. Instead, the Backup BNG node must send the traffic to the Master BNG node via a redundant-interface. The Master SRRP node would then forward traffic directly to the subscriber. Source MAC address of this traffic would then be the MAC address of SRRP instance. This traffic shunting over the redundant interface can result in a substantial load on the link between the two BNG nodes.

The increase in shunted traffic can quickly become an issue if the redundant BNG nodes that are not collocated. To minimize the shunt traffic, more granular routing information must be presented to the network core. This would lead to more optimal routing where downstream subscriber traffic would be directed towards the Master BNG node, without the need to cross the redundant interface. The downside of this approach is that this would further fragment the IP address space within the network core. In the extreme case where /32 (subscriber) IP addresses are advertised, the churn that /32s can cause in the core routing would most likely be unsustainable. In this case, routing updates in the core would be triggered by subscribers coming on/off-line.

Optimal operation would call for the shunt traffic to be eliminated and at the same time, a high IP route aggregation on the network side is achieved. The existence of the shunt traffic stems from the fact that routing protocols advertise subscriber subnets into the network with no awareness of the SRRP activity state (Master/Standby). To address this problem along with better aggregation of advertized subnets, two SRRP enhancements are introduced:

- SRRP fate-sharing
- SRRP aware routing

Both of this concepts are described under the 'SRRP Enhancements" section.

Traffic destined to/from the subscriber is forwarded under the condition that the subscriber-interface is operationally UP. This applies also to shunting of downstream subscriber traffic from the STANDBY to MASTER node. It is always necessary to keep the subscriber-interface operationally UP by configuring a dummy *group-interface* with a command *oper-up-while-empty* under it. This is especially true for the MC-LAG which causes the messaging SAP on the STANDBY node always to be in the INIT state. In case that MSAPs are used on such group-interfaces, the group-interfaces would be also operationally DOWN, causing the subscriber-interface to be operationally DOWN.

Subnet Assignment and Advertisement - Option ‘A’

A single IP subnet is used for all subscribers terminated within the redundant BNG nodes. The upside of the Option ‘A’ is that it offers aggregated IP addressing in the network core per pair of redundant BNG nodes. The downside is that the subscriber termination point (active BNG for the SRRP group) is hidden from the network core. Since both BNG nodes share the same IP subnet for the subscribers, the natural routing can cause downstream traffic to be sent to the standby BNG which in turn will have to shunt the traffic to the active BNG. It is likely that half of the traffic will be shunted over the redundant-interface with this approach. This scenario is shown in Figure 97.

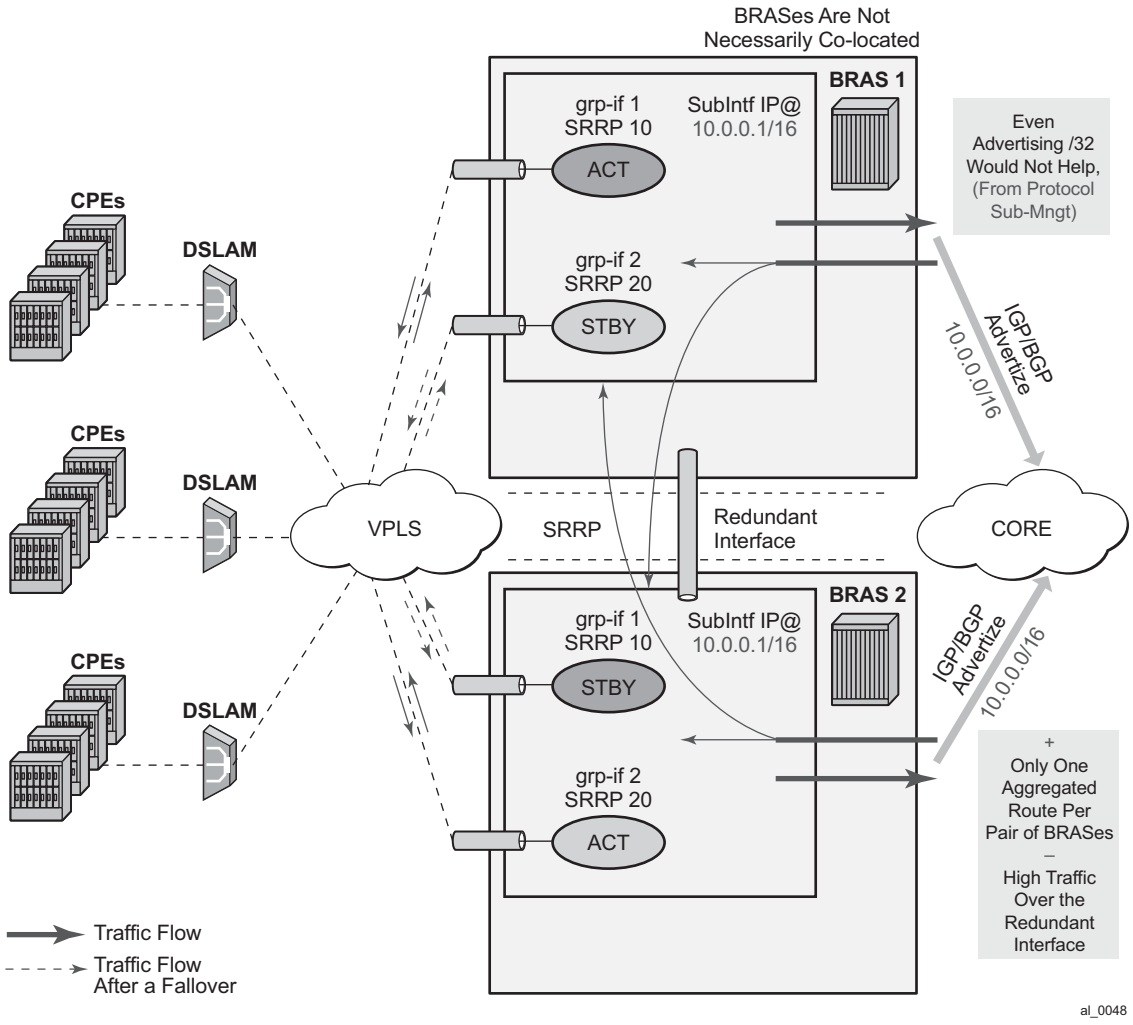


Figure 97: Shared Subscriber IP Space

Subnet Assignment and Advertisement - Option ‘B’

With the option ‘B’, an IP address pool (or subnet) can be allocated per group of SRRP instances that are in the Master state. The routing decision on the network side is further influenced by the static increase of the metric of the advertised route on the BNG node hosting the active SRRP groups (Figure 98).

This approach would cause greater IP space segmentation in the network core, but at the same time, it would indirectly provide more information about the subscriber whereabouts and thus minimize or eliminate the shunt traffic during the normal operation. However, in the case of a SRRP switchover, the shunt traffic would ensue. The amount of the shunted traffic would depend on the scale of the failure. From the Figure 98, it can be concluded that:

- In the depicted scenario on Figure 98, there is no shunted traffic.
- If any of the SRRP instances transitions out of the Master state, traffic for an entire IP network associated with this failed SRRP instance would be shunted. The reason for this is that the advertised route metric is static and it does not follow changes in SRRP state.

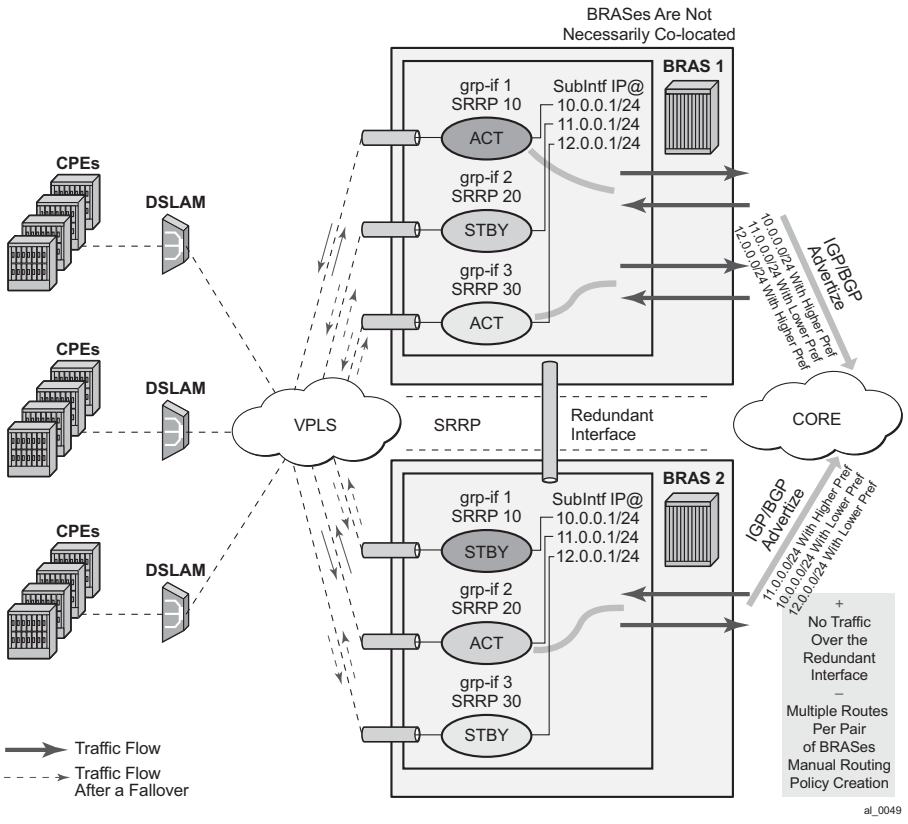


Figure 98: Option ‘B’ – IP Subnet per Active SRRP Group

MSAP Considerations

As per RFC 2516 (PPPoE), this has the implications on the operation of the capture SAP. In IPoE environment, the initial DHCP traffic related to host establishment will use its native MAC of the physical port on 7x50. Once the group-interface is learnt (later in the process, via RADIUS or msap-policy), the MAC address is switched to SRRP MAC address (virtual MAC). The IPoE client will adapt easily to this change. On the contrary, for the proper operation of PPPoE with SRRP, the initial destination MAC address learned by the PPPoE client does not change during the lifetime of the session.

This is ensured by indirectly referencing the grp-if under the capture SAP:

```
configure>service>vpls
     sap 1/1/1:1.* capture-sap
track-srrp 10
     sap 1/1/1:2.* capture-sap
track-srrp 20

configure>service>vprn>
          subscriber-interface <if-name>
               group-interface <grp-if-name>
                    sap 1/1/1:1.1
                    srrp 10
                         message-path 1/1/1:1.1

               group-interface <grp-if-name>
                    sap 1/1/1:2.1
                    srrp 20
                         message-path 1/1/1:2.1
```

With this approach the grp-if is nailed during the session initiation phase by referencing the SRRP instance in track-srrp statement (srrp is a grp-if wide concept). RADIUS returned grp-if name must match the one on which referenced SRRP instance runs.

The capture SAP of the form

```
sap port-id:*.* capture-sap
     track-srrp X
```

assumes that there is only one grp-if associated with all msaps under this capture SAP.

A check is put in place to make sure that the MAC addresses associated with the SRRP instance is the same as the MAC address of the associated capture SAP. A log is raised if there is a discrepancy between the MAC addresses while the grp-if is operationally UP. If there is a MAC address change (user misconfiguration) then the existing PPPoE sessions will time out and the new sessions will fail to establish until the condition is corrected.

Unnumbered Interface Support

For unnumbered subscriber-interface support in PPPoE, the gw IP address that is used to send gratuitous ARP is not available. For this reason, the system IP address is used to send gratuitous ARPs. Gratuitous ARP is used to update the Layer 2 network forwarding path towards the BNG node in the upstream direction.

The system IP address is used automatically if the subscriber interface is unnumbered.

Compatibility with MC-LAG

SRRP for PPPoE works in an environment where MC-LAG is enabled. For example, the standby LAG link automatically puts the SRRP node in a Backup state and the SRRP becomes master on the active MC-LAG link. It is important that the SRRP on the standby leg of the MC-LAG is forced into a Backup state, or any new state that will force the downstream traffic to use the redundant interface.

Traffic destined to/from the subscriber is forwarded under the condition that the subscriber-interface is operationally UP. This applies also to shunting of downstream subscriber traffic from the STANDBY to MASTER node. It is always necessary to keep the subscriber-interface operationally UP by configuring a dummy group-interface with a command oper-up-while-empty under it. This is especially true for the MC-LAG which causes the messaging SAP on the STANDBY node always to be in the INIT state. In case that MSAPs are used on such group-interfaces, the group-interfaces would be also operationally DOWN, causing the subscriber-interface to be operationally DOWN.

IPv6 Support

Prerequisite for MC IPv6 Redundancy is to synchronize PPPoEv6 and IPoEv6 subscribers between the nodes via MCS.

In PPPoE environment, SRRP is used to refresh the forwarding path (MAC addresses) in the access aggregation network (via gratuitous ARP). SRRP ensures that the upstream traffic is steered to the Master BNG node. In the downstream direction, the Backup BNG directs traffic over to the Master BNG node via redundant-interface.

The IPv6 functionality currently relies on IPv4 based SRRP and IPv4 based redundant-interface. In other words, IPv4 is required to run on the access side as well as on the redundant-interface.

The redundant-interface is used in the downstream direction. Traffic arriving on the network links on the Standby node is shunted over to the Master node over the redundant-interface. This is required to ensure consistent QoS and accounting functionality across the nodes (upstream and downstream traffic on the access links for a subscriber must traverse the same BNG node). There is no IPv6 related CLI associated with the redundant-interface.

All IPv6 subscriber traffic that arrives on the Standby node in the downstream direction is automatically shunted over the IPv4 redundant-interface to the Master node. When IPv6 traffic arrives over the redundant-interface on the Master node, it is either PPPoEv6 encapsulated or left as plain IPoEv6 before it is forwarded to the subscriber.

In the upstream direction (AN->BNG) the behavior is the following:

- PPPoEv6

  On the switchover, gratuitous ARPs is sent from the new Master on each vlan. The IP address in gARP is the IPv4 gw-ip address or the system IP in the case of unnumbered interfaces. This updates the Layer 2 network path with the proper SRRP MAC address.

- IPoEv6

  IPv4 based SRRP is used to update the Layer 2 forwarding path in the case of a switchover. A gratuitous ARP is sent in the same fashion as it is used for IPoE v4 hosts. Router Advertisements (RA) are not sent out in the case of the switchover.

  However, the two BNG nodes share the same virtual Link Local (LL) IPv6 address. This address is used by the clients as a default-gw and only the Master BNG advertises this LL address in RAs. RAs are suppressed on the Standby node. As already mentioned, RAs are not sent during the switchover. RAs are sent:

  → When the client first gets established – this is how the client learns its default-gw (in PPPoE case RA can also be used for SLAAC – stateless address configuration).

  → As a reply to Router Solicitations messages sent by the clients.

  → Periodically to each client.

  Note that RAs are unicasted to each client.

  Neighbor Advertisements (NA) used for address resolution are sent only from the Master. NA has the SRRP MAC address in the target link layer option on SRRP enabled group interfaces (on non-SRRP enabled group-interfaces, NAs contains the group interface MAC address).

  The syntax to configure the LL address on the subscriber interface is the following:

```
configure>service>ies | vprn>
          subscriber-interface <if-name>
               ipv6
[no] link-local-address <ipv6-address>

          <ipv6-address> : ipv6-address – x:x:x:x:x:x:x:x:x:x:x:x:x:d.d.d.d
          x    [0..FFFF]H
          d    [0..255]D
```

  The LL IPv6 address must be the same on both nodes. In addition, the gw-mac address must be the same on both nodes. The IPv6 clients will not be aware of the switchover and therefore they will not send NS to solicit the update of its neighbor cache with the possibly different gw-mac address.

Note that the current version of SRRP relies only on IPv4 routes. The connection between SRRP and IPv4 routes is done via the subnets with gw IP addresses defined under the subscriber-

interfaces in the ESM context. This connection is needed so that SRRP can send Gratuitous ARP properly.

These are the cases for PPPoEv6 MC Redundancy that are supported:

- unnumbered subscriber-interfaces (config>service>subscriber-interface hierarchy)
- numbered IPv4 subscriber-interfaces (config>service>subscriber-interface hierarchy)
- numbered IPv4 AND IPv6 subscriber-interfaces (config>service>subscriber-interface and config>service>subscriber-interface>ipv6 hierarchy)

numbered IPv6 only subscriber-interfaces (config>service>subscriber-interface>ipv6 hierarchy) is not supported

Considerations with Local DHCP Server

When local DHCP Server redundancy/synchronization is used, using address-range failover local | remote, in conjunction with PPPoE in multi-chassis environment, both DHCP servers must be referenced under the corresponding group-interface on each node. For address-range failover access-driven configurations only one DHCP server must be referenced.

```
subscriber-interface <sub-if>
     group-interface <grp-if>
          dhcp
               server <local-dhcp-ip-address> <remote-dhcp-ip-address>
```

Otherwise, the PPPoE clients will not be synchronized via MCS.

Note that this is not the requirement in IPoE environment. In IPoE environment, it is enough that the DHCP server points to the IP address of the local DHCP server. If the IP lease is originally assigned by the peer DHCP server, the request for renewal is automatically forwarded to the remote DHCP server by the virtue of the IP address of the original DHCP server that is included in the renewal request.

It is necessary for the successful renewal of the IP address on the remote DHCP server, that the remote DHCP server has a valid return path back to the gi-address of the forwarder of the renewal request.

Redundant Interface Considerations

In PPPoE dual-chassis environment without the redundant-interface in place, SRRP aware routing should always be used. Otherwise, if the downstream traffic arrives on the backup node, it will get forwarded directly to the client over the access network (assuming that the access network is operational) with the source MAC address of the group-interface (instead of gw-mac). This grp-if MAC address is different from the MAC address (gw-mac) negotiated during the initial PPPoE phase, and therefore, this traffic will be dropped by the client. It must be ensured that the downstream traffic is always attracted to the Master node in the absence of redundant.

Routed Central Office (CO)

This section describes the Alcatel-Lucent routers acting as a Broadband Service Router (BSR), with Enhanced Subscriber Management enabled.

In the so called Routed Central Office (Routed CO) model, a router is positioned directly behind a DSLAM. This design removes the need for a Layer 2 aggregation network between the router and the DSLAM, however it does involve more routing entities in the network.

Figure 99 shows a DSLAM connected to a router using a Layer 3 interface within an IES or VPRN service. Operators that do not require an aggregation network can implement this topology. Typical DSLAM connection models include:

- One SAP for all subscribers with all services.
  - → Subscriber management will be used for subscriber separation with DSCP/Dot1p service separation.
- One SAP per service.
  - → Subscriber management will be used for subscriber separation with the SAP being the service differentiator.
- One SAP per subscriber.
  - → Model with SAP level subscriber separation with DSCP/Dot1p service separation.

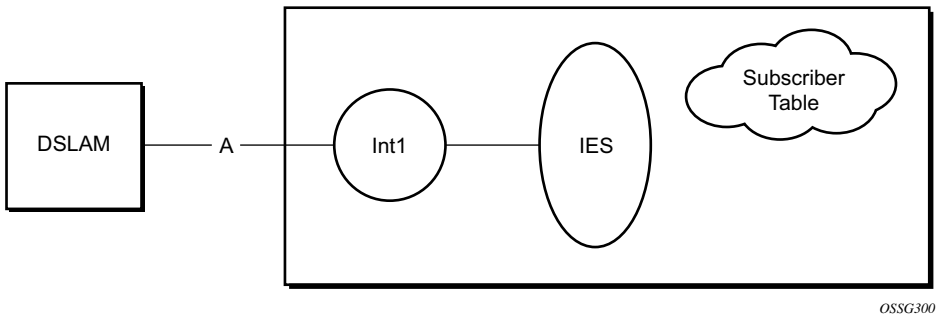


Figure 99: DSLAM Connection

Layer 3 Subscriber Interfaces

On regular interfaces in an IES or VPRN service, only one SAP can be associated. A group-interface allows multiple SAPs to be configured as part of a single interface. All SAPs in a single group-interface must be within the same port. Since broadcast is not allowed in this mode, forwarding to the subscriber is based on IP/MAC addresses information gathered by the subscriber management module and stored in the subscriber management table. These entries are based on both static and dynamic DHCP hosts. Routed CO must be used with standard subscriber management or enhanced subscriber management. DSLAMs are typically deployed with Ethernet interfaces.

This model is a combination of two key technologies, subscriber interfaces and group interfaces. While the subscriber interface define the subscriber subnets, the group interfaces are responsible for aggregating the SAPs.

As depicted in Figure 100, an operator can create a new subscriber interface in the IES or VPRN service. A subscriber interface allows for the creation of multiple group interfaces. The IP space is defined by the subnets of the subscriber interface's addresses. Figure 100 shows the details of group interface A.

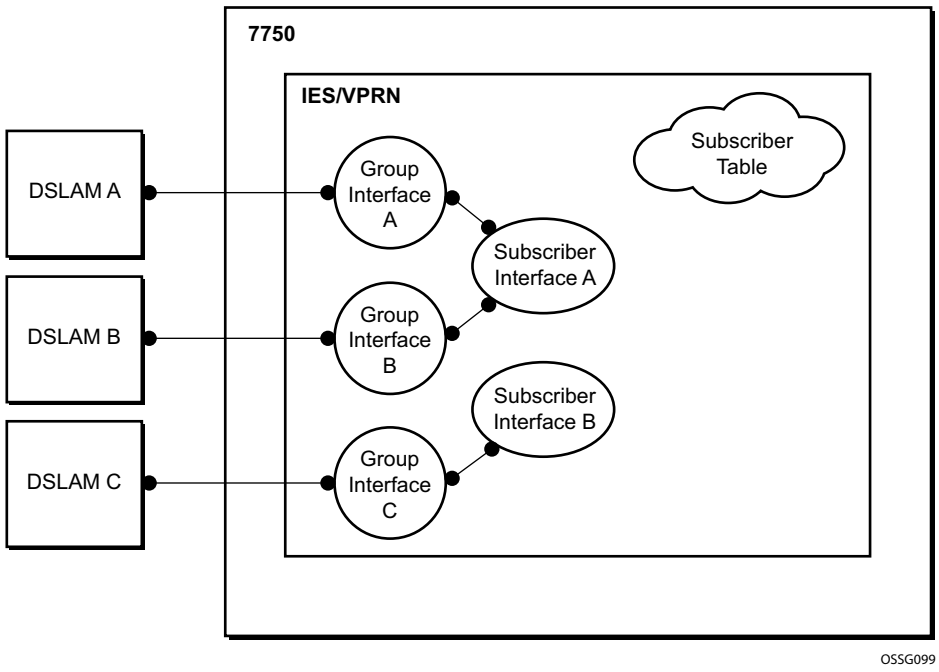


Figure 100: Subscriber Interface in an IES/VPRN Service

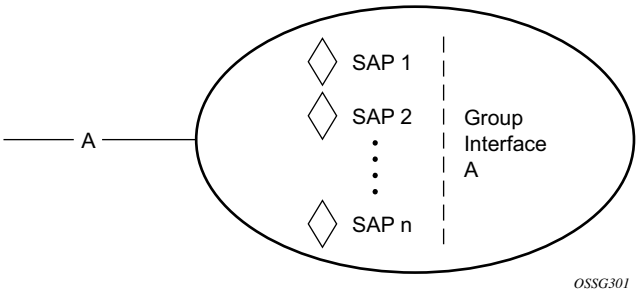


Figure 101: Details of a Group Interface

Figure 102 shows a network diagram where the DSLAM are connected directly to a Broadband Service Router (BSR) providing access to an IP subnet. Subscribers from multiple DSLAMs can be part of the same subnet. Note that BSR is also referred to as Broadband Network Gateway (BNG).

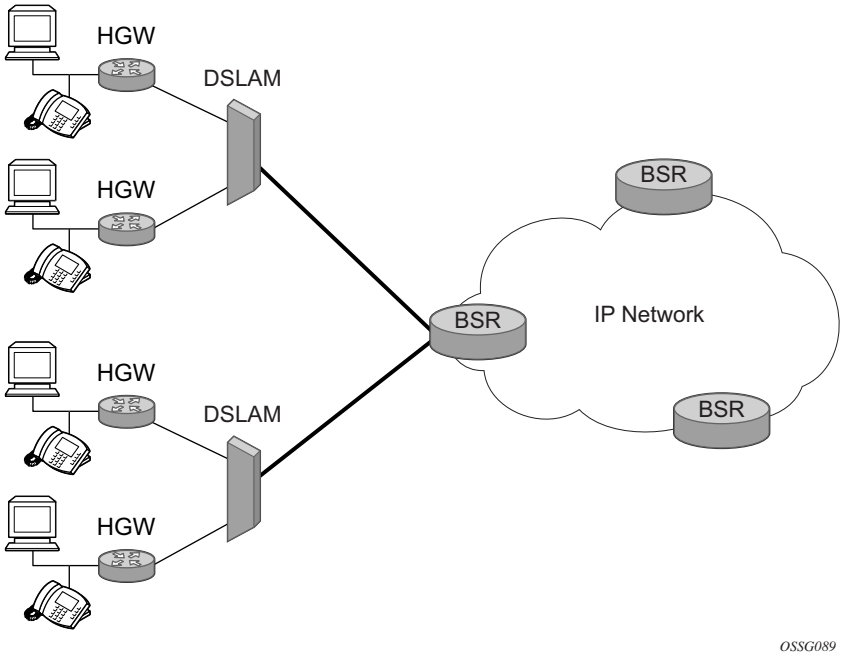


Figure 102: Aggregation Network with Direct DSLAM-BSE Connection

The BSR can be configured with multiple subnets, allowing subscribers to be part of a single subnet as well as providing mechanisms for re-addressing or expanding existing services without affecting existing users.

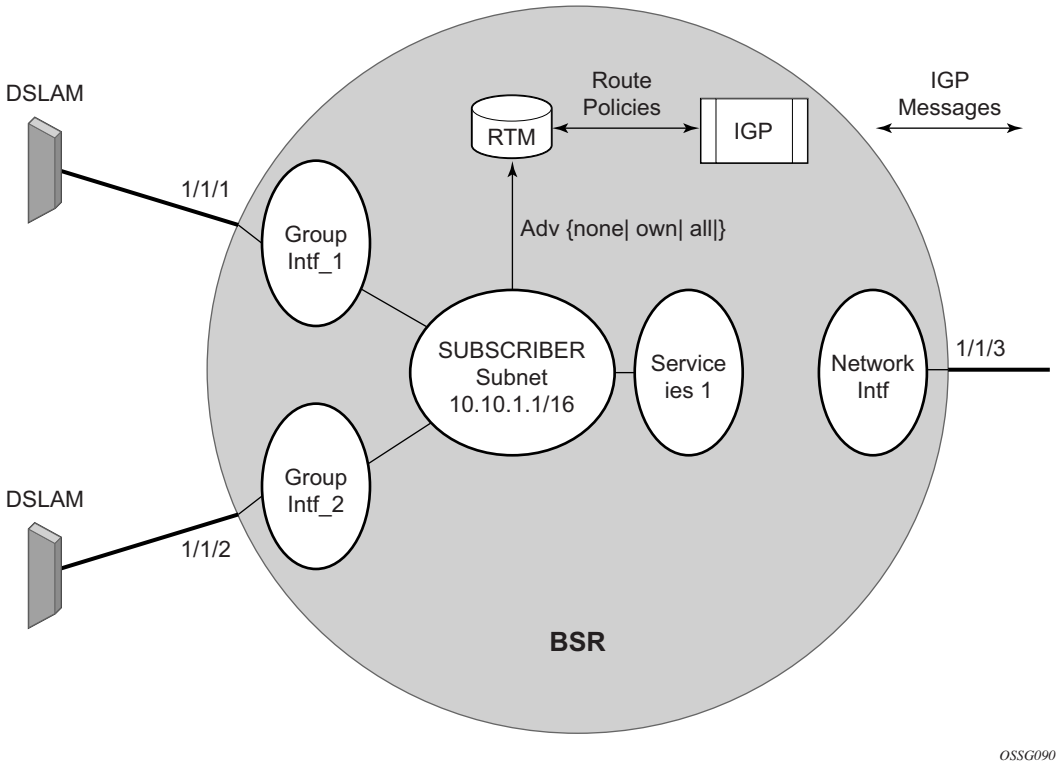


Figure 103: Detailed View of Configurable Objects Related to Layer 3 Subscriber Interfaces

Figure 103 shows a detailed view of a router and the configuration objects implemented to support Layer 3 subscriber interfaces.

- A subscriber service is defined by an IES Service. One or more IES services can be created.
- Each IES service concentrates a number of subscriber-interfaces. The operator can create multiple subscriber interfaces (represented as a subscriber subnet). A subscriber interface will define at least one subnet.
- A group-interface will be provisioned within the subscriber interface for each DSLAM connected. All group interfaces created under the subscriber interface will share the same subnet (or subnets). Group interfaces (shown as intf_1 and intf_2 in Figure 103) are configured as unnumbered and are associated with the subscriber-interface under which they are configured.
- SAPs can be configured under the group-interface. In a VLAN-per-DSLAM model only, one SAP per group-interface is needed, while in the VLAN-per-subscriber model, a subscriber of

the DSLAM will require its own SAP. All SAPs on a group-interface must be on the same physical port or LAG.

The individual features related to subscribers, such as DHCP relay, DHCP snooping and anti-spoofing filters, are enabled at group-interface level. For a Routed CO model of subscriber management, and when enhanced subscriber management (if sub-sla-mgmt is configured). Then, hashing will be based on an internally assigned subscriber-ID. Having a unique subscriber ID configured in CLI will ensure that each subscriber is assigned a unique internal subscriber ID.

It is assumed that individual end-user devices (further referred to as subscriber hosts) get their IP address assigned through either DHCP or static configuration. The management of individual subscriber hosts (such as creation, queue allocation, etc.) is performed by Enhanced Subscriber Management.

The operator can provision how the system advertises routes. While most deployments will advertise the full subnet it is possible to have the system advertise only the active, discovered or static host routes.

The distribution of this information into routing protocols will be driven by import/export route policies configured by the operator.

DHCP Interactions

The DHCP relay process has been enhanced to record incoming DHCP discover and request messages. Since forwarding to the SAPs is done by the information in the subscriber management table and multiple SAPs are allowed in one interface it was impossible to know which SAP will be used to forward the DHCP replies. The node maintains a cache of the DHCP requests. The cache can be viewed using the **tools>dump>router>dhcp>group-if-mapping** command. The cache holds an entry for 30 seconds. If an ACK/NAK packet was not received from the server within the timeout the node discards the cache entry. The node can use the Option 82 circuit-id field as part of the temporary host entry. If used, the ACK must contain the same circuit-id field in Option 82 to be found in the cache only if the match-circuit-id is specified at the DHCP level of the group-interface. When the match-circuit-id command is enabled a check is performed for option 82 circuit-id.

Routed CO for IES Service

The routed CO model depends on subscriber management to maintain the subscriber host information. To create a group-interface the operator must first create a subscriber interface within the service (**config>service>ies>subscriber-interface** *ip-int-name*). The subscriber interface maintains up to 256 subscriber subnets and is configured with a host address for each subnet.

When a DHCP ACK is received the IP address provided to the client will be verified to be in one of the subscriber subnets associated with the egress SAP. It will be noted that when DHCP snooping is enabled for regular IES interfaces the same rule will apply.

The subscriber interface is an internal loopback interface. The operational state is driven from the child's group-interface states and the configuration of an address in the RTM.

The group interface is an unnumbered interface. The interface will be operationally up if it is in the no shutdown state and if at least one SAP has been defined and is up and the parent subscriber interface is administratively up. The first SAP defined will determine the port for the group-interface. If the user attempts to define a subsequent SAP that is on a different port will result in an error. When the subscriber-interface or the group-interface is in shutdown state no packets will be delivered/received to/from the subscriber hosts but the subscriber hosts, both dynamic and static, will be maintained based on the lease time.

In the routed CO model, the router acts as a DHCP relay agent and also serves as the subscriber-identification agent. The DHCP actions are defined in the group-interface. All SAPs in that interface inherit these definitions. The group-interface DHCP definition are a template for all SAPs.

Lease-populate is enabled by default with the number-of-entries set to 1. This enables DHCP lease state for each SAP in the group-interface.

Since the group-interface can aggregate subscribers in different subnets a GI address must be defined for the DHCP relay process. The address must be in one of the host addresses defined for the subscriber interface. The GI address can be defined at the subscriber interface level which will

cause all child group interface to inherit that route. The GI address can then be overridden at the group interface level. A GI address must be defined in order for DHCP relay to function.

Because of the nature of the group-interface, local-proxy-arp, as well as arp-populate, should be enabled. This would allow the system to respond to subscriber ARP requests if the ARP request contains an IP address which is in the same subnet as one of the subscriber interface subnets.

When an authentication policy is specified for a SAP under a group interface, DHCP will intercept DHCP discover messages for RADIUS authentication. If the system is a DHCP-relay defined in a group-interface and the GI address was not configured the operational state of DHCP will be down.

Routed CO for VPRN Service

Much like in Routed CO for IES service, the Routed CO model for VPRN depends on subscriber management to maintain the subscriber host information. To create a group-interface, the operator must first create a subscriber interface in the config>service>vprn context. The subscriber interface can maintain up to 256 subscriber subnets and can be configured with a host address for each subnet. The host IP address can be installed as a result of both relaying to a DHCP server and proxy to a RADIUS server. In both cases the host IP address must be in the subnet defined by the VPRN's subscriber interface.

Basic subscriber management is allowed only in a subscriber/SAP model and can be used only in a dedicated VPRN architecture. A RADIUS service selection (using Managed SAPs) will require Enhanced Subscriber Management. The subscriber interface's subnets are allowed to be advertised to both IGPs and BGP within a VPRN.

When an authentication policy is specified for a group-interface, DHCP snooping must be enabled to intercept DHCP discover and renew messages for RADIUS authentication. Subscriber management RADIUS extensions are allowed if the operator chooses to have the RADIUS server return the subscriber identification, subscriber profile and sla-profile strings using RADIUS.

The node can be defined with both a DHCP relay or proxy function. If the user configures a DHCP relay, the local-proxy-server command will enable DHCP split leases. In that configuration the node will provide the configured DHCP lease to the client using either RADIUS or the real DHCP server as the source of the IP address to be provided.

The RADIUS server can send a Change of Authorization (CoA) message containing the DHCP forcerenew VSA which prompts the local-proxy-server to send a forcerenew message to the client. The node ACKs when the Force-Renew has been sent, regardless of whether the subscriber responds. If the client fails to respond or if a new session cannot be established due to resource management issues or otherwise the node must respond with a NACK to the RADIUS server.

If the CoA message contains an IP address that is different than the configured IP address (when RADIUS was providing IP addresses) the node must send a forcerenew message to the client and NAK the request and provide a new IP address. If the node fails to receive a request the CoA is ACK'd when the force-renew has been sent

The operational state of group and subscriber interfaces are dependent on the state of active SAPs. A group interface can become operationally up only if at least one SAP is configured and is in an operationally up state. A subscriber interface becomes operationally up if at least one group interface is operationally up or the associated wholesale forwarding interface is operationally up. This ensures that, in a failure scenario that affects all group interfaces in a given subscriber subnet, the node will stop advertising the subnet to the network. The SRRP state will affect this behavior as well and can cause the subnet to be removed if all group interfaces (and SRRP instances) are in backup state.

Wholesale Retail Routed CO

VPRN Routed CO allows a provider to resell wholesaler services (from a carrier) while providing direct DSLAM connectivity. An operator can create a VPRN service for the retailer and configure the access from subscribers as well as to the retailer network. Any further action will be as if the VPRN is a standalone router running the Routed CO model. All forwarding to these servers must be done within the VPRN service. The operator can leak routes from the base routing instance. In this model, the operator can use RADIUS for subscriber host authentication, DHCP relay and DHCP proxy. This provides maximum flexibility to the retailer while minimizing the involvement of the wholesaler. Access cannot be shared among retailers unless a subscriber SAP is used. This requires that the wholesaler maintain a different access node (DSLAM) for each retailer that does not scale well. The wholesale retail model described in this section overcomes these limitations.

Wholesale Retail Model

In the wholesale retail model (Figure 104), the wholesaler instance connections that are common to the access nodes are distributed to many retail instances. A subscriber host attached to an access node connected in the wholesaler service can be instantiated in a retail service and obtain IP addresses from the retailers address space. The service context of the retailer is determined during the subscriber host authentication phase (for example via the Alc-Retail-Serv-Id attribute in RADIUS or the retail-service-id CLI in the local user database).

Upstream subscriber traffic ingresses into the wholesaler instance and after identification is then forwarded into the retail instance. The reverse will occur for traffic in the downstream direction.

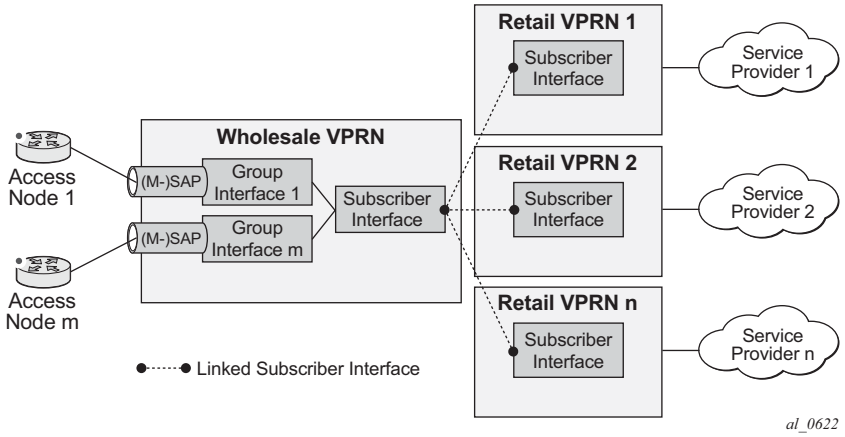


Figure 104: Wholesale Retail Model

In a wholesale retail model, two subscriber interfaces must be configured and linked together: one in the wholesale VPRN and one in the retail service.

The wholesale subscriber interface defines the IP subnets and host specific configuration parameters for subscriber hosts belonging to the wholesaler. There are associated group interfaces that contain the SAPs which connect to the access nodes.

The retail subscriber interface defines the IP subnets and host specific configuration parameters for subscriber hosts belonging to the retailer. The retail subscriber interface is linked to a wholesale subscriber interface for forwarding via explicit configuration. There are no associated group interfaces.

For example:

```
config>service
        vprn 1000 customer 1 create
            subscriber-interface "sub-int-ws-1" create
            # wholesale subscriber interface
                --- snip ---
                group-interface "group-int-1-1" create
                    --- snip ---
                    sap 1/1/1:1 create
                        --- snip ---
                    exit
                exit
            exit
        exit


       vprn 1001 customer 1 create
            subscriber-interface "sub-int-rt-1" fwd-service 1000    \\
                                 fwd-subscriber-interface "sub-int-ws-1" create
            # linked retail subscriber interface
                --- snip ---
            exit
        exit
```

A retail subscriber interface can be linked to a single wholesale subscriber interface and context only. Subscriber interface chaining (linking a retail subscriber interface to another retail subscriber interface) is not supported. Multiple retail subscriber interfaces belonging to different retail contexts can be associated with a single wholesale subscriber interface. When a retail subscriber interface is linked to a wholesale context, all other retail subscriber interfaces from the same retailer must be linked to the same wholesale context.

Configuration and Applicability

As explained in the previous section, the wholesale retail model is provisioned with the linking of a subscriber interface in a retail service to a subscriber interface in the wholesale VPRN service.

Because a retail subscriber interface does not have a group-interface context, some group-interface specific CLI parameters such as to configure dhcp relay are made available at the retail subscriber interface level. Other CLI parameters such as to provision Radius or local user database authentication are configured at the wholesale subscriber or group interface and apply to both wholesale and retail subscriber hosts.

The DHCP lease-populate configuration is special in wholesale retail as it is configured in both wholesale and retail context. The lease-populate value in the wholesale group-interface dhcp context controls the per SAP limits while the lease-populate value configured in the retail subscriber interface dhcp context controls the limits for the retailer subscriber interface. Both limits must be satisfied before a new subscriber host can be instantiated.

The sample configurations below enable dual stack IPoE devices to connect to wholesale service VPRN 4000 and retail service VPRN 4001. Hosts connected in VPRN 4000 get their IP address assigned from Radius, hence the proxy server configuration. Hosts connected in VPRN 4001 get their IP address from a DHCP server, hence the DHCP relay configuration.

Only the service configurations are shown. They have to be completed with authentication policies and subscriber management configuration such as radius-server-policies, sub- and sla-profiles, etc.

Sample configuration – Wholesale VPRN Service:

```
config>service
        vprn 4000 customer 1 create
            autonomous-system 64500
            route-distinguisher 64500:4000
            auto-bind-tunnel
                resolution-filter
                    ldp
                    rsvp
                exit
                resolution filter
            exit
            vrf-target target:64500:4000
            subscriber-interface "sub-int-1" create
                address 10.10.1.254/24
                address 10.10.2.254/24
                ipv6
                    delegated-prefix-len variable
                    subscriber-prefixes
                        prefix 2001:db8:a:100::/56 wan-host
                        prefix 2001:db8:a001::/48 pd
                    exit
                exit
                group-interface "group-int-1" create
                    ipv6
                        router-advertisements
                            no shutdown
```

```
                        exit
                        dhcp6
                            proxy-server
                                no shutdown
                            exit
                        exit
                    exit
                    arp-populate
                    dhcp
                        proxy-server
                            emulated-server 10.10.1.254
                            no shutdown
                        exit
                        lease-populate 100
                        no shutdown
                    exit
                    authentication-policy "auth-policy-1"
                    sap 1/1/4:1201.27 create
                        sub-sla-mgmt
                            sub-ident-policy "sub-ident-1"
                            multi-sub-sap 100
                            no shutdown
                        exit
                    exit
                exit
            exit
            no shutdown
        exit
```

Sample configuration – Retail VPRN Service:

```
config>service>
        vprn 4001 customer 1 create
            autonomous-system 64501
            route-distinguisher 64500:4001
            auto-bind-tunnel
                resolution-filter
                    ldp
                    rsvp
                exit
                resolution filter
            exit
            vrf-target target:64500:4001
            interface "int-loopback-1" create
                address 192.0.2.5/32
                ipv6
                    address 2001:db8::5/128
                exit
                loopback
            exit
           subscriber-interface "sub-int-rt-4000-1" fwd-service 4000 fwd-subscriber-inter-
face "sub-int-1" create
                address 10.10.11.254/24
                address 10.10.12.254/24
                dhcp
                    server 192.0.2.4
                    lease-populate 100
                    gi-address 10.10.11.254
```

```
            no shutdown
        exit
        ipv6
            subscriber-prefixes
                prefix 2001:db8:b:100::/56 wan-host
                prefix 2001:db8:b001::/48 pd
            exit
            dhcp6
                relay
                    source-address 2001:db8::5
                    server 2001:db8::4
                    no shutdown
                exit
            exit
            router-advertisements
                no shutdown
            exit
        exit
    exit
    no shutdown
exit
```

The wholesale retail model applies to all IPoE, PPPoE PTA, IPv4 and IPv6 host types.

The wholesale service type must be VPRN. For IPoEv4 hosts, the retail service type must be a VPRN. For all other host types, the retail service type can be IES or VPRN.

Multicast per host replication can be enabled without support for multi-chassis redundancy.

The wholesale retail model can be deployed in combination with managed SAPs

Hub-and-Spoke Forwarding

In some cases, hub-and-spoke-type forwarding is needed for the retailer's VPRN. When the retailer expects all subscriber traffic to reach its router (for accounting, monitoring, wiretapping, etc.) normal best-hop behavior within the retailer VPRN is not desired. Any subscriber-to-subscriber traffic will be forwarded within the VPRN preventing the retailer from receiving these packets. To force all subscriber packets to the retailer network a new type of hub-and-spoke topology is defined: "type subscriber-split-horizon". It can be used to force all subscriber traffic (upstream) to the retailers network. The system requires that the operator will shutdown the VPRN service to enable this flag.

With retail VPRN type configured to subscriber-split-horizon, routes learned from MBGP, IGP through a regular interface, static routes through regular interfaces and locally attached regular interface routes are considered hub routes and are used for upstream traffic forwarding. Subscriber subnets cannot be used for upstream traffic forwarding. Downstream traffic will use routes in both hub and spoke routing instances.

Figure 105 shows user to user traffic forwarding for both retail VPRN type regular and subscriber-split-horizon.

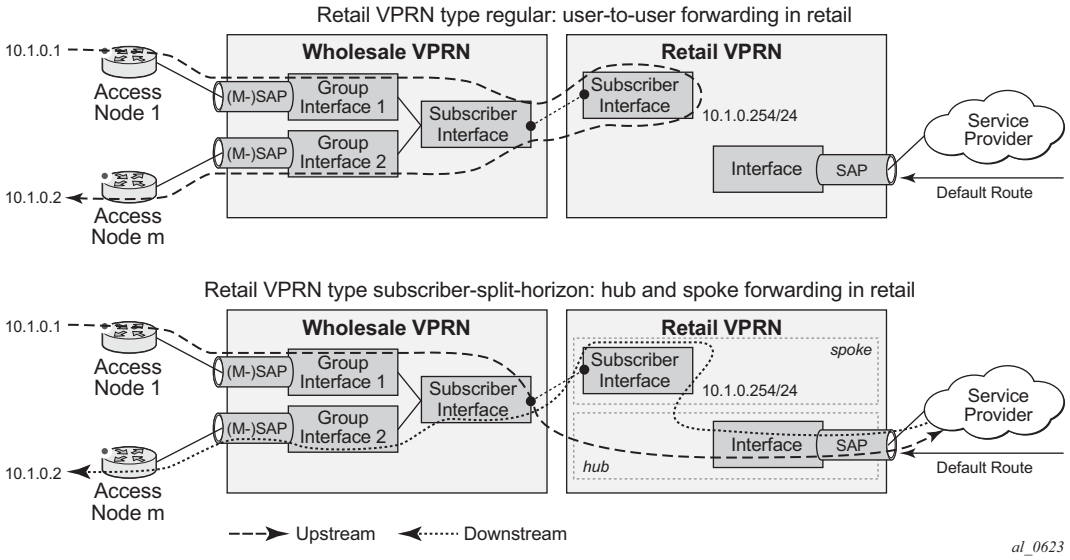


Figure 105: Wholesale Retail – Hub and Spoke Forwarding

Routed Subscriber Hosts

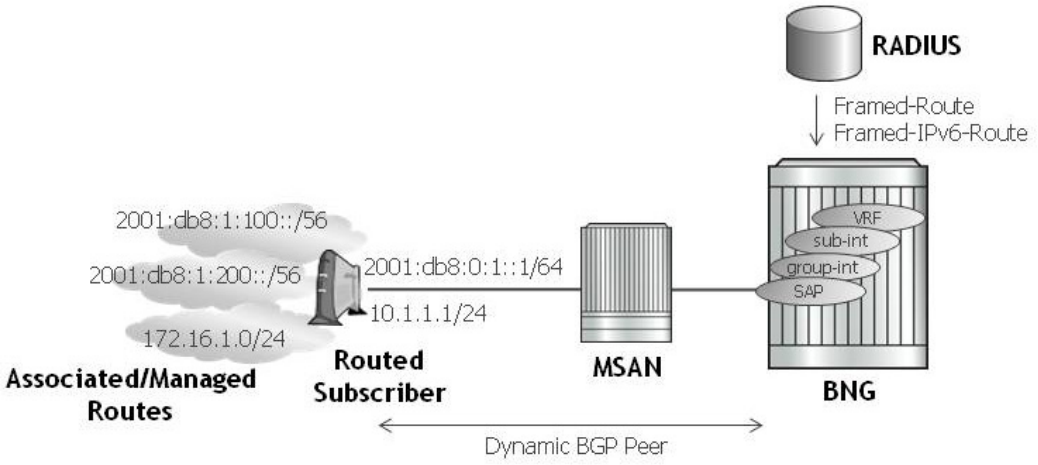


Figure 106: Router Subscriber Hosts

A routed subscriber host associated route is a global routable subnet/prefix behind a routed CPE or Home Gateway. The routed CPE is identified in the BNG as an ESM subscriber host: QoS, accounting and anti-spoofing is enforced per CPE. The associated routes are installed in the BNG route table with next-hop pointing to the routed subscriber host's WAN address.

Routed subscriber host associated routes are supported on IES/VPRN subscriber interfaces in a routed CO configuration. To put a SAP or MSAP in routed subscriber mode, the anti-spoof type for the SAP or MSAP must be configured to nh-mac:

```
configure
    service ies/vprn <service-id>
        subscriber-interface <ip-int-name>
            group-interface <ip-int-name>
                sap <sap-id>
                          anti-spoof nh-mac

configure
    subscriber-mgmt
        msap-policy <msap-policy-name>
            ies-vprn-only-sap-parameters
                anti-spoof nh-mac
```

There are three ways to learn about a routed subscriber host associated IPv4 route:

1. Configuration for a static host
2. A dynamic BGP peer
3. The RADIUS [22] Framed-Route attribute

A routed subscriber host associated IPv6 route can only be learned with the RADIUS [99] Framed-IPv6-Route attribute.

Static Configured IPv4 Managed Route

The routes associated with a static host are populated in the routing table as “Remote Managed” routes. Up to sixteen managed routes can be configured for a static host.

```
config>service>ies>sub-if>grp-if>sap
config>service>vprn>sub-if>grp-if>sap

    static-host ip 10.1.1.20 create
        sla-profile "sla-profile-1"
        sub-profile "sub-profile-1"
        subscriber "static-host-1"
        managed-routes
            route 172.20.1.0/24
            . . .
            route 172.20.16.0/24
        exit
        no shutdown
           exit
```

To display the managed routes associated with a routed subscriber host, use following commands:

show service id *service-id* **static-host detail**

Static Configured IPv6 Managed Route

The routes associated with a static host are populated in the routing table as “Remote Managed” routes. Up to sixteen managed routes can be configured for a static host.

```
config>service>ies>sub-if>grp-if>sap
config>service>vprn>sub-if>grp-if>sap
     anti-spoof nh-mac
     static-host ip 2001::1/128 create
          sla-profile "sla-profile-1"
          sub-profile "sub-profile-1"
          subscriber "static-host-1"
          managed-routes
               route 2000::/56
                    . . .
               route 3000::/56
          exit
          no shutdown
     exit

     static-host ip 2001:1::/64 create
          sla-profile "sla-profile-1"
          sub-profile "sub-profile-1"
          subscriber "static-host-1"
          managed-routes
               route 4000::/56
```

```
                . . .
            route 5000::/56
        exit
        no shutdown
    exit
```

To display the managed routes associated with a routed subscriber host, use following commands:

show service id *service-id* **static-host detail**

Dynamic BGP Peering

Routed subscriber host associated IPv4 routes can be learned over a dynamic BGP IPv4 peer that is automatically set up when a subscriber host is instantiated. The parameters for the BGP peer are configured in a BGP peering policy or obtained in Radius VSA attributes. The subscriber-host IPv4 address is used as the BGP peer IP address. The BGP peering is torn down and the associated routes removed from the routing table as soon as the subscriber-host is removed.

Dynamic BGP peering is supported for routed subscriber hosts terminated in a VPRN service and is not supported for routed subscriber hosts terminated in an IES service. The BGP learned routes scaling is limited by the BGP scaling limits. The routes learned via a dynamic BGP peer are populated in the routing table as "Remote BGP" routes.

To display the BGP learned routes associated with a routed subscriber host, use the regular BGP commands. For example:

show router *service-id* **bgp neighbor** *ip-address* **received-routes**

A dynamic BGP group must be configured in the BGP cli context of the VPRN service where the subscriber host is started:

config>service>vprn>bgp

```
    group "dynamic-peer-1" dynamic-peer
    exit
```

The BGP peering policy to be used must be configured in the subscriber-mgmt CLI context:

```
config>subscr-mgmt

    bgp-peering-policy "bgp-policy-1" create
    exit
```

A dynamic BGP peer is established for a subscriber host if the RADIUS attribute [26-6527-55] "Alc-BGP-Policy" returned in the Access-Accept contains the name of a local configured bgp-peering-policy and if a dynamic peer group is configured in the VPRN BGP context.

BGP peering parameters can be specified from multiple sources:

- Use BGP peering parameters returned in Radius VSA attributes
- If not available from RADIUS, use BGP peering parameters configured in the bgp-peering-policy

- If not configured in the bgp-peering-policy, use BGP peering parameters configured for the dynamic-peer group
- If not configured in the dynamic-peer group, use the BGP peering parameters configured in the VPRN service BGP CLI context.
- If not configured in the VPRN service BGP CLI context, use the defaults

The import and export policies to be used for the dynamic bgp peer are determined in following priority order:

1. Use import/export policies returned in RADIUS VSA attributes and append policies configured in the bgp-peering-policy.
2. If not available from RADIUS AND not configured in the bgp-peering-policy, use the policies configured in the dynamic-peer group.
3. If not configured in the dynamic-peer group, use the policies configured in the VPRN service BGP CLI context.

Table 17 details the RADIUS VSA attributes that can be used to setup dynamic BGP peering.

Table 17: RADIUS VSA Attributes to Setup Dynamic BGP Peering

Attribute-ID	Attribute Name	Description
26-6527-55	Alc-BGP-Policy	Mandatory attribute to setup a dynamic BGP peer. References a bgp peering policy configured in the “configure subscriber-mgmt bgp-peering-policy <policy-name>” CLI context.
26-6527-56	Alc-BGP-Auth-Keychain	Optional. References a keychain configured in the “configure system security keychain <keychain-name> “ CLI context.
26-6527-57	Alc-BGP-Auth-Key	Optional. The MD5 authentication key used between BGP peers for BGP session establishment.
26-6527-58	Alc-BGP-Export-Policy	Optional. References a pre-configured BGP export routing policy.
26-6527-59	Alc-BGP-Import-Policy	Optional. References a pre-configured BGP import routing policy.
26-6527-60	Alc-BGP-PeerAS	Optional. Specifies the Autonomous System number for the remote peer

RIP Listener

If a routed subscriber host is associated with a RIP policy, the host's IPv4 routes can be learned over RIP. The BNG only supports RIP listener and does not support sending RIP routes to subscribers. To enable RIP for a subscriber, the subscriber must first be associated with a **rip-policy**. The group interface of the subscriber must also be configured as a RIP neighbor. The rip-policy can be associated to the subscriber during authentication from LUDB or via Radius. It can also be configured directly for static hosts. The RIP routes learned from a subscriber is removed as a subscriber is purged or shutdown from the system. RIP listening for ESM host is supported on both IES and VPRN.

To display the RIP learned routes associated with a routed subscriber host, use the regular RIP commands. For example:

```
show  router service-id rip neighbor interface advertised-routes
```

The group interface must be configured in the RIP CLI context of the routed instance where the subscriber host is created:

```
config>router/service vprn>rip
     group "rip-listener"
          neighbor "group-interface-01"
```

The RIP policy is configured in the subscriber-mgmt CLI context:

```
config>sub-mgmt
     rip-policy "rip-policy-01" create
```

A RIP neighbor is established for a subscriber host if the RADIUS attribute [26-6527-207] "Alc-RIP-Policy" is returned in the Access-Accept or in LUDB. RIP parameters such as **authentication key** and **type** can be specified in the RIP policy.

For more information about RIP, refer to the 7x50 SR OS Routing Protocols Guide.

RADIUS: Framed-Route and Framed-IPv6-Route

RADIUS attribute [22] Framed-Route can be specified in a Radius Access-Accept message to associate an IPv4 route with an IPv4 routed subscriber host and Radius attribute [99] Framed-IPv6-Route can be used to associate an IPv6 route with an IPv6 routed subscriber wan host (DHCPv6 IA-NA or SLAAC). These routes are populated in the routing table as "Remote Managed" routes. Up to sixteen managed routes can be installed for a routed subscriber host; this corresponds with up to sixteen Framed-Routes and sixteen Framed-IPv6-Routes for a dual stack routed subscriber. Framed-IPv6-Routes cannot be associated with a Prefix Delegation host (DHCP IA-PD).

The Framed-Route and Framed-IPv6-Route attributes should be formatted as:

"<ip-prefix>[/<prefix-length>] <space> <gateway-address> [<space> <metric>] [<space> tag <space> <tag-value>] [<space> pref <space> <preference-value>]"

where:

<space> — is a white space or blank character.

<ip-prefix>[/prefix-length] — is the managed route to be associated with the routed subscriber host. The prefix-length is optional for an IPv4 managed route. When not specified, a class-full class A,B or C subnet is assumed. The prefix-length is mandatory for an IPv6 managed route.

<gateway-address> — must be the routed subscriber host IP address.
"0.0.0.0" is automatically interpreted as the host IPv4 address for managed IPv4 routes.

"::" and "0:0:0:0:0:0:0:0" are automatically interpreted as the wan-host IPv6 address for managed IPv6 routes.

[<metric>] — Optional. Installed in the routing table as the metric of the managed route. If not specified, metric zero is used. Value = [0.. 65535].

[tag <tag-value>] — Optional. The managed route will be tagged for use in routing policies. If not specified, or tag-value = 0, then the route is not tagged. Value = [0..4294967295].

[pref <preference-value>] — Optional. Installed in the routing table as protocol preference for this managed route. If not specified, preference zero is used. Value = [0..255].

If the optional metrics (metric, tag and/or preference) are specified in a wrong format or with out of range values, then the defaults are used for all metrics: metric=0, no tag and preference=0. No event is logged.

If the Framed-Route or Framed-IPv6-Route is invalid (for example because the gateway address specified does not match the host wan IP address or because the host bits are not zero) then the routed subscriber host is instantiated without the ill defined managed route. An event is logged in this case.

Equal Cost Multi-Path (ECMP) is supported for IPv4 Framed-Route:

The maximum number of equal cost paths in a routing instance is configured with:

```
config>router>
config>service>vprn>
```

```
ecmp <max-ecmp-routes>
```

If an identical managed route is associated with different routed subscriber hosts in the context of the same IES/VPRN service, up to <*max-ecmp-routes*> managed routes are installed in the routing table. Candidate ECMP Framed-Routes have:

- Identical prefix
- Equal lowest preference
- Equal lowest metric

A tie breaker determines if more candidate ECMP Framed-Routes are available than the configured <max-ecmp-routes> is: Lowest ip next-hop.

Other identical managed routes are shadowed and an event is logged.

Note that Candidate ECMP Framed-Routes must not belong to the same subscriber.

Equal Cost Multi-Path (ECMP) is not supported for Framed-IPv6-Route.

If an identical managed IPv6 route is associated with different routed subscriber hosts in the context of the same IES/VPRN service only one managed IPv6 route is installed in the routing table. The selection criteria are (in order of priority):

1. Lowest preference
2. Lowest metric
3. Lowest ip next-hop

Other identical managed IPv6 routes are shadowed and an event is logged.Valid Framed-Routes and Framed-IPv6-Routes are persistent (stored in the persistency file for recovery after reboot) and synchronized in a Multi-Chassis Redundancy configuration.

RADIUS-learned Framed-Route/Framed-IPv6-Route and static host associated managed routes that are installed in the routing table can be identified in routing policies for redistribution as protocol “managed”.

To display the managed routes associated with a routed subscriber host, use following commands:

show service id *service-id* **dhcp lease-state detail**

show service id *service-id* **dhcp6 lease-state detail**

show service id *service-id* **slaac host detail**

show service id *service-id* **ppp session detail**

show service id *service-id* **pppoe session detail**

show service id *service-id* **arp-host detail**

Valid RADIUS-learned managed routes can be included in Radius accounting messages with following configuration:

```
configure
    subscriber-mgmt
```

```
radius-accounting-policy <name>
    include-radius-attribute
        framed-route
        framed-ipv6-route
```

Associated managed routes for an instantiated routed subscriber host are included in RADIUS accounting messages independent of the state of the managed route (Installed, Shadowed, HostInactive, etc.)

In case of a PPP session, when a Framed-Route or Framed-IPv6-Route is available while the corresponding routed subscriber host is not yet instantiated, the managed route is in the state “notYetInstalled” and will not be included in Radius accounting messages.

Dual Homing

All residential networks are based on two models: Layer 2 CO and Layer 3 CO. Dual homing methods for Layer2 CO include MC-LAG and MC-Ring. Dual homing for Layer 3 CO is based on SRRP and can be done in ring-topologies (l3-mc-ring or with directly attached nodes. All methods use multi-chassis synchronization protocol to sync subscriber state.

Dual Homing to Two PEs (Redundant-Pair Nodes) in Triple Play Aggregation

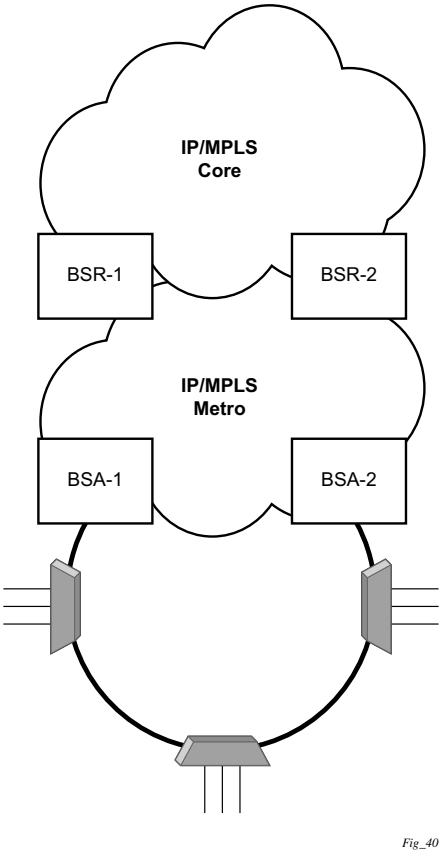


Figure 107: Dual-Homing to Two PEs

Figure 107 depicts dual-homing to two different PE nodes. The actual architecture can be based on a single DSLAM having two connections to two different PEs (using MC-LAG) or ring of DSLAMs dual-connected to redundant pair of PEs.

Similarly to previous configuration, both aggregation models (VLAN-per-subscriber or VLAN-per-service) are applicable.

Configurations include:

- Loop resolution and failure recovery — Can be based on MC-LAG or mVPLS.
- DHCP-lease-state persistency — Stores all required information to recover from node failure.
- DHCP-lease-state synchronization — A mechanism to synchronize the DHCP lease-state between two PE nodes in the scope of redundancy groups (a group of SAPs used for dual homing).
- IGMP snooping state synchronization — Similarly to DHCP lease-state synchronization, IGMP snooping state is synchronized to ensure fast switchover between PE nodes. In a VPLS network, a BTV stream is typically available in all PE nodes (the ring interconnecting all PEs with Mcast routers is typically used) so the switch over can be purely driven by RSTP or MC-LAG.
- ARP reply agent responses — The ARP reply agent can response to ARP requests addressing a host behind the given SAP if the SAP is in a forwarding state. This prevents the FDB table in the VPLS from being “poisoned” by ARP responses generated by the node with a SAP in a blocking state (see Figure 108).

Figure 108 shows a typical configuration of network model based on Layer 2 CO model. Individual rings of access nodes are aggregated at BSA level in one (or multiple) VPLS services. At higher aggregation levels (the BSR), individual BSAs are connected to Layer 3 interfaces (IES or VPRN) by spoke SDP termination. Every Layer 3 interface at BSR level aggregates all subscribers in one subnet.

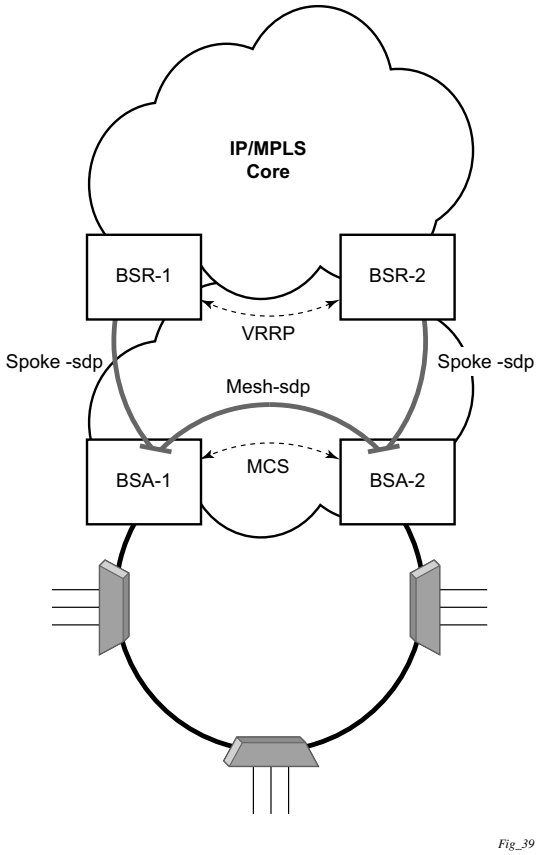


Figure 108: Layer 2 CO Dual Homing - Network Diagram

Typically, BTV service distribution is implemented in a separate VPLS service with a separate SAP per access-node. This extra VPLS is not explicitly indicated in Figure 108 (and subsequent figures) but the descriptions refer to its presence.

From a configuration point of view in this model, it is assumed that all subscriber management features are enabled at the BSA level and that synchronization of the information (using multi-chassis synchronization) is configured between redundant pair nodes (BSA-1 and BSA-2 shown in Figure 108 on page 1165). The multi-chassis synchronization connection is used only for synchronizing active subscriber host database and will operate independently from dual-homing connectivity control. At the BSR level, there are no subscriber management features enabled.

The operation of redundancy at the BSR level through VRRP is the same as dual homing based on MC-LAG. The operation of dual homing at BSA level is based on two mechanisms. Ring control connection between two BSAs have two components, in-band and out-of-band communication. With in-band communication, BFD session between BSA-1 and BSA-2 running through the access ring and using dedicated IES/VPRN interface configured on both nodes. This connection uses a separate VLAN throughout the ring. The access nodes provides transparent bridging for this

VLAN. The BFD session is used to continuously verify the integrity of the ring and to detect a failure somewhere in the ring.

With out-of-band communication, the communication channel is used by BSA nodes to exchange information about the reachability of individual access nodes as well as basic configurations in order to verify the consistency of the ring. The configuration information is synchronized through multi-chassis synchronization and therefore it is mandatory to enable multi-chassis synchronization between two nodes using the multi-chassis-ring concept.

In addition, the communication channel used by MC-LAG or MC-APS control protocol is used to exchange some event information. The use of this channel is transparent to the user.

Ring node connectivity check continuously checks the reachability of individual access nodes in the ring. The session carrying the connection is conducted on separate VLAN, typically common for all access nodes. SHCV causes no interoperability problems.

Steady-State Operation of Dual-homed Ring

Figure 109 illustrates the operation of the dual-homed ring. The steady state is achieved when both nodes are configured in a consistent way and the peering relation is up. The multi-chassis ring must be provisioned consistently between two nodes.

In-Band Ring Control Connection (IB-RCC) is in operational UP state. Note that this connection is set up using a bi-directional forwarding session between IP interfaces on BSA-1 and BSA-2.

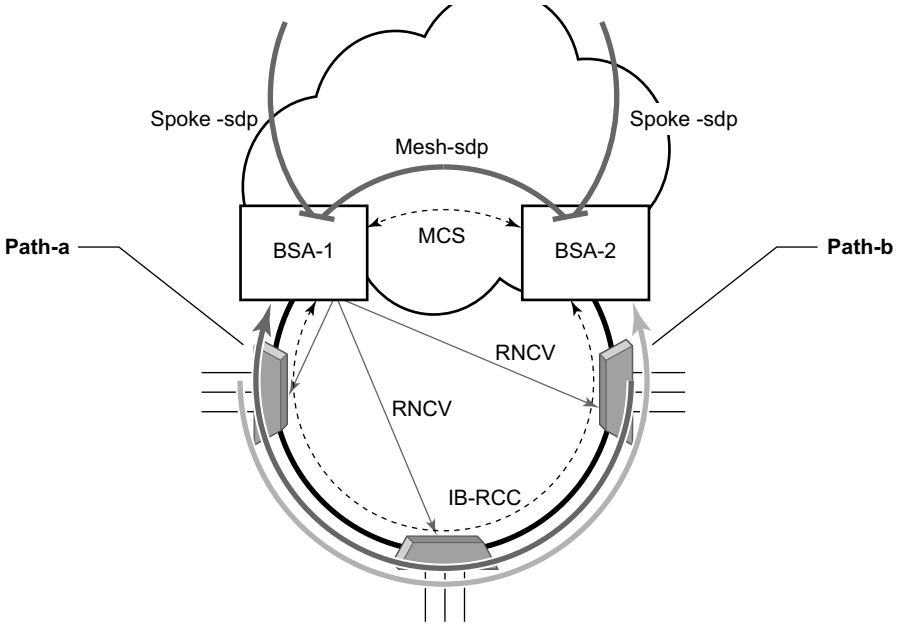


Figure 109: Dual Homing Ring Under Steady-State Condition

In Figure 109, the ring is fully closed and every access node has two possible paths towards the VPLS core. Figure 109 refers to these as **path-a** and **path-b**. In order to avoid the loop created by the ring, only one of the paths can be used by any given ring node for any given VLAN. The assignment of the individual VLANs to path-a or path-b, respectively, has to be provisioned on both BSAs.

The selection of the BSA master for both paths will be based on the IP address of the interface used for IB-RCC communication (bi-directional forwarding session). The BSA with the lower IP address of the interface used as IB-RCC channel will become master for ring nodes and their respective VLANs assigned to path-a. The master of path-b will be other BSA.

In this example, each path in the ring has a master and standby BSA. The functionality of both devices in steady state are as follows:

In the master BSA:

- All SAPs that belong to the path where the given BSA is a master, are operationally UP and all FDB entries of subscriber hosts associated with these SAPs point to their respective SAPs.
- The master of a path performs periodical Ring Node Connectivity Verification (RNCV) check to all ring nodes.
- In case of a RNCV failure, the respective alarm will be raised. Note that the loss of RNCV to the given ring node does not trigger any switchover action even if the other BSA appears to have the connection to that ring node. As long as the BFD session is up, the ring is considered closed and the master/standby behavior is driven solely by provisioning of the individual paths.
- The ARP reply agent replies to ARP requests addressing subscriber hosts where the BSA master.

In the standby BSA:

All SAPs that belong to a BSA's path, the standby will be operationally down and all FDB entries of subscriber hosts associated with those SAPs will be pointing towards SDP connecting to master BSA (also called a shunt SDP).

In both BSAs:

- The information on individual paths assignment is exchanged between both BSAs through multi-chassis synchronization communication channel and conflicting SAPs (being assigned to different paths on both BSA nodes) will be forced to path-a (the default behavior).
- For IGMP snooping, the corresponding multi-chassis IDs are targeting all subscriber-facing SAPs on both nodes. On the standby BSA node, the corresponding SAPs are in an operationally down state to prevent the MC traffic be injected on the ring twice.

Broken-Ring Operation and the Transition to this State

Figure 110 illustrates the model with a broken ring (link failure or ring node failure). This state is reached in following conditions:

- Both nodes are configured similarly.
- Peering is up.
- The multi-chassis ring is provisioned similarly between two nodes
- IB-RCC is operationally down.

In this scenario, every ring node has only one access path towards the VPLS core and hence, the Path-a and Path-b notion has no meaning in this situation.

Functionally, both BSAs are now the master for the reachable ring nodes and will take action as described in Steady-State Operation of Dual-homed Ring on page 1166. For all hosts behind the unreachable ring nodes, the corresponding subscriber host FDB entries point to the shunt SDP.

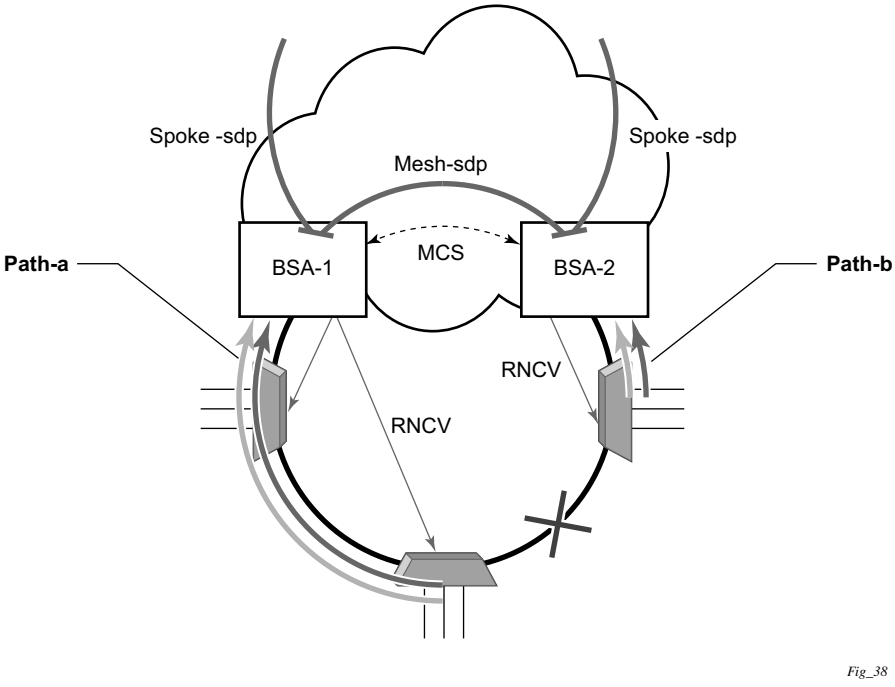


Figure 110: Broken Ring State

The mapping of individual subscriber hosts into the individual ring nodes is complicated, especially in the VLAN-per-service model where a single SAP can represent all nodes on the ring. In this case, a given BSA can have subscriber hosts associated with the given SAP that are behind

reachable ring nodes as well as subscriber hosts behind un-reachable ring nodes. This means that the given SAP cannot be placed in an operationally down state (as in a closed ring state), but rather, selectively re-direct unreachable subscriber states to the shunt SDP.

All SAPs remain in an operationally up state as long as the ring remains broken. This mainly applies for BTV SAPs that do not have any subscriber hosts associated with and do not belong to any particular ring node.

In order to make the mapping of the subscriber-hosts on the given ring node automatically provisioned, the ring node identity will be extracted during subscriber authentication process from RADIUS or from a Python script. The subscriber hosts which are mapped to non-existing ring node will remain attached to the SAP.

At the time both BSA detect the break in IB-RCC communication (if BFD session goes down) following actions are taken:

- Both nodes trigger a RNCV check towards all ring nodes. The node, which receives the reply first, will assume a master functionality and will inform the other BSA through an out-of-band channel. This way, the other node can immediately take actions related to the standby functionality without waiting for an RNCV timeout. Even if the other node receives an RNCV response from the given ring node later, the master functionality remains with the node the received the response first.
- After assuming the master functionality for hosts associated with the given SAP(s), the node will send out FIB population messages to ensure that new path towards the VPLS core is established. The FIB population messages are sourced from the MAC address of the default gateway used by all subscriber hosts (such as the VRRP MAC address) which is provisioned at the service level.

Transition from Broken to Closed Ring State

By its definition, the multi-chassis ring operates in a revertive mode. This means that whenever the ring connectivity is restored, the BSA with lower IP address in the IB-RCC communication channel will become master of the path-a and vice versa for path-b.

After restoration of BFD session, the master functionality, as described in Steady-State Operation of Dual-homed Ring on page 1166, is assumed by respective BSAs. The FDB tables are updated according to the master/standby role of the given BSA and FDB population messages is sent accordingly.

Provisioning Aspects and Error Cases

The multi-chassis ring can operate only if both nodes similarly configured. The peering relation must be configured and both nodes must be reachable at IP level. The multi-chassis ring with a corresponding sync-tag as a ring-name identifying a local port ID must be provision on both nodes. And, BFD session and corresponding interfaces needs to be configured in a consistent way.

In case the multi-chassis rings are not provisioned consistently, the ring will not become operational and the SAP managed by it will be in operationally up state on both nodes.

The assignment of individual SAPs to path-a and path-b is controlled by configuration of VLAN ranges according to the following rules:

- By default, all SAPs (and hence all VLANs on the given port) are assigned to path-a.
- An explicit statement defining the given VLAN range assigns all SAPs falling into this range to the path-b.
- An explicit statement defining the given VLAN range defines all SAPs that are excluded from the multi-chassis ring control.
- In case of a conflict in the configuration of VLAN ranges between two redundant nodes is detected, all SAPs falling into the “conflict-range” will be assigned to path-a, on both nodes regardless the local configuration.
- For QinQ-encapsulated ports the VLAN range refers to the outer VLAN.

Dual Homing to Two BSR Nodes

Figure 111 depicts a single DSLAM dual-homed to two BSRs.

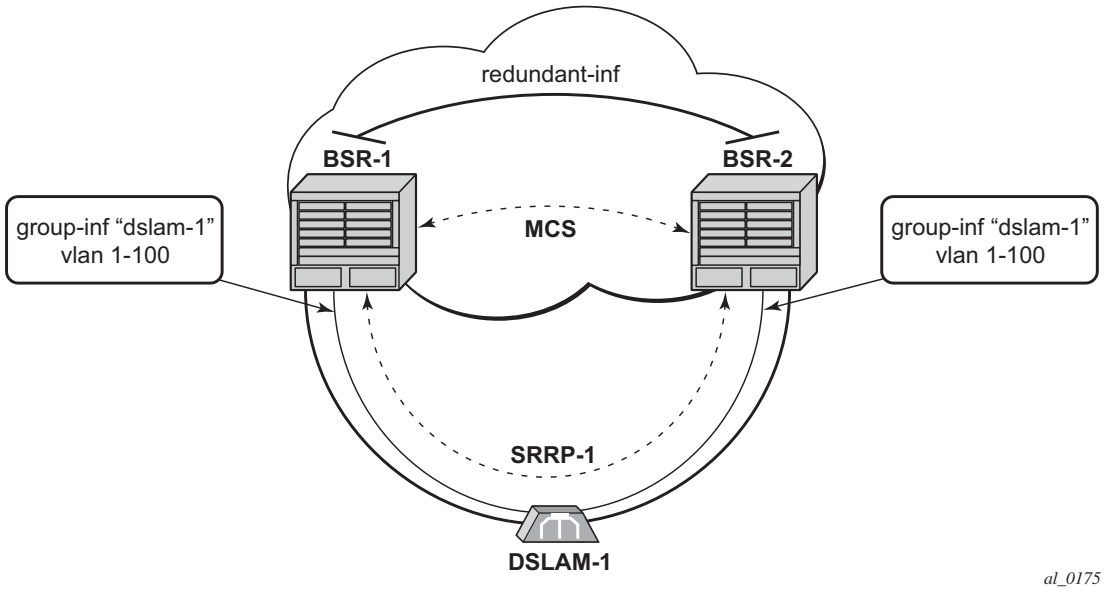


Figure 111: Low

In order to provide dual-homing in the context of subscriber interfaces, the following items must be configured on both BSRs:

- Group interface (dslam-1) with corresponding SAPs (vlan 1-100)
- SRRP instance controlling given group interface
- Redundant interface between BSRs to provide “shunt” connectivity
- MCS connection to provide synchronization of dynamic subscriber-host entries

During the operation, BSR-1 and BSR-2 will resolve master-backup relation and populate respective FIBs in such a way that at master side, subscriber-host entries point to corresponding group-interface while at the back-up side, subscriber-host entries point to the redundant interface. Note that the logical operation of the ring in the Layer 3 CO model is driven by SRRP. For more details on SRRP operation, refer to Subscriber Routed Redundancy Protocol (SRRP) on page 1116.

MC Services

The typical implementation of MC services at the network level is shown in Figure 112.

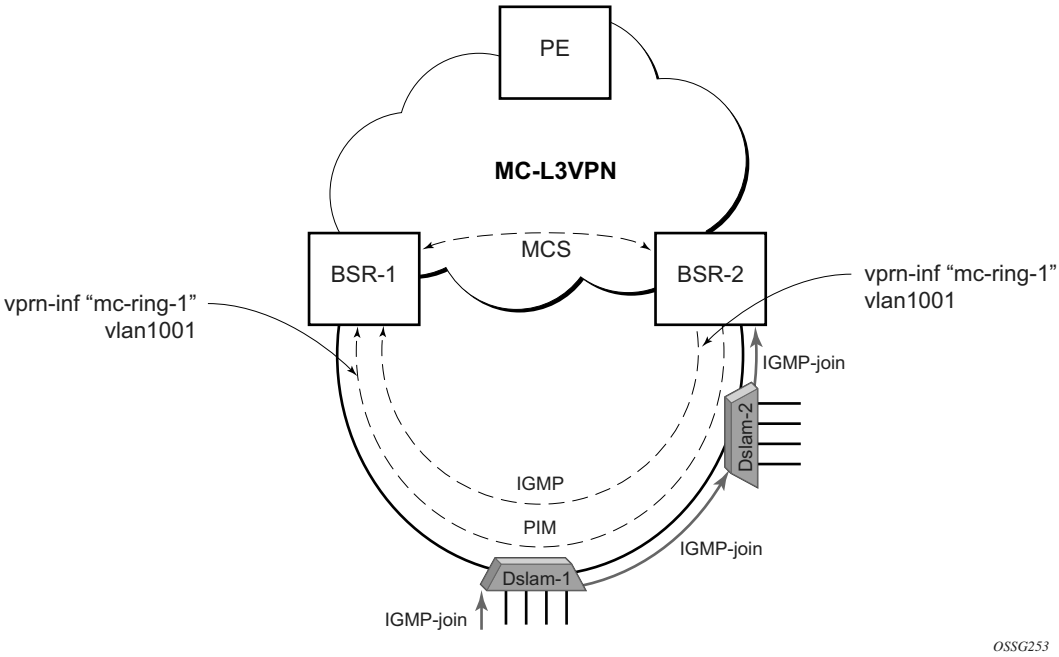


Figure 112: MC Services in a Layer 3-Ring Topology (a)

The IGMP is used to register joins and leaves of the user. IGMP messaging between BSRs is used to determine which router performs the querier role (BSR2 in Figure 112). PIM is used to determine which router will be the designated router and the router that sends MC streams on the ring.

The access nodes have IGMP snooping enabled and from IGMP messaging between BSR, they are aware which router is the querier. In the most generic case, IGMP snooping agents (in access nodes) send the IGMP-joins messages only to IGMP-querier. The synchronization of the IGMP entries can be then be performed through MCS. In some cases, access nodes can be configured in such a way that both ring ports are considered as m-router ports and IGMP joins are sent in both directions.

All of the above is a steady state operation which is transparent to the topology used in a Layer 2 domain.

A ring-broken state is shown in Figure 113.

In this case, IGMP and PIM messaging between BSRs is broken and both router assume role of querier and role of designated router. By the virtue of ring topology, both routers will see only

IGMP joins/leaves generated by host attached to a particular “half” of the ring. This means that both routers will have “different” view on dynamic IGMP state.

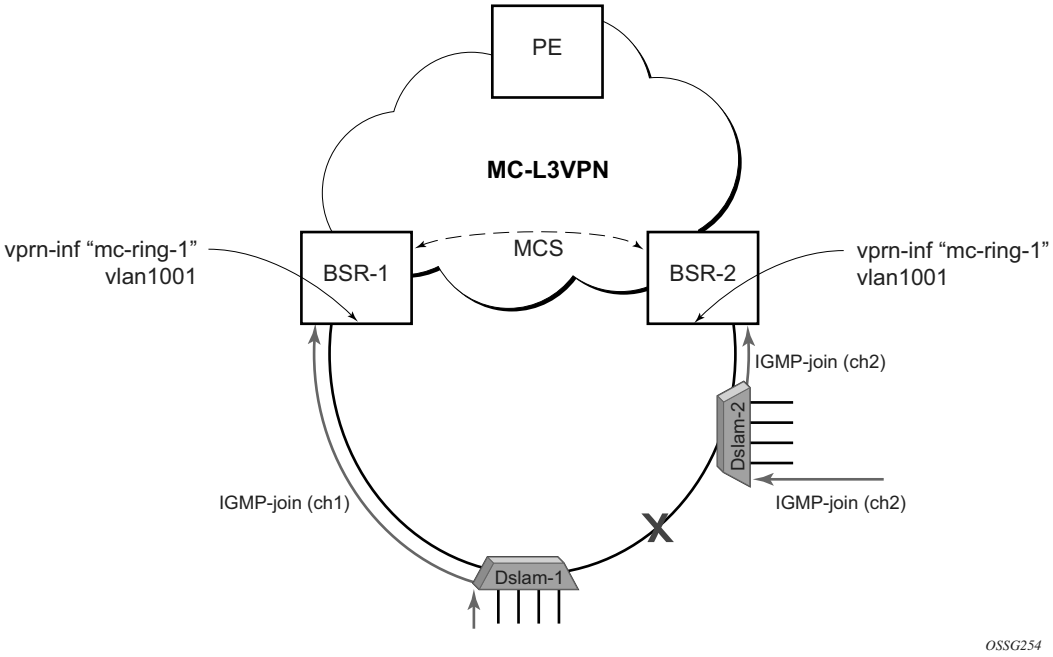


Figure 113: MC Services on a Layer 3-Ring Topology (b)

In principle, MCS could be used to synchronize both routers, but in case of a Layer 2 ring, the implementation sends all IGMP messages to a “ring-master: which then performs IGMP processing and consequently, MCS sync. As a result, any race conditions are avoided.

Another ring-specific aspect is related to ring healing. The ring continuity check is driven by BFD which then drives SRRP and PIM messaging. BFD is optimized for fast detection of ring-down events while ring-up events are announced more slowly. There is a time window when routers are not aware that the ring is recovered. In the case of MC, this means traffic will be duplicated on the ring.

To avoid this, the implementation of BFD provides a “raw mode” which provides visibility on “ring-up” events. The protocols, such as SRRP and PIM, use this raw mode rather than the BFD API.

Routed CO Dual Homing

Routed CO dual homing is a solution that allows seamless failover between nodes for all models of routed CO. In the dual homed environment, only one node will forward downstream traffic to a given subscriber at a time. Dual homing involves several components:

- Redundant Interface — This is used to shunt traffic to the active node for a given subscriber for downstream traffic.
- SRRP — This is used to monitor the state of connectivity to the DSLAM. Refer to the SRRP section for more detail.
- MCS — This is used to exchange subscriber host and SRRP information between the dual homed nodes.

Routed CO dual homing can be configured for both wholesaling models. Dual homing is configured by creating a redundant interface that is associated with the protected group interfaces. The failure detection mechanism can be VRRP. If VRRP is used, each node monitors the VRRP state to determine the priority of its own interface.

Dual homing is used to aggregate a large number of subscribers in order to support a redundancy mechanism that will allow a seamless failover between nodes. Because of the Layer 3 nature of the model, forwarding is performed for the full subscriber subnet.

Redundant Interfaces

In dual homing, a redundant interface must be created. A redundant interface is a Layer 3 spoke SDP-based interface that allows delivery of packets between the two nodes. The redundant interface is required to allow a node with a failed link to deliver packets destined to subscribers behind that link to the redundant node. Since subscriber subnets can span multiple ports it is not possible to stop advertising the subnet, thus, without this interface the node would black hole.

The redundant interface is associated with one or more group interfaces. An interface in backup state will use the redundant interface to send traffic to the active interface (in the active node). The SAP structure under the group interface must be the same on both nodes as the synchronization of subscriber information is enabled on a group interface basis. Traffic can be forwarded through the redundant interface during normal operation even when there are no failed paths. See Figure 114.

SRRP in Dual Homing

Subscriber Router Redundancy Protocol (SRRP) allows two separate connections to a DSLAM to operate in an active/standby fashion similar to how VRRP interfaces operate. Since the SRRP state is associated with the group-interface, multiple group-interfaces may be created for a given port such that some of the SAPs will be active in one node and others active on the other node. While each SRRP pair is still allowed to be active/backup, the described configuration is allowed for load balancing between the nodes. Note that in a failure scenario subscriber bandwidth will be affected. For more information about SRRP, refer to Subscriber Routed Redundancy Protocol

(SRRP) on page 1116.

If SRRP is configured before the redundant interface is up, and in backup state the router will forward packets to the access node via the backup interface but will not use the gateway MAC address. This applies to failures in the redundant interface as well. If the redundant interface exists and up the router will send downstream packets to the redundant interface and will not use the backup group interface.

In a dual homing architecture the nodes must be configured with SRRP to support redundant paths to the access node. The nodes must also be configured to synchronize subscriber data and IGMP state. To facilitate data forwarding between the nodes in case some of the ports in a given subscriber subnet are affected a redundant interface must be created and configured with a spoke. The redundant interface is associated with one or more group interfaces.

The service IDs for both the wholesale VPRN and the retailer VPRN must be the same in both nodes.

An interface in backup state will use the redundant interface to send traffic to the active interface (in the active node). The SAP structure under the group interface must be the same on both nodes as the synchronization of subscriber information is enabled on a group interface basis.

SRRP is associated a group-interface. Multiple group-interfaces can be created for a given port such that some of the SAPs will be active in one node and others active on the other node. While every SRRP pair is still allowed to be active/backup the described configuration will allow for load balancing between the nodes. Note that in a failure scenario subscriber bandwidth will be affected.

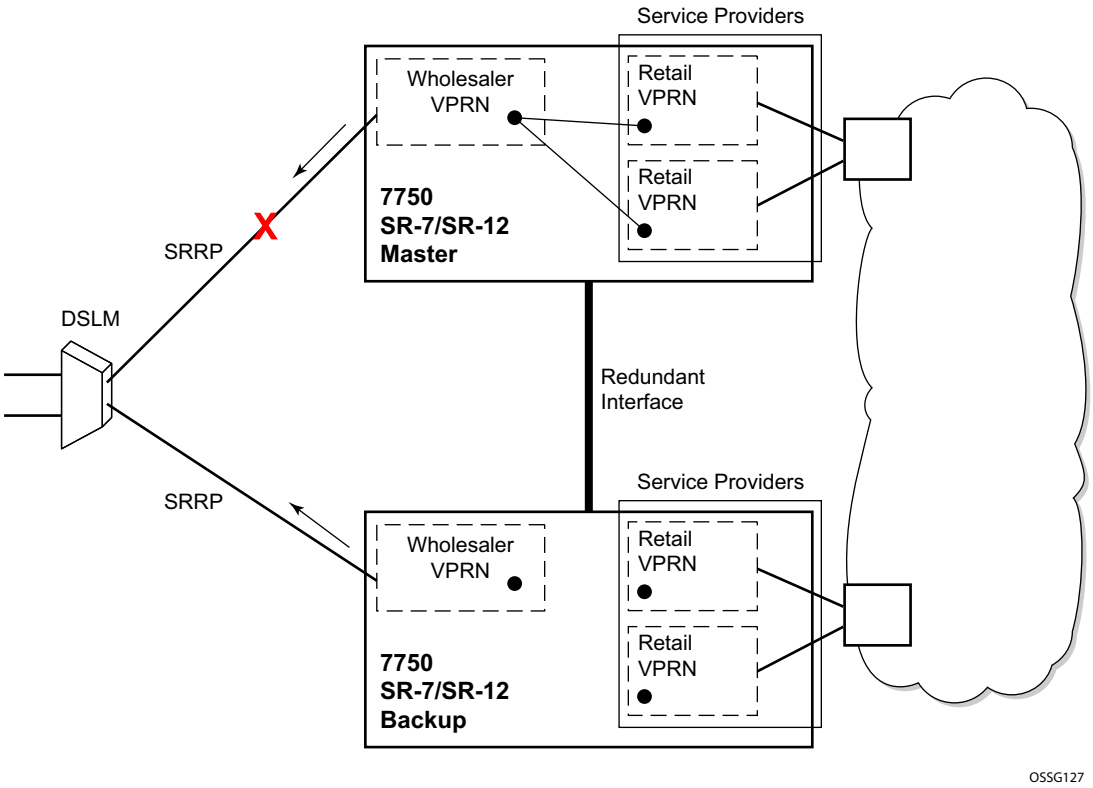


Figure 114: Dual Homing Example

Synchronization

To establish subscriber state the nodes must synchronize subscriber information. Refer to the 7750 SR Basic Configuration Guide for multi-chassis synchronization configuration information. The operator must complete the configuration and the system must have data synchronized before the backup node may deliver downstream packets to the subscriber.

If dual homing is used with regular interfaces that run IGMP the nodes must be configured to synchronize the Layer 3 IGMP state.

The service IDs for both the wholesale VPRN and the retailer VPRN must be the same in both nodes.

Wholesale-Retail Multi-Chassis Redundancy

Multi-Chassis Redundancy for a retail service is enabled with the SRRP and redundant interface configuration on the wholesale group-interface parented by the forwarding subscriber interface. The Multi-Chassis state (active or standby) of the retail subscriber host is determined from the SRRP state (master / non-master) of the group-interface that parents the SAP of the retail subscriber host. The retail service id must be equal on both nodes.

Sample wholesale service configuration:

```
vprn 3000 customer 1 create
    description "Wholesale service"
    route-distinguisher 64500:3000
    auto-bind mpls
    vrf-target import target:64500:3000
    redundant-interface "red-int-1" create
        address 192.168.100.0/31
        ip-mtu 1500
        spoke-sdp 12:3000 create
            no shutdown
        exit
    exit
    subscriber-interface "sub-int-1" create
        address 10.1.1.253/24 gw-ip-address 10.1.1.254
        address 10.1.2.253/24 gw-ip-address 10.1.2.254
        group-interface "group-int-1-1" create
            dhcp
                --- snip ---
            exit
            redundant-interface "red-int-1"
            sap 1/1/6:1.4001 create
                description "SRRP 1 message path"
            exit
            srrp 1 create
                message-path 1/1/6:1.4001
                send-fib-population-packets outer-tag-only
                no shutdown
            exit
            pppoe
                --- snip ---
```

```
                exit
            exit
            group-interface "group-int-1-2" create
                dhcp
                    --- snip ---
                exit
                redundant-interface "red-int-1"
                sap 1/1/6:2.4001 create
                    description "SRRP 2 message path"
                exit
                srrp 2 create
                    message-path 1/1/6:2.4001
                    priority 50
                    send-fib-population-packets outer-tag-only
                    no shutdown
                exit
                pppoe
                    --- snip ---
                exit
            exit
        exit
        no shutdown
    exit
```

Sample retail service configuration:

```
    vprn 3001 customer 1 create
        description "Retail service"
        route-distinguisher 64500:3001
        auto-bind mpls
        vrf-target target:64500:3001
       subscriber-interface "sub-int-rt-3000-1" fwd-service 3000 fwd-subscriber-inter-
face "sub-int-1" create
            address 10.1.11.253/24 gw-ip-address 10.1.11.254
            address 10.1.12.253/24 gw-ip-address 10.1.12.254
            dhcp
                --- snip ---
            exit
            pppoe
                --- snip ---
            exit
        exit
        no shutdown
    exit
```

Overlapping addresses in retail subscriber interfaces (enabled with private-retail-subnets) cannot be used in combination with Multi-Chassis Redundancy. Retail subscriber subnets leaked in the wholesale service are needed to forward shunted traffic. The address of an unnumbered subscriber host (enabled with **unnumbered** *ip-int-name*|*ip-address* or **allow-unmatching-subnets** on the retail subscriber interface) is not contained in the subnets configured on the retail subscriber interface. The export of the retail subscriber host routes to the wholesale service must be explicitly enabled with the **export-host-routes** command:

```
        vprn 3001 customer 1 create
           subscriber-interface "sub-int-rt-3000-1" fwd-service 1000 fwd-subscriber-inter-
face "sub-int-1" create
                allow-unmatching-subnets
                address 10.1.11.253/24 gw-ip-address 10.1.11.254
                address 10.1.12.253/24 gw-ip-address 10.1.12.254
                export-host-routes
                --- snip ---
```

Multi-Chassis Redundancy is supported for IPoEv4 and PPPoEv4 retail subscriber hosts.

SRRP and Multi-Chassis Synchronization

In order to take full advantage of SRRP resiliency and diagnostic capabilities, the SRRP instance will be tied to a MCS peering that terminates on the redundant node. Once the peering is associated with the SRRP instance, MCS will synchronize the local information about the SRRP instance with the neighbor router. MCS automatically derives the MCS key for the SRRP instance based on the SRRP instance ID. An SRRP instance ID of 1 would appear in the MCS peering database with a MCS-key srrp-0000000001.

The SRRP instance information stored and sent to the neighbor router consists of:

- The SRRP instance MCS key
- Containing service type and ID
- Containing subscriber IP interface name
- Subscriber subnet information
- Containing group IP interface information
- The SRRP group IP interface redundant IP interface name, IP address and mask
- The SRRP advertisement message SAP
- The local system IP address (SRRP advertisement message source IP address)
- The group IP interface MAC address
- The SRRP gateway MAC address
- The SRRP instance administration state (up/down)
- The SRRP instance operational state (disabled/becoming-backup/backup/becoming-master/master)
- The current SRRP priority
- Remote redundant IP interface availability (available/unavailable)
- Local receive SRRP advertisement SAP availability (available/unavailable)

Dual Homing and ANCP

Alcatel-Lucent provides a feature related to exchange of control information between DSLAM and BRAS (BSA is described in this model). This exchange of information is implemented by in-band control connection between DSLAM and BSA, also referred to as ANCP connection.

In case of dual homing, two separate connections will be set. As a consequence, there is no need to provide synchronization of ANCP state. Instead every node of the redundant-pair obtains this information from the DSLAM and creates corresponding an ANCP state independently.

SRRP Enhancement

The SRRP enhancements addressed in this section is to reduce the need for redundant-interface between the pair of redundant nodes without sacrificing the subnet aggregation on the back-end.

Redundant BNG nodes are not always collocated. This means that the logical link associated with the redundant (shunt) interfaces is taking the uplink path thus wasting valuable bandwidth (downstream traffic that arrives to the Standby node is routed via uplinks for the second time over to the Master node).

To meet the requirement to reduce the existence of shunted traffic only to the short transitioning period between SRRP switchovers while the routing on the network side is converging, the following was required (referring to Figure 115):

1. Share IP subnets over multiple SRRP instances. This is not mandatory, but it would helps to load balance traffic over the two nodes. For example, IP subnets 10 and 11 can be shared over SRRP instances 10 and 20 on node 1, and the IP subnet 12 can be associated with the SRRP instance 30 on node 2.
2. *SRRP aware routing* – this allows to dynamically increase routing metric on the IP subnets advertised from the Master SRRP node in comparison to the Standby SRRP node. It also allows to advertise/withdraw routes from a routing protocol based on the SRRP state. In this fashion, downstream traffic is routed in a predictable manner towards the Master SRRP node.
3. *SRRP Fate Sharing* for SRRP instances 10 and 11. This ensures congruency of SRRP states on the same node. This is a necessary step towards *SRRP aware routing*.

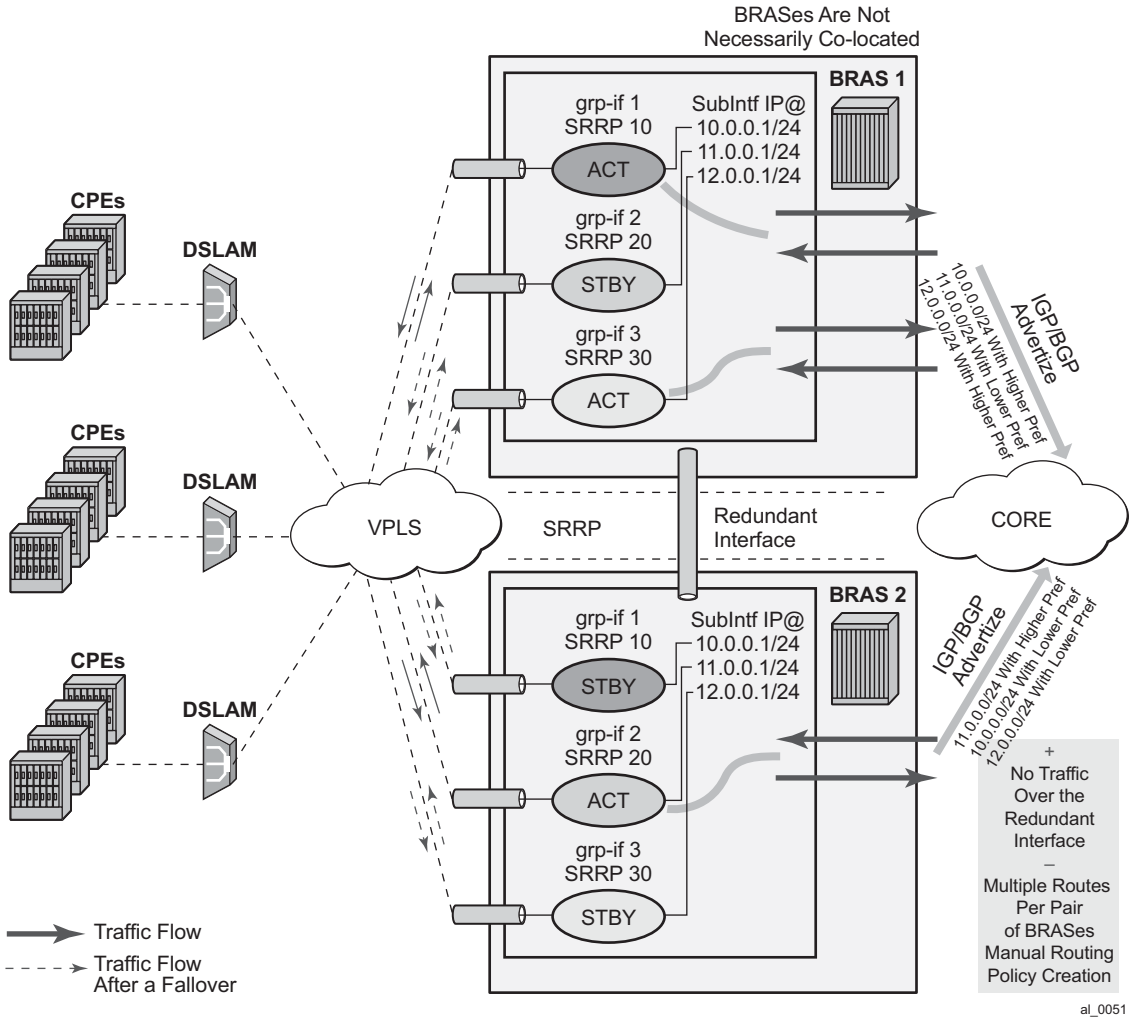


Figure 115: IP Subnet Per SRRP Master Group

SRRP Fate Sharing

SRRP Fate Sharing is a concept in which a group of SRRP instances track a single operational-object comprised of SRRP messaging SAPs. The SRRP instances behave as one (in the single failure case) with regards to SRRP mastership. The group of SRRP instances that are sharing fate on a paired node are referred as a Fate Sharing Group (FSG).

Transition of a single messaging SAP within the FSG into a DOWN state forces the SRRP instance on top of it into the INIT state. Consequently, all other SRRP instances within the same FSG transitions into a Backup state. In other words, SRRP instances within the FSG all share the same fate as the failed SRRP instance as shown in Figure 116. SRRP Fate Sharing provides

optimal protection in the context of a single failure in the network.

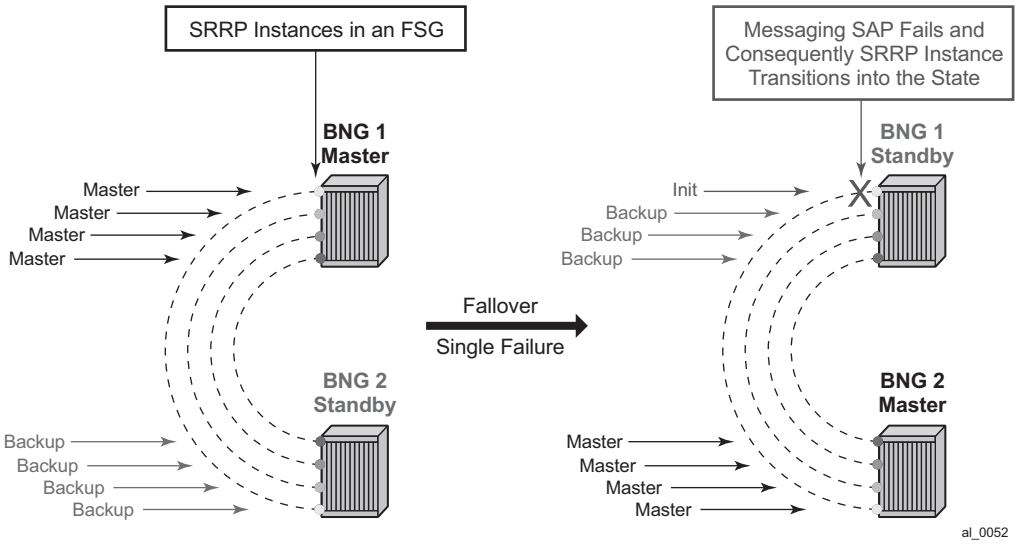


Figure 116: FSG –— Single Network Failure

In the case of multiple network failures, the concept of the FSG breaks as there is a possibility that a ‘FSG’ contains SRRP instances that are in any of the three possible SRRP states: Master, Backup, or Init. This Fate Sharing feature may not provide optimal protection when there are multiple network failures distributed over both redundant nodes.

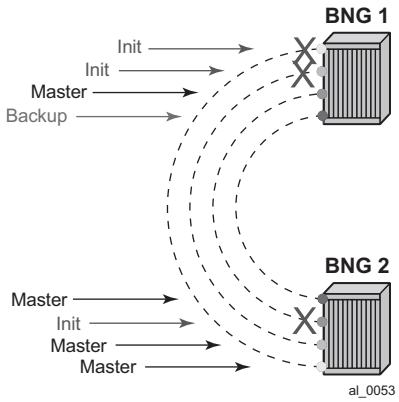


Figure 117: Multiple Network Failures

The whereabouts of the failure in the network path that SRRP is designed to monitor are not always clearly reflected through SRRP states. For example, if the network failure is somewhere in the aggregation network beyond the direct reach of our BNG, SRRP assumes Mastership on both BNG nodes. This is a faulty condition and the reason why solely monitoring of the SRRP states is not enough to protect against failures. On the other hand, the SRRP messaging SAP states are more indicative of the network failure since they can be tied into Eth-OAM.

Once a single network failure is detected and as a result an SRRP instance transitions into a non-Master state, the remaining SRRP instances in the FSG are forced into a Backup state. This is achieved by changing the priority of each individual SRRP instance in the FSG.

In the case of simultaneous multiple failures (multiple ports fail at the same time), it is possible that the SRRP instances within the FSG settle in any of the three possible SRRP states: Master, Backup, or Init. In such scenario shunted traffic will ensue.

In the premise of SRRP Fate Sharing, the network failure will be reflected in the operational state of the messaging SAP over which SRRP runs. This will certainly be the case if the failure is localized to the BNG (somewhere on the directly connected link). In the case of non-localized failure (beyond the direct reach of the BNG node), Eth-OAM might be needed in to detect the remote end failure and consequently bring the SAP operationally into a DOWN state.

Once the single network failure is detected, all instance within the FSG transitions into a non-Master state.

If there are no failures in the network, all SAPs are UP and SRRP instances within the FSG are in a homogeneous and deterministic state based on their configured priorities.

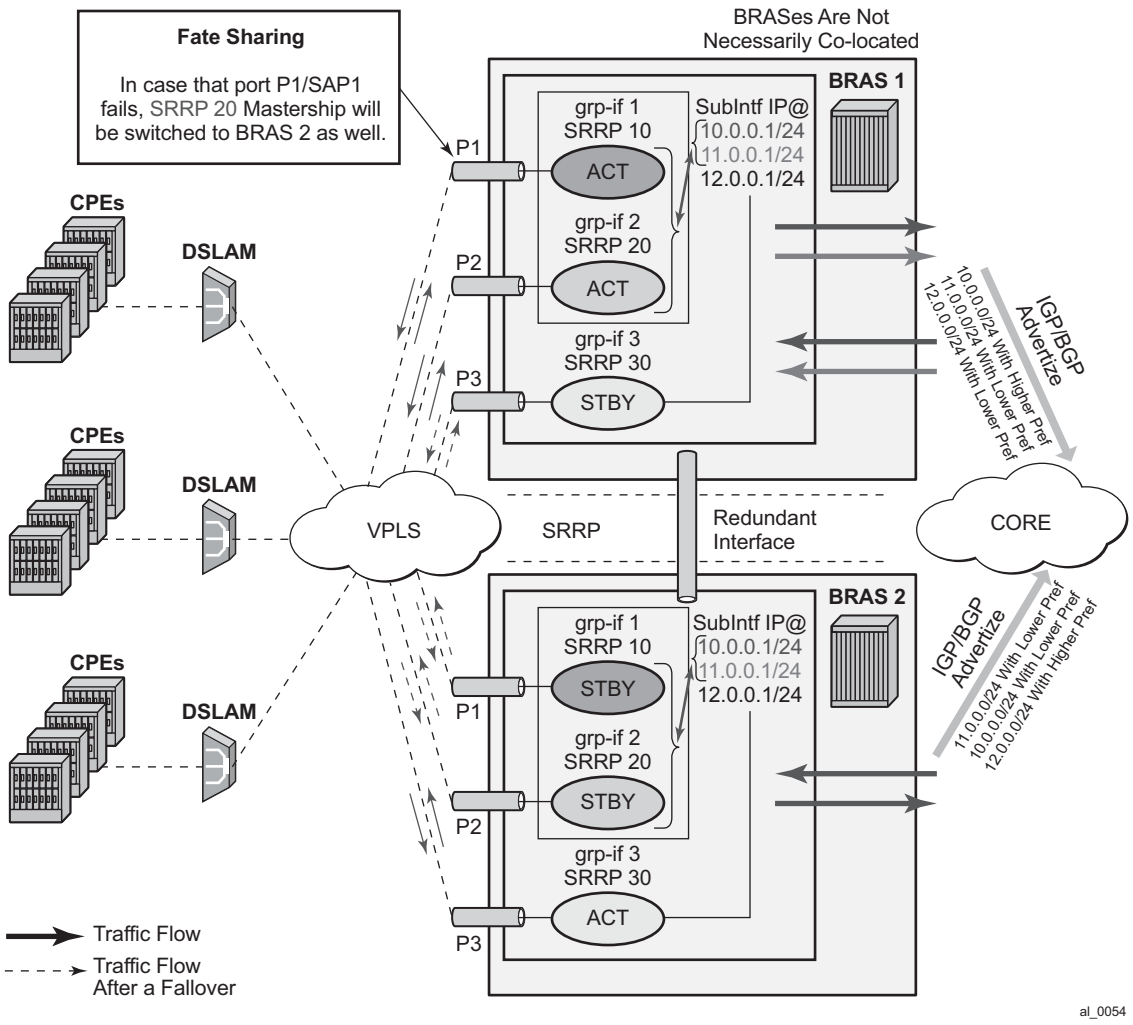


Figure 118: SRRP Fate Sharing

Failure Detection in a Fate Sharing Group

1. Dual homing over directly connected ports.
   No Eth-OAM is needed, AN is directly connected to the BNG.

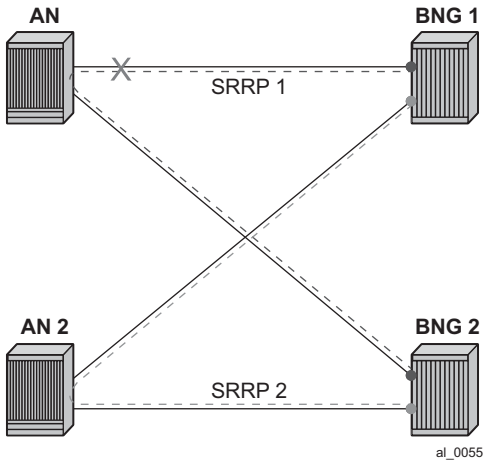


Figure 119: Scenario 1

2. Dual homing with aggregation network - aggregation network has no redundancy between Layer 2 switches (STP). To determine whereabouts of failure at point 1 in the figure below, Eth-OAM is needed.

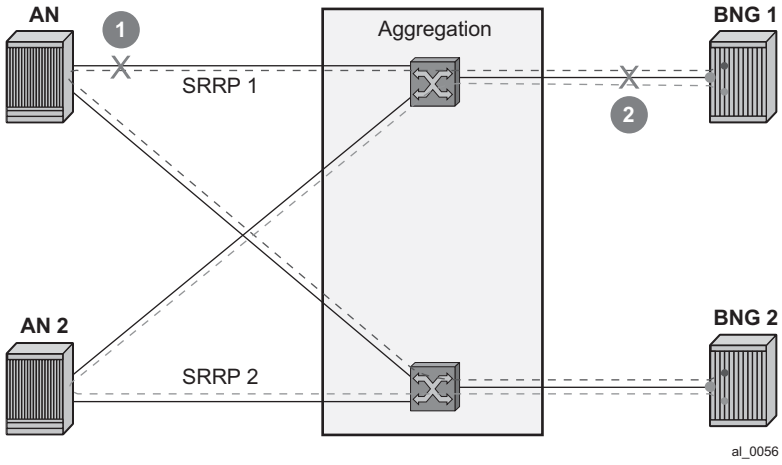


Figure 120: Scenario 2

3. Dual homing with aggregation network - aggregation network with redundancy between Layer 2 switches (STP).
   No Eth-OAM is needed in this case for successful operation. However, the failure detection is based on the failure of the directly attached ports.

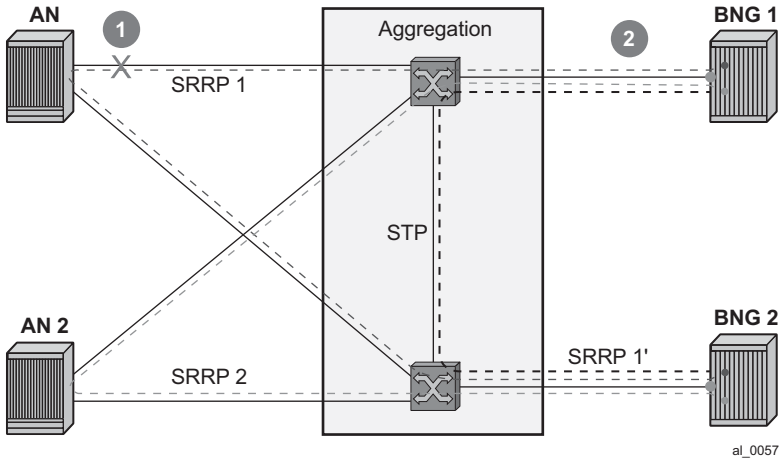


Figure 121: Scenario 3

4. Single homing with aggregation network.
   In this case, SRRP can protect only against direct failures. Any remote failure leaves a part of the network isolated from the subscriber point of view.

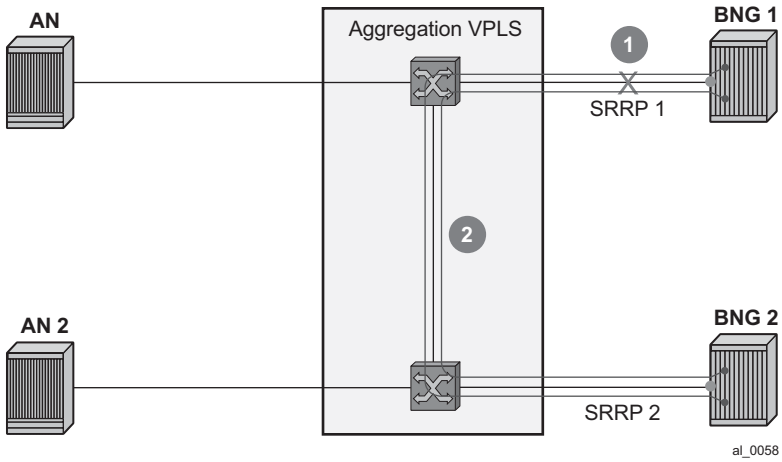


Figure 122: Scenario 4

Fate Sharing Algorithm

Fate Sharing Algorithm (FSG) is relaying on tracking the state of messaging SAPs over which SRRP instances run. An SRRP instance with the messaging SAP operationally DOWN will transition into the Init state.

The transitioning of any messaging SAP in a FSG into an UP/DOWN state will trigger SRRP priority adjustment within the FSG. The SRRP priorities should be chosen carefully to achieve the desired behavior. They are modified dynamically as the SAP states change. The range in which SRRP priorities can be modified is from 1 to the SRRP priority that is initially configured under the SRRP node. Here are some general guidelines for choosing SRRP priorities in a FSG:

- Initially configured SRRP priorities for all SRRP instance within the FSG within the node should be the same.
- Initially configured SRRP priorities should be different between pairing FSGs. For example, SRRP instances in the BNG node A within an FSG will all have the same SRRP priority 'X', while corresponding SRRP instances on the paired node within corresponding FSG will all have SRRP priority 'Y'. This ensures that SRRP mastership is clearly defined between the two BNG nodes. Note that this step is not mandatory as SRRP will naturally break the Mastership tie in the case that all SRRP priorities are the same. However, following this step may provide a clearer view from an operational perspective.
- The priority-step used for dynamic SRRP priority adjustment must be greater than the difference in initially configured SRRP priorities between two BNG nodes. This ensures that a single failure event triggers the SRRP switchover. Otherwise, if the dynamically lowered SRRP priority is still greater than the one from the SRRP peer, the switchover would not be triggered. Therefore, the fate sharing concept would not function as intended.
- Initially configured SRRP priority of each SRRP instance should be greater than the (anticipated) number of SRRP instances in a FSG multiplied by the SRRP priority-step. This ensures that the dynamically priority never tries to go below 1. There is a code check that prevents SRRP priority going below 1. Nonetheless, it is recommended not to get into a situation where this needs to be enforced in the code.

Note: The priorities will never be less than 1 or greater than initially configured SRRP priority.

Example scenarios:

Assume 3 SRRP instances in a FSG. The SRRP instances in the FSG-1 on BNG 1 have the priority of 100, while the SRRP instances in the FSG-2 on BNG 2 have the priority of 95. The priority-step is 6. The SRRP instances and underlying messaging SAPs will be referred as SRRP 1, 2, 3 and SAP 1,2,3, respectively.

Initialization:

Scenario 1 – all SAPs are operationally UP.

BNG 1 boots up and all messaging SAPs transition into the UP state. When the first SRRP instance in FSG-1 comes up, it looks under the FSG to finds out how many messaging SAPs are operationally UP. Since all messaging SAPs are operationally UP, this first SRRP instance

assumes its initially configured priority of 100. The other two SRRP instances in the same FSG follows the same sequence of events.

BNG 2 follows the same flow of events. As a result, BNG 1 assumes mastership over BNG 1 for all SRRP instances within the corresponding FSG.

Scenario 2 – messaging SAP 1 is operationally DOWN on BNG 1, the rest of the messaging SAPS are operationally UP.

SRRP 2 and 3, during the initialization, pick up SRRP priority of 94 (100 – 1*priority-step).

On BNG 2, all messaging SAPs are UP and consequently all SRRP instances within the FSG on BNG 2 have SRRP priority of 95. The SRRP instances on BNG 2 assumes Mastership.

Scenario 3 – Continuing from scenario 2, the SAP 1 on BNG 1 transitions into the UP state. SRRP priority of each SRRP instance in FSG-1 is increased by 6, bringing it to 100, enough to assume Mastership.

Adding a New Instance into an FSG

To introduce minimal network disruption, first create messaging SAPs in both BNG nodes and ensure that both SAPs are operationally UP. Then a new SRRP 4 instance should be created on both BNG nodes. The next step would be to include this new messaging SAP into a SAP monitoring group. And finally, the SRRP-4 is added into the FSG (1 and 2). This triggers the recalculation of SRRP priorities for the existing FSG-1 and FSG-2. Since all SRRP priorities are at the max (initially configured priority), nothing changes.

There are more disruptive ways of adding an SRRP instance into a FSG. One such example would be in the case where SRRP priorities are not at their maximum (initially configured) priority. If an SRRP instance is first added into an FSG that is in a 'Backup' state, this would increase the FSG priority and potentially cause a switchover. If the SRRP instances is then added in a FSG on the peer BNG (previously Master), the priority of this FSG would be increased again and the switchover would unnecessarily occur for the second time. The new SRRP instances, once operational, should always be added in the Master FSG first.

SRRP priority re-calculation within the FSG is triggered by the following events:

- SRRP initialization
- addition of a SAP under the monitoring group
- messaging SAP failure

This priority calculation looks into how many SAPs are in the DOWN state within the monitored SAP group. Based on this number, the priority is calculated as follows:

SRRP priority = configured-priority – priority-step * num_down_SAPs.

SRRP Aware Routing - IPv4/IPv6 Route Advertisement Based on SRRP State

There are three cases that need to be covered, each case with its own specifics:

- Subscriber Interface Routes (IPv4/IPv6)
- Managed Routes
- Subscriber Management Routes (/32 IPv4 hosts routes and IPv6 PD wan-host routes)

Depending on the route type, the action is to either modify the route metric based on the SRRP state that the route is tracking, OR to advertise/withdraw the route based on the SRRP state that the route is tracking. The action is defined in the routing policy and it is based on the new attributes with which the routes are associated.

To achieve a better granularity of the routes that are advertized, an origin attribute is added to the subscriber management routes (/32 IPv4 routes and IPv6 PD wan-host) with three possible values:

aaa

IPv4

subscriber-management /32 host routes that are originated through RADIUS framed-ip-address VSA other than 255.255.255.254. The 255.255.255.254 returned by the RADIUS indicates that the BNG (NAS) should assign an IP address from its own pool.

IPv6

subscriber-management routes that are originated through framed-ipv6-prefix (SLAAC), delegated-ipv6-prefix (IA_PD) or alc-ipv6-address (IA_NA) RADIUS attributes . This is valid for IPoE and PPPoE type host.

dhcp

IPv4

subscriber-management /32 host routes that are originated via DHCP server (local or remote) and also RADIUS framed-ip-address=255.255.255.254 (RFC 2865).

IPv6

subscriber-management routes that are assigned via local DHCPv6 server pools whose name is obtained through Alc-Delegated-IPv6-Pool (PD pool) and Framed-IPv6-Pool (NA pool) RADIUS attributes. This is valid for IPoE and PPPoE type hosts.

In addition, for IPoEv6 only, the pool name can be also obtained via ipv6-delegated-prefix-pool (PD pool) and ipv6-wan-address-pool (NA pool) from LUDB.

ludb

IPv4

subscriber-management /32 host routes that are originated via LUDB. This also covers RADIUS fallback category (RADIUS falls back to system-defaults or to LUDB).

IPv6

subscriber-management routes obtained from LUDB via ipv6-address (IA_NA) or ipv6-prefix (IA_PD). This is supported only for IPoE.

Overall, the following new route attribute is added:

state: srrp-master, srrp-non-master

The existing origin attribute is expanded to contain the following values:

origin: aaa, dhcp, ludb

These two attribute types are applied in the following fashion:

The state attribute is applied to all three route types: *subscriber interface routes, managed routes* and *subscriber management routes*. Each route listens to the SRRP state.

If an attribute is defined in the routing policy as a match condition (from statement) but the route itself does not have this attribute, the route is evaluated into a non-match condition.

The origin attribute is always applied only to subscriber management routes. No additional statement is needed to explicitly apply this attribute as it may be the case for the state attribute.

Every time there is a change in the attribute associated with the route, the route is re-evaluated in the RTM by the routing policy and corresponding action is taken.

Subscriber Interface Routes (IPv4 and IPv6)

Optimized routing and elimination of downstream shunt traffic during normal operation can be achieved by **statically** favoring the routes on the network side that are advertized with an increased metric by Master SRRP nodes.

The downside of this static approach is that during the port/card failure and consequently a SRRP switchover, the node with the failed port/card will continue to advertise routes with the same high metric as long as the subscriber interface is in the ‘UP’ state (or a single SAP under it). That is, the network side will not be aware of the switchover. It will continue to forward traffic to the standby node, and as a result, heavy shunt traffic will ensue. To effectively deal with this, the network side must be aware of the routing change that occurred in the access layer.

When failure is detected, the metric for the route is changed automatically based on the following configuration:

```
configure
     service <type> <id>
          subscriber-interface <intf-name>
address <ip-address> gw-ip-address <gw-address> track-srrp        <srrp-inst> holdup-time
<msec>
ipv6
subscriber-prefixes
     prefix <ipv6-prefix> pd track-srrp <srrp-id> holdup-time <msec>
     prefix <ipv6-prefix> wan-host track-srrp <srrp-id> holdup-time <msec>


     policy-options
          begin
          policy-statement <name>
```

```
                entry 1
                    from
protocol direct
                        state 'srrp-master'
                    exit
                    action accept
                        metric set 100
                    exit
                exit
                entry 2
                    from
protocol direct
                        state 'srrp-non-master'
                    exit
                    action accept
                        metric subtract 10
                    exit
                exit
                entry 3
                    from
                        protocol direct
                    exit
                    action accept
                exit
            exit
```

This configuration ensures that the route metric is changed for the subscriber interface routes based on the SRRP state while the other, non-subscriber directly attached routes are unaffected by SRRP.

Route Advertisement based on SRRP State requirement is applicable to BGP (IPv4, IPv4-IPVPN) and IGP.

Routing policy also provides the flexibility to prevent route advertisement (*action reject*) instead of changing the route metric.

Although this feature is designed to minimize or eliminate the use of the redundant-interface, it is important to note that the redundant-interfaces would still be used in the case of transient conditions. An example of such condition would be:

1. Messaging SAP Fails
2. SRRP switches over
3. Stale routing in the core is still in the effect while the metric is being propagated (or the route is being advertised/withdrawn). During this time, traffic is flowing over the redundant interface.
4. Network convergence is complete
5. Traffic in the network core is redirected to the new Master SRRP node

Managed Routes

Only the state attribute is applicable to managed routes, and only to the ones that are synchronized (static and RADIUS obtained – framed-route and framed-ipv6-route). The managed routes obtained via BGP are not synchronized and this feature is not applicable to them.

Based on the SRRP state, the managed route can be either advertized with a modified metric or be withdrawn altogether.

For example:

Managed routes that are tracking SRRP state are only advertised from the Master node and denied from Backup node. All other managed routes that are not tracking SRRP state are advertised regardless of the SRRP state.

```
policy-options
         begin
         policy-statement <name>
              entry 1
                   from
protocol managed
                        state 'srrp-master'
                   exit
                   action accept
                   exit
              exit
              entry 2
                   from
protocol managed
                        state 'srrp-non-master'
                   exit
                   action reject
                   exit
              exit
              entry 3
                   from
                        protocol managed
                   exit
                   action accept
              exit
         exit
```

Subscriber Management Routes (/32 IPv4 Host Routes, IPv6 PD WAN-Host Routes)

Both attributes (state and origin) are applicable to the subscriber management routes.

For Example:

A Service Provider wants to advertise only subscriber-management routes with the origin DHCP and AAA from the Master node. Routes with the LUDB origin are not advertised. Standby node is not advertising any /32 subscriber management routes.

```
policy-options
         begin
         policy-statement <name>
              entry 1
                   from
origin dhcp
origin aaa
                        state 'srrp-master'
                   exit
                   action accept
                   exit
              exit
         exit
```

Default action is reject.

Activating SRRP State Tracking

The SRRP state tracking by routes is turned on only when desired.

For subscriber-interface routes (IPv4 and IPv6), this is performed explicitly.

```
subscriber-interface <intf-name>
address <ip-address> gw-ip-address <gw-address> track-srrp        <inst-name> holdup-time
<msec>
ipv6
subscriber-prefixes
     prefix <ipv6-prefix> pd track-srrp <srrp-id> holdup-time <msec>
      prefix <ipv6-prefix> wan-host track-srrp <srrp-id> holdup-time <msec>
```

For managed and subscriber management routes, this is explicitly enabled under the group interface:

```
group-interface <name>
     srrp-enabled-routing holdup-time <msec>
```

SRRP in Conjunction with a PW in ESM Environment – Use Case

In certain cases, subscriber traffic is terminated on the BNG via an EPIPE. In this case, the subscriber traffic can be offloaded onto a plain Ethernet port via a VSM module (a 'loop') so that it can be terminated in ESM. EPIPEs can be configured in A/S configuration and terminated on two BNG nodes in multihomed environment.

In such multi-homed environment with EPIPEs and 'loops', the ESM itself would be detached from the EPIPE, which brings the subscriber traffic to the BNG. Because of that, the ESM would not know if the PW's state is Active or Standby. As a result, in the downstream direction, traffic could end up being forwarded towards the Standby PW, effectively being black-holed.

To overcome this, SRRP can be used in conjunction with an additional mechanism to help monitor the activity of the PWs. This monitoring mechanism is very similar to Fate-sharing. The difference in this case is that the messaging SAP (instead of SRRP instance) is monitoring the activity of the PW. As a result, the SRRP messaging SAP reflects the state of the PW. For example, the PW in a Standby mode would cause the messaging SAP to be in the DOWN state while the PW Active state would cause the messaging SAP to be in the UP state. That is, the SRRP instance reflects the operational state of the messaging SAP. SRRP is indirectly tied into PW state.

Modifying the priority of SRRP instance based on PW's state as a mean of mapping the Master SRRP into the Active PW would not help here as SRRP messages are not flowing over standby PWs. This is why SRRP state must be enforced via the messaging SAP.

Fate-sharing for PW termination in conjunction with SRRP is not supported.

Metric adjustment for the subscriber routes is supported. Once the tracked SRRP instance transitions into a non-Master state, the state attribute of the route changes and the appropriate action defined in the routing-policy is taken.

Group-monitor

The failure detection mechanism to trigger an action within FSG relies on the operational state of the messaging SAP. Such failure detection mechanism is referred as a group monitor.

Group monitor can also be used to detect the state change of the PW. PW state change is reflected in the messaging SAP which in turn triggers the state change of an SRRP instance.

All this is implemented through an oper-group object which is described in the 'Services Guide'. All entities that needs to be monitored (messaging SAPs and PWs) are associated with this oper-group object. Finally, an SRRP instance (in case of FSG) or a messaging SAP (in case of PW) is instructed to monitor the entities in the oper-group object. State transitions of objects in a oper-group object trigger state transitions of entities that are monitoring them (messaging SAPs and SRRP instances). State transitions of monitored objects in a oper-group will cause the following actions:

- In the case of an FSG, priorities of SRRP instances are recalculated
- In the case of PW termination on BNG, the operational state of the messaging SAP is changed.

This is an overview of the CLI syntax showing the principles of how should this work (for exact description of commands and full syntax, please see the command reference):

```
configure>service
oper-group <name>   //oper-group creation

configure>service(IES | VPRN)>sub-if>grp-if>sap
     oper-group <name>  //adds the SAP to the oper-group
     monitor-oper-group <name> // links the status of the oper-group to the SAP. In this
fashion a messaging SAP can monitor the state of a PW.

configure>service(IES | VPRN)>sub-if>grp-if>srrp x
     monitor-oper-group <name> priority-step [0-253] //with this, a state transition of the
objects in the oper-group should trigger SRRP priority recalculation. The state of the
oper-group is not important but in the state of the objects within. If an object within the
oper-group goes down, the SRRP priority is lowered by a priority-step. The SRRP priority
will be adjusted on every state transition of member objects.

configure>service>epipe>spoke-sdp
     oper-group <name>  // this will add a PW to the oper-group. A messaging SAP monitors
this PW and it assumes the state according to the state of the PW in the oper-group. A
standby or a DOWN PW state causes the messaging SAP to assume a DOWN state. Otherwise the
messaging SAP would be in the UP state. In order for the SAP to assume the DOWN state, both
RX and TX side of the PW must be shut. In other words, a PW in standby mode also must have
the local TX disabled by the virtue of the 'slave' flag (standby-signaling-slave command
under the spoke-sdp hierarchy). Without the TX disabled, the SAP monitoring the PW would
not transition in the down state.
```

Hold timer is provided within the oper-group command to suppress flapping of the monitored object (SAP or pseudowire).

Example with ESM over pseudowire through a VSM 'loop'.

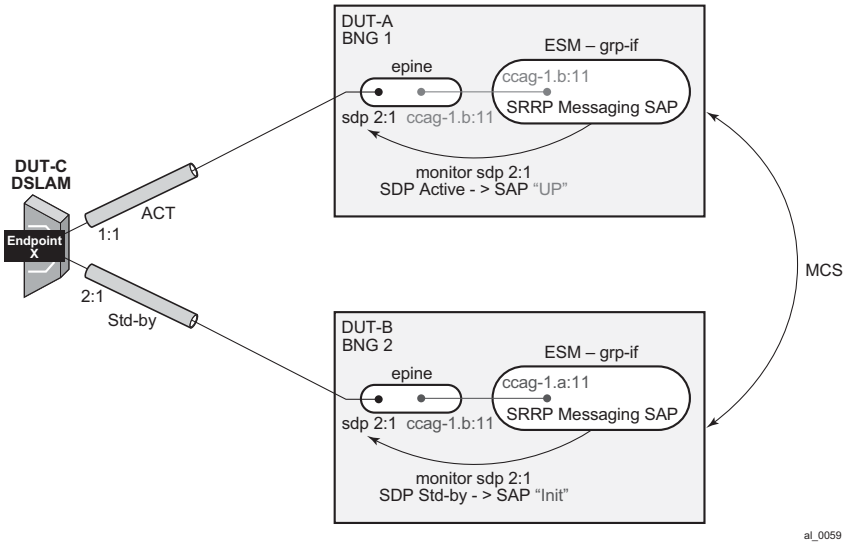


Figure 123: Pseudowire Example

```
*A:Dut-C>config>service>epipe# info
----------------------------------------------
            endpoint "x" create
                standby-signaling-master
            exit
            sap 1/1/7:1 create
            exit
            spoke-sdp 1:1 endpoint "x" create
                precedence primary
                no shutdown
            exit
            spoke-sdp 2:1 endpoint "x" create
                no shutdown
            exit
            no shutdown
----------------------------------------------

*A:Dut-A>config>service>epipe# info
----------------------------------------------
            sap ccag-1.b:11 create
            exit
            spoke-sdp 2:1 create
                standby-signaling-slave
                oper-group "1"
                no shutdown
            exit
            no shutdown
----------------------------------------------
*A:Dut-B>config>service>epipe# info
----------------------------------------------
            sap ccag-1.b:11 create
            exit
            spoke-sdp 2:1 create
                standby-signaling-slave
                oper-group "1"
                no shutdown
            exit
            no shutdown
----------------------------------------------
*A:Dut-A>config>service>ies# info
----------------------------------------------
            redundant-interface "redif11" create
                address 101.1.1.2/24 remote-ip 101.1.1.4
                spoke-sdp 1:1 create
                    no shutdown
                exit
            exit
            subscriber-interface "subif_1" create
                shutdown
                address 1.1.1.2/24 gw-ip-address 1.1.1.100
                group-interface "grpif_1_2" create
                    shutdown
                    redundant-interface "redif11"
                exit
            exit
            subscriber-interface "subTest" create
                address 80.1.1.2/24 gw-ip-address 80.1.1.254
                group-interface "grpTest" create
                    redundant-interface "redif11"
```

```
                    sap ccag-1.a:1 create
                    exit
                    sap ccag-1.a:11 create
                        monitor-oper-group "1"
                    exit
                    srrp 11 create
                        message-path ccag-1.a:11
                        no shutdown
                    exit
                exit
            exit
            no shutdown
-----------------------------------------------
*A:Dut-B>config>service>ies# info
-----------------------------------------------
            redundant-interface "redif11" create
                address 101.1.1.4/24 remote-ip 101.1.1.2
                spoke-sdp 1:1 create
                    no shutdown
                exit
            exit
            subscriber-interface "subif_1" create
                shutdown
                address 1.1.1.4/24 gw-ip-address 1.1.1.100
            exit
            subscriber-interface "subTest" create
                address 80.1.1.4/24 gw-ip-address 80.1.1.254
                group-interface "grpTest" create
                    redundant-interface "redif11"
                    sap ccag-1.a:1 create
                    exit
                    sap ccag-1.a:11 create
                        monitor-oper-group "1"
                    exit
                    srrp 11 create
                        message-path ccag-1.a:11
                        no shutdown
                    exit
                exit
            exit
            no shutdown
-----------------------------------------------
*A:Dut-B>config>service>ies# show srrp
===============================================================================
SRRP Table
===============================================================================
ID        Service        Group Interface                Admin     Oper
-------------------------------------------------------------------------------
11        1              grpTest                        Up        initialize
-------------------------------------------------------------------------------
No. of SRRP Entries: 1
===============================================================================
*A:Dut-A>config>service>ies# show srrp
*A:Dut-A>config>service>ies#
===============================================================================
SRRP Table
===============================================================================
ID        Service        Group Interface                Admin     Oper
-------------------------------------------------------------------------------
```

```
11        1              grpTest                         Up        master
-------------------------------------------------------------------------------
No. of SRRP Entries: 1
===============================================================================
```

Subscriber Override

This feature provides the ability to override queue and policer parameters (CIR, PIR, CBS, MBS) as well as HQoS parameters (egress aggregate-rate and root-arbiter rate) configured at sla-profile and sub-profile level in order to provide per-subscriber-(host) customizations. The goal is to avoid an explosion of the sub-profiles and sla-profiles to cover all service level combinations. This customization of QoS related parameters can in principle occur during authentication (auth-response message) or during sub-host life time by RADIUS CoA messages.

The QoS parameter customizations are communicated by RADIUS server in form of RADIUS VSAs which can be included in RADIUS-authentication response message or in CoA message.

The Alc-Subscriber-QoS-Override VSA (126) is a string with following layout "direction:type:[key:]values" where:

- Object-type:
  - → **direction** represents single character indicating **i** for ingress and **e** for egress.
  - → **type** represents single character indicating **q** for queue, **p** for policer, **r** for aggregate-rate and **a** for arbiter.
  - → **key** is indicated the queue or policer-id. It is not used in case of aggregate-rate and root-arbiter.
  - → **values** indicates actual values preceded with keywords used in CLI (e.g., cir).

Aspects, such as parent, priority level, stats- mode are not accessible through this customization. Instead, a new policy should be created on the node.

The key identifying the subscriber-host in the RADIUS CoA message is accounting-session-id This is different in previous releases, where the *service-id* and *ip-address* are mandatory fields in RADIUS CoA message.

The operational value of the QoS objects (queues or schedulers) are derived from different inputs. As in queue/policer parameters, the following hierarchy of inputs are respected (highest priority is the first):

- On-line charging overrides
- RADIUS response/CoA overrides
- Queue overrides configured at sla-profile level
- Queue parameters set in QoS policy level

In the case of scheduler/arbiter-overrides, the following hierarchy of inputs apply:

- ANCP overrides
- RADIUS response overrides
- Scheduler/arbiter parameters as configured in scheduling/policer-control-policy.

The above rules are generic. If any given override mechanism is not yet applicable to policers (or arbiters) it will be skipped. The above rules indicate the priority if all mechanisms are supported.

The QoS overrides received in RADIUS message (in the form of a VSA) are per definition related to a given subscriber-host the given message is referring to. Internally, the overrides are applied on per SLA instance level (queue/policer-overrides) and per-subscriber-level (scheduler/arbiter overrides). The subscriber-overrides are applicable to PPPoE hosts only.

In a dual-homing environment, the adapted values are synchronized through MCS, but they do not need to be persistent.

Dual Stack Lite

Dual Stack Lite feature is supported on the 7710 SR-Series in combination with the MS-ISA to function as a DS-Lite Address Family Transition Router (AFTR).

Dual Stack Lite is an IPv6 transition technique that allows tunnelling of IPv4 traffic across an IPv6-only network. Dual-stack IPv6 transition strategies allow service providers to offer IPv4 and IPv6 services and save on OPEX by allowing the use of a single IPv6 access network instead of running concurrent IPv6 and IPv4 access networks. Dual-Stack Lite has two components: the client in the customer network, known as the Basic Bridging BroadBand element (B4) and an Address Family Transition Router (AFTR) deployed in the service provider network.

Dual-Stack Lite leverages a network address and port translation (NAPT) function in the service-provider AFTR element to translate traffic tunneled from the private addresses in the home network into public addresses maintained by the service provider. On the 7750 SR, this is facilitated through the Carrier Grade NAT function.

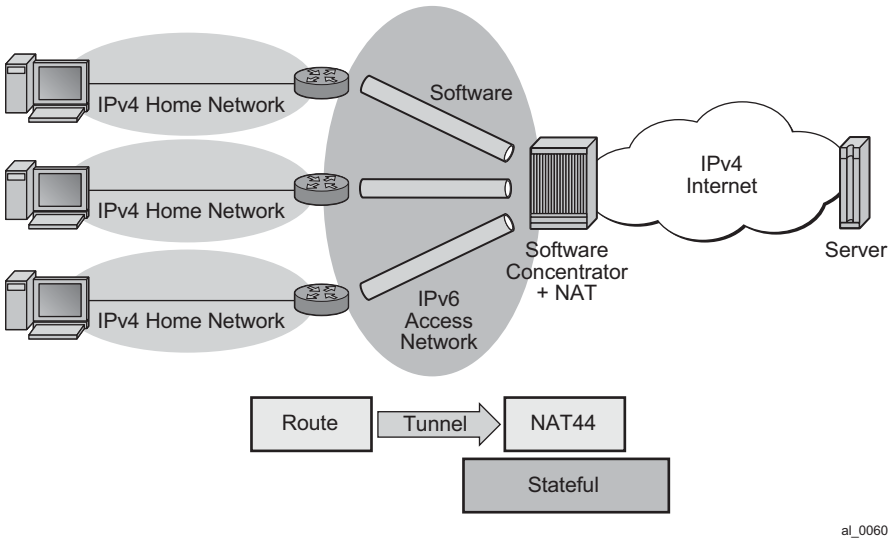


Figure 124: Dual-Stack Lite

As shown in Figure 124, Dual-Stack Lite has two components, a softwire initiator in the RG and a softwire concentrator, deployed in the service provider network, where control-less IP-in-IP (using protocol 4 - IPv4 in IPv6) is used for tunnelling. When using control-less protocol, packets are sent on the wire for the remote softwire endpoint without prior setup of a tunnel.

The softwire initiator in the home network is combined with a routing function, where the default route is passed to the softwire pseudo-interface. Note that there is no NAT function, therefor, the private IP addresses of the home network are encapsulated without source address modification,

and forwarded to the softwire concentrator where all NAT is performed. The softwire pseudo-interface unicasts all IPv4 traffic to the IPv6 address of the softwire concentrator, which was pre-configured.

When encapsulated traffic reaches the softwire concentrator, the device treats the source-IP of the tunnel to represent a unique subscriber. The softwire concentrator performs IPv4 network address and port translation on the embedded packet by re-using Large Scale NAT and L2-Aware NAT concepts.

IP-in-IP

As shown in Figure 125, IP-in-IP uses IP protocol 4 (IPv4) to encapsulate IPv4 traffic from the home network across an IPv6 access network. The IPv4 traffic tunnelling is treated as best-effort with no subscriber management or policy, and does not use ESM. The scale is dependant only on the internal structures of the MS-ISA and CPM, that is, the IP-in-IP model can support more subscribers than an ESM-based approach.

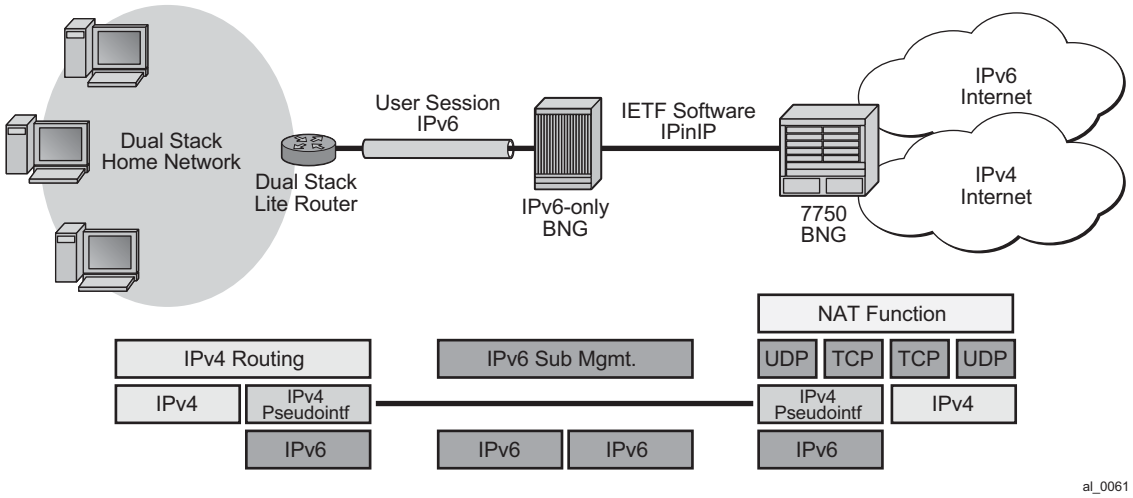


Figure 125: IP-in-IP

Dual-Stack Lite IP-in-IP is configured through the existing **nat** command that is inside the CLI statements that are within the base router or VPRN. A service performing large scale NAT supports Dual-Stack Lite.

Dual-Stack Lite expects a routing (non-NATing) gateway in the home, where many different IPv4 inside addresses exist for each subscriber. These inside addresses may overlap other subscriber's address, especially given the heavy use of RFC 1918 address space.

The lack of control of protocol for the IP-in-IP tunnels simplifies the functional model, since any received IPv4 packet to the ISA dual-stack-lite address can simply be:

- Checked for protocol 4 in the IPv6 header.
- Checked that the embedded IP packet is IPv4.
- Processed as if it were L2-Aware, where the source-IP of the tunnel (the source IPv6 address) is used as the subscriber identifier.

Note that the inside IP address in the NAT, tables must not be the IPv6 address of the tunnel, but the true IPv4 address of any host within the home. The subscriber-id must be the literal IPv6 address (appreciating this may be 34 characters in length).

Configuring Dual Stack Lite

Dual Stack Lite is configured on an inside service and uses the existing Large Scale NAT nat-policies and outside pools. Dual-Stack Lite and NAT44 Large Scale NAT can operate concurrently on the same inside and outside services.

Dual Stack Lite is configured using the following CLI:

```
configure {router | service vprn service-id}
     - [no] nat
          - inside
               - [no] dual-stack-lite
                    - [no] *address ipv6-address
```

L2TP over IPv6

In this mode, L2TP provides the transport for IPv4 that allows full ESM capabilities on the 7750 SR. From the 7750 perspective, the L2TP tunnel is no different in capability to those already supported. Only the underlying transport (IPv6 instead of IPv4) distinguishes this approach.

To support legacy IPv4 access, L2TP over IPv6 is combined with the existing L2-Aware NAT feature as shown in Figure 126.

As ESM is used, scale is limited by the number of ESM hosts supported on a chassis and any associated resources like queues.

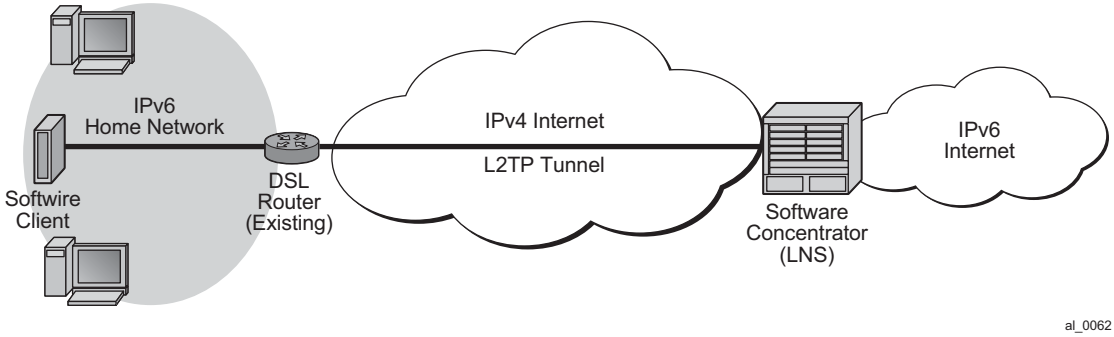


Figure 126: L2TP over IPv6

L2TP LNS over IPv6 is supported in both the base routing instance and VPRN that has 6VPE configured.

Like the SR-OS 8.0 LNS implementation, tunnels are terminated on any routing interface, including loopback, SAP, or network port. A single interface simultaneously supports IPv4 and IPv6 L2TP tunnel termination by having two different addresses configured.

For greater scalability, L2TP tunnel and session count per chassis are increased to allow 1 tunnel per session.

NAT capabilities are supported via existing L2-Aware NAT methods. Note that the L2TP LNS over IPv6 may be used without NAT as well and the L2TP sessions may be either IPv6-only or dual-stack.

L2TP Tunnel RADIUS Accounting

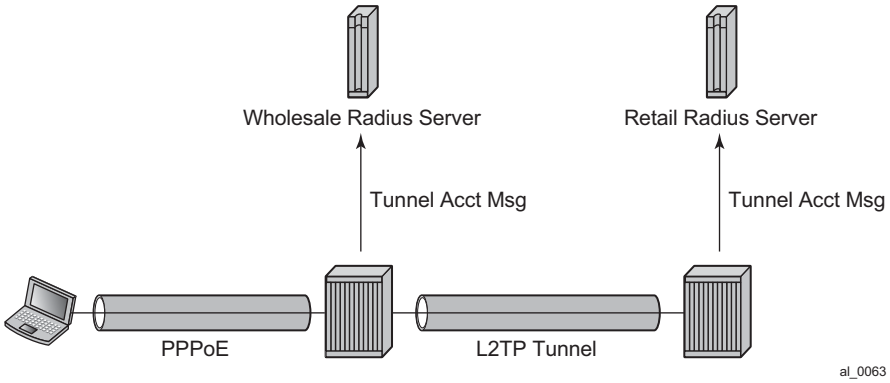


Figure 127: L2TP Tunnel Accounting

When L2TP tunnel accounting is enabled, except for **host** or **sla-profile**-based accounting packets and attributes, the following are additional accounting packets and attributes:

- Accounting packets: tunnel-start/stop/reject; tunnel-link-start/stop/reject — There are no interim updates for L2TP tunnel/session accounting.
- RADIUS accounting attributes:
  - → Tunnel-Assignment-Id (LAC only)
  - → Acct-Tunnel-Connection
  - → Acct-Tunnel-Packets-Lost

These attributes were added into current account-start/stop/interim-update packets (host accounting/sla-profile accounting)

Tunnel level accounting and session level accounting can be enabled or disabled independently.

New accounting packets and related RADIUS attribute list are described in Table 18.

Some considerations of RADIUS attributes are described in RADIUS Attributes Value Considerations on page 1211

Accounting Packets List

Table 18 describes L2TP tunnel accounting behavior along with some key RADIUS attributes (apply for both LAC and LNS):

Table 18: L2TP Tunnel Accounting Behavior

Act-Packet	When	Key Attributes	Remark
Tunnel-Start	A new L2TP tunnel is created	Acct-Session-ID	
		Event-Timestamp	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Tunnel-Server-Auth-Id:0	
Tunnel-Reject	A new L2TP tunnel creation failed	Acct-Session-Id	
		Event-Timestamp	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Acct-Terminate-Cause	
Tunnel-Stop	An established L2TP tunnel is removed	Acct-Session-Id	
		Event-Timestamp	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	

Table 18: L2TP Tunnel Accounting Behavior (Continued)

Act-Packet	When	Key Attributes	Remark
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Tunnel-Server-Auth-Id:0	
		Acct-Session-Time	
		Acct-Input-Gigawords	
		Acct-Input-Octets	
		Acct-Output-Gigawords	
		Acct-Output-Octets	
		Acct-Input-Packets	
		Acct-Output-Packets	
		Acct-Terminate-Cause	
Tunnel-Link-Start	An L2TP session is created	User-Name	
		Acct-Session-Id	This is the same as Acct-Session-id in access-request of host auth
		Event-Timestamp	
		Service-Type	Framed
		Class	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Tunnel-Server-Auth-Id:0	

Table 18: L2TP Tunnel Accounting Behavior (Continued)

Act-Packet	When	Key Attributes	Remark
		Acct-Tunnel-Connection	See RADIUS Attributes Value Considerations on page 1211
Tunnel-Link-Reject	A new L2TP session creation is failed	Acct-Session-Id	Should be as same as Acct-Session-id in access-request of host auth
		Event-Timestamp	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	
		Tunnel-Server-Endpoint:0	
		Acct-Terminate-Cause	
		Acct-Tunnel-Connection	
Tunnel-Link-Stop	A established L2TP session is removed	User-Name	
		Acct-Session-Id	Should be as same as Acct-Session-id in access-request of host auth
		Event-Timestamp	
		Service-Type	Framed
		Class	
		Tunnel-Type:0	
		Tunnel-Medium-Type:0	
		Tunnel-Assignment-Id:0	
		Tunnel-Client-Endpoint:0	
		Tunnel-Client-Auth-Id:0	

Table 18: L2TP Tunnel Accounting Behavior (Continued)

Act-Packet	When	Key Attributes	Remark
		Tunnel-Server-Endpoint:0	
		Tunnel-Server-Auth-Id:0	
		Acct-Tunnel-Connection	
		Acct-Session-Time	
		Acct-Input-Gigawords	
		Acct-Input-Octets	
		Acct-Output-Gigawords	
		Acct-Output-Octets	
		Acct-Input-Packets	
		Acct-Output-Packets	
		Acct-Tunnel-Packets-Lost	
		Acct-Terminate-Cause	

Notes:

- Errors will occur if there are multiple hosts sharing the same sla-profile instance and then these hosts go to different tunnel.
- 7750 SRs have an internal limitation of 500 pps for accounting messages. This feature shares the same limitation

RADIUS Attributes Value Considerations

- The value of Acct-Tunnel-Connection uniquely identify a L2TP session, and in order to match LAC and LNS accounting record, the value of Acct-Tunnel-Connection is determined by a method shared by LAC and LNS. This means for a given L2TP session, Acct-Tunnel-Connection from the LAC and LNS are the same.
- Current ESM stats are used in Tunnel-Link and tunnel level accounting. This applies for both standard attribute and the 7750's own VSA.
- Tunnel level accounting stats need to aggregate all sessions stats that belong to the tunnel. Note: there could be sessions come and go before tunnel is down, so system need to remember the stats of every session that has been created within the tunnel.

  This applies for both standard attribute and 7750's own VSA.
- The value of Acct-Tunnel-Packets-Lost is the aggregation of all discarded packets on both ingress and egress.

Other Optional RADIUS Attributes

Table 19 lists the optional attributes that could be optionally included in tunnel accounting packet, some of them are applied for link level accounting only.

Table 19: Optional RADIUS Attributes

Attribute	Tunnel/Link
nas-identifier	Both
nas-port	Link level only
nas-port-id	Link level only
nas-port-type	Link level only

RADIUS VSA to Enable L2TP Tunnel Accounting

In order to support pure RADIUS-enabled L2TP tunnel accounting on LAC side, the following RADIUS VSA are supported:

Table 20: Supported RADIUS VSAs

VSA	Type	Value
ALC-Tunnel-Accounting-Policy	String	Policy-name; if the name is **disable** then this means L2TP tunnel accounting is disabled for this tunnel

Note: ALC-Tunnel-Accounting-Policy takes precedence over what has been defined in CLI when Alc-Tunnel-Group is also returned.

MLPPP on the LNS Side

With MLPPP, the counter on LNS side is only available for the bundle, not for each link, so the SR OS's behavior is:

- For each new link session system sends a tunnel-link-start.
- For each link session that is deleted system sends a tunnel-link-stop.
- For all link sessions except the last one system reports 0 for all counters.
- For the last link session, system reports the actual counters for the bundle.

RADIUS Route Download

The RADIUS route download mechanism periodically polls a RADIUS server for routes to download. The main objective of this feature is to download, in advance, customer-assigned subnets so that they can be re-advertised to the corresponding routing protocols. In this way, subscriber bringup can potentially be done faster (as the routes are already in place and advertised) and, most importantly, reduce the routing protocol churn as subscribers connect and disconnect. The routes being learned through this mechanism could be both managed routes/delegated prefixes as well as the WAN IP assigned to the subscriber in the case PPPoE and un-numbered interfaces are being used.a

The route download process requests the routes to a configured RADIUS server by triggering an access-request message. The key identifier for this message is the username, which is a combination of the system's name (or an optionally configured value), appended by a dash ("-") and then a monotonically increasing integer. The download process sends an access request starting with 1 (such as "hostname-1") and the RADIUS server replies with an access-accept message and a number of routes embedded within the message. The system then increases the counter and sends another access request (this time being hostname-2) and receive a reply with the next batch of routes to download. The process continues, incrementing the counter by 1 each time until the system gets an access-reject or the maximum number of routes that can be downloaded is reached.

The routes to be accepted are in the following format:

> [vrf {vprn-name | vprn-service-id}] prefix-mask {null0 | null 0 | black-hole} [metric] [tag tag-value]

The prefix-mask could be in any form as 'prefix/length', 'prefix mask' or 'prefix' (in the latter case, for IPv4 routes, the mask shall be derived from the IP class of the prefix).

The route formats are supported:

- Framed-Route (RADIUS attribute 22)

```
Framed-Route = "192.168.3.0 255.255.255.0 null0"
Framed-Route = "vrf vrfboston 192.168.1.0/24 null 0 0 tag 6"
Framed-Route = "vrf 2001 192.168.10.0/24 black-hole 0 tag 8"
```

- Cisco-AVPair (Cisco VSA 26-1)

```
cisco-avpair = "ip:route = 192.168.3.0 255.255.255.0 null0"
cisco-avpair = "ip:route = vrf vrfboston 192.168.1.0/24 null 0 0 tag
6"
```

IPv6 routes are also supported. The format is based on using the IETF-defined IPv6 Framed-IPv6-Route (attribute 99). The following text shows the supported formats.

- Framed-IPv6-Route (RADIUS attribute 99)

```
Framed-Route = "2001:100:bad:cafe::/64 null0"
Framed-Route = "vrf vrfboston 2100:5aaa:dead:beaf::/96 null 0 0 tag
6"
Framed-Route = "vrf 3000 2200:1bbbb:dead::/48 black-hole 0 tag 6"
```

All the routes downloaded will be a new protocol type "**periodic**". The downloader process re-starts the AAA requests after a given interval (a configurable value but target refresh rate is 15 minutes) and routes shall be updated according to the following process:

- When the router initiates a new download process, the routes are kept in a temporary table until the download process completes (receives an access-reject from the AAA). The temporary download table is then checked for errors and finally, any changes reflected to the actual routing table.
- Routes no longer present in the download will be removed from the routing table.
- If the AAA server responds with an access-reject for the first username (that is, an implicit empty route-download table), all routes will be removed from the routing table.
- If there are any protocol errors (at the RADIUS level), such as time-out, no response, bad record format, too many records, etc., the download process is suspended and retried after a configurable timer. The minimum retry timer is at least 1 minute and given the light load this represents control-plane-wise (concurrent downloads are not supported) the retries can continue infinitely until the next refresh period occurs, where the download restarts from the beginning. An exponential backoff algorithm with a configured minimum and maximum delay will be used to determine the retry timer.
- In any case, the routes are only purged from the routing table after a complete download process was achieved (properly terminated with an access-reject message). Under any other failure condition, the routes shall remain active. Shutting down the download process should not remove the downloaded routes. A clear command will be provided to clear the periodic routes.
- All the imported routes (blackholes) will be imported into the line-card FIBs to avoid the routing loops caused by announcing the prefixes but not installing the actual blackholes.

Managed SAP (MSAP)

Managed SAPs allow the use of policies and a SAP template for the creation of a SAP. Although the router supports automatic creation of subscriber hosts in a shared SAP, the most secure mode of operation and common mode is the subscriber per SAP model. In this model, each subscriber is defined with its own VLAN. This feature uses authentication mechanisms supported by the node to provide a SAP.

The reception of a trigger packet initiates a RADIUS or local user database authentication to provide the service context in which the MSAP should be created. The VLAN of the created MSAP is the same as the trigger packet. An MSAP is similar to a regular SAP but its configuration is not user editable and not maintained in the configuration file. The managed SAP remains active as long as the session is active.

The following trigger types are supported:

- DHCP discover (or requests if configured) for DHCP clients. The managed SAP lifetime is defined by the lease time.
- PPPoE PADI for the PPPoE client. The managed SAP lifetime is defined by the session time. The MSAP is installed after the IP address is provided. A short temporary state handles packets between the PADO and ACK.
- ARP defines the managed SAP lifetime. The ARP entry refresh behavior is maintained.
- DHCP6
- PPP
- rtr-solicit (SLAAC hosts)

Multiple trigger types can be enabled on a single capture-sap.

Trigger packets are received on a capture SAP that must be configured in a VPLS service. A capture SAP is defined in a similar way as a regular default SAP but it does not forward traffic. It's sole purpose is to capture trigger packets for authentication. Refer to the following configuration example:

```
vpls 10 customer 1 create
    sap 1/1/1:*.* capture-sap create
        description "capture sap"
        trigger-packet arp dhcp dhcp6 pppoe
        authentication-policy "auth-policy-1"
    exit
    no shutdown
exit
```

A capture SAP and default SAP cannot be configured at the same time for a single port with the dot1q encapsulation or for a single port:topq combination with qinq encap. The capture SAP is used if a more specific match for the Q or Q-in-Q tags is not found by the IOM. If a capturing SAP is defined, triggering packets are sent to the CPM. Non-triggering packets captured by the capturing SAP are dropped.

An ingress VLAN ID (VID) type mac filter can be configured on a capture-sap to have additional control on the vlans that are allowed to initiate a host setup. Other filter types are not supported on a capture-sap.

Supported modes:

- Port:*: Provides a context for the trigger packet and SAP template.
- A capture SAP can be created in the format Port:Q.
- Port:Q: A specific Q-tag defined SAP for the port and already running managed SAPs.

Supported Q-in-Q modes:

- Port:*.*, or Q.*: Both q-tags will always be sent to RADIUS. The MSAP created will bear both q-tags that arrived in the original packet if authenticated by RADIUS.
- Port:*.Q: It is an inverse capture-sap that matches on a fixed inner tag with the outer tag identifying the user. The following restrictions apply when an inverse capture-sap is configured on a port:
  - Ethernet ports only
  - It is not possible to create y.* saps when there is a *.x capture sap present on the port (y=0,1..4094,* and x=1..4094).
  - It is not possible to create a y.* network interface when there is a *.x capture SAP present on the port (y=0,1..4094,* and x=1..4094).

A set of mandatory parameters should be provisioned for MSAP creation are as follows:

- **Service id**: service context in which the MSAP will be created.
- **Interface id**: name of the group-interface context in which the MSAP will be created. The group-interface must exist in the provided service for the MSAP to be installed (routed CO scenario only).
- **MSAP policy**: name of the policy that defines the MSAP parameters. The policy must exist in the subscriber-mgmt context.

These parameters can be obtained from the following order of preference:

1. Local user database lookup.
2. RADIUS attributes.
3. Defaults configured at the capture-sap context.

The MSAP parameters can be obtained from a local user database. The local user database should be configured at the capture sap and group-interface context. For example,

IPoEv4 hosts

```
>config>service>vpls>sap# dhcp-user-db <local-user-db-name>
>config>service>ies>sub-if>grp-if>dhcp# user-db <local-user-db-name>
```

IPoEv6 hosts

```
>config>service>vpls>sap# dhcp6-user-db <local-user-db-name>
>config>service>ies>sub-if>grp-if>ipv6>dhcp6# user-db <local-user-db-name>
```

PPP hosts

```
>config>service>vpls>sap# pppoe-user-db <local-user-db-name>
>config>service>ies>sub-if>grp-if>pppoe# user-db <local-user-db-name>
```

When RADIUS authentication is still required after local user database authentication, then the authentication policy must be specified in the local user database. In this case no authentication policy may be configured at the group-interface context. For example,

IPoE hosts

```
>config>subscr-mgmt>loc-user-db>dhcp>host# auth-policy <policy-name>
```

PPP hosts

```
>config>subscr-mgmt>loc-user-db>ppp>host# auth-policy <policy-name>
```

The MSAP parameters are configured at the local user database host context. For example,

```
>config>subscr-mgmt>loc-user-db>dhcp>host# msap-defaults
>config>subscr-mgmt>loc-user-db>ppp>host# msap-defaults

  - msap-defaults

 [no] group-interface - Configure the group interface
 [no] policy          - Configure the MSAP policy
 [no] service         - Configure the service
```

When RADIUS authentication is required to return the MSAP parameters without prior local user database authentication, then the authentication policy should be configured at the capture-sap context. In a Bridged CO model, the authentication policy specified in the capture-sap will also be used for the MSAP in the VPLS service. In a Routed CO model, the same authentication policy must also be configured at the group-interface context. For example,

```
>config>service>vpls>sap# authentication-policy <auth-policy-name>
>config>service>ies>sub-if>grp-if# authentication-policy <auth-policy-name>
```

The MSAP will not be created if the group-interface name returned from RADIUS has a different authentication policy than the authentication policy configured at the capture-sap.

The following table lists the RADIUS attributes (VSAs) to include in a RADIUS access accept message to obtain MSAP parameters in the RADIUS authentication phase.

Attribute name	Type	Purpose and Format
Alc-MSAP-Serv-Id [26-6527-31]	Integer	Service ID of the service context in which the MSAP will be created.
Alc-MSAP-Policy [26-6527-32]	String	Name of the policy that defines the MSAP parameters.
Alc-MSAP-Interface [26-6527-33]	String	Name of the group-interface context in which the MSAP will be created.

MSAP parameters that are not obtained from a local user database lookup, and that are not returned from RADIUS can be specified in the default-msap section of the capture-sap context (last resort):

```
>config>service>vpls>sap# msap-defaults ?
  - msap-defaults

 [no] group-interface - Configure the group interface
 [no] policy          - Configure the MSAP policy
 [no] service         - Configure the service
```

MSAPs can be created in IES or VPRN group interfaces (Routed CO model) and in a VPLS service (Bridged CO model).

The managed SAP configuration can be persistent. The template MSAP policy is stored with the subscriber host which in turn can be made persistent.

If local user database or RADIUS authentication did not provide all the required information to create the subscriber host (no IP address for example), then the MSAP is created with a short timer while waiting for the host to acquire the missing information. If no host is instantiated when the timer expires, the MSAP is deleted.

Multiple subscribers and/or subscriber hosts can share a single MSAP. The MSAP is created with the first instantiated subscriber host and deleted when the last associated subscriber host is removed from the system. Note that only a single MSAP policy is allowed to be specified for a given MSAP. An attempt to change the MSAP policy by a new subscriber host for an existing MSAP will result in a host setup failure.

MSAPs can be created in a wholesale VPRN service while the corresponding subscriber host or session is terminated in a retail VPRN or IES service. Both wholesale MSAP data (service, group-interface and policy) and retail service id must be provided during authentication.

ESM Identification Process

SAP-ID ESM Identifier

Providers migrating from Basic Subscriber Management (BSM) can assign a subscriber to a SAP. The SAP ID ESM identifier makes the transition easier by allowing the operator to continue using the *sap-id* as a subscriber-ID.

An ESM SAP ID provides the system the ability to:

- Provide access to the SAP ID string in the Python script.
- Allow the automatic assignment of the SAP-ID to a static subscriber or subscriber host.

DSLAM-ID

A DSLAM ID provides the system the ability to define a DSLAM-ID string provided through the Python script, RADIUS, or local user database. If the DSLAM-ID was provided, but the subscriber host is instantiated on a regular MDA (a non-HSMDA), the DSLAM-ID will be ignored.

The HSMDA and the ability to aggregate subscribers into DSLAMs for the purpose of QoS, can use the SAP ID to identify subscribers and associated DSLAMs.

Default-Subscriber

This feature provides a default subscriber definition under the SAP. If the object was configured the operator may use ESM without enabling a processing script or a RADIUS authentication policy. In the event both have been disabled any host that was installed for the SAP will be installed with the configured default subscriber ID. If a RADIUS policy was used or if a script was enabled but a subscriber ID was not returned the default subscriber ID will be used.

Multicast Management

The multicast-management CLI node contains the bandwidth-policy and multicast-info-policy definitions. The bandwidth-policy is used to manage the ingress multicast paths into the switch fabric. The multicast-info-policy is used to define how each multicast channel is handled by the system. The policy may be used by the ingress multicast bandwidth manager, the ECMP path manager and the egress multicast CAC manager.

Subscriber Mirroring

This section describes mirroring based on a subscriber match. Enhanced subscriber management provides the mechanism to associate subscriber hosts with queuing and filtering resources in a shared SAP environment. Mirroring used in subscriber aggregation networks for lawful intercept and debugging is required. With this feature, the mirroring capability allows the match criteria to include a subscriber-id.

Subscriber mirroring provides the ability to create a mirror source with subscriber information as match criteria. Specific subscriber packets can be mirrored mirror when using ESM with a shared SAP without prior knowledge of their IP or MAC addresses and without concern that they may change. The subscriber mirroring decision is more specific than a SAP. If a SAP (or port) is placed in a mirror and a subscriber host of which a mirror was configured is mirrored on that SAP packets matching the subscriber host will be mirrored to the subscriber mirror destination.

The mirroring configuration can be limited to specific forwarding classes used by the subscriber. When a forwarding class (FC) map is placed on the mirror only packets that match the specified FCs are mirrored. A subscriber can be referenced in maximum 2 different mirror-destinations: 1 for ingress and 1 for egress.

Volume and Time Based Accounting

Time and volume-based accounting includes the following components:

- Metering function performing stateful monitoring of the service delivery to the subscriber.
- Communication with an external management system that gets and updates credit per subscriber, notifications of credit exhaustion, etc.
- Action on credit exhaustion takes pre-defined action when the credit has been exhausted

Metering

Metering represents the core of time and volume-based accounting. Service usage is typically measured by performing an accounting of the traffic passing through corresponding subscriber-host queues (volume usage) or by keeping lease-state while the given subscriber-host is connected to the network (time usage).

- Statefullness — The accounting information is compared with pre-defined credit expressed in terms of time or volume to monitor service usage.
- Sensitivity — Defining so called activity-threshold allows distinction between subscriber-host being connected and subscriber-host effectively using the service. This is particularly of interest in cases of time based charging.
- Aggregated usage per-category per-subscriber-host — Accounting information can be reported on per-queue per-sla instance of the given subscriber. In many situations, a certain level of aggregation (such as a per-subscriber or HSI ingress and egress traffic) is required to perform meaningful mechanism for pre-paid services.

Categories Map and Categories

This feature introduces a new object category-map which defines individual aggregates (such as data in and out, video and data, etc.) and their mapping to individual forwarding queues.

The following output depicts a category-map configured in the subscriber management context.

```
*A:ALA-48>config>subscr-mgmt# info
----------------------------------------------
...
        category-map "triple-play" create
            category "data" create
                queue 1 ingress-egress
            exit
            category "video" create
                queue 2 egress-only
            exit
            category "voice" create
                queue 3 ingress-egress
            exit
        exit
        category-map "aggr-subscriber-service" create
            category "data-services" create
                queue 1 ingress-egress
                queue 3 egress-only
            exit
        exit
...
----------------------------------------------
*A:ALA-48>config>subscr-mgmt#
```

Based on a category-map the system gathers usage information (volume/time) on a per-sla-instance-per-category basis. In order to do so, statistics of all queues forming the category of the given sla-instance are aggregated.

- Single subscriber host (routed CPE) — Single SLA instance.
- Multiple subscriber hosts on the same SAP (bridged CPE) — Single SLA instance. Note that several hosts use the same credit and the renewal of one will cause renewal for all.
- Multiple subscriber hosts on different SAP (bridged CPE) — SLA instance per host.

The per-category usage gathered as described above is compared with per-subscriber-host-per-category credit and when credit is exhausted several actions can be taken.

There are several category-maps pre-configured on the system. The category-map applicable to a given subscriber-host will be derived at the host creation from the RADIUS VSA in an authentication-response, Python script, or static configuration in the local-user-database. All subscriber-hosts belonging to the same subscriber and created on the same SAP (hence, sharing the same sla-instance) must use the same category-map. In case of conflict, (an existing subscriber host has a different category-map than the one derived for the new host) the category-map of the last host will be applied to a given sla-instance. As a consequence, all previous information related to the status of the credit will be lost.

There can be multiple queues aggregated into one category. There can be up to three categories in a category map.

Quota Consumption

There are two types of quota (credit), volume and time. In volume usage monitoring, the system accumulates byte counters per category-sla-instance and compares it with the assigned quota. Once the credit is exhausted (or threshold for renewal is met) the system attempts to renew it with corresponding management system.

In time-based credit, the distinction between active-usage and active-connection is made by defining an activity-threshold, where an object defines an average data rate under which the subscriber-host is considered silent.

As long as the effective rate of the application usage does not exceed the rate defined by the activity-threshold, the given subscriber host will be considered silent and its corresponding credit will not be used. As long as the application usage exceeds the rate, the application-credit will be consumed (in terms of time).

RADIUS VSA Credit-Control-Quota

The quota in the RADIUS VSA Credit-Control-Quota uses this fixed format:

Alc-Credit-Control-Quota = “<volume quota>|<time quota>|<category name>”

- Where Volume: in bytes (B), kilobytes (K or KB), megabytes (M or MB), gigabytes (G or GB)
- Where Time: in seconds (s), in minutes (m), in hours (h), in days (d) or a combination (5m30s) but there is a restriction; a lower unity may never exceed the higher unity (5m60s is not allowed)

For example, Alc-Credit-Control-Quota = “1G|1h30m|cat1”

Volume quota, as well as time quota, needs to be specified.

- The minimum volume quota is 100 megabytes.
- The minimum time quota is 15 minutes.

Credit Negotiation Mechanisms

The per-subscriber per-category credit can be obtained by several ways:

- RADIUS during authentication process.
- Static configuration - configured in the **config>subscr-mgmt>category-map>category** context.

Credit can be expressed by either

- Volume
- Time

The renewal of the credit using RADIUS authentication is triggered by credit exhaustion or (if configured) by depletion of the credit to exhausted-credit-threshold level. If this occurs, the system will send a RADIUS authentication message indicating the corresponding category and usage. The following are several possibilities for the RADIUS server response (as shown in figure below):

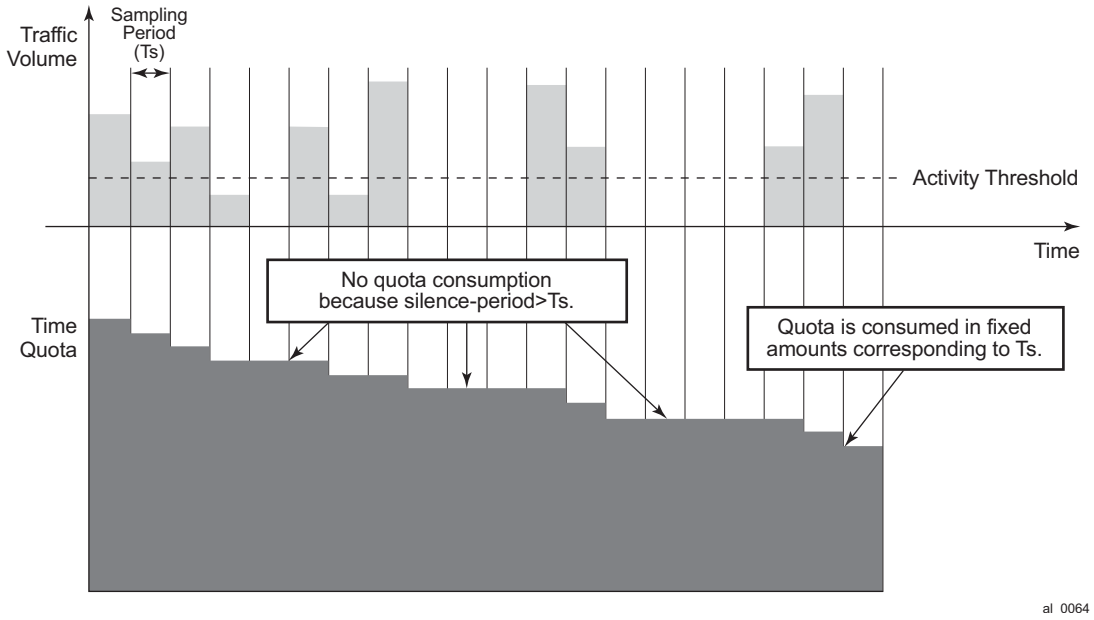


Figure 128: Threshold Configured/Not Configured

1. No authentication response — The system will install out-of-credit action after the original credit has been used.
2. Authentication response with reject — The corresponding host is removed after the original credit has been used.

3. Authentication response with accept and no credit VSA included — The system will install out-of-credit action.
4. Authentication response with accept and credit VSA included — The out-of-credit will be installed.
   Note that the new credit is always reduced by the amount of credit consumed in time between renewal has been initiated and authentication-respond has been received. In case of a negative result (the newly receive credit is smaller than the amount consumed in the mean-time) the test cr
5. is installed.

In order to identify that the given RADIUS-auth request is related to credit renewal rather than to plain authentication, the node will include empty credit VSAs, depending on categories which has been exhausted. The RADIUS server can identify which category has requested credit renewal.

Action on Credit Exhaustion

System supports configurable actions once the credit for given subscriber is exhausted:

- Sends an SNMP trap and continue (the credit-usage counter is reset).
- Disconnect.
- Changes to a pre-defined service level (such as adjusting the queue rate).
- Blocks the category.

Action on Error-Conditions

During credit negotiation, the number of errors can occur which can lead to a given subscriber-host category with no new credit renewed. This is different from credit exhaustion where a separate configurable action will be taken. The following occurs:

- Sends an SNMP trap and continues.
- Sends a trap and blocks the category.

Applicability of Volume and Time Based Accounting

Volume and time based accounting is applicable to the ESM mode of operation only. Using credit control concept is not mutually exclusive with other accounting methods. In many network implementations the more traditional accounting methods such as XML file or RADIUS accounting will be still used in a combination with the credit concept but with larger intervals. This is helpful when providing overviews of the average usage and service utilization.

Subscriber Host Idle Timeout

An idle timeout is the maximum time that a subscriber session can be idle before the session is terminated or a connectivity check is started. Idle timeout applies to PPPoE, PPPoEoA, PPPoA and IPoE hosts.

The time/volume based accounting model is used to configure an idle timeout:

- Create a category-map (Categories Map and Categories on page 1222)
  - → Define a category with queues and/or policers to be monitored for activity (packets being forwarded).
  - → An activity threshold (in kbps) must be configured for idle timeout to take effect. The activity threshold suppresses background traffic (for example control flows) from activity monitoring.

Example:

```
config>subscr-mgmt
        category-map "idle-timeout" create
            activity-threshold 25
            category "cat-1" create
                queue 1 ingress-egress
            exit
        exit
```

- In the sla-profile, associate the category-map and optionally define
  - → An idle-timeout (60..15552000 seconds). The default is infinite (no idle-timeout).

  The idle-timeout can also be specified from RADIUS in an access-accept or CoA message with the [28] Idle-Timeout attribute. A RADIUS specified idle-timeout overrides the CLI-configured value. The values outside the limits are accepted but rounded to these boundaries.

Attribute ID	Attribute name	Type	Limits	Purpose and Format
28	Idle-Timeout	integer	[60..15552000] seconds	0 = infinite (no idle-timeout) [60..15552000] in seconds For example: Idle-Timeout = 3600

  - → An idle-action:
    - – **shcv-check** — Perform a subscriber host connectivity check (IPoE hosts only). Host connectivity verification should be enabled on the corresponding group-interface for the **idle-action shcv-check** to take effect:

    configure service ies|vprn *service-id* **subscriber-interface** *ip-int-name* **group-interface** *ip-int-name* **host-connectivity-verify**

If the shcv check is successful, the subscriber host is not disconnected and the idle-timeout timer is reset to zero. If the shcv check fails, the subscriber host is disconnected (same as terminate).

For PPP hosts, the **idle-action shcv-check** is ignored and has the same effect as "idle-action terminate"

- Terminate (default): disconnect the subscriber hosts
  - IPoE:
    - Delete the subscriber host
    - Send a DHCP release message to the DHCP server
    - Send an Accounting Stop message to the RADIUS accounting server
  - PPP:
    - Delete the subscriber host
    - Send a terminate request message to the CPE
    - Send an Accounting Stop message to the RADIUS accounting server

Example

```
config>subscr-mgmt
        sla-profile "sla-profile-1" create
            category-map "idle-timeout"
                category "cat-1" create
                    idle-timeout 3600
                    idle-timeout-action terminate
                exit
            exit
        exit
```

At host instantiation, a timer is initialized to the idle-timeout value (one timer per sla-profile instance). Each queue or policer in the category is monitored for activity over a fixed polling interval:

- During the polling interval:
  - → if the forwarding rate falls below the configured activity threshold then the timer is deducted by the polling interval (time elapsed).
  - → If the forwarding rate is above the configured activity threshold then the timer is initialized to the idle-timeout value.

When the timer becomes zero, the idle-timeout-action is performed for all hosts associated with the SLA-profile-instance (all hosts from a subscriber on a single sap and that share the same sla-profile).

Web Authentication Protocol (WPP)

The Web Authentication Protocol (WPP) is a protocol running between BNG and Web portal server. WPP is used for web portal authentication of WLAN users (DHCP Host). It can function like a web portal that can trigger BNG to do RADIUS authentication for WLAN users, or send user disconnection notification to BNG.

The Figure 129 illustrates high level of call flow of WPP authentication.

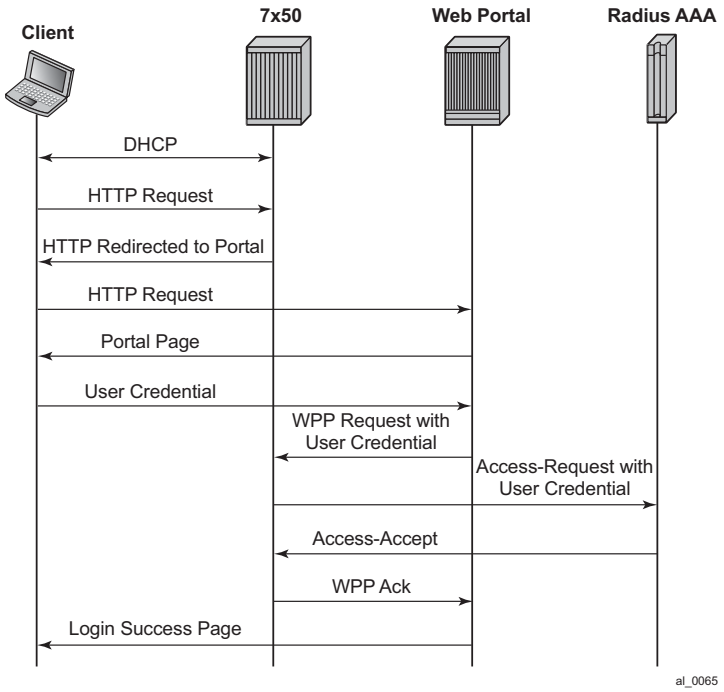


Figure 129: WPP Authentication

The following describes WPP authentication call flow:

1. When the WLAN user starts a DHCP exchange with a 7750, the 7750 will create a DHCP host from following configurations:
   - → Sub-id is the default sub-id configured in the **sap>sub-sla-mgmt** context.
   - → sla-profile/sub-profile/aa-profile will take the configuration from CLI command **grp-if>wpp>initial-sla-profile/initial-sub-profile/initial-app-profile**.
   - → IP address from local or external DHCP server will be assigned to the host.
2. When the user sends an HTTP request to visit a web site by browser, the 7750 redirects the HTTP request to the web portal.
3. The portal server sends an authentication page to the WLAN user.

4. WLAN user enters username and password in the authentication page and submit to the Portal Server.
5. The portal server sends a WPP request to router together with the user credentials.
6. The 7750 sends an access-request to RADIUS server with user credentials.
7. RADIUS returns an access-accept if authentication succeeds.
8. The 7750 returns a WPP ack to portal server.
9. If it was access-accept, then the 7750 can optionally override the following host properties:
   → Sub-id: sub-id from RADIUS. If there is no sub-id from RADIUS, then the host will keep using current sub-id.
   → Sla-profile/sub-profile/aa-profile: The system will use the RADIUS server returned values. If the RADIUS server did not return these then the system will try to use the LUDB (in local DHCP server) return values if they are available. If not, the system will try to use the default values configured under SAP.

WPP Configurations

A minimal WPP configurations must include the following:

- WPP portal server — Specifies the name and IP address of the WPP portal server.
- Enable WPP under the group-interface:
  → WPP portal server that system should listen to.
  → **authentication-policy** on **group-interface** that specifies address of RADIUS server.
  → **def-sub-id** under sap>sub-sla-mgmt that is used for DHCP host before user is authenticated by portal server.
  → **initial-sla-profile** and **initial-sub-profile** that are used for the DHCP host before user is authenticated by portal server.
  Note: initial-sla-profile should include a ingress filter that has **http-redirection** entry.

The following is an example configuration:

```
#--------------------------------------------------
echo "Web Portal Protocol Configuration"
#--------------------------------------------------
        wpp
            portals
                portal "portal-1" address 9.9.9.9 create
                    no shutdown
                exit
            exit
            no shutdown
        exit
config>service>vprn# info
----------------------------------------------------
```

```
            subscriber-interface "sub-if" create
                address 192.168.10.1/24
                group-interface "grp-if" create
                    dhcp
                        server 1.1.1.1
                        gi-address 192.168.10.1
                        no shutdown
                    exit
                    authentication-policy "radius-auth"
                    sap 1/1/9 create
                        sub-sla-mgmt
                            def-sub-id "WLAN-User-Unauth"
                            no shutdown
                        exit
                    wpp
                        initial-sla-profile "webportal"
                        initial-sub-profile "webportal"
                        portal router "Base" name "portal-1"
                        no shutdown
                    exit
                exit
            exit
…
-----------------------------------------------
```

WPP Triggered Host Creation

In some cases, a 7750 SR can sit behind a Layer 3 device (such as an CMTS), where the 7750 does not participate in client's DHCP process. Such a use case is different from a normal WPP use case where 7750s rely on getting client's DHCP request to create an initial ESM host.

This feature allows the system to create an ESM host upon successful WPP authentication without creating an initial host.

In the above use case (behind a Layer 3 device) the user also need to configure one or more default hosts on the SAP to allow HTTP redirection without an ESM host. The default-host subnet is the user's source subnet and the nexthop address is the Layer 3 device's interface address that connect to the SAP. Users also need to configure the **lease-populate l2-header** command in the **grp-if>dhcp** context to make HTTP redirection with default-host work. The **grp-if>dhcp** context could be shutdown in the meantime.

This feature does not work with wholesale/retail

LUDB Support For WPP

Since R12.0R1, the SR OS supports LUDB lookup for WPP authentication. Users can configure LUDB to return WPP-related attributes such as a portal name, initial-sla-profile/initial-sub-profile, etc. The system could access LUDB when creating the initial host before WPP authentication and the LUDB returned attribute will override the corresponding configuration under the group-interface.

WPP Multi-Chassis Redundancy Support

The SR OS supports multi-chassis redundancy to WPP. This can be achieved by doing following:

- Create a loopback interface on both 7750 with the same IP address X.
- Use the **track-srrp** parameter while configuring address X to track the corresponding SRRP instance.
- Configure a portal with the same name and same service-id on both nodes to send WPP packets to the destination address.
- Use an route-policy to export X to the routing protocol. The metric the route X can be set is based on the a specified SRRP state (master or non-master) so that master node can advertise route X with a better metric. Then the WPP packet from the portal will be attracted to the master.
- Only the master process WPP packet, however in case of standby node receives (such as routing is still re-converging) the WPP packet, then standby will shunt the WPP back to master.
- WPP hosts will be synced via MCS.

One-time HTTP Redirection Overview

With this feature enabled, after an ESM host is created, only the FIRST HTTP request from the host will be redirected to a configured URL with specified parameters. Subsequent HTTP request will go through without being redirected.

This feature could be used by service providers to push a web-page to broadband users for purpose of advertisement, announcements, and such.

A **one-time-http-redirection** filter could be configured in **sla-profile**, this filter will be replaced by ingress filter in **sla-profile** after 1st HTTP request is redirected. There is also a RADIUS VSA (ALC-Onetime-Http-Redirection-Filter-Id) that could be included in access-accept or CoA request to override CLI configuration. The format of ALC-Onetime-Http-Redirection-Filter-Id is **Ingr-v4:***filter-id*; for example, **Ingr-v4:1000**. If the the filter-id is 0, then system will replace the current **one-time-http-redirection** filter with ingress filter.

Note: In case of CoA, if the host's **one-time-http-filter** has already been replaced then system will just ignore the ALC-Onetime-Http-Redirection-Filter-Id.

If a 7750 SR receives filter insertion via CoA or access-accept when **one-time-http-redirection** filter is still active then the received filter entries will only be applied to the ingress filter. And after 1st http redirection, the update ingress filter will replace the one-time-http-redirection filter.

This feature only supports IPv4 filter.

ESM over MPLS Pseudowires

This feature allows IPoE and PPPoE (terminated or L2TP tunneled) subscriber sessions to be backhauled through an Ethernet aggregation network using MPLS pseudowires terminating directly on the BNG. The MPLS pseudowire originates from the first hop aggregation PE (referred to as access PE) upstream of the Access-Node (or directly from a multi-service AN), and terminates on the BNG. Multiple subscriber sessions from a given access-port on the Access-PE can be backhauled over a single P2P MPLS pseudowire towards the BNG. This capability allows the network to scale and does not require a MPLS pseudowire per subscriber between Access-PE and the BNG. The access-port on the Access-PE can be dot1q, q-in-q or NULL encapsulated. The BNG terminates the MPLS pseudowire, decapsulates the received frames, and provides ESM functions including HQoS, without requiring an internal or external loopback. Each MPLS pseudowire is represented on the BNG as a "PW-port" for which SAPs are created. A PW-port can be configured with capture SAP. Both static and managed SAPs are supported. The underlying Ethernet port is required to be in hybrid mode. The feature set is supported for IOM3-XP and HSMDAv2. This feature is supported on the 7750 SR and 7450 ESS in mixed mode.

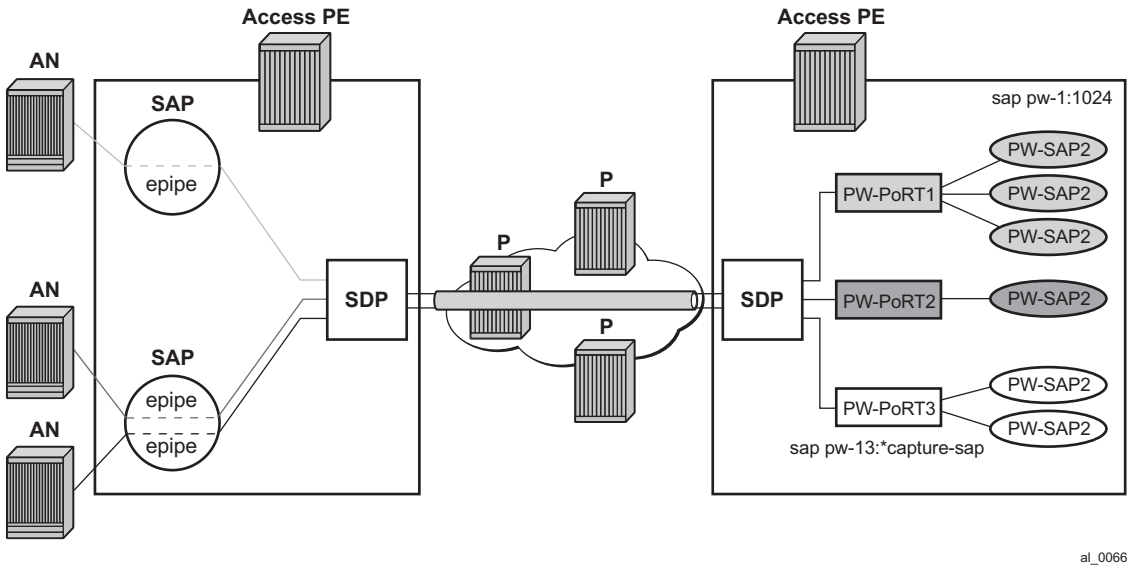


Figure 130: ESM over MPLS Pseudowire Example

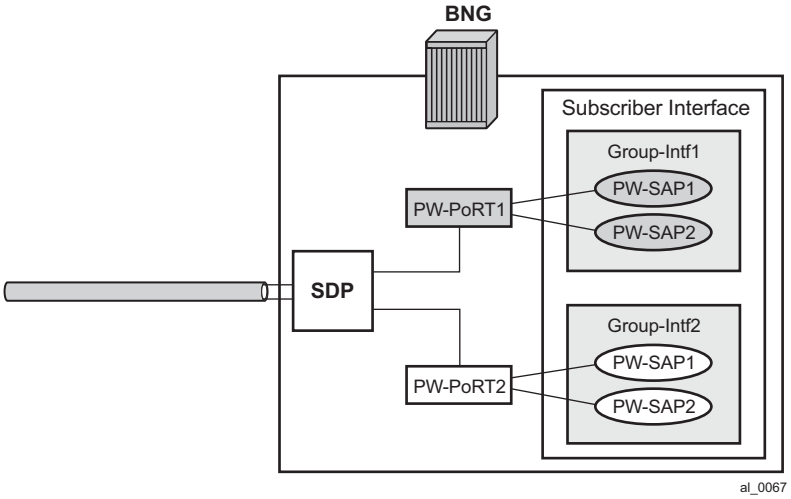


Figure 131: Group Interface Example

Encapsulation

The subscriber frame encapsulated within the pseudowire is shown in Figure 132. Optional control word is not supported. The SDP could be LDP, RSVP or LDP over RSVP. Hash labels are not supported. SDP is bound to a port or a LAG. In case the SDP is re-routed, the corresponding PW-ports are operationally brought down. The PW-ports are associated with the SDP by configuration.

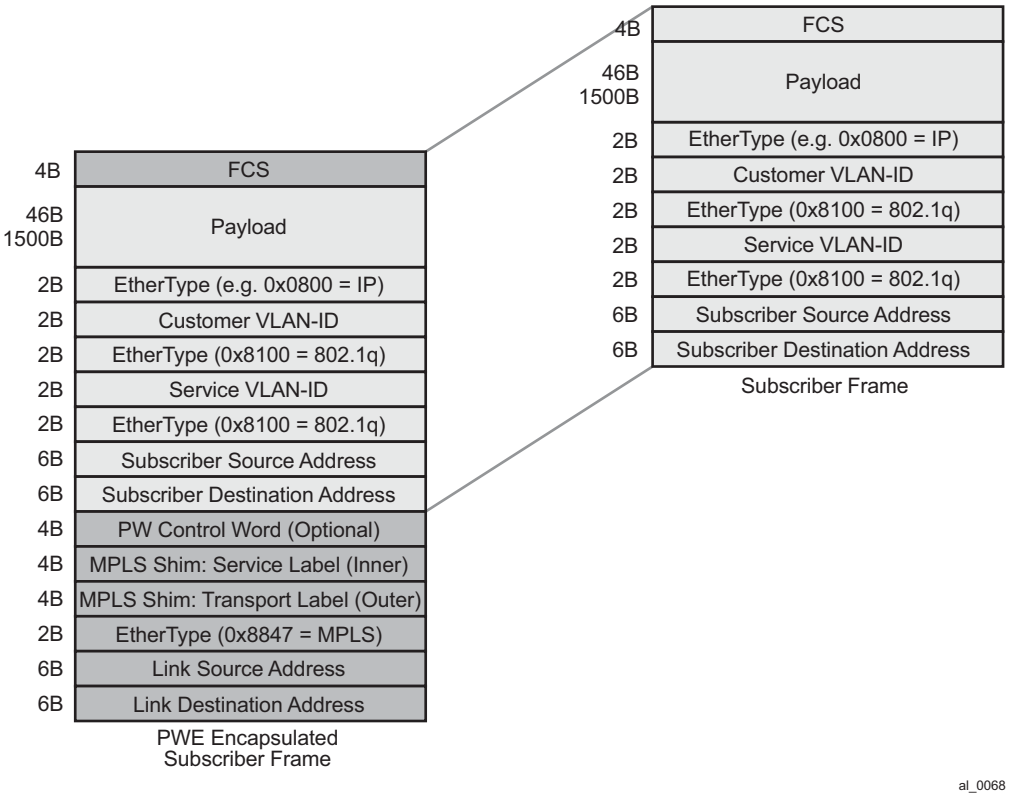


Figure 132: Subscriber Frame with PWE Encapsulation

ESM Configuration with PW-Ports and PW-SAPs

BNG requires configuration for PW-ports. The VC-label for configured PW-port is dynamically signaled using T-LDP with the far-end A-PE. The configuration for the PW-port includes the port-id (unique identifier within the chassis), vc-id (virtual circuit identifier, which is signaled to the peer), and the vc-type (Ether or VLAN, which is signaled to the peer). The vc-id and vc-type must match with the configuration of the PW on the far-end. The vc-id MUST be unique across PW-ports. The encapsulation type (dot1Q or q-in-q) on the PW-port is configurable. The default value

for vc-type is Ether, and the default encapsulation type is dot1Q. With vc-type vlan, the vc-vlan-tag can be configured. vc-type vlan forwarding mode can only be set if encapsulation type is dot1Q. On the BNG, the vc-vlan-tag is only relevant for transport, and not service delineation and ESM. On the BNG, with vc-type vlan configured on the PW-port, the configured vc-type-vlan tag is inserted when forwarding traffic into the PW (i.e. in downstream direction), and top dot1Q tag is stripped when forwarding traffic out of the PW (i.e. in upstream direction). On the BNG, with vc-type ether configured on the PW-port, the received tags (max two, including any provider tag inserted by the far-end) are preserved and passed for PW-SAP lookup or creation. In the downstream direction the PW-SAP tags are inserted and passed back to the far-end.

The following output displays an ESM configuration with PW-ports and PW-SAPs.

```
config>service#
  customer 1 create
     description "Default Customer"
  exit
  sdp 1 mpls create
       description "Default sdp description"
       far-end 10.20.1.2
       ldp
       keep-alive
          shutdown
       exit
       binding
          port 1/1/3
          pw-port 11 vc-id 11 create
             vc-type vlan        #### default encaps-type dot1Q
             no shutdown
          exit
          pw-port 44 vc-id 2 create #### default vc-type Ether, encaps-type dot1Q
             no shutdown
          exit
        exit
        no shutdown
    exit
    vpls 1 customer 1 vpn 1 create
       sap pw-11:* capture-sap create
           trigger-packet arp dhcp dhcp6 pppoe #
           msap-defaults
               group-interface "grpif-pw-11"
               policy "msap-policy1"
               service 3
           exit
           authentication-policy "base_authpolicy"
        exit
        no shutdown
     exit

     ies 3 customer 1 vpn 3 create
         description "Default ies description for sevice id 3"
         subscriber-interface "subif" create
              address 11.11.1.1/16
              address 44.44.1.1/16
              group-interface "grpif-pw-11" create
                 arp-populate
                 dhcp
                    server 10.20.1.2
```

```
            gi-address 11.11.1.1
            no shutdown
         exit
         authentication-policy "base_authpolicy"
         sap pw-11:11 create
             sub-sla-mgmt
                  def-sub-profile "sub_prof_1"
                  def-sla-profile "sla_prof_1"
                  no shutdown
              exit
          exit
      exit
group-interface "grpif-pw-44" create
     arp-populate
     dhcp
        server 10.20.1.2
        gi-address 11.11.1.1
        no shutdown
     exit
     sap pw-44:44 create
          sub-sla-mgmt
              def-sub-profile "sub_prof_1"
              def-sla-profile "sla_prof_1"
              no shutdown
      exit
   exit
   no shutdown
exit
```

QoS Support

QoS is supported for ESM over PW-SAPs as with ESM over regular SAPs, and includes currently supported models.

- FC to queue mapping
- H-QOS
  - → Per-subscriber HQOS (service scheduler child to port-scheduler parent).
  - → PW-SAP queues attached to H-QOS scheduler by parent statement.
  - → Scheduler attached to port scheduler by "port-parent" statement.
- Direct service queue to port-scheduler.
  - → Aggregate-rate-limit.

Bandwidth Control at PW-Port Level via Vport

Bandwidth control per PW-port (per AN or per AN/ per service), via vport.

- The vport can be created on the binding port.
- The vport can be associated with the PW-port either via static assignment or dynamic selection via inter-dest-id (returned from RADIUS or DHCP for a host).
- Aggregate-rate-limit can be configured to shape the egress traffic across all hosts associated with the vport via inter-dest-sting match or via static association of underlying PW-port with the vport.

The following output displays a dynamic vport selection based on an inter-dest-id configuration.

```
config>
   Port 1/1/1
      ethernet
         mode hybrid
         encap-type dot1Q
         mtu 1540
         access
            egress
            vport "v1" create
               agg-rate-limit 1000
               host-match dest "dslam-1"    #### hosts will be associated with
            exit                            #### vport based on inter-dest-id
          exit
      exit
   exit

config>service>sdp>binding
   pw-port 11 vc-id 11 create
       egress
          shaping int-dest-id "dslam-1"   #### dynamic vport selection based on
                                          #### int-dest-id.
```

The following output displays a static assignment of PW-port to vport configuration.

```
config>
   Port 1/1/2
      ethernet
         mode hybrid
         encap-type dot1Q
         access
            egress
            vport "v2" create
               agg-rate-limit 1000
            exit
          exit
      exit
   exit

config>service>sdp>binding
    pw-port 20 vc-id 20 create
       egress
          shaping vport "v2"    #### static assignment of pw-port to vport.
       exit
    exit
```

Last Mile Shaping

With normal Ethernet aggregation in the next-mile, when last-mile shaping is on, fixed encapsulation-offset is calculate based on the last-mile encapsulation type and the next-mile encapsulation (26 Bytes with q-in-q). This offset is applied to the frame, and the ATM overhead is then dynamically calculated on the adjusted size. The resulting dynamically calculated overhead in the data-path is then applied to the queue-rates and the subscriber aggregate-rate.

With this feature of backhauling subscriber sessions using MPLS PW in the aggregation network, the encapsulation is shown in Fig 3. The last mile does not see any MPLS PW overhead. The next-mile includes overhead due to the PW encapsulation shown in Figure 132. Therefore, when last mile shaping is enabled, the fixed encapsulation-offset is calculated based on the difference between last-mile encapsulation type and next-mile encapsulation, The next-mile encapsulation takes into account the additional PW overhead, which includes:

```
14B Ethernet header + [4B] (optional network interface Q-tag) + MPLS
Labels (variable)
```

In the data-path the actual PW encapsulation overhead, taking into account the MPLS labels which could be variable (with FRR or PHP) is tracked, and is applied to the computed "encapsulation offset". This adjusted "encapsulation offset" is applied to the frame. The ATM overhead is then dynamically calculated on the adjusted size, and applied for last mile shaping (to queue-rates and subscriber-aggregate-rate). Note that there is no change from ESM over normal SAPs, in how last-mile shaping is triggered or how the last mile encapsulation type is determined (via configuration in egress context of subscriber profile or dynamically learned from Access-Loop-Encapsulation sub-TLV in vendor specific PPPoE tags).

BNG Redundancy with ESM over Pseudowire

This feature provides support for stateful BNG redundancy (when the far-end aggregation PE (A-PE) is dual-homed to two BNGs terminating subscriber sessions over MPLS pseudowires (pws) that are initiated from the A-PE and provides ESM). Subscriber state between BNGs is synced using MCS.

EPIPE Based Aggregation Service

For an EPIPE based aggregation service, the redundancy is based on active/standby PWs from A-PE to dual BNGs. A-PE signals active/standby pseudowire status to peer BNGs. An SRRP instance per PW-Port (group-interface) is required on the BNG with messaging SAP on each PW-Port. BNG terminating active PW assumes the mastership for the SRRP instance on the corresponding PW-Port. SRRP state is tied to the state of the messaging SAP. The messaging SAP goes down when the underlying PW-Port goes down, based on PW status bit signaled by the A-PE.

In this model, there is no SRRP message exchange between the two BNGs, as there is no L2 path between the BNGs. The purpose of SRRP is to get SRRP-aware routing for subscriber routes and managed routes, and/or to be able to use the redundant (shunt) interface. Downstream traffic for a subscriber that ingresses the backup BNG can only be shunted to the active BNG, if the corresponding subscriber-interface on the backup BNG is operationally UP. This can be achieved by creating a second empty group-interface (without SAPs) on the same subscriber-interface with the knob 'oper-up-while-empty' configured. Multiple PWs with endpoint configuration is not supported on the BNG.

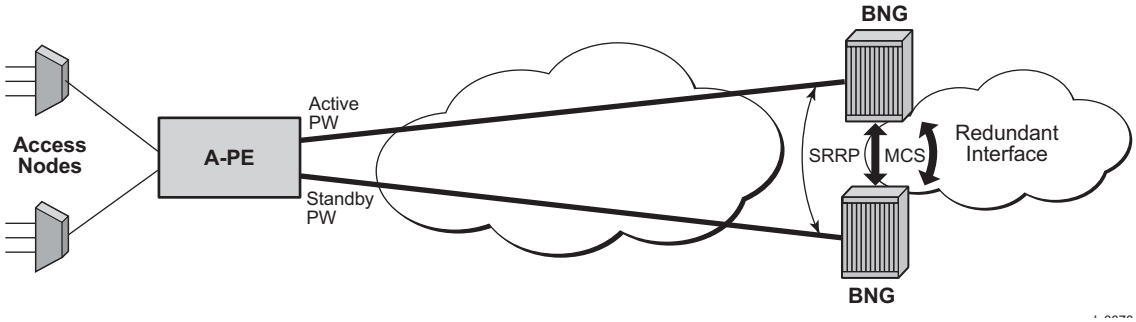


Figure 133: BNG Redundancy Based on Active/Standby PW Signaling

Sample Configuration on Master BNG

```
config>
    pw-port 2 create
    exit

config>redundancy#
     multi-chassis
         peer 10.20.1.3 create
             source-address 10.20.1.2
                sync
                    srrp
                    sub-mgmt ipoe pppoe
                    port pw-2 sync-tag "tag2" create
                    exit
                    no shutdown
                exit
                no shutdown
            exit
         exit
     exit

config>service>ies#
       redundant-interface "redundant-interface" create
          address 10.10.30.2/24 remote-ip 10.10.30.3
          spoke-sdp 23:1000 create
             no shutdown
          exit
       exit
config>service#
    sdp 1 mpls create
       far-end 10.20.1.2
       ldp
       keep-alive
          shutdown
       exit
       binding
          port 1/1/1
          pw-port 2 vc-id 2 create
             vc-type vlan        #### default encaps-type dot1Q
             no shutdown
          exit
       exit
       no shutdown
    exit
config>service#
       subscriber-interface "subif" create
           address 11.11.1.2/16 gw-ip-address 11.11.1.1 populate-host-routes
                group-interface "grpif" create
                    authentication-policy "base_authpolicy"
                    redundant-interface "redundant-interface"
                    sap pw-2:1000 create
                        description "sap-grp-3"
                    exit
                    srrp 1 create
                        message-path pw-2:1000
```

```
                    no shutdown
                exit
                arp-host
                    host-limit overall 8000
                    min-auth-interval 1
                    no shutdown
                exit
            exit
        exit
    exit
```

Sample Configuration on Slave BNG

```
config>
    pw-port 2 create
    exit
config>redundancy#
     multi-chassis
         peer 10.20.1.2 create
             source-address 10.20.1.3
                sync
                    srrp
                    sub-mgmt ipoe pppoe
                    port pw-2 sync-tag "tag2" create
                    exit
                exit
                no shutdown
            exit
        exit
     exit
config>service>ies#
       redundant-interface "redundant-interface" create
          address 10.10.30.3/24 remote-ip 10.10.30.2
          spoke-sdp 32:1000 create
             no shutdown
          exit
       exit
config>service#
    sdp 1 mpls create
       far-end 10.20.1.2
       ldp
       keep-alive
          shutdown
       exit
       binding
          port 1/1/1
          pw-port 2 vc-id 2 create
             vc-type vlan        #### default encaps-type dot1Q
             no shutdown
          exit
       exit
       no shutdown
    exit
config>service#
       subscriber-interface "subif" create
           address 11.11.1.3/16 gw-ip-address 11.11.1.1 populate-host-routes
```

```
            group-interface "grpif" create
                authentication-policy "base_authpolicy"
                redundant-interface "redundant-interface"
                sap pw-2:1000 create
                    description "sap-grp-3"
                exit
                srrp 1 create
                    keep-alive-interval 1
                    message-path pw-2:1000
                    no shutdown
                exit
                arp-host
                    host-limit 8000
                    min-auth-interval 1
                    no shutdown
                exit
            exit
            group-interface "dummy" create
                oper-up-while-empty
            exit
        exit
    exit
```

Sample Configuration on A-PE

```
config>service>epipe#
     description "Default epipe description for service id 103"
     service-mtu 1492
     service-name "XYZ Epipe 103"
     endpoint "x" create
         standby-signaling-master
     exit
     sap 1/1/3 create
          description "Default sap description for service id 103"
     exit
     spoke-sdp 1:2 endpoint "x" create
          description "Description for Sdp Bind 1 for Svc ID 103"
          precedence primary
          no shutdown
     exit
     spoke-sdp 2:2 endpoint "x" create
          description "Description for Sdp Bind 2 for Svc ID 103"
          no shutdown
     exit
     no shutdown
```

VPLS Based Aggregation Service

With VPLS based aggregation service from A-PE, normal SRRP message exchange can take place between the primary and backup BNGs. Master-ship decision and switch-over is based on SRRP. SRRP instance is configured per group-interface corresponding to PW-Port. Fate-sharing groups (FSG) can be configured for a set of SRRP instances (for example, SRRP instances corresponding to PW-Ports sharing the same subnet). Standard **oper-group** *grp-id* would need to be configured with messaging SAPs for all PW-Ports that are in the same FSG, and **monitor-oper-group** *grp-id* would need to be configured under each SRRP instance in same FSG. Existing SRRP support defined in Triple-play services guide for ESM over regular group-interfaces and subscriber SAPs is applicable identically to ESM over PW-Ports and PW-SAPs.

Note: With PW over ESM, redundancy in the aggregation network based on MC-LAG between A-PE and dual BNGs is not supported.

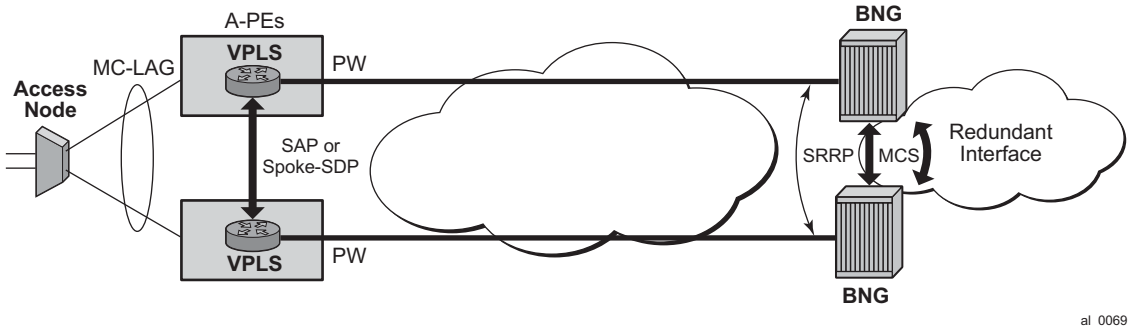


Figure 134: BNG Redundancy with VPLS Based Aggregation Service

Sample BNG Redundancy (SRRP/MCS) Configuration with VPLS Service on A-PE

```
config>
    pw-port 1 create
    exit

config>redundancy#
     multi-chassis
         peer 10.20.1.2 create
             source-address 10.20.1.3
                sync
                    srrp
                    sub-mgmt ipoe pppoe
                    port pw-1 sync-tag "tag1" create
                    exit
                exit
                no shutdown
            exit
        exit
     exit

 config>service>ies
       redundant-interface "red-1-1" create
           address 1.1.1.2/24 remote-ip 1.1.1.1
               spoke-sdp 1:1 create
                  no shutdown
               exit
           exit

       subscriber-interface "sub-1-1" create
            address 20.1.2.2/16 gw-ip-address 20.1.255.254 track-srrp 1
            address 20.2.2.2/16 gw-ip-address 20.2.255.254 track-srrp 2
            dhcp
                gi-address 20.1.2.2
            exit
            group-interface "grp-1-1-1" create
                 srrp-enabled-routing
                 arp-populate
                 dhcp
                     server 10.20.1.2
                     trusted
                     lease-populate 32767
                     client-applications dhcp ppp
                     gi-address 20.1.2.2
                     no shutdown
                 exit
                    authentication-policy "iesAuthPol"
                    redundant-interface "red-1-1"

                   sap pw-1:1.1 create
                       sub-sla-mgmt
                           def-sub-profile “sub_prof_1”
                           def-sla-profile “sla_prof_1”
                           no shutdown
                   exit
                   sap pw-1:4000.1 create
                        oper-group "1"
                   exit
```

```
                srrp 1 create
                     gw-mac 00:00:5e:00:01:01
                     keep-alive-interval 50
                     message-path pw-1:4000.1
                     monitor-oper-group "1" priority-step 10
                     no shutdown
                 exit
            exit
```

A-PE configuration with VPLS Aggregation Service (A-PE1)

```
config>service
     customer 1 create
         description "Default customer"
     exit
     sdp 1000 mpls create
         far-end 10.20.1.2
         lsp "lsp_1"
         path-mtu 1600
         keep-alive
         no shutdown
      exit
      sdp 1002 mpls create
         far-end 10.20.1.3
         lsp "lsp_3"
         path-mtu 1600
         keep-alive
         no shutdown
      exit
      vpls 1 customer 1 create
          service-mtu 1600
          stp
          sap 1/1/2 create   // to Access-Node
          exit
        sap 1/1/3 create; //to A-PE2
        exit
          spoke-sdp 1000:1 create  // to BNG1
              no shutdown
          exit
          no shutdown

        exit
    exit
```

A-PE Configuration with VPLS Aggregation Service (A-PE2)

```
config>service
     customer 1 create
         description "Default customer"
     exit
     sdp 1002 mpls create
         far-end 10.20.1.3
         lsp "lsp_2"
         path-mtu 1600
```

```
      keep-alive
      no shutdown
    exit

    vpls 1 customer 1 create
        service-mtu 1600
        stp
        sap 1/1/2 create   // to Access-Node
        exit
      sap 1/1/3 create; //to A-PE1
      exit
        spoke-sdp 1002:1 create  // to BNG2
            no shutdown
        exit
        no shutdown
      exit
exit
```

Show Commands Related to Active/Standby Pseudowire on Dual BNGs

The following example shows SRRP status, subscriber host, and routing information on master BNG:

```
A:Dut-B>config>redundancy# show srrp 1

===============================================================================
SRRP Instance 1
===============================================================================
Description         : (Not Specified)
Admin State         : Up                Oper State       : master
Preempt             : yes               One GARP per SAP : no
Monitor Oper Group  : None
System IP           : 10.20.1.2
Service ID          : VPRN 3
Group If            : grpif             MAC Address      : 1c:85:ff:00:00:00
Grp If Description  : N/A
Grp If Admin State  : Up                Grp If Oper State: Up
Subscriber If       : subif
Sub If Admin State  : Up                Sub If Oper State: Up
Address             : 11.11.1.2/16      Gateway IP       : 11.11.1.1
Redundant If        : redundant-interfa*
Red If Admin State  : Up                Red If Oper State: Up
Address             : 10.10.30.2/24
Red Spoke-sdp       : 23:1000
Msg Path SAP        : pw-2:1000
Admin Gateway MAC   :                   Oper Gateway MAC : 00:00:5e:00:01:01
Config Priority     : 100               In-use Priority  : 100
Master Priority     : 100
Keep-alive Interval : 1 deci-seconds    Master Since     : 05/29/2012 07:22:26
Fib Population Mode : all
VRRP Policy 1       : None              VRRP Policy 2    : None
===============================================================================
* indicates that the corresponding row element may have been truncated.

A:Dut-B>config>redundancy# show service id 3 arp-host

===============================================================================
ARP host table, service 3
===============================================================================
IP Address      Mac Address       Sap Id              Remaining           MC
                                                      Time                Stdby
-------------------------------------------------------------------------------
11.11.1.11      00:80:00:00:00:01 [pw-2:11]           03h35m47s
11.11.1.12      00:80:00:00:00:02 [pw-2:12]           03h35m47s
-------------------------------------------------------------------------------
Number of ARP hosts : 2
===============================================================================

A:Dut-B>config>redundancy# show router 3 route-table 11.11.1.11

===============================================================================
Route Table (Service: 3)
===============================================================================
Dest Prefix[Flags]                            Type    Proto    Age         Pref
      Next Hop[Interface Name]                                    Metric
-------------------------------------------------------------------------------
```

```
11.11.1.11/32                                    Remote  Sub Mgmt 00h24m26s   0
       [grpif]                                                                0
-------------------------------------------------------------------------------
No. of Routes: 1
Flags: L = LFA nexthop available    B = BGP backup route available
       n = Number of times nexthop is repeated
===============================================================================
A:Dut-B>config>service>vprn#
```

The following shows SRRP status, subscriber host, and routing info in slave BNG:

```
A:Dut-C>config>redundancy# show srrp 1

===============================================================================
SRRP Instance 1
===============================================================================
Description         : (Not Specified)
Admin State         : Up                Oper State       : initialize
Preempt             : yes               One GARP per SAP : no
Monitor Oper Group  : None
System IP           : 10.20.1.3
Service ID          : VPRN 3
Group If            : grpif             MAC Address      : 1c:87:ff:00:00:00
Grp If Description  : N/A
Grp If Admin State  : Up                Grp If Oper State: Down
Subscriber If       : subif
Sub If Admin State  : Up                Sub If Oper State: Up
Address             : 11.11.1.3/16      Gateway IP       : 11.11.1.1
Redundant If        : redundant-interfa*
Red If Admin State  : Up                Red If Oper State: Up
Address             : 10.10.30.3/24
Red Spoke-sdp       : 32:1000
Msg Path SAP        : pw-2:1000
Admin Gateway MAC   :                   Oper Gateway MAC : 00:00:5e:00:01:01
Config Priority     : 1                 In-use Priority  : 1
Master Priority     : 1
Keep-alive Interval : 1 deci-seconds    Master Since     : 05/29/2012 07:22:26
Master Down Interval: 0.000 sec (Expires in 0.000 sec)
Fib Population Mode : all
VRRP Policy 1       : None              VRRP Policy 2    : None
===============================================================================
* indicates that the corresponding row element may have been truncated.


A:Dut-C>config>redundancy# show service id 3 arp-host

===============================================================================
ARP host table, service 3
===============================================================================
IP Address      Mac Address       Sap Id              Remaining           MC
                                                      Time                Stdby
-------------------------------------------------------------------------------
11.11.1.11      00:80:00:00:00:01 [pw-2:11]           03h38m01s           Yes
11.11.1.12      00:80:00:00:00:02 [pw-2:12]           03h38m02s           Yes
-------------------------------------------------------------------------------
Number of ARP hosts : 2
===============================================================================

A:Dut-C>config>redundancy# show router 3 route-table 11.11.1.11
```

```
===============================================================================
Route Table (Service: 3)
===============================================================================
Dest Prefix[Flags]                              Type    Proto    Age         Pref
      Next Hop[Interface Name]                                     Metric
-------------------------------------------------------------------------------
11.11.1.11/32                                   Remote  Sub Mgmt 00h22m03s   0
       [redundant-interface]                                          0
-------------------------------------------------------------------------------
No. of Routes: 1
Flags: L = LFA nexthop available    B = BGP backup route available
       n = Number of times nexthop is repeated
===============================================================================
```

On-Demand Subnet Allocation (ODSA)

DHCP pool *subnet-binding-key*

To share a DHCP pool among BNG, the DHCP server will first require a **gi-address**. This feature is used in conjunction with **use-gi-address** from the **local-dhcp-server** and the scope should be *pool* to allow allocation of all subnets within the pool. The DHCP discovery must contain any of the three vendor specific options in Option 82: service ID, service-plus-system ID, or custom string. The intent is to bind a subnet from the shared pool to one of the three required parameters from the vendor specific option (VSO).

When starting to use the shared pool for the first time, a DHCP request should arrives with one of the three required VSOs. The DHCP server looks for a free subnet to bind to the VSO, and then an address is offered to the subscriber. Only subscribers utilizing the same DHCP VSO are allowed to request addresses from the same registered subnet. All new DHCP discovery VSOs are matched against VSOs bound to existing subnets. For the case where a DHCP discovery VSO matches a VSO bound to a subnet, an address from the subnet is offered to subscriber until exhaustion. Once exhausted, the DHCP looks for a free available subnet (if any) for binding and the same process continues until the new subnet is exhausted. Subscribers with non-matching DHCP VSOs are prohibited to request address from the bounded subnet. For the case where a DHCP discovery VSO fails to match any of the current binding, a new unbound subnet is searched for binding (if any).

Each subscriber interface sharing a DHCP pool, must utilize a unique **gi-address**. This is to ensure that the DHCP offer can correctly route back to the subscriber interface as shown in Figure 135. The number of subscriber interfaces sharing the DHCP pool, must have at least the equivalent number of subnets in the DHCP pool. The number of subnets available for sharing should always be equal or greater then the number of subscriber interfaces.

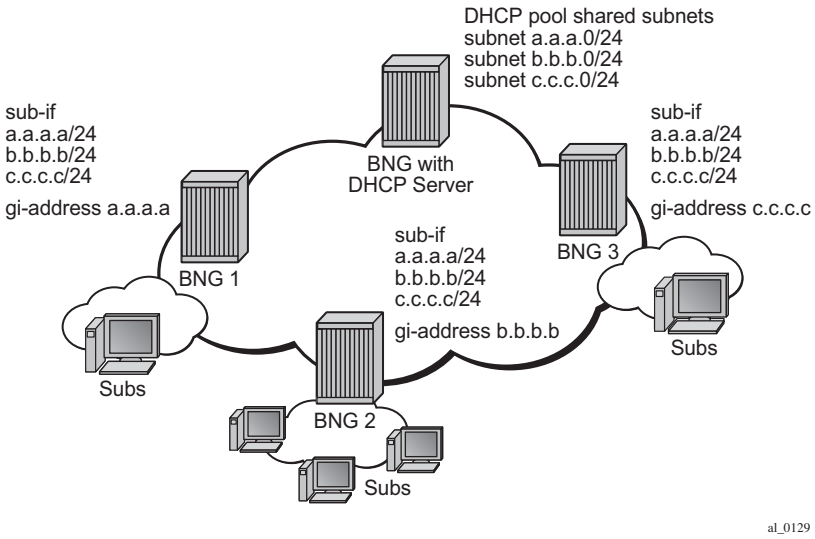


Figure 135: Subscriber Interfaces Sharing a DHCP Pool

ODSA Subnet Advertisement and Routing

To avoid advertising the same IP subnet from multiple subscriber interfaces. A combination of router aggregation and route policies are used to ensure BNGs do not advertisement overlaps subnets. If BNG1, BNG2, and BNG N are sharing a DHCP pool with subnet A,B,C,…,Z. All BNGs must first provision the same subnets on their subscriber interfaces. These subscriber interfaces must not be included in any IGP interfaces, because that will lead to multiple BNG advertising the same subnets which is undesirable. The key is to advertise a subnet only if a subscriber has successfully allocated an address from that particular subnet. Aggregate route can be used to accomplish this. First, the aggregation route will specify a smaller (more specific) subnet of the subscriber interface. For example if Subnet A is 1.1.1.1/24 then the aggregation route would be split into the next smallest subnet 1.1.1.0/25 and 1.1.1.128/25 respectively. A Route policy is then used to advertise the two /25 into IGP only if these aggregate routes become active. A subscriber that has successfully obtained an IP address from the shared pool will activate the aggregate route in the RIB. Once activated in the RIB, the route policy exports these routes by means of IGP or BGP. This in conjunction with ODSA, allows a subnet to be shared between BNGs and provides proper routing for all subscriber traffic.

ODSA with SRRP

For PPPoE SRRP setups, it is mandatory to use “string” as the subnet-binding key. For IPoE SRRP setups, “string” is preferred but not a mandatory requirement. The benefits of using “string” as a binding key are discussed later in the failover and recovery sections.

For an ODSA PPPoE SRRP setup, there are two mandatory requirements. They are:

- Configure a DHCP vendor specific string under the group interface PPPoE option.
- ODSA DHCP pools must use “string” as the subnet-binding key.

Each group interface can have its own customized string. This will result in each group-interface requesting for its own subnet. Another possibility is to share subnets among all group interfaces under a single subscriber interface. This is accomplished by using the same string on all group-interface under the single subscriber interface. A pair of SRRP group interface between two BNGs should use the same string.

For an IPoE setup, both SRRP and non SRRP, it is possible to insert a custom string via the DHCP relay (configured under the dhcp-relay option). Remember to also use “string” as the subnet-binding.

ODSA SRRP Failover DHCP Behavior

ODSA allows the option of binding a subnet to any of 3 following keys: system-id, system-id + svc-id, or string. For SRRP setups, while PPPoE only allow the use of “string”, IPoE allow the use of any of the three keys for subnet binding. Notice that first two keys both use the element “system-id” for binding. During a SRRP failover, the slave system-id takes over and the new system-id will in turn bind to new subnets. Existing subnet bounded by the old master system-id are non-accessible even if there are still free addresses available. Subscribers created before the failover still requires DHCP renews, requests, and releases of their addresses. When the DHCP server receives these, renews, requests, and releases, the gi-address and system-id might no longer match. The DHCP server will still answer these DHCP messages as long as the IP and MAC address matches the one registered on the server. This allows the subscriber to experience a seamless connection during a SRRP failover.

The other option is subnet-binding with “string” which is mandatory for ODSA PPPoE SRRP setup and optional for ODSA IPoE SRRP setup. Unlikely the system-id, the “string” is customizable and can match between two SRRP group interfaces across two different BNGs. During a failover, the subnet-binding key will remain the same. New subscribers can reuse existing subnet already bound by the group interface. No free addresses are wasted. The key requirement is that each pair of SRRP group interface must have a custom unique string.

ODSA SRRP Recovery DHCP Behavior

When SRRP is repaired, one of the nodes will become the slave. All DHCP relays will come from the SRRP master. For example, if node 1.1.1.3 becomes the slave, then all DHCP relay messages will have the gi-address of 1.1.1.2. Old subscribers that utilize 1.1.1.3 to retrieve DHCP address still require DHCP requests, renews, and releases from the DHCP pool. In the case of IPoE, DHCP server will allow old subscribers with matching IP and MAC to perform DHCP requests, renews, and releases even though the system-id does not match the previous one. This is to ensure subscribers will have uninterrupted services during a recovery.

To recover the addresses/subnets from the slave node, DHCP drain can be used to ensure that IP addresses are released back to the pool when the leases expire. Otherwise, it is best to wait for the DHCP leases to expire for subscribers to ensure that services are uninterrupted. Once expired, subscribers will route through the proper Master SRRP using the correct system-id to retrieve DHCP addresses.

In the case where the subnet-binding key is “string”, the SRRP recovery is more seamless. Although utilizing a different gi-address, DHCP relays will utilize the same “string” for all DHCP transaction. The same subnets will continue to supply, renew, and release DHCP addresses. There is no need to manually drain unused subnets because the same subnets will be used.

Logical Link Identifier (LLID)

This feature enables service providers to track subscribers on the basis of a virtual-port known as logical line ID (LLID). The LLID (an alphanumeric string) is a logical identification of a subscriber line. Mapping of physical line of a subscriber to LLID is performed via pre-authentication with a separate AAA server than the AAA server used for authenticating the subscriber session during normal access authentication.

LLID serves the purpose of abstracting the physical line of the user from the ISP. If the user moves to a new physical line, the RADIUS server database maintaining the physical line of the subscriber to LLID is updated. Because a subscriber's LLID remains same regardless of subscriber's physical location, using LLID gives service provider a stable and secure identifier for tracking subscriber.

The local user database assigned to the PPPoE node under the group interface can have both a pre-authentication policy and an authentication policy. The purpose of the pre-authentication policy is to retrieve the LLID from the AAA server. The pre-authentication will only extract the calling-station-id attribute (0x31) which is used as the LLID, anything else returned during pre-authentication are simply ignored. If the pre-authentication is missing the LLID, the session will move on to the authentication policy. In the authentication policy that follows, it is possible to use the LLID as the calling-station ID.

It is possible to convey LLID from the LAC to the LNS. The LLID is retrieved through PPPoE pre-authentication where the returned RADIUS attribute calling station ID is used as the LLID. This LLID is selectable attribute in L2TP as a calling-number (AVP 22) to be passed from LAC to LNS. At the LNS, the subscriber calling station number is retrieved from AVP 22 and can be included as an attribute during authentication.

Open Authentication Model for DHCP and PPPoE Hosts

Terminology

LUDB – Local User Database configured within 7x50

- IP Address Assignment via DHCP Relay — IP address assignment request (DHCP or IPCP) from the host is relayed to an internal or external DHCP server. Gi-address must be present in this relayed request while the pool name is optional. The internal 7x50 DHCP server may select the IP address from is local pool based on the gi-address or based on the pool-name present in the request. The IP address selection method is configuration dependent. Third party DHCP servers may consider additional fields in IP address selection process (mac address, circuit-id, etc).
- IP Address Assignment via DHCP Proxy — A preconfigured IP address in LUDB or RADIUS server is handed out to the host via a 7x50 DHCP proxy function. This proxy function responds natively using DHCP protocol to the IPoE host. Although PPPoE hosts are not utilizing DHCP protocol, the DHCP proxy functionality within 7x50 is still needed for successful IP address delegation to PPPoE hosts.

LUDB and RADIUS Access Models

During the subscriber-host instantiation phase in 7x50, various parameters for the hosts are gathered from a single or multiple sources. These parameters represent the level of service within 7x50 to which the host is entitled. Some of the parameters are mandatory for subscriber instantiation while others are optional. The following lists the parameter sources in the order of priority:

- LUDB
- RADIUS
- DHCP Server => DHCP server directly queries LUDB
- DHCP option processed on DHCP ACK that is indicated in subscriber identification policy.
- Extraction from the DHCP Ack via Python (IPv4 only)
- Defaults that are statically configured on the 7x50 node (SAP, msap-policy, capture-sap, and subscriber-identification-policy).

In most cases, the host IP address assignment process is controlled by the parameters returned via LUDB or RADIUS. As such, the IP address delegation is integral part of the host instantiation process and will consequently be described in the following sections.

No Authentication

IPoE and PPPoE v4/v6 hosts on static SAPs can be instantiated without the need to access LUDB or RADIUS server. In this case, the default subscriber host parameters (sla-profile, sub-profile, subscriber-id) must be provisioned statically under the SAP. The IP address assignment is provided by internal or external DHCP server. The IP address selection on 7x50 based DHCP server is based on the gi-address while third party DHCP servers may provide additional means to select the IP address (*mac-address*, *circuit-id*, etc.).

A DHCP pool name cannot be provided by 7x50 DHCP relay agent, since the LUDB and/or RADIUS are not utilized.

This model does not support IP address delegation via DHCP Proxy function since there is no LUDB or RADIUS server available that can supply pre-configured IP address.

Host instantiation without LUDB or RADIUS access on dynamic VLANs (capture SAP and consequently mSAP) is not supported.

LUDB Only Access

Subscriber-host authentication, identification and IP address assignment can be performed via LUDB without the need to access the RADIUS server.

The LUDB is normally configured under the group-interface>ppp/dhcp hierarchy and can provide subscriber-identification parameters as well as IP addressing parameters:

Pool names for DHCP relay function (IPv4, IPv6 IA-NA, IPv6 IA-PD)

Fixed IP addresses – IPv4, IPv6 IA-NA, IPv6 IA-PD and IPv6 SLAAC prefix.

In case of capture SAP, the LUDB name configured under the capture SAP must much the LUDB name under the group-interface>dhcp/ppp hierarchy. If the LUDB names do not mach, the subscriber-host instantiation will fail.

LUDB Access via DHCPv4 Server

In case that the IPv4 addressing assignment is facilitated by the DHCPv4 relay and an internal DHCPv4 server, the DHCPv4 server itself can query the LUDB for IPv4 address information. LUDB can provide a v4 pool name and IPv4 DHCP options to the DHCPv4 server or it can instruct it to use the gi-address as the IPv4 address selection mechanism.

ESM strings can also be provided via LUDB queried by the DHCPv4 server.

If LUDB access via DHCPv4 server is provided in addition to other authentication means (another LUDB under the group-interface, or RADIUS server), the ESM strings from the LUDB under the grp-interface or from the RADIUS server will have priority over the ESM strings configured under the LUDB accessed by the DHCPv4 server. On the other hand, the IPv4 addressing information will have the highest priority from the LUDB accessed directly by the DHCPv4 server.

Accessing LUDB directly via DHCPv4 server should be used in rare and exceptional cases.

LUDB access under the group-interface, possibly complemented by the RADIUS server will provide necessary means for subscriber-host instantiation in majority of use cases.

RADIUS Only Access

Similar to LUDB-only access, RADIUS server can provide all the necessary information for subscriber-host instantiation, including the IP addressing parameters (pool names or IP addresses/prefixes). Authentication-policy which defines the RADIUS access must be applied to the group-interface.

In case of capture SAP, the authentication policy must be applied under the capture SAP. This authentication policy name must match the authentication policy name that is configured under the group-interface. Otherwise, the host instantiation will fail.

Consecutive Access to LUDB and RADIUS

LUDB and RADIUS access can be combined during subscriber-host instantiation phase.

Configuration wise, LUDB must be referenced under the **group-interface>dhcp/ppp/pppoe** hierarchy (and possibly under the capture SAP), while the authentication-policy is specified within the LUDB. In this fashion, LUDB access is followed by RADIUS access. The subscriber-host parameters retrieved from both sources are combined with LUDB parameters being prioritized over RADIUS parameters in case that both sources return the same parameters.

In case that LUDB and authentication policy are configured simultaneously under the group-interface (and possibly under the capture SAP), the RADIUS authentication policy will be evaluated and LUDB will be ignored.

RADIUS Fallback

In case that RADIUS server is not accessible (non-responsive), the host instantiation phase can be:

Terminated in the case the there is no fallback action within authentication policy specified.

Continued within LUDB if the fallback action within the authentication-policy references LUDB.

Continued without any response from RADIUS. Subscriber-host will be instantiated if defaults parameters are statically configured or the instantiation will fail in case that the defaults are not available.

The fallback action takes effect once the preconfigured RADIUS timeout period expires.

RADIUS fallback is currently not supported for DHCPv6 hosts.

Subscriber Services

Subscriber services enable an operational model to activate and deactivate subscriber functions from RADIUS through an Access-Accept or CoA message. Using the flexible RADIUS Python script interface, the operator defines the subscriber service functionality by populating a data structure using a parameter list received in a RADIUS Vendor Specific Attribute (VSA). The format and content of the parameter list VSA is defined by the operator. Each subscriber service instance can have a dedicated RADIUS accounting session; an accounting start/stop is sent when the subscriber service is activated/deactivated. Optionally, interim updates are sent with an interim update interval that can be specified per subscriber service instance. Accounting interim update and stop messages contain the subscriber service related statistics (time or volume-and-time).

Subscriber services can be activated on a dual-stack PPPoE session or a single stack IPv4 host. Subscriber service functionality is supported for subscriber QoS overrides: changing queues or policer parameters like rate or burst sizes and adapting root arbiter or subscriber aggregate rates. For example, an operator defines a service to boost the downstream rate using the parameters ("rate-limit":downstream-rate-in-mbps). A subscriber service is activated through a subscriber service activate VSA with value “rate-limit:20” that is received for a PPPoE session. This triggers the operator-defined RADIUS Python script to populate the subscriber-service data-structure variable that changes the subscriber aggregate downstream rate to 20 Mbps. Optionally an accounting start is sent for the subscriber service. Later, when a subscriber service deactivate VSA with the same value “rate-limit:20” is received for the same PPPoE session, the original subscriber aggregate downstream rate is restored, and optionally an accounting stop sent.

Flexible Subscriber-Interface Addressing (Unnumbered Subscriber-Interfaces)

Terminology

Subscriber host — A 7x50 representation of an external host requesting a service. Each such host is fully instantiated within the 7x50 for the purpose of providing traffic control and billing services (for example, QoS, filtering, antispoofing, accounitng). The external hosts may represent variety of devices such as regular PCs, STBs, residential gateways, CPEs, VoIP devices. In most cases, the external host will run a DHCPv4/v6 or PPPoEv4/v6 client. DHCP and PPPoE initiation messages from such clients will trigger host instantiation within 7x50. For this the subscriber host term can be interchangeablye used with a term DHCP client or PPPoE client.

Flexible Subscriber-Interface Addressing for IPOE/PPPOE v4/v6 Subscribers

In certain wholesale/retail environments, the wholesale provider that own the 7x50-BNG does not know the IP addresses that the retailers will assign to their clients in advance. For this reason, wholesaler's 7x50-BNG must accept any IP address from retailers and consequently pass it to the client during subscriber-host initiation phase.

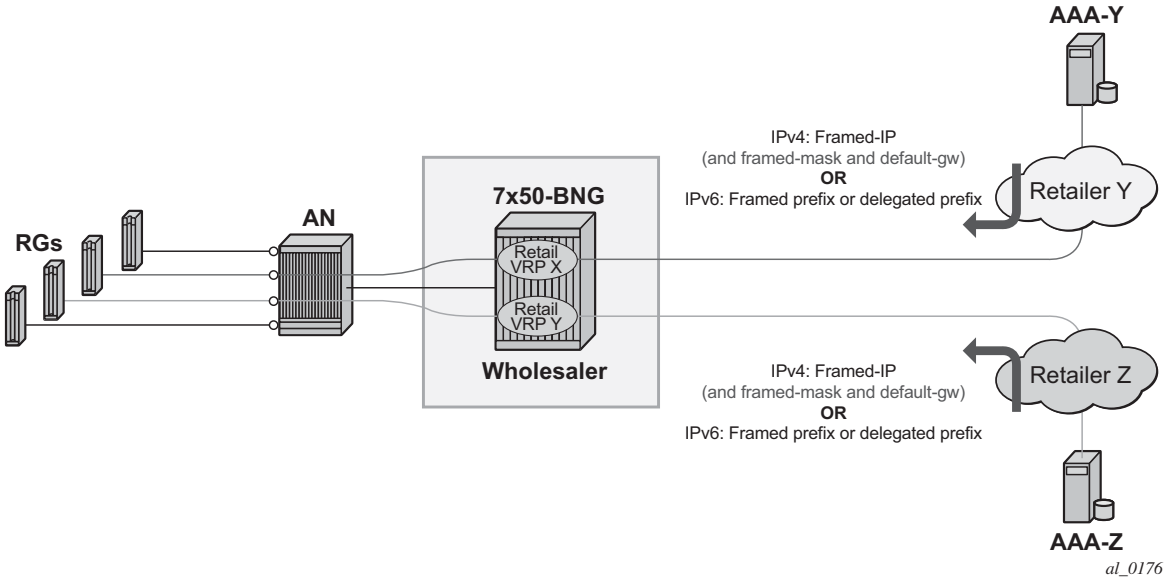


Figure 136: Use Case for Flexible IP Addressing Model

Flexible addressing of the subscriber-interface assumes two deployment scenarios:

1. Subscriber-interface is unnumbered — For example, there is no explicit assigned IP address. Instead the subscriber-interface borrows the IP address from an existing interface that is operationally UP and is located in the same routing instance (router | vprn)[2].

   In this case any IP address can be assigned to the subscriber host under the unnumbered subscriber-interface. The subscriber IPv4 address will be installed in the FIB as /32 route while IPv6 address will be installed as an entry of the length anywhere between 64 and 128 bits.

2. Subscriber-interface is numbered — The IP address/prefix is explicitly configured and solely owned by the subscriber-interface.

   In this case, all subscriber IP addresses/prefixes that fall under the subnet/prefix dictated by the configured subscriber-interface IP address/prefix will be directly aggregated under the subscriber-interface subnet. As such they will occupy a single entry in the FIB. The rest of the subscriber hosts with IP addresses/prefixes that fall outside of the configured range will be installed in the FIB as individual entries (/32 for IPv4 and an entry of the length anywhere between 64 and 128 bits for IPv6 hosts).

Default Gateway in IPv4 Flexible Addressing

In scenarios where subscriber host IPv4 address lies within the configured subscriber-interface subnet, the default-gw IPv4 address for the host will be one of the subscriber-interface IPv4 addresses. In this case, the service provider is aware of the IPv4 addressing scheme in the 7x50-BNG and as such it will supply the DHCP client with the appropriate default-gw IPv4 address via LUDB, RADIUS or DHCP Server (in that order of priority).

In scenarios where the retail service provider wants to maintain independence from the IPv4 addressing scheme deployed in the 7x50-BNG (that is controlled by wholesaler), the retailer can always supply its own IPv4 address, the subnet mask and the default-gw IPv4 address. But if the default-gw IPv4 address and/or subnet mask is not supplied by the retailer, then they will be auto-generated by 7x50-BNG. Once the default-gw IPv4 address is auto-generated, it will be sent to the requesting DHCP client via DHCP offer in option 3 (RFC 2132, Router Option, section 3.5). There is no additional configuration needed for this action. 7x50-BNG will automatically detect whether the default-gw IPv4 address is supplied via LUDB, RADIUS or DHCP server and it will act correspondingly.

The default-gw IPv4 address is auto-generated based on the assigned IPv4 address/mask by setting the last bit of the assigned host IPv4 address to binary 01 or binary 10. For example if the subscriber host's assigned IPv4 address is 10.10.10.10 255.255.255.0, then the default-gw IPv4

2. Note that an interface must have an IP address assigned in order to be operationally UP. Therefore, an unnumbered subscriber-interface must reference another existing interface that is operationally UP in the same routing instance. The subscriber-interface will borrow the IP address from the referenced interface.

address is set to 10.10.10.1. If the assigned IPv4 address is 10.10.10.1 255.255.255.0 , then the auto-generated default gateway IPv4 is set to 10.10.10.2.

The default gateway IPv4 address will always have to be within the subscriber's subnet. If it is not, the behavior might be inconsistent. For example:

1. RADIUS (or DHCP) returns IP@, mask and def-gw:
   - → IP 10.10.10.1
   - → Subnet mask 255.255.255.0
   - → Def-gw 10.10.0.254

The subscriber will be successfully instantiated in 7x50-BNG but the client may not ARP for a default-gw outside of its configured subnet. Whether the client will or will not ARP for a default-gw outside of its configured subnet will depend on the implementation in the RG and CPE.

2. RADIUS returns IP@ and subnet mask.
   - → In this case the auto-generated default-gw IPv4 address will always be within subscriber's subnet.

Flexible IPv4 addressing with auto-generated default-gw is supported only in Routed Central Office (RCO) model with routed residential gateways (RGs) or CPEs. In RCO model with bridged residential gateways or CPEs, the default-gw IPv4 addresses and the assigned IPv4 addresses may overlap. Once the IPv4 address of the default-gw is auto-generated, it is possible that the second host behind the bridged residential gateway or CPE is assigned the same IPv4 address as the IPv4 address of the default gateway of the first host. Such hosts would not be able to communicate with outside world.

For example:

RADIUS or DHCP server assigns IPv4 address and subnet mask to the first host in a bridged environment:

IP1: 10.10.10.1

Auto-generated default-gw IPv4 address: 10.10.10.2

Since the RADIUS and DHCP Server are not aware of the auto-generated default-gw, they may assign the following IPv4 address to the second host that comes on-line:

IP 2: 10.10.10.2 (same IPv4 address as the default-gw IPv4 address of the first host)

Auto-generated default-gw IPv4 address: 10.10.10.1

Now the first host will forward all traffic outside of the configured subnet to the second hosts which will discard this traffic, effectively rendering this operation model non-deployable. And vice versa.

IPv4 Subnet Sharing

Subnet sharing between the hosts in flexible IPv4 addressing model is supported. In other words, in flexible IPv4 addressing model the operator can assign all IPv4 addresses (minus one – the default-we IPv4 address) from a given subnet. In this fashion, all subscribers (routed RGs or CPEs) within a single subnet can share the same default gateway.

For example if the operator owns the IPv4 subnet 10.10.10.0/24, then one IPv4 address can be set aside for the default-gw (for example 10.10.10.254) and the remaining addresses can be assigned to the subscriber (routed RGs or CPEs). An example would be:

RG1: IP=10.10.10.1/24 def-gw 10.10.10.254

RG2: IP=10.10.10.2/24 def-gw 10.10.10.254

RG3: IP=10.10.10.3/24 def-gw 10.10.10.254

:

RG100: IP=10.10.10.100/24 def-gw 10.10.10.254

The subnet sharing is also supported in conjunction with auto-generated default-gw IPv4 address. The implication of this is that the IPv4 address of the default-gw can collide with the same IPv4 address already assigned to an existing subscriber. This is not an issue for routed RGs or CPEs since 7x50-BNG will always answers ARPs for the IPv4 address of the default-gw with its own (7x50) MAC address. However, local-proxy ARP functionality in 7x50-BNG MUST be enabled to support this.

This behavior can be further clarified with the following example.

Let's assume that we have scenario with two routed RGs:

RG-1, IP=10.10.10.0/24, default-gw IP=10.10.10.1

RG-2, IP=10.10.10.1/24, default-gw IP=10.10.10.0

Once RG-1 ARPs for its default gateway of 10.10.10.1, 7x50-BNG will reply with its own MAC address.

Now that host RG-1 has resolved ARP for it default-gw (mac address pointing to 7x50), it can send traffic to the outside world via 7x50-BNG. When such traffic arrives to 7x50, the destination IPv4 address of the received packet will determine the forwarding decision within 7x50. If the destination IPv4 address matches the IPv4 address of any subscriber (RG) instantiated within 7x50, the traffic will be forwarded to the that RG. This also includes the case where the destination IPv4 address is the default-gw IPv4 address (10.10.10.1), which represents just another RG within 7x50. The traffic will be consequently passed from RG-1 via 7x50 to RG-2.

IPv4 Subnet Mask Auto-Generation

The subnet mask corresponding to the IPv4 address assigned to the subscriber is auto-generated in case that the IPv4 addressing authority (LUDB, RADIUS or DHCP Server) does not supply it. The subnet mask is derived from the IPv4 address of the subscriber and possibly the default-gw IPv4 address and it is the smallest subnet that contains both, the IPv4 address of the subscriber and the default-gw.

For example if the RADIUS received IPv4 address is 10.10.10.138 and the received default –gw IPv4 address is 10.10.10.170 , then the subnet mask will be auto-generated and set to 255.255.255.192 (/26).

138 = 10001010

170 = 10101010

192 = 11000000

In case that neither the subnet mask nor the default-gw are returned, then both would be auto-generated:

1. Subnet mask would be set to /31
2. Default-gateway which must belong to the subscriber’s subnet would be set to 10.10.10.139.

In cases where the host IPv4 address and the default-gw are directly supplied by the addressing authority but the subnet mask is missing, the subnet mask auto-generation may cause the host part of the default-gw IPv4 address to become a broadcast IPv4 address. If this is an issue, then it can be avoided by directly providing the subnet mask via the addressing authority.

Local-proxy-arp and arp-populate

Local-proxy-arp and arp-populate are two commands that are relevant only to IPoEv4 hosts.

Local-proxy-arp command ensures that 7x50 answers ARP Requests with its own MAC address for any ‘active’ IPv4 address under the subnet on which the ARP request arrived. The ‘active’ IPv4 address is considered the one that is assigned to an already instantiated hosts or the default-gw (even auto-generated).

In absence of local-proxy-arp command, the only ARP Request that 7x50 will answer is the one for the statically configured IPv4 addresses of the subscriber-interface. In flexible IPv4 addressing, the IPv4 address of the default-gw does not necessarily match any of the configured subscriber-interface IPv4 addresses. The ARP Request for such default-gw IPv4 address would go unanswered. Consequently, the subscriber hosts would not be able to communicate with outside world. Therefore, the flexible IPv4 addressing requires that the local-proxy-arp command is configured.

Arp-populate command disables dynamic learning of ARP entries (IPv4<->MAC mapping) on an interface based on the ARP protocol. In this case, the ARP table is populated based on the DHCPv4 lease state table which contains IPv4<->MAC mappings obtained via DHCP processing during the host instantiation phase. Arp-populate functionality is highly desirable in case of flexible IPv4 addressing.

When arp-populate command is disabled the ARP entries are dynamically learned based on the ARP protocol. This, in conjunction with flexible IPv4 addressing may cause certain issues. Consider the following example:

- The subscriber-host is instantiated in 7x50
- The subscriber-interface is unnumbered
- The ARP table does not contain an ARP entry for the subscriber-host

In this case, downstream traffic towards the subscriber host will trigger 7x50 to send ARP Request for the subscriber host IPv4 address. 7x50 needs to know the MAC address of the subscriber-host in order to forward traffic. Since the subscriber-interface is unnumbered , the source IPv4 address of the ARP request is unknown and consequently the ARP Request will not be sent. As a result, downstream traffic will be dropped.

Note however that the above example is an unlikely scenario. If the subscriber host sends the ARP Request for the default-gw first, 7x50 would create an entry in the ARP table for it and the issue would be resolved. This is the most likely outcome since the subscriber host will always try to initiate communication with the outside and therefor ARP for the IPv4 address of the default-gw (which is 7x50).

Gi-address Configuration Consideration

With flexible IPv4 address assignment, the gi-address can be configured as any IPv4 address that is already assigned to an interface (loopback interface, regular interface attached to physical port or subscriber interface) within the same routing instance (VRF or GRT).

PPPoE Considerations

PPPoE subscriber hosts do not have the concept of default-gw. Consequently the default-gw auto-generation concept does not apply to PPPoE hosts.

IPoEv6 Considerations

The default-gw for IPoEv6 hosts is link-local IPv6 address. Since this address is always present, there is no need for auto-generation during the subscriber instantiation time.

SLAAC hosts are installed as /64 entries, the length of the installed DHCP-PD prefix is dictated by the prefix-length and the DHCP-NA hosts are installed as /128 entries.

General Configuration Guidelines for Flexible IP Address Assignment

Flexible IP addressing for IPoE/PPPoE v4 and v6 hosts is by default disabled. In other words, the subscriber hosts will be instantiated in 7x50-BNG with ability to forward traffic only if their assigned IP addresses belong to one of the configured subnets/prefixes that are associated with the subscriber-interfaces. IPv4 and IPv6 cases will be examined separately:

IPv4:

By default, IPoE and PPPo subscriber host creation will fail in the following two cases:

1. The subscriber-interface does not have an IPv4 address configured, and therefore it will be operationally down. This configuration is also known as unnumbered subscriber-interface.
2. The subscriber-interface does have an IPv4 address configured but the IPv4 address assigned to the subscriber host itself is outside of the subscriber-interface configured subnet(s). In such case the host will be instantiated but the forwarding will be disabled.

Subscriber host instantiation and forwarding can be explicitly enabled for both cases above with flexible IP addressing functionality.

For case 1, this can be achieved by borrowing an IP address for the subscriber-interface from any interface that is operationally up within the given routing context. This functionality can be enabled with the following command:

```
configure service ies <id>
configure service vprn <id>
subscriber-interface <intf-name>
     unnumbered <ip-addr | interface-name >
```

To enable forwarding for the subscribers whose IP address falls outside of the configured subnet under the subscriber-interface (case 2), the following command must be entered:

```
configure service ies <id>
configure service vprn <id>
subscriber-interface <intf-name>
     allow-unmatching-subnets
```

The above commands (**unnumbered** and **allow-unmatching-subnets**) are mutually exclusive. In addition, the unnumbered command can be configured only if the subscriber-interface does not have an IP address already configured. Otherwise the execution of this command will fail.

In both of these cases the host will be installed in the routing table as /32.

IPv6:

For IPv6 there is a single command that will enable flexible IP addressing for both cases:

1. IPv6 prefixes are not configured under the **subscriber-interface>ipv6** node
2. IPv6 prefixes are configured but the actual address or prefix assigned to the subscriber (via DHCP, LUDB or RADIUS) is outside any prefix that is configured under the **subscriber-interface>ipv6** hierarchy.

This single command is:

```
configure service ies <id>
configure service vprn <id>
         subscriber-interface <name>
              ipv6
                   allow-unmatching-prefixes
```

To summarize, the following scenarios are possible:

- PPPoEv4
  - → An IPv4 address under the subscriber-interface is configured
    - By default hosts outside of the sub-intf subnet are instantiated but they are in a non-forwarding-state. Traffic is dropped.
    - **allow-unmatching-subnets** is configured. This command is allowed only if subscriber-interface has also configured its own IPv4 address(es). In this case the IP address for IPCP negotiation is one of the sub-intf addresses. Hosts outside of the sub-intf subnets are instantiated and forwarded.

  - The **unnumbered** <*ip-address* | *intf*> command is not allowed in this scenario.

→ An IPv4 address under the subscriber-interface is not configured

  - By default, the subscriber-interface is operationally down. Subscribers cannot be instantiated.
  - The **allow-unmatching-subnets** command has no effect since subscriber-interface does not have an IPv4 address configured and is therefore operationally down. No subscribers can be instantiated.
  - The **unnumbered** <*ip-address* | *intf*> command is the only viable option in this case. The subscriber-interface borrows an IPv4 address from another interface that is operationally UP and consequently this allows subscribers to be instantiated. This command is mutually exclusive with **allow-unmatching-subnets**. In addition, this command can only be configured if the subscriber-interface itself does not have explicitly configured an IPv4 address.

- IPoEv4

  Similar to the PPPoE case above.

- IPoEv6 and PPPoEv6 — the **allow-unmatching-prefixes** command is independent of any IPv4 command related to flexible IP address assignment (**unnumbered** or **allow-unmatching-subnets**). This command can always be enabled, regardless of the v6 prefixes configured under the **subscriber-interface>ipv6** hierarchy. Any subscriber, regardless of the subscriber-interface prefix configuration will be instantiated and forwarded.

Caveats

- Auto-generation of the default-gw IPv4 address is supported only in RCO model with routed RGs/CPEs. Bridged RGs/CPEs are not supported.
- A configured IPv4 address cannot be removed from the subscriber-interface when DHCPv4 hosts under the corresponding subnet are instantiated in the system.
- An IPv4 address cannot be configured under the subscriber-interface while (unnumbered) DHCPv4 hosts under that subnet are already instantiated.
- Executing the **no allow-unmatching-subnets** command is only allowed when there are no unnumbered DHCPv4 hosts instantiated under the subscriber-interface.

uRPF for Subscriber Management

uRPF is supported for IPv4 and IPv6 dual-stack subscribers with framed routes.

For IPv4, uRPF is supported on group interfaces using anti-spoofing filters. A group interface configured for NATed subscribers will be configured with MAC/IP/PPPoE Session-ID anti-spoofing filters.

IPv6 subscribers, which are non-NAT, are always treated as being on a local subnet. For such subscribers, a 7x50 BNG will install a FIB entry for local routes that match either the wan-host prefix, or the delegated prefix, or both. In strict mode for IPv6 ESM, the uRPF check will check not just that the route matching the SA (which should be a local route, i.e. a subnet) would route the packet back out of the interface it came in on, but in addition that we would route the packet out to the same SAP it was received on.

SROS supports the ability to configure a NH-MAC anti-spoof type for non-NATed subscribers. When configured, the datapath performs ingress anti-spoofing based on source MAC address and egress anti-spoof (also referred to as egress subscriber-host look-up) based on the nh-ip address.

The NH-MAC anti-spoof type is configured under the following context:

config>service>vprn>if>sap

config>service>ies>sub-if>grp-if>sap

config>service>vprn>sub-if>grp-if>sap

config>subscr-mgmt>msap-policy

A uRPF check is also performed that prefixes delegated to a subscriber on that MAC address exist in the FIB.

IPoE Sessions

The IP stacks of dual stack IPoE devices are set up and configured independently using different protocols such as DHCPv4, DHCPv6 or SLAAC. As opposed to PPPoE, there is no single protocol that binds the IP stacks from a single end device together.

To facilitate subscriber management of dual stack IPoE devices as a single entity similar as for PPPoE sessions instead of handling individual IPoE subscriber hosts, there is a need for a logical IPoE session construct. An IPoE session enables single authentication, session accounting and policy management (mid-session changes) for dual stack IPoE devices.

An IPoE session is a logical grouping of IPoEv4 and IPoEv6 subscriber hosts that represent the different IP stacks of a single end device and that share authentication data such as subscriber id, subscriber and SLA profile, session-timeout, etc. The grouping of subscriber hosts in an IPoE session is based on a configurable session key per group-interface. The IPoE session key includes by default the SAP identifier and MAC address and can be extended with Circuit-Id/Interface-Id or Remote-Id. For DHCPv6 Remote-Id, the enterprise number is excluded from the session-key. Circuit-id/Interface-Id or Remote-id should only be used in the IPoE session key if all subscriber host associated with the IPoE session have this field in their protocol trigger packets. The IPoE session creation or subscriber host association to an IPoE session fails if the Circuit-Id/Interface-Id or Remote-id is not present in a trigger packet while the field is part of the session-key.

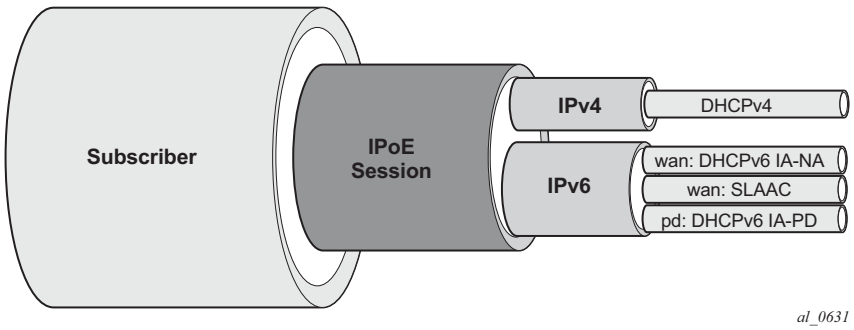


Figure 137: IPoE Session

An IPoE session represents a single end device and can have following associated IP stacks:

- IPv4 — A single DHCPv4 host.
- IPv6 WAN — One DHCPv6 IA-NA host and/or one SLAAC host.
- IPv6 PD — One DHCPv6 IA-PD host or PD as managed route.

A violation of the above rules will result in a setup failure of the subscriber host when an attempt is made to associate it to the IPoE session.

Enabling IPoE Sessions

IPoE sessions are supported in a Routed CO environment with Enhanced Subscriber Management (ESM) enabled. To enable the IPoE session instantiation, the **ipoe-session** CLI context on the capture SAP (managed SAP scenario) and/or group-interface must be configured to no shutdown. See also the configuration steps below.

IPoE sessions cannot be enabled on a group-interface with active subscriber hosts.

Disabling IPoE sessions by executing an **ipoe-session no shutdown** or **no ipoe-session** CLI command on a group-interface will delete all active sessions and associated hosts on that group-interface, resulting in service impact for these subscribers.

IPoE Session Authentication

A single authentication is performed for all subscriber hosts that belong to the same IPoE session. The table below lists the packets that trigger an IPoE session authentication.

Table 21: IPoE Session Authentication Trigger Packets

IP stack	Trigger packets
IPv4	DHCPv4 Discover
	DHCPv4 Request
IPv6 WAN	DHCPv6 Solicit
	DHCPv6 Request
	DHCPv6 Relay Forward (Solicit)
	DHCPv6 Relay Request (Solicit)
	Router Solicitation
IPv6 PD	DHCPv6 Solicit
	DHCPv6 Request
	DHCPv6 Relay Forward (Solicit)
	DHCPv6 Relay Request (Solicit)

When a trigger packet is received on a capture SAP or group-interface with IPoE sessions enabled, an IPoE session lookup is performed based on the configured IPoE session key:

- If no IPoE session is found, a new session is created and authenticated following the ESM authentication configuration such as local user database lookup, Radius or Diameter authentication, defaults, and such. After successful authentication, the authentication data is stored in the IPoE session state. The subscriber host is created and associated with the session.
- If an IPoE session already exists, and no re-authentication must be performed then the subscriber host is created using the stored IPoE session data. The subscriber host is associated with the session.
- If an IPoE session already exists, and re-authentication must be performed then the session is re-authenticated. When successful, the authentication data for the IPoE session is updated and applied to all associated hosts. The subscriber host is created and associated with the session. When unsuccessful, existing hosts associated with the session are not impacted and the session data is kept unchanged.

Re-authentication is by default disabled for IPoE sessions. To enable re-authentication, a minimum authentication interval must be configured. The min-auth-interval CLI parameter configures the maximum frequency of re-authentications by specifying a minimum interval between two non-forced authentications for the same IPoE session. A re-authentication is triggered by the renewal of any host belonging to the IPoE session. Setting the min-auth-interval to zero seconds, will always re-authenticate on each trigger packet. The re-authentication CLI knob in a Radius authentication policy is ignored for IPoE session authentication.

A forced authentication is performed when the Circuit-Id/Interface-Id or Remote-Id in the trigger packet has changed. An empty or absent Circuit-Id/Interface-Id or Remote-Id is not considered as a change. The default forced authentication behavior is changed with the force-auth CLI command in the group-interface ipoe-session context: only force authenticate on Circuit-Id/Interface-Id change or only force authenticate on Remote-Id change or disable forced authentications.

A new local user database config in the ipoe-session CLI context on a capture SAP or group interface ensures that all subscriber hosts associated with an IPoE session are using the same database and therefore common match criteria. The per subscriber host type user-db configs, such as **ipv6 dhcp6 user-db**, **dhcp user-db** and **rtr-solicit-user-db** are ignored when IPoE sessions are enabled.

IPoE Session Accounting

All Radius accounting modes can be enabled for IPoE sessions: queue instance accounting, host accounting or session accounting.

With session accounting, a Radius accounting start is generated when the first host of the session is created and an accounting stop when the last host of the session is deleted. The generation and

interval of periodic interim updates can be configured. Optionally, triggered interim update messages can be generated when a host is deleted from the session or an additional host is associated.

A unique accounting session id is generated for the IPoE session and is used in RADIUS session accounting. The IPoE session accounting session id can be included in the Radius Access Request message via CLI **config>subscr-mgmt>auth-plcy# include-radius-attribute acct-session-id session.**

This accounting session ID can also be used in RADIUS CoA or Disconnect Messages to target the IPoE session.

IPoE Session Mid-Session Changes

Mid-session changes such as those initiated via RADIUS CoA or Diameter Gx RAR are applied to all hosts associated with the IPoE session.

A RADIUS CoA message targeting any host of an IPoE session has the same effect as a Radius CoA message targeting the IPoE session using the IPoE session Acct-Session-Id as key: all host of the session are targeted and the session state is updated with the new data.

The following tools commands are available to manually enforce a mid-session change:

```
# tools perform subscriber-mgmt edit-ipoe-session sap <sap-id> mac <mac-address> [sub-
scriber <sub-ident-string>] [sub-profile-string <sub-profile-string>] [sla-profile-string
<sla-profile-string>] [inter-dest-id <intermediate-destination-id>] [ancp-string <ancp-
string>] [app-profile-string <app-profile-string>] [circuit-id <circuit-id>] [remote-id
<remote-id>]

# tools perform subscriber-mgmt eval-ipoe-session [svc-id <service-id>] [sap <sap-id>]
[mac <mac-address>] [circuit-id <circuit-id>] [remote-id <remote-id>] [subscriber <sub-
ident-string>]
```

IPoE Session Termination

When the last subscriber host associated with an IPoE session is deleted from the system, then the IPoE session is also deleted.

An IPoE session and all associated subscriber hosts can be deleted via

- CLI clear command: **clear service id <service-id> ipoe session**
- An **ipoe-session no shutdown** CLI command on a group-interface
- A **no ipoe-session** CLI command on a group-interface. This command resets to the default behavior, which is IPoE sessions disabled.
- Session timeout, configured in the IPoE session policy or obtained from AAA
- Idle timeout

- RADIUS Disconnect Message
- Diameter Gx session termination
- Credit Control: Radius or Diameter Gy

Limiting the Number of IPoE sessions

The number of IPoE sessions per SAP is limited with the **sap-session-limit** CLI command configured in the **group interface ipoe-session** context.

The number of IPoE sessions per group interface or retail subscriber interface is limited with the **session-limit** CLI command configured in the group interface ipoe-session or retail subscriber interface ipoe-session context.

Hosts associated with IPoE sessions are subject to the SLA Profile Instance limits configured in the **sla profile >config>subscr-mgmt>sla-prof>host-limits>** CLI context.

SAP Session Index

The system will keep track of the number of IPoE sessions active on a given SAP and assign a per SAP session index to each such that always the lowest free index is assigned to the next active IPoE session. When RADIUS authentication is used, the SAP session index can be sent to, and received from, the RADIUS server using the [26-6527-180] Alc-SAP-Session-Index attribute.

It should only be used in a subscriber per VLAN model as the session index is per SAP.

The intended use of the SAP session index is to provide the ability for IPoE sessions in a bridged RG environment to have their own set of queues (for QoS and accounting purposes) when using the same SLA profile name received from a RADIUS server. See section Subscriber per PPPoE Session Index on page 586 for details.

Resiliency

For non-redundant BNG deployments, the IPoE session state is stored in the subscriber-mgmt persistency file for recovery from Compact Flash after a node maintenance operation or failure. This is configured at the system persistence CLI context.

For multi chassis redundancy scenarios, the IPoE session state is synchronized via the “sub-mgmt ipoe” Multi Chassis Synchronization (MCS) application.

Notes:

- Static hosts can be configured on a group-interface with IPoE sessions enabled. A static host will not be associated with an IPoE session.
- Up to sixteen Framed-Routes and sixteen Framed-IPv6-Routes can be associated with an IPoE session.

- A fall back action (accept or local user database lookup) when no Radius servers are available for Radius authentication can be specified for IPoE sessions.
- Lawful Intercept sources initiated from Radius always include all IP stacks from the IPoE session regardless the targeted host in the CoA message.
- ARP hosts are not supported in an IPoE session and cannot be instantiated on a group-interface with IPoE sessions enabled.
- The creation of an IPv4 host using the Alc-Create-Host attribute in a Radius CoA message is not supported on a group-interface with IPoE session enabled.
- A local user database host identification based on option60 is ignored when authenticating an IPoE session.
- Radius authentication of an IPoE session fails when the user-name-format is configured to dhcp-client-vendor-options, mac-giaddr or ppp-user-name
- The alc.dtc.setESM() API in the DHCP Transaction Cache (DTC) Python module cannot be used in combination with IPoE sessions.
- The DHCP Python module (alc.dhcp) used to derive subscriber host attributes from a DHCPv4 ACK message is not supported in combination with IPoE sessions.
- A Radius CoA message containing an Alc-Force-Nak or Alc-Force-Renew attribute is not supported for IPoE sessions
- Subscriber Host Connectivity Verification (SHCV) will continue to work on a per-stack basis. In other words, in a dual stack scenario with SHCV action remove enabled for both stacks, a failure in IPv4 connectivity will not clean up the session unless the IPv4 subscriber host was the last associated host.

Configuration steps

To create an IPoE session policy:

```
configure
    subscriber-mgmt
        ipoe-session-policy "ipoe-policy-1" create
            description "Default IPoE session policy"
            session-key sap mac            # default
            no session-timeout             # default
        exit
```

Enable IPoE sessions on the capture SAP and/or group interface.

If IPoE sessions is enabled on a capture-sap, then it must also be enabled on the target group-interface. If an IPoE session local user database lookup is configured at the capture-sap, then the same local user database lookup must be configured at the target group-interface.

```
configure
    service

        vpls 10 customer 1 create
            ---snip---
            sap 1/1/4:*.* capture-sap create
                ---snip---
                ipoe-session
                    description "IPoE sessions - capture-sap"
                    ipoe-session-policy "ipoe-policy-1"
                    user-db "ludb-1"
                    no shutdown
                exit

        ies 1000 customer 1 create
            subscriber-interface "sub-int-1" create
                ---snip---
                group-interface "group-int-1-1" create
                    ---snip---
                    ipoe-session
                        description "IPoE sessions - IES group-interface"
                        force-auth cid-change rid-change       # default
                        ipoe-session-policy "ipoe-policy-1"
                        min-auth-interval infinite             # default
                        sap-session-limit 1                    # default
                        session-limit 1000
                        user-db "ludb-1"
                        no shutdown
                    exit
```

To display the IPoE session state, use following command:

```
# show service id <service-id> ipoe session [detail]
```

Configuring Enhanced Subscriber Management with CLI

This section provides information to configure subscriber management features using the command line interface. It is assumed that the reader is familiar with VPLS and IES services.

Topics in this section include:

Configuring RADIUS Authentication of DHCP Sessions

When RADIUS authentication for subscriber sessions is enabled, DHCP messages from subscribers are temporarily held by the BSA, while the user's credentials are checked on a RADIUS server.

Configuring RADIUS authentication for subscriber sessions is done in two steps:

- First define an authentication-policy in the **config>subscriber-mgmt>authentication-policy** context.
- Then apply the policy to one or more SAPs in the **config>service>vpls>sap>authentication-policy** ***auth-plcy-name*** context (for a VPLS service).

  Or apply the policy to one or more interfaces **config>service>ies>if>authentication-policy** ***auth-plcy-name*** context (for an IES service):

The following example displays a partial BSA configuration with RADIUS authentication:

```
A:ALA-1>config>service# info
----------------------------------------------
subscriber-management
     authentication-policy BSA_RADIUS create
          description "RADIUS policy for DHCP users Authentication"
          password "mysecretpassword"
          radius-authentication-server
               server 1 address 10.100.1.1 secret "radiuskey"
               retry 3
               timeout 10
          exit
          re-authentication
          user-name-format circuit-id
     exit
exit
...
vpls 800 customer 6001
     description "VPLS with RADIUS authentication"
     sap 2/1/4:100 split-horizon-group DSL-group create
          authentication-policy BSA_RADIUS
     exit
     sap 3/1/4:200 split-horizon-group DSL-group create
          authentication-policy BSA_RADIUS
     exit
     no shutdown
exit
...
----------------------------------------------
A:ALA-1>config>service#
```

Configuring Enhanced Subscriber Management

Basic Configurations

Configuring and applying the Enhanced Subscriber Management profiles and policies are optional. There are no default Profiles or policies.

The basic Enhanced Subscriber Management profiles and policies must conform to the following:

- Unique profile or policy names (IDs)
- Profiles and/or policies must be associated with a VPLS or IES service to facilitate Enhanced Subscriber Management.
- QoS and IP filter entries configured in Enhanced Subscriber Management profiles and policies override the defaults and/or modified parameters or the default policies.
- The Enhanced Subscriber Management profiles and policies must be configured within the context of VPLS or IES.

Subscriber Interface Configuration

The following output displays a basic subscriber interface configuration.

```
*A:ALA-48>config>service>ies>sub-if# info
----------------------------------------------
                description "Routed CO - Antwerp 2018"
                address 192.168.2.254/24
                address 192.168.3.254/24
                address 192.168.4.254/24
                address 192.168.5.254/24
                address 192.168.6.254/24
                group-interface "DSLAM_01" create
                    description "Routed CO - vlan / subscriber"
                    sap 1/1/2:1001 create
                        static-host ip 192.168.2.2 create
                        exit
                    sap 1/1/2:1002 create
                        static-host ip 192.168.2.2 create
                        exit
                    sap 1/1/2:1004 create
                        static-host ip 192.168.2.4 create
                        exit
                    sap 1/1/2:1100 create
                        static-host ip 192.168.2.100 create
                        exit
                    exit
                exit
----------------------------------------------
*A:ALA-48>config>service>ies>sub-if#
```

Configuring Enhanced Subscriber Management Entities

Configuring a Subscriber Identification Policy

The following displays an example of a subscriber identification policy configuration:

```
A:ALA-48>config>subscr-mgmt# info
----------------------------------------------
...
        sub-ident-policy "Globocom" create
            description "Subscriber Identification Policy Id Globocom"
            sub-profile-map
                entry key "1/1/2" sub-profile "ADSL Business"
            exit
            sla-profile-map
                entry key "1/1/2" sla-profile "BE-Video"
            exit
            primary
                script-url "primaryscript.py"
                no shutdown
            exit
            secondary
                script-url "secundaryscript.py"
            exit
            tertiary
                script-url "tertiaryscript.py"
                no shutdown
            exit
        exit
...
----------------------------------------------
A:ALA-48>config>subscr-mgmt#
```

Configuring a Subscriber Profile

Enhanced Subscriber Management subscriber profile configurations specify existing QoS scheduler profiles. In the following example, “BE-Video-max100M” is specified in the sub-profile “ADSL Business” for the ingress-scheduler-policy. “Upload” is specified in the sub-profile egress-scheduler-policy.

```
#--------------------------------------------------
echo "QoS Policy Configuration"
#--------------------------------------------------
    qos
        scheduler-policy "BE-Video-max100M" create
            description "Scheduler Policy Id BE-Video-max100M"
            tier 1
                scheduler "tier1" create
                    description "Scheduler Policy Id BE-Video-max100M Tier 1 tier1"
                exit
            exit
        exit
        scheduler-policy "Upload" create
            description "Scheduler Policy Id Upload"
            tier 3
                scheduler "tier3" create
                    description "Scheduler Policy Id Upload Tier 3 tier3"
                exit
            exit
        exit
        sap-ingress 2 create
            description "Description for Sap-Ingress Policy id # 2"
            queue 1 create
              parent "tier1"
            exit
            queue 11 multipoint create
              parent "tier1"
            exit
        exit
        sap-egress 3 create
            description "Description for Sap-Egress Policy id # 3"
            queue 1 create
              parent "tier3"
            exit
        exit
    exit
#----------------------
```

The following displays an example of a subscriber identification policy configuration:

```
A:ALA-48>config>subscr-mgmt# info
----------------------------------------------
...
        sub-profile "ADSL Business" create
            description "Subscriber Profile Id ADSL Business"
            ingress-scheduler-policy "BE-Video-max100M"
                scheduler "tier1" rate 99
            exit
            egress-scheduler-policy "Upload"
                scheduler "tier3" rate 1 cir 1
            exit
            sla-profile-map
                entry key "1/1/3" sla-profile "BE-Video"
            exit
        exit
----------------------------------------------
A:ALA-48>config>subscr-mgmt#
```

Configuring an SLA Profile

The following displays an example of a SLA Profile configuration:

```
A:ALA-48>config>subscr-mgmt# info
----------------------------------------------
    subscriber-mgmt
        sla-profile "BE-Video" create
            description "SLA Profile Id BE-Video"
            ingress
                qos 2
                    queue 1
                    exit
                exit
            exit
            egress
                qos 3
                    queue 1
                    exit
                exit
            exit
        exit
----------------------------------------------
A:ALA-48>config>subscr-mgmt#
```

Configuring Explicit Mapping Entries

The following displays an example of a explicit subscriber mapping:

```
A:ALA-7>config>subscr-mgmt# info
------------------------------------------------
A:ALA-48>config>subscr-mgmt# info
----------------------------------------------
...
        explicit-subscriber-map
            entry key "1/1/1:1111" sub-profile "ADSL GO" alias "Sub-Ident-1/1/1:
1111" sla-profile "BE-Video"
        exit
...
----------------------------------------------
A:A:ALA-48>config>subscr-mgmt#
```

Routed CO with Basic Subscriber Management Features

The following displays the output of an IES service configured with and without enhanced subscriber management.

```
A:term17>config>service>ies# inf
------------------------------------------------
            subscriber-interface "s2" create
                address 11.20.1.1/16
                dhcp
                    gi-address 11.20.1.1
                exit
                group-interface "g3" create
                    description "With Enhanced Subscriber Mgmt"
                    arp-populate
                    dhcp
                        server 12.1.1.1
                        trusted
                        lease-populate 8000
                        no shutdown
                    exit
                    sap lag-1:11 create
                        sub-sla-mgmt
                            def-sub-profile "subProf"
                            def-sla-profile "slaProf"
                            sub-ident-policy "foo"
                            multi-sub-sap
                            no shutdown
                        exit
                     host ip 11.20.1.10 mac 00:00:aa:aa:aa:dd subscriber "One" sub-profile
"subProf" sla-profile "slaProf"
                    exit
                exit
            exit
            subscriber-interface "s3" create
                address 11.39.1.1/16
                dhcp
                    gi-address 11.39.1.1
                exit
                group-interface "g5" create
                    description "Without Enhanced Subscriber Mgmt"
                    arp-populate
                    dhcp
                        server 12.1.1.1
                        trusted
                        lease-populate 8000
                        no shutdown
                    exit
                    sap 4/1/1:24.4094 create
                    exit
                exit
            exit
            no shutdown
------------------------------------------------
A:term17>config>service>ies#
```

Applying the Profiles and Policies

NOTE: Subscriber interfaces operate only with basic (or enhanced) subscriber management. At the very least, a host, either statically configured or dynamically learned by DHCP must be present in order for the interface to be useful.

Apply the Enhanced Subscriber Management profiles and policies to the following entities:

- SLA Profile on page 1291
- Subscriber Identification Policy on page 1295
- Subscriber Profile on page 1295

SLA Profile

CLI Syntax:

```
configure>service>ies service-id
    interface ip-int-name
       sap sap-id
          host {[ip ip-address] [mac ieee-address} [subscriber
            sub-ident-string] [sub-profile sub-profile-name]
            [sla-profile sla-profile-name]
          sub-sla-mgmt
             def-sla-profile default-sla-profile-name
             single-sub-parameters
                non-sub-traffic sub-profile sub-profile-name
                   sla-profile sla-profile-name [subscriber sub-
                   ident-string]
    subscriber-interface ip-int-name
          group-interface ip-int-name
             sap sap-id
                host ip ip-address [mac ieee-address] [subscriber
                   sub-ident-string] [sub-profile sub-profile-
                   name] [sla-profile sla-profile-name]
                sub-sla-mgmt
                   def-sla-profile default-sla-profile-name
                   single-sub-parameters
                      non-sub-traffic sub-profile sub-profile-
                      name sla-profile sla-profile-name [sub-
                      scriber sub-ident-string]
```

CLI Syntax:
```
configure>service>vpls service-id
 sap sap-id
    host {[ip ip-address] [mac ieee-address]} [subscriber sub-
       ident-string] [sub-profile sub-profile-name] [sla-pro-
       file sla-profile-name]
    sub-sla-mgmt
       def-sla-profile default-sla-profile-name
       single-sub-parameters
          non-sub-traffic sub-profile sub-profile-name sla-
          profile sla-profile-name [subscriber sub-ident-
          string]
```

CLI Syntax:
```
configure>service>vprn service-id
 interface ip-int-name
    sap sap-id
       host {[ip ip-address] [mac ieee-address]} [subscriber
         sub-ident-string] [sub-profile sub-profile-name]
         [sla-profile sla-profile-name]
```

CLI Syntax:
```
configure>subscriber-mgmt
 explicit-subscriber-map
    entry key sub-ident-string [sub-profile sub-profile-name]
       [alias sub-alias-string] [sla-profile sla-profile-
       name]
 sub-ident-policy sub-ident-policy-name
    sla-profile-map
       entry key sla-profile-string sla-profile sla-profile-
         name
 sub-profile sla-profile-map
    sla-profile-map
       entry key sla-profile-string sla-profile sla-profile
```

Configuring Dual Homing

The following displays an example of a dual homing configuration. The configuration shows dual homing with a peer node with a system address of 1.1.1.23. The DHCP server returns a default route with a 11.21.1.3 next hop.

```
A:ALA-48#
#------------------------------------------------
echo "Redundancy Configuration"
#------------------------------------------------
    redundancy
        multi-chassis
            peer 1.1.1.23 create
                sync
                    srrp
                    sub-mgmt
                    port lag-100 sync-tag "Tag1" create
                    exit
                    no shutdown
                exit
                no shutdown
            exit
        exit
    exit
#------------------------------------------------
echo "Service Configuration"
#------------------------------------------------
    service
        customer 1 create
            description "Default customer"
        exit
        sdp 23 create
            far-end 1.1.1.23
            no shutdown
        exit
        ies 40 customer 1 create
            redundant-interface "r40-1" create
                address 2.1.1.1/31
                spoke-sdp 23:1 create
                exit
            exit
            subscriber-interface "s40-1" create
                address 11.21.1.1/16 gw-ip-address 11.21.1.3
                dhcp
                    gi-address 11.21.1.1
                exit
                group-interface "g40-1" create
                    dhcp
                        server 12.1.1.1
                        lease-populate 8000
                        no shutdown
                    exit
                    redundant-interface r40-1
                    remote-proxy-arp
                    sap lag-100:1 create
                        sub-sla-mgmt
                            def-sub-profile "subProf"
                            def-sla-profile "slaProf"
                            sub-ident-policy "subIdentPolicy"
                            multi-sub-sap
```

```
                                    no shutdown
                                exit
                            exit
                            sap lag-100:4094 create
                            exit
                            srrp 1 create
                                message-path lag-100:4094
                                no shutdown
                            exit
                        exit
                    exit
                    no shutdown
                exit
            exit
...
-----------------------------------------------
A:ALA-48#
```

Subscriber Identification Policy

CLI Syntax:
```
configure>service>ies service-id
 interface ip-int-name
    sap sap-id
       host {[ip ip-address] [mac ieee-address} [subscriber
         sub-ident-string] [sub-profile sub-profile-name]
         [sla-profile sla-profile-name]
       sub-sla-mgmt
          single-sub-parameters
             non-sub-traffic sub-profile sub-profile-name
                sla-profile sla-profile-name [subscriber sub-
                ident-string]
          sub-ident-policy sub-ident-policy-name
```

Subscriber Profile

CLI Syntax:
```
configure>service>ies service-id
 interface ip-int-name
    sap sap-id
       host {[ip ip-address] [mac ieee-address} [subscriber
         sub-ident-string] [sub-profile sub-profile-name]
         [sla-profile sla-profile-name]
       sub-sla-mgmt
          def-sub-profile default-subscriber-profile-name
          single-sub-parameters
             non-sub-traffic sub-profile sub-profile-name
                sla-profile sla-profile-name [subscriber sub-
                ident-string]
```

CLI Syntax:
```
configure>service>vpls service-id
 sap sap-id
    host {[ip ip-address] [mac ieee-address]} [subscriber sub-
       ident-string] [sub-profile sub-profile-name] [sla-pro-
       file sla-profile-name]
    sub-sla-mgmt
       def-sub-profile default-sub-profile-name
       single-sub-parameters
          non-sub-traffic sub-profile sub-profile-name sla-
          profile sla-profile-name [subscriber sub-ident-
          string]
```

CLI Syntax:
```
configure>subscriber-mgmt
 sub-profile subscriber-profile-name
 explicit-subscriber-map
    entry key sub-ident-string [sub-profile sub-profile-name]
       [alias sub-alias-string] [sla-profile sla-profile-
       name]
 sub-ident-policy sub-ident-policy-name
    sub-profile-map
       entry key sub-profile-string sub-profile sub-profile-
         name
```

Subscriber Management Command Reference

Configuration Commands

Note: Enhanced Subscriber Management is supported on the redundant chassis model only.

Subscriber management commands are also described in the Triple Play Services Command Reference on page 73 section.

ANCP Commands

```
config
    — subscriber-mgmt
        — ancp
            — ancp-policy name
                — egress
                    — rate-adjustment adjusted-percent
                    — no rate-adjustment
                    — rate-modify agg-rate-limit
                    — rate-modify {scheduler scheduler-name | arbiter arbiter-name}
                    — no rate-modify
                    — rate-monitor kilobit-per-second [alarm]
                    — no rate-monitor
                    — rate-reduction kilobit-per-second
                    — no rate-reduction
                — ingress
                    — rate-adjustment adjusted-percent
                    — rate-modify {scheduler scheduler-name | arbiter arbiter-name}
                    — rate-monitor kilobit-per-second [alarm] [log]
                    — rate-reduction kilobit-per-second
                — [no] port-down
                    — [no] disable-shcv [alarm] [hold-time seconds]
            — ancp-static-map
                — entry key ancp-string customer customer-id multi-service-site customer-site-name ancp-policy policy-name
                — entry key ancp-string sap sap-id ancp-policy policy-name
                — no entry key ancp-string customer customer-id multi-service-site customer-site-name
                — no entry key ancp-string sap sap-id
```

GSMP Configuration Commands

```
config
    — service
        — vpls service-id [customer customer-id] [create] [vpn vpn-id] [m-vpls] [b-vpls|i-vpls]
        — no vpls service-id
        — [no] vprn service-id [customer customer-id] [vpn vpn-id] [m-vpls]
            — gsmp
                — [no] group name
                    — ancp
                        — [no] dynamic-topology-discover
                        — [no] oam
                    — description description-string
                    — no description
                    — hold-multiplier multiplier
                    — no hold-multiplier
                    — [no] idle-filter
                    — keepalive seconds
                    — no keepalive
                    — [no] neighbor ip-address
                        — description description-string
                        — no description
                        — local-address ip-address
                        — no local-address
                        — priority-marking dscp dscp-name
                        — priority-marking prec ip-prec-value
                        — no priority-marking
                        — [no] shutdown
                    — [no] persistency-database
                    — [no] shutdown
                — [no] shutdown
```

Authentication Policy Commands

```
config
    — subscriber-mgmt
        — aaa
            — radius-coa-port {1647|1700|1812|3799}
            — no radius-coa-port
            — [no] authentication-policy name
                — [no] accept-authorization-change
                — accept-script-policy policy-name
                — no accept-script-policy
                — description description-string
                — no description
                — fallback-action accept
                — fallback-action user-db-local-user-name
                — no fallback-action
                — [no] include-radius-attribute
                    — [no] access-loop-options
                    — [no] acct-session-id
                    — [no] called-station-id
                    — calling-station-id
                    — calling-station-id {mac | remote-id | sap-id | sap-string}
                    — no calling-station-id
                    — [no] circuit-id
                    — [no] dhcp-options
                    — [no] dhcp6-options
                    — [no] dhcp-vendor-class-id
                    — [no] mac-address
                    — [no] nas-identifier
                    — nas-port-id [prefix-string string] [suffix suffix-option]
                    — nas-port-type
                    — nas-port-type [0..255]
                    — no nas-port-type
                    — [no] pppoe-service-name
                    — [no] remote-id
                    — [no] sap-session-index
                    — [no] tunnel-server-attrs
                — password password
                — no password
                — ppp-user-name append domain-name
                — ppp-user-name default-domain domain-name
                — ppp-user-name replace domain-name
                — ppp-user-name strip
                — no ppp-user-name
                — pppoe-access-method {none | padi | pap-chap}
                — no pppoe-access-method
                — radius-authentication-server
                    — access-algorithm {direct | round-robin}
                    — no access-algorithm
                    — [no] access-loop-options
                    — fallback-action accept
                    — fallback-action user-db local-user-db-name
                    — no fallback-action
                    — hold-down-time seconds
                    — no hold-down-time
```

— **retry** *count*
— **no retry**
— **router** *router-instance*
— **router** *service-name*
— **no router**
— **server** *server-index* **address** *ip-address* **secret** *key* [**hash** | **hash2**] [**port** *port*] [*coa-only*]
— **no server** *server-index*
— **source-address** *ip-address*
— **no source-address**
— **timeout** *seconds*
— **no timeout**

— **radius-server-policy** *radius-server-policy-name*
— [**no**] **radius-server-policy**
— **server** *server-index* **address** *ip-address* **secret key** [**hash** | **hash2**] [**port** *port-num*] [**coa-only**] [**pending-requests-limit** *limit*]
— **hold-down-time**
— [**no**] **re-authentication**
— **request-script-policy** *policy-name*
— **no request-script-policy**
— **send-acct-stop-on-fail** {[**on-request-failure**] [**on-reject**] [**on-accept-failure**]}
— **no send-acct-stop-on-fail**
— **user-name-format** *format* [**mac-format** *mac-format*]
— **user-name-format** *format* **append** [*domain-name*] [**mac-format** *mac-format*]
— **user-name-format** *format* **append domain-name**
— **user-name-format** *format* **default-domain** *domain-name* [**mac-format** *mac-format*]
— **user-name-format** *format* **replace** *domain-name*[**mac-format** *mac-format*]
— **user-name-format** *format* **strip** [**mac-format** *mac-format*]
— **no user-name-format**

RADIUS Accounting Policy Commands

```
config
    — subscriber-mgmt
        — [no] radius-accounting-policy name
            — [no] custom-record
                — [no] override-counter override-counter-id
                    — e-counters [all]
                    — no e-counters
                        — [no] in-profile-octets-discarded-count
                        — [no] in-profile-octets-forwarded-count
                        — [no] in-profile-packets-discarded-count
                        — [no] in-profile-packets-forwarded-count
                        — [no] out-profile-octets-discarded-count
                        — [no] out-profile-octets-forwarded-count
                        — [no] out-profile-packets-discarded-count
                        — [no] out-profile-packets-forwarded-count
                    — i-counters [all]
                    — no i-counters
                        — [no] all-octets-offered-count
                        — [no] all-packets-offered-count
                        — [no] high-octets-discarded-count
                        — [no] high-packets-discarded-count
                        — [no] in-profile-octets-forwarded-count
                        — [no] in-profile-packets-forwarded-count
                        — [no] low-octets-discarded-count
                        — [no] low-packets-discarded-count
                        — [no] out-profile-octets-forwarded-count
                        — [no] out-profile-packets-forwarded-count
                — [no] queue queue-id
                    — e-counters [all]
                    — no e-counters
                        — [no] in-profile-octets-discarded-count
                        — [no] in-profile-octets-forwarded-count
                        — [no] in-profile-packets-discarded-count
                        — [no] in-profile-packets-forwarded-count
                        — [no] out-profile-octets-discarded-count
                        — [no] out-profile-octets-forwarded-count
                        — [no] out-profile-packets-discarded-count
                        — [no] out-profile-packets-forwarded-count
                    — i-counters [all]
                    — no i-counters
                        — [no] all-octets-offered-count
                        — [no] all-packets-offered-count
                        — [no] high-octets-discarded-count
                        — [no] high-octets-offered-count
                        — [no] high-packets-discarded-count
                        — [no] high-packets-offered-count
                        — [no] in-profile-octets-forwarded-count
                        — [no] in-profile-packets-forwarded-count
                        — [no] low-octets-discarded-count
                        — [no] low-octets-offered-count
                        — [no] low-packets-discarded-count
                        — [no] low-packets-offered-count
```

— [no] out-profile-octets-forwarded-count
— [no] out-profile-packets-forwarded-count
— [no] uncoloured-octets-offered-count
— [no] uncoloured-octets-offered-count
— ref-override-counter *ref-override-counter-id*
— ref-override-counter all
— no ref-override-counter
— e-counters [all]
— no e-counters
— [no] in-profile-octets-discarded-count
— [no] in-profile-octets-forwarded-count
— [no] in-profile-packets-discarded-count
— [no] in-profile-packets-forwarded-count
— [no] out-profile-octets-discarded-count
— [no] out-profile-octets-forwarded-count
— [no] out-profile-packets-discarded-count
— [no] out-profile-packets-forwarded-count
— i-counters [all]
— no i-counters
— [no] all-octets-offered-count
— [no] all-packets-offered-count
— [no] high-octets-discarded-count
— [no] high-packets-discarded-count
— [no] in-profile-octets-forwarded-count
— [no] in-profile-packets-forwarded-count
— [no] low-octets-discarded-count
— [no] low-packets-discarded-count
— [no] out-profile-octets-forwarded-count
— [no] out-profile-packets-forwarded-count
— ref-queue *queue-id*
— ref-queue all
— no ref-queue
— e-counters [all]
— no e-counters
— [no] in-profile-octets-discarded-count
— [no] in-profile-octets-forwarded-count
— [no] in-profile-packets-discarded-count
— [no] in-profile-packets-forwarded-count
— [no] out-profile-octets-discarded-count
— [no] out-profile-octets-forwarded-count
— [no] out-profile-packets-discarded-count
— [no] out-profile-packets-forwarded-count
— i-counters [all]
— no i-counters
— [no] all-octets-offered-count
— [no] all-packets-offered-count
— [no] high-octets-discarded-count
— [no] high-octets-offered-count
— [no] high-packets-discarded-count
— [no] high-packets-offered-count
— [no] in-profile-octets-forwarded-count
— [no] in-profile-packets-forwarded-count
— [no] low-octets-discarded-count
— [no] low-packets-discarded-count
— [no] low-octets-offered-count

```
                                        — [no] low-packets-offered-count
                                        — [no] out-profile-octets-forwarded-count
                                        — [no] out-profile-packets-forwarded-count
                                        — [no] uncoloured-octets-offered-count
                                        — [no] uncoloured-packets-offered-count
                                    — significant-change delta
                                    — no significant-change
                            — description description-string
                            — no description
                            — fallback-action accept
                            — fallback-action user-db local-user-db-name
                            — no fallback-action accept
                            — [no] host-accounting [interim-update]
                            — include-radius-attribute
                                    — [no] access-loop-options
                                    — [no] acct-authentic
                                    — [no] acct-delay-time
                                    — [no] all-authorized-session-addresses
                                    — [no] called-station-id
                                    — [no] calling-station-id
                                    — [no] circuit-id
                                    — [no] delegated-ipv6-prefix
                                    — [no] detailed-acct-attributes
                                    — [no] dhcp-vendor-class-id
                                    — [no] framed-interface-id
                                    — [no] framed-ip-addr
                                    — [no] framed-ip-netmask
                                    — [no] framed-ipv6-prefix
                                    — [no] framed-ipv6-route
                                    — [no] framed-route
                                    — [no] ipv6-address
                                    — [no] mac-address
                                    — [no] nas-identifier
                                    — [no] nas-port
                                    — [no] nas-port-id
                                    — [no] nas-port-type
                                    — [no] nat-port-range
                                    — [no] remote-id
                                    — [no] sla-profile
                                    — [no] std-acct-attributes
                                    — [no] sub-profile
                                    — [no] subscriber-id
                                    — [no] tunnel-server
                                    — [no] user-name
                                    — [no] v6-aggregate-stats
                                    — [no] wifi-rssi
                            — queue-instance-accounting [interim-update]
                            — no queue-instance-accounting
                            — radius-authentication-server
                                    — access-algorithm {direct | round-robin}
                                    — no access-algorithm
                                    — retry count
                                    — no retry
                                    — router router-instance
                                    — no router
```

- — **server** *server-index* [**address** *ip-address*] [**secret** *key*] [**port** *port*] [**pending-requests-limit** *limit*]
- — **no server** *server-index*
- — **source-address** *ip-address*
- — **no source-address**
- — **timeout** *seconds*
- — **no timeout**

— **radius-server-policy** *radius-server-policy-name*
— [**no**] **radius-server-policy**
— **session-accounting** [**interim-update**] [**host-update**]
— **no session-accounting**
— **session-id-format** {**description** | **number**}
— **no session-id-format**
— **update-interval** *minutes*
— **no update-interval**
— **update-interval-jitter absolute** *seconds*
— [**no**] **update-interval-jitter**

RADIUS Route Download Commands

```
configure
    — aaa
        — route-downloader name [create]
        — no route-downloader name
            — base-user-name user-name
            — no base-user-name
            — default-metric metric
            — no default-metric
            — default-tag tag
            — no default-tag
            — description description-string
            — no description
            — download-interval minutes
            — no download-interval
            — max-routes routes
            — no max-routes
            — password password [hash|hash2]
            — no password
            — radius-server-policy policy-name
            — no radius-server-policy
            — retry-interval min minimum max maximum
            — no retry-interval
            — [no] shutdown
```

Diameter Policy Commands


```
config
    — aaa
        — diameter-peer-policy peer-policy-name [role {client | proxy}] [create]
        — no diameter-peer-policy peer-policy-name
            — applications {[gx] [gy] [nasreq]}
            — no applications
            — connection-timer connection-time
            — no connection-timer
            — description description-string
            — no description
            — origin-host origin-host-string
            — no origin-host
            — origin-realm origin-realm-string
            — no origin-realm
            — peer name [create]
            — no peer name
                — address ip-address
                — no address
                — connection-timer connection-time
                — no connection-timer
                — destination-host destination-host-string
                — no destination-host
                — destination-realm destination-realm-string
                — no destination-realm
                — preference preference
                — no preference
                — [no] shutdown
                — transaction-timer seconds
                — no transaction-timer
                — transport tcp port port
                — no transport
                — watchdog-timer seconds
                — no watchdog-timer
            — python-policy [32 chars max]
            — no python-policy
            — router service service-name
            — router router-instance
            — no router
            — source-address ip-address
            — no source-address
            — transaction-timer transaction-time
            — no transaction-timer
            — vendor-support {three-gpp | vodafone}
            — no vendor-support
            — watchdog-timer wd-time
            — no watchdog-timer
```

Subscriber Management Diameter Application Policy Commands

```
configure
    — subscriber-mgmt
        — diameter-application-policy application-policy-name [create]
        — no diameter-application-policy application-policy-name
            — application {gx | gy | nasreq}
            — no application
            — description description-string
            — no description
            — diameter-peer-policy peer-policy-name
            — no diameter-peer-policy
            — gx
                — avp-subscription-id origin [type type]
                — no avp-subscription-id
                — [no] include-avp
                    — [no] an-gw-address
                    — [no] called-station-id
                    — calling-station-id [type {llid | mac | remote-id | sap-id | sap-string}]
                    — no calling-station-id
                    — [no] ip-can-type
                    — [no] logical-access-id
                    — nas-port binary-spec
                    — no nas-port
                    — nas-port-id [prefix-type {none | user-string}] [prefix-string prefix-string] [suffix {circuit-id | none | remote-id | user-string}] [suffix-string suffix-string]
                    — no nas-port-id
                    — nas-port-type [ [0..255] ]
                    — no nas-port-type
                    — [no] physical-access-id
                    — [no] rat-type
                    — [no] supported-features
                    — user-equipment-info [type ue-info-type]
                    — no user-equipment-info
                — mac-format mac-format
                — no mac-format
                — [no] report-ip-address-event
            — gy
                — avp-subscription-id origin [type type]
                — no avp-subscription-id
                — out-of-credit-reporting {final | quota-exhausted}
                — no out-of-credit-reporting
                — vendor-support {three-gpp | vodafone}
                — no vendor-support
                — [no] include-avp
                    — 3gpp-imsi {circuit-id | imsi | subscriber-id}
                    — no 3gpp-imsi
                    — called-station-id [64 chars max]
                    — no called-station-id
                    — [no] radius-user-name
                    — service-context-id name
                    — no service-context-id
            — nasreq
```

- [**no**] **include-avp**
  - [**no**] **called-station-id**
  - **calling-station-id** [**type** {**llid** | **mac** | **remote-id** | **sap-id** | **sap-string**}]
  - **no calling-station-id**
  - [**no**] **circuit-id**
  - **nas-port** *binary-spec*
  - **no nas-port**
  - **nas-port-id** [**prefix-type** {**none** | **user-string**}] [**prefix-string** [*8 chars max*]] [**suffix-type** {**circuit-id** | **none** | **remote-id** | **user-string**}] [**suffix-string** [*64 chars max*]]
  - **no nas-port-id**
  - **nas-port-type** [0..255]
  - **nas-port-type**
  - **no nas-port-type**
  - [**no**] **remote-id**
- **mac-format** *mac-format*
- **no mac-format**
- **password** *password*
- **no password**
- **user-name-format** *format*
- **no user-name-format**
- **user-name-operation operation** [**domain** *domain-name*]
- **no user-name-operation**

- **on-failure** [**failover** {**enabled** | **disabled**}] [**handling** {**continue** | **retry-and-terminate** | **terminate**}]
- **no on-failure**
- **tx-timer** *seconds*
- **no tx-timer**

Category Map and Credit Control Policy Commands

```
config
    — subscriber-mgmt
        — category-map category-map-name [create]
        — no category-map category-map-name
            — description description-string
            — no description
            — activity-threshold kilobits-per-second
            — no activity-threshold
            — category category-name [create]
            — no category category-name
                — credit-type-override {volume | time}
                — no credit-type-override
                — default-credit volume credits bytes|kilobytes|megabytes|gigabytes
                — default-credit time seconds
                — no default-credit
                — description description-string
                — no description
                — [no] exhausted-credit-service-level
                    — [no] egress-ip-filter-entries
                        — entry entry-id [create]
                            — action drop
                            — action forward
                            — action http-redirect url
                            — no action
                            — description description-string
                            — no description
                            — match [protocol protocol-id]
                            — no match
                                — dscp dscp-name
                                — no dscp
                                — dst-port {lt|gt|eq} dst-port-number
                                — dst-port range start end
                                — no dst-port
                                — fragment {true|false}
                                — icmp-code icmp-code
                                — no icmp-code
                                — icmp-type icmp-type
                                — no icmp-type
                                — ip-option ip-option-value [ip-option-mask]
                                — no ip-option
                                — multiple-option {true | false}
                                — option-present {true | false}
                                — src-ip {ip-address/mask | ip-address netmask}
                                — no src-ip
                                — src-port {lt|gt|eq} src-port-number
                                — src-port range start end
                                — no src-port
                                — tcp-ack {true|false}
                                — no tcp-ack
                                — tcp-syn {true|false}
                                — no tcp-syn
                    — [no] egress-ipv6-filter-entries
```

```
— entry entry-id [create]
    — action drop
    — action forward
    — no action
    — description description-string
    — no description
    — match [next-header next-header]
    — no match
        — dscp dscp-name
        — no dscp
        — dst-port {lt|gt|eq} dst-port-number
        — dst-port range start end
        — no dst-port
        — icmp-code icmp-code
        — no icmp-code
        — icmp-type icmp-type
        — no icmp-type
        — src-ip {ip-address/mask | ip-address net-mask}
        — no src-ip
        — src-port {lt|gt|eq} src-port-number
        — src-port range start end
        — no src-port
        — tcp-ack {true|false}
        — no tcp-ack
        — tcp-syn {true|false}
        — no tcp-syn
— [no] ingress-ip-filter-entries
    — entry entry-id [create]
        — action drop
        — action forward
        — action http-redirect url
        — no action
        — description description-string
        — no description
        — match [protocol protocol-id]
        — no match
            — dscp dscp-name
            — no dscp
            — dst-ip {ip-address/mask | ip-address net-mask}
            — no dst-ip
            — dst-port {lt|gt|eq} dst-port-number
            — dst-port range start end
            — no dst-port
            — fragment {true|false}
            — icmp-code icmp-code
            — no icmp-code
            — icmp-type icmp-type
            — no icmp-type
            — ip-option ip-option-value [ip-option-mask]
            — no ip-option
            — multiple-option {true|false}
            — option-present {true|false}
            — src-port {lt|gt|eq} src-port-number
```

```
                                        — src-port range start end
                                        — no src-port
                                        — tcp-ack {true|false}
                                        — no tcp-ack
                                        — tcp-syn {true|false}
                                        — no tcp-syn
                                — [no] ingress-ipv6-filter-entries
                                        — entry entry-id [create]
                                            — action drop
                                            — action forward
                                            — no action
                                            — description description-string
                                            — no description
                                            — match [next-header next-header]
                                            — no match
                                                — dscp dscp-name
                                                — no dscp
                                                — dst-ip {ip-address/mask | ip-address net-
                                                  mask}
                                                — no dst-ip
                                                — dst-port {lt|gt|eq} dst-port-number
                                                — dst-port range start end
                                                — no dst-port
                                                — icmp-code icmp-code
                                                — no icmp-code
                                                — icmp-type icmp-type
                                                — no icmp-type
                                                — src-port {lt|gt|eq} src-port-number
                                                — src-port range start end
                                                — no src-port
                                                — tcp-ack {true|false}
                                                — no tcp-ack
                                                — tcp-syn {true|false}
                                                — no tcp-syn
                                            — pir pir-rate
                                            — pir max
                                            — no pir
                                    — out-of-credit-action-override {continue | block-category | change-ser-
                                      vice-level}
                                    — no out-of-credit-action-override
                                    — policer policer-id {ingress-only|egress-only|ingress-egress}
                                    — no policer policer-id
                                    — queue queue-id {ingress-only | egress-only | ingress-egress}
                                    — no queue queue-id
                                    — rating-group rating-group-id
                                    — no rating-group
                            — credit-exhaust-threshold threshold-percentage
                            — no credit-exhaust-threshold
                            — credit-type {volume | time}
                            — no credit-type
                    — credit-control-policy policy-name [create]
                    — no credit-control-policy policy-name
                            — credit-control-server radius
                            — no credit-control-server
                            — default-category-map category-map-name
```

— **no default-category-map**
— **description** *description-string*
— **no description**
— **error-handling-action** {**continue** | **block**}
— **no error-handling-action**
— **out-of-credit-action** *action*
— **no out-of-credit-action**

Filter Commands

```
config
    — filter
        — copy {ip-filter | mac-filter | ipv6-filter} src-filter-id [src-entry src-entry-id] to dst-filter-id
          [dst-entry dst-entry-id] [overwrite]
        — ip-filter filter-id [create]
        — no ip-filter filter-id
            — default-action drop|forward
            — description description-string
            — entry entry-id [time-range time-range-name] [create]
            — no entry entry-id
                — action drop|forward
                — no action
                — log log-id
                — no log
                — match [next-header next-header]
                — no match
                    — dscp
                    — no dscp
                    — dst-ip
                    — no dst-ip
                    — dst-port
                    — no dst-port
                    — icmp-code
                    — no icmp-code
                    — icmp-type
                    — no icmp-type
                    — src-ip
                    — no src-ip
                    — src-port
                    — no src-port
                    — tcp-ack
                    — no tcp-ack
                    — tcp-syn
                    — no tcp-syn
            — group-inserted-entries application application location location
            — renum old-entry-id new-entry-id
            — scope exclusive|template
            — no scope
            — shared-radius-filter-wmark low low-watermark high high-watermark
            — sub-insert-radius start-entry entry-id count count
            — no sub-insert-radius
            — sub-insert-credit-control start-entry entry-id count count
            — no sub-insert-credit-control
            — sub-insert-shared-radius start-entry entry-id count count
            — sub-insert-wmark [low percentage] [high percentage]
            — no sub-insert-wmark
        — ipv6-filter ipv6-filter-id [create]
        — no ipv6-filter ipv6-filter-id
            — default-action drop|forward
            — description description-string
            — entry entry-id [time-range time-range-name] [create]
            — no entry entry-id
                — action drop|forward
```

- **no action**
- **log** *log-id*
- **no log**
- **match** [**next-header** *next-header*]
- **no match**
  - **dscp**
  - **no dscp**
  - **dst-ip**
  - **no dst-ip**
  - **dst-port**
  - **no dst-port**
  - **icmp-code**
  - **no icmp-code**
  - **icmp-type**
  - **no icmp-type**
  - **src-ip**
  - **no src-ip**
  - **src-port**
  - **no src-port**
  - **tcp-ack**
  - **no tcp-ack**
  - **tcp-syn**
  - **no tcp-syn**

- **group-inserted-entries application** *application* **location** *location*
- **renum** *old-entry-id new-entry-id*
- **scope** *exclusive*|*template*
- **no scope**
- **shared-radius-filter-wmark low** *low-watermark* **high** *high-watermark*
- **sub-insert-radius start-entry** *entry-id* **count** *count*
- **no sub-insert-radius**
- **sub-insert-credit-control start-entry** *entry-id* **count** *count*
- **no sub-insert-credit-control**
- **sub-insert-shared-radius start-entry** *entry-id* **count** *count*
- **sub-insert-wmark** [**low** *percentage*] [**high** *percentage*]
- **no sub-insert-wmark**

BGP Peering Policy Commands

```
config
    — subscriber-mgmt
        — bgp-peering-policy policy-name [create]
        — no bgp-peering-policy policy-name
            — [no] advertise-inactive
            — [no] aggregator-id-zero
            — [no] as-override
            — auth-keychain name
            — no auth-keychain
            — authentication-key [authentication-key | hash-key] [hash | hash2]
            — no authentication-key
            — cluster cluster-id
            — no cluster
            — [no] connect-retry seconds
            — [no] damping
            — description description-string
            — no description
            — [no] disable-4byte-asn
            — [no] disable-client-reflect
            — disable-communities [standard] [extended]
            — no disable-communities
            — [no] disable-fast-external-failover
            — export policy-name [policy-name...(upto 5 max)]
            — no export
            — hold-time seconds
            — no hold-time
            — import policy-name [policy-name...(up to 5 max)]
            — no import
            — keepalive seconds
            — no keepalive
            — local-address ip-address
            — no local-address
            — local-as as-number [private]
            — no local-as
            — local-preference local-preference
            — no local-preference
            — loop-detect {drop-peer | discard-route | ignore-loop| off}
            — no loop-detect
            — med-out {number | igp-cost}
            — no med-out
            — min-as-origination seconds
            — no min-as-origination
            — min-route-advertisement seconds
            — no min-route-advertisement
            — multihop ttl-value
            — no multihop
            — [no] next-hop-self
            — [no] passive
            — peer-as as-number
            — preference preference
            — no preference
            — prefix-limit limit [log-only] [threshold percent]
            — no prefix-limit
```

— [**no**] **remove-private**
— **ttl-security** *min-ttl-value*
— **no ttl-security**
— **type** {**internal** | **external**}
— **no type**

Explicit Subscriber Mapping Commands

```
config
    — subscriber-mgmt
        — explicit-sub-map
            — entry key sub-ident-string [sub-profile sub-profile-name] [alias sub-alias-string] [sla-profile sla-profile-name]
            — no entry key sub-ident-string
```

IGMP Policy Commands

```
config
    — subscriber-mgmt
        — igmp-policy policy-name [create]
            — description description-string
            — no description
            — egress-rate-modify [egress-rate-limit | scheduler scheduler-name]
            — [no] fast-leave
            — import policy-name
            — no import
            — max-num-groups max-num-groups
            — no max-num-groups
            — max-num-sources max-num-sources
            — no max-num-sources
            — max-num-grp-sources [1..32000]
            — no max-num-grp-sources
            — [no] mcast-reporting
                — mcast-reporting-dest dest-name
                — no mcast-reporting-dest
                — opt-reporting-fields [host-mac] [pppoe-session-id] [svc-id] [sap-id]
                — no opt-reporting-fields
                — [no] shutdown
            — per-host-replication [uni-mac|mcast-mac]
            — no per-host-replication
            — redirection-policy policy-name
            — no redirection-policy
            — static
                — [no] group ip-address
            — version version
            — no version
        — sub-mcac-policy policy-name
        — sub-profile
            — sub-mcac-policy policy-name
```

Host Lockout Commands

```
config
    — subscriber-mgmt
        — host-lockout-policy policy-name [create]
        — no host-lockout-policy policy-name
            — description description-string
            — no description
            — host-key {mac}
            — no host-key
            — lockout-reset-time seconds
            — no lockout-reset-time
            — lockout-time [min seconds] [max seconds]
            — no lockout-time
            — max-lockout-hosts hosts
            — no max-lockout-hosts
config
    — service
        — vprn service-id [customer customer-id]
        — no vprn service-id
            — [no] interface ip-int-name
                — sap sap-id [create]
                — no sap sap-id
                    — host-lockout-policy policy-name
                    — no host-lockout-policy
            — subscriber-interface ip-int-name [fwd-service service-id fwd-subscriber-inter-
              face ip-int-name] [create]
            — no subscriber-interface ip-int-name
                — sap sap-id [create]
                — no sap sap-id
                    — host-lockout-policy policy-name
                    — no host-lockout-policy
config
    — service
        — ies service-id [customer customer-id] [vpn vpn-id]
            — [no] interface ip-int-name
                — [no] sap sap-id
                    — host-lockout-policy policy-name
                    — host-lockout-policy
            — [no] subscriber-interface ip-int-name [fwd-service service-id fwd-subscriber-
              interface ip-int-name] [create]
                — [no] sap sap-id
                    — host-lockout-policy policy-name
                    — no host-lockout-policy
config
    — service
        — [no] vpls service-id [customer customer-id]  [vpn vpn-id] [m-vpls]
            — sap sap-id [split-horizon-group group-name] [create] [capture-sap] [eth-ring
              ring-index]
            — no sap sap-id
                — host-lockout-policy policy-name
                — no host-lockout-policy
```

Host Tracking Policy Commands

```
config
    — subscriber-mgmt
        — host-tracking-policy policy-name [create]
        — no host-tracking-policy policy-name
            — description description-string
            — no description
            — egress-rate-modify agg-rate-limit
            — egress-rate-modify scheduler scheduler-name
            — no egress-rate-modify
```

PIM Policy Commands

```
config
    — subscriber-mgmt
        — pim-policy policy-name [create]
        — no pim-policy policy-name
            — description description-string
            — no description
```

SLA Profile Commands

```
config
    — subscriber-mgmt
        — [no] sla-profile sla-profile-name
            — category-map category-map-name [create]
            — no category-map category-map-name
                — category category-name [create]
                — no category category-name
                    — idle-timeout timeout
                    — no idle-timeout
                    — idle-timeout-action {shcv-check|terminate}
                    — no idle-timeout-action
            — description description-string
            — no description
            — egress
                — [no] ip-filter filter-id
                — qos sap-egress-policy-id [vport-scheduler|port-scheduler] [force]
                — no qos
                    — queue queue-id
                    — no queue queue-id
                        — avg-frame-overhead percent
                        — no avg-frame-overhead
                        — burst-limit
                        — no burst-limit
                        — burst-limit size-in-kbytes
                        — no burst-limit
                        — high-prio-only percent
                        — no high-prio-only
                        — mbs size-in-kbytes
                        — no mbs
                        — rate pir-rate [cir cir-rate]
                        — no rate
                        — stat-mode stat-mode
                        — no stat-mode
                    — policer policer-id [create]
                    — no policer policer-id
                        — cbs {size [bytes | kilobytes] | default}
                        — no cbs
                        — mbs {size [bytes | kilobytes] | default}
                        — no mbs
                        — packet-byte-offset {add bytes | subtract bytes}
                        — no packet-byte-offset
                        — rate {max | kilobits-per-second} [cir {max | kilobits-
                          per-second}]
                        — no rate
                        — stat-mode stat-mode
                        — no stat-mode
                — [no] qos-marking-from-sap
                — report-rate agg-rate-limit
                — report-rate  scheduler scheduler-name
                — report-rate pppoe-actual-rate
                — report-rate rfc5515-actual-rate
                — no report-rate
                — scheduler-policy scheduler-policy-name
```

```
            — no scheduler-policy
            — [no] use-ingress-l2tp-dscp
      — [no] host-limits
            — ipv4-arp max-nr-of-hosts
            — no ipv4-arp
            — ipv4-dhcp max-nr-of-hosts
            — no ipv4-dhcp
            — ipv4-overall max-nr-of-hosts
            — no ipv4-overall
            — ipv4-ppp max-nr-of-hosts
            — no ipv4-ppp
            — ipv6-overall max-nr-of-hosts
            — no ipv6-overall
            — ipv6-pd-ipoe-dhcp max-nr-of-hosts
            — no ipv6-pd-ipoe-dhcp
            — ipv6-pd-overall max-nr-of-hosts
            — no ipv6-pd-overall
            — ipv6-pd-ppp-dhcp max-nr-of-hosts
            — no ipv6-pd-ppp-dhcp
            — ipv6-wan-ipoe-dhcp max-nr-of-hosts
            — no ipv6-wan-ipoe-dhcp
            — ipv6-wan-ipoe-slaac max-nr-of-hosts
            — no ipv6-wan-ipoe-slaac
            — ipv6-wan-overall max-nr-of-hosts
            — no ipv6-wan-overall
            — ipv6-wan-ppp-dhcp max-nr-of-hosts
            — no ipv6-wan-ppp-dhcp
            — ipv6-wan-ppp-slaac max-nr-of-hosts
            — no ipv6-wan-ppp-slaac
            — lac-overall max-nr-of-hosts
            — no lac-overall
            — overall max-nr-of-hosts
            — no overall
            — [no] remove-oldest
      — ingress
            — [no] ip-filter filter-id
            — qos sap-ingress-policy-id [shared-queuing | multipoint-shared | service-
              queuing] [force]
            — no qos
                  — queue queue-id
                  — no queue queue-id
                        — burst-limit
                        — no burst-limit
                        — burst-limit size-in-kbytes
                        — no burst-limit
                        — high-prio-only percent
                        — no high-prio-only
                        — mbs size-in-kbytes
                        — no mbs
                        — rate pir-rate [cir cir-rate]
                        — no rate
                        — stat-mode {v4-v6}
                        — no stat-mode
                  — policer policer-id [create]
                  — no policer policer-id
```

- **cbs** {*size* [**bytes** | **kilobytes**] | **default**}
- **no cbs**
- **mbs** {*size* [**bytes** | **kilobytes**] | **default**}
- **no mbs**
- **packet-byte-offset** {**add** *bytes* | **subtract** *bytes*}
- **no packet-byte-offset**
- **rate** {**max** | **kilobits-per-second**} [**cir** {**max** | **kilobits-per-second**}]
- **no rate**
- **stat-mode** {**v4-v6**}
- **no stat-mode**

- **report-rate agg-rate-limit**
- **report-rate scheduler** *scheduler-name*
- **no report-rate**

- **one-time-http-redirection** *filter-id*

Subscriber Identification Policy Commands

```
config
    — subscriber-mgmt
        — [no] sub-ident-policy sub-ident-policy-name
            — app-profile-map
                — entry key app-profile-string app-profile app-profile-name
                — no entry key app-profile-string
                — [no] use-direct-map-as-default
            — description description-string
            — no description
            — primary
                — script-url dhcp-primary-script-url
                — no script-url
                — [no] shutdown
            — secondary
                — script-url dhcp-secondary-script-url
                — no script-url
                — [no] shutdown
            — sla-profile-map
                — entry key sla-profile-string  sla-profile sla-profile-name
                — no entry key sla-profile-string
                — [no] use-direct-map-as-default
            — sub-profile-map
                — entry key sub-profile-string sub-profile sub-profile-name
                — no entry key sub-profile-string
                — [no] use-direct-map-as-default
            — tertiary
                — script-url dhcp-tertiary-script-url
                — no script-url
                — [no] shutdown
```

Auto-Generated Subscriber Identification Key Commands

Note: These commands are supported on the 7450 ESS in mixed mode.

```
config
    — subscriber-mgmt
        — auto-sub-id-key
            — ipoe-sub-id-key sub-id-key [sub-id-key...(up to 4 max)]
            — no ipoe-sub-id-key
            — ppp-sub-id-key sub-id-key [sub-id-key...(up to 5 max)]
            — no ppp-sub-id-key
```

Auto-Generated Subscriber Identification Key Service Commands

Notes: Refer to the 7750 SR OS Services Guide/7450 ESS OS Services Guide for further services commands.

```
config
    — service
        — vprn
            — subscriber-interface ip-int-name
                — group-interface ip-int-name
                    — sap sap-id
                        — sub-sla-mgmt
                            — def-sub-id use-auto-id
                            — def-sub-id use-sap-id
                            — def-sub-id string sub-id
                            — no def-sub-id
        — vpls
            — sap sap-id
                — sub-sla-mgmt
                    — def-sub-id use-auto-id
                    — def-sub-id use-sap-id
                    — def-sub-id string sub-id
                    — no def-sub-id
        — ies
            — subscriber-interface ip-int-name
                — group-interface ip-int-name
                    — sap sap-id
                        — sub-sla-mgmt
                            — def-sub-id use-auto-id
                            — def-sub-id use-sap-id
                            — def-sub-id string sub-id
                            — no def-sub-id

    — subscriber-management
        — msap-policy msap-policy-name
            — sub-sla-mgmt
```

```
— def-sub-id use-auto-id
— def-sub-id use-sap-id
— def-sub-id string sub-id
— no def-sub-id
```

Subscriber MCAC Policy Commands

```
config
    — subscriber-mgmt
        — sub-mcac-policy sub-mcac-policy-name [create]
        — no sub-mcac-policy sub-mcac-policy-name
            — description description-string
            — no description
            — [no] shutdown
            — unconstrained-bw mandatory-bw mandatory-bw
            — no unconstrained-bw
```

Subscriber Profile Commands

For information about configuring accounting policies, refer to the **SR OS System Management Guide**.

```
config
    — subscriber-mgmt
        — [no] sub-profile subscriber-profile-name
            — accounting-policy acct-policy-id
            — no accounting-policy
            — ancp
                — ancp-policy name
                — no ancp-policy
                    — egress
                        — rate-adjustment
                        — rate-adjustment adjusted-percent
                        — no rate-adjustment
                        — rate-modify scheduler scheduler-name
                        — no rate-modify
                        — rate-monitor kilobit-per-second [alarm]
                        — no rate-monitor
                        — rate-reduction kilobit-per-second
                        — no rate-reduction
                    — ingress
                        — rate-adjustment adjusted-percent
                        — no rate-adjustment
                        — rate-modify scheduler scheduler-name
                        — no rate-modify
                        — rate-monitor kilobit-per-second [alarm]
                        — no rate-monitor
                        — rate-reduction kilobit-per-second
                        — no rate-reduction
            — [no] collect-stats
            — description description-string
            — no description
            — egress
                — agg-rate-limit agg-rate [queue-frame-based-accounting]
                — no agg-rate-limit
                — avg-frame-size bytes
                — no avg-frame-size
                — encap-offset [type type]
                — no encap-offset
                — lag-per-link-hash class {1|2|3} weight 1..1024
                — no lag-per-link-hash
                — policer-control-policy policy-name
                — no policer-control-policy
                    — max-rate {kilobits-per-second | max}
                    — no max-rate
                    — priority-mbs-thresholds
                        — min-thresh-separation size [bytes | kilobytes]
                        — no min-thresh-separation
                        — priority level
                            — mbs-contribution size [bytes | kilobytes] [fixed]
                — scheduler-policy scheduler-policy-name
```

```
            — no scheduler-policy
                — scheduler scheduler-name rate [pir-rate] [cir cir-rate]
                — no scheduler scheduler-name
        — [no] host-tracking-policy
        — no host-tracking-policy policy-name
            — description description-string
            — no description
            — egress-rate-modify agg-rate-limit
            — egress-rate-modify scheduler scheduler-name
            — no egress-rate-modify
        — hsmda
            — egress-qos
                — agg-rate-limit agg-rate
                — no agg-rate-limit
                — qos policy-id
                — no qos
                    — wrr-policy weight
                    — no wrr-policy
                    — packet-byte-offset {add add-bytes | subtract sub-bytes}
                    — no packet-byte-offset
                    — queue queue-id [create]
                    — no queue queue-id
                        — rate pir-rate [cir cir-rate]
                        — no rate
                        — rate {max | kilobits-per-second}
                        — no rate
                        — slope-policy hsmda-slope-policy-name
                        — no slope-policy
                        — stat-mode {v4-v6}
                        — no stat-mode
                        — wrr-weight weight
                        — no wrr-weight
            — ingress-qos
                — qos policy-id
                — no qos
                    — queue queue-id
                        — rate {max | kilobits-per-second}
                        — no rate
                        — cbs {size [bytes | kilobytes] | default}
                        — no cbs
                        — mbs kilobits
                        — no mbs
                        — stat-mode {v4-v6}
                        — no stat-mode
                    — policer policer-id [create]
                        — cbs {size [bytes | kilobytes] | default}
                        — no cbs
                        — mbs kilobits
                        — no mbs
                        — packet-byte-offset {add add-bytes | subtract sub-bytes}
                        — no packet-byte-offset
                        — rate {max | kilobits-per-second}
                        — no rate
```

```
                                    — stat-mode {v4-v6}
                                    — no stat-mode
            — igmp-policy policy-name
            — no igmp-policy
            — ingress
                    — policer-control-policy policer-control-policy-name
                    — no policer-control-policy
                            — max-rate {rate | max}
                            — no max-rate
                            — priority-mbs-thresholds
                                    — min-thresh-separation size [bytes|kilobytes]
                                    — min-thresh-separation default
                                    — no min-thresh-separation
                                    — priority level
                                            — mbs-contribution size [bytes | kilobytes]
                    — scheduler-policy scheduler-policy-name
                    — no scheduler-policy
                            — scheduler scheduler-name  rate [pir-rate] [cir cir-rate]
                            — no scheduler scheduler-name
            — pim-policy policy-name
            — no pim-policy policy-name
            — radius-accounting-policy
            — no radius-accounting-policy
            — sla-profile-map
                    — entry key sla-profile-string sla-profile sla-profile
                    — no entry key sla-profile-string
                    — [no] use-direct-map-as-default
            — sub-mcac-policy policy-name
            — no sub-mcac-policy
            — volume-stats-type {ip|default}
            — no volume-stats-type
```

IPoE Session Policy Commands

```
config
    — subscriber-mgmt
            — ipoe-session-policy policy-name [create]
            — no ipoe-session-policy policy-name
                    — description description-string
                    — no description
                    — session-key sap mac [cid] [rid]
                    — no session-key
                    — session-timeout timeout
                    — no session-timeout
```

Multi-Chassis Redundancy Commands

```
config
    — redundancy
        — multi-chassis
            — [no] peer ip-address
                — authentication-key [authentication-key | hash-key] [hash | hash2]
                — no authentication-key
                — description description-string
                — no description
                — mc-ipsec
                    — bfd-enable service service-id interface interface-name dst-ip
                      ip-address
                    — no bfd-enable
                    — discovery-interval interval-1 [boot interval-2]
                    — no discovery-interval
                    — hold-on-neighbor-failure multiplier
                    — no hold-on-neighbor-failure
                    — keep-alive-interval time-interval
                    — no keep-alive-interval
                    — tunnel-group group-id [create]
                    — no tunnel-group group-id
                        — peer-group group-id
                        — no peer-group
                        — priority priority
                        — no priority
                        — [no] preempt
                        — [no] shutdown
                — [no] mc-lag
                    — hold-on-neighbor-failure multiplier
                    — no hold-on-neighbor-failure
                    — keep-alive-interval interval
                    — no keep-alive-interval
                    — lag lag-id lacp-key admin-key system-id system-id [remote-lag
                      lag-id] system-priority system-priority
                    — no lag lag-id
                    — [no] shutdown
                — mc-ring
                    — [no] ring sync-tag
                        — in-band-control-path
                            — [no] debounce
                            — dst-ip ip-address
                            — no dst-ip
                            — interface ip-int-name
                            — no interface
                            — no max-debounce-time
                            — service-id service-id
                            — no service-id
                        — [no] path-b
                            — [no] range vlan-range
                        — [no] path-excl
                            — [no] range vlan-range
                        — [no] ring-node ring-node-name
                            — connectivity-verify
```

```
                        — dst-ip  ip-address
                        — no dst-ip
                        — interval interval
                        — no interval
                        — service-id service-id
                        — no service-id
                        — [no] shutdown
                        — src-ip ip-address
                        — no src-ip
                        — src-mac ieee-address
                        — no src-mac
                        — vlan [0..4094]
                        — no vlan
                    — [no] shutdown
            — [no] l3-ring sync-tag
                    — in-band-control-path
                        — [no] debounce
                        — dst-ip ip-address
                        — no dst-ip
                        — interface ip-int-name
                        — no interface
                        — max-debounce-time max-debounce-time
                        — no max-debounce-time
                        — service-id service-id
                        — no service-id
                    — [no] ring-node ring-node-name
                        — connectivity-verify
                            — dst-ip  ip-address
                            — no dst-ip
                            — interval interval
                            — no interval
                            — service-id service-id
                            — no service-id
                            — [no] shutdown
                            — src-ip ip-address
                            — no src-ip
                            — src-mac ieee-address
                            — no src-mac
                            — vlan [0..4094]
                            — no vlan
                        — [no] srrp-instance srrp-id
                        — [no] shutdown
        — [no] shutdown
        — source-address ip-address
        — no source-address
        — [no] sync
                — [no] igmp
                — [no] igmp-snooping
                — [no] ipsec
                — [no] local-dhcp-server
                — [no] mc-ring
                — [no] mld-snooping
                — port [port-id|lag-id] [sync-tag sync-tag] [create]
                — no port [port-id | lag-id]
                    — range encap-range [sync-tag sync-tag]
```

```
            — no range encap-range
— [no] shutdown
— [no] srrp
— [no] sub-host-trk
— [no] sub-mgmt
— tunnel-group tunnel-group-id sync-tag tag-name [create]
— no tunnel-group
```

Subscriber Management Service Commands

VPLS Subscriber Management Configuration Commands

```
config
    — service
        — [no] vpls service-id [customer customer-id] [vpn vpn-id] [m-vpls]
            — sap sap-id [split-horizon-group group-name] [create] [capture-sap]
            — no sap sap-id
                — arp-host
                    — host-limit max-num-hosts
                    — no host-limit
                    — min-auth-interval min-auth-interval
                    — no min-auth-interval
                    — [no] shutdown
                — diameter-auth-policy name
                — no diameter-auth-policy
                — host [ip ip-address [mac mac-address]} [subscriber-sap-id | subscriber
                  sub-ident-string [sub-profile sub-profile-name [sla-profile sla-profile-
                  name [ancp-string ancp-string] [app-profile app-profile-name] [inter-
                  dest-id intermediate-destination-id]
                — no host [ip ip-address [mac mac-address]
                — no host all
                — host-connectivity-verify source-ip ip-address [source-mac ieee-address]
                  [interval interval] [action {remove | alarm}]
                — [no] sub-sla-mgmt
                    — def-app-profile default-app-profile-name
                    — no def-app-profile
                    — def-sla-profile default-sla-profile-name
                    — no def-sla-profile
                    — def-sub-id string sub-ident-string
                    — def-sub-id use-sap-id
                    — no def-sub-id
                    — def-sub-profile default-sub-profile-name
                    — no def-sub-profile
                    — [no] mac-da-hashing
                    — multi-sub-sap number-of-sub
                    — no multi-sub-sap
                    — [no] shutdown
                    — single-sub-parameters
                        — non-sub-traffic sub-profile sub-profile-name sla-pro-
                          file sla-profile-name [subscriber sub-ident-string]
                        — no non-sub-traffic
                        — [no] profiled-traffic-only
                    — sub-ident-policy sub-ident-policy-name
                    — no sub-ident-policy
            — sap sap-id [create] capture-sap
                — ipoe-session
                    — description description-string
                    — no description
                    — ipoe-session-policy policy-name
                    — no ipoe-session-policy
                    — user-db local-user-db-name
                    — no user-db
```

— **[no] shutdown**

Managed SAP Policy Commands

```
config
    — subscriber-mgmt
        — msap-policy msap-policy-name [create]
        — no msap-policy msap-policy-name
            — cpu-protection policy-id [mac-monitoring ]
            — no cpu-protection
            — description description-string
            — no description
            — no dist-cpu-protection policy-name
            — ies-vprn-only-sap-parameters
                — anti-spoof {ip-mac | nh-mac}
                — no anti-spoof
            — igmp-host-tracking
                — expiry-time expiry-time
                — no expiry-time
                — import policy-name
                — no import policy-name
                — max-num-group max-num-groups
                — no max-num-group
                — max-num-sources max-num-sources
                — no max-num-sources
                — max-num-grp-sources [1..32000]
                — no max-num-grp-sources [1..32000]
            — lag-link-map-profile link-map-profile-id
            — no lag-link-map-profile
            — sub-sla-mgmt
                — def-app-profile app-profile-name
                — no def-app-profile
                — def-inter-dest-id {string string | use-top-q}
                — no def-inter-dest-id
                — def-sla-profile sla-profile-name
                — no def-sla-profile
                — def-sub-id use-sap-id
                — def-sub-id string sub-id
                — no def-sub-id
                — def-sub-profile sub-profile-name
                — no def-sub-profile
                — multi-sub-sap [limit limit]
                — no multi-sub-sap
                — single-sub-parameters
                    — non-sub-traffic sub-profile-name sla-profile sla-profile-name
                      [subscriber sub-ident-string] [app-profile app-profile-name]
                    — no non-sub-traffic
                    — [no] profiled-traffic-only
                — sub-ident-policy policy-name
                — no sub-ident-policy
            — vpls-only-sap-parameters
                — arp-host
                    — host-limit max-num-hosts
                    — no host-limit
                    — min-auth-interval min-auth-interval
                    — no min-auth-interval
                — arp-reply-agent [sub-ident]
```

- **no arp-reply-agent**
- **dhcp**
  - **lease-populate** [*nbr-of-leases*]
  - **no lease-populate**
  - [**no**] **option**
    - **action** *dhcp-action*
    - **no action**
    - **circuit-id** {**ascii-tuple** | **vlan-ascii-tuple**}
    - **remote-id** {**mac** | **string** *string*}
    - **no remote-id**
    - [**no**] **vendor-specific-option**
      - [**no**] **client-mac-address**
      - [**no**] **sap-id**
      - [**no**] **service-id**
      - [**no**] **string**
      - [**no**] **system-id**
  - **proxy-server**
    - **emulated-server** *ip-address*
    - **no emulated-server**
    - **lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] [**radius-override**]
    - **no lease-time**
    - [**no**] **shutdown**
- **egress**
  - **multicast-group** *group-name*
  - **no multicast-group**
- **igmp-snooping**
  - [**no**] **fast-leave**
  - **import** *policy-name*
  - **no import**
  - **last-member-query-interval** *interval*
  - **no last-member-query-interval**
  - **max-num-groups** *max-num-groups*
  - **no max-num-groups**
  - **mcac**
    - **mc-constraints**
      - **level** *level-id* **bw** *bandwidth*
      - **no level** *level-id*
      - **number-down** *number-lag-port-down* **level** *level-id*
      - **no number-down** *number-lag-port-down*
      - **policy** *policy-name*
      - **no policy**
      - **unconstrained-bw** *bandwidth* **mandatory-bw** *mandatory-bw*
      - **no unconstrained-bw**
  - **mvr**
    - **from-vpls** *service-id*
    - **no from-vpls**
  - **query-interval** *seconds*
  - **no query-interval**
  - **query-response-interval** *seconds*
  - **no query-response-interval**
  - **robust-count** *robust-count*
  - **no robust-count**

- [**no**] **send-queries**
- **version** *version*
- **no version**

- [**no**] **mac-da-hashing**
- **split-horizon-group** *group-name*
- **no split-horizon-group**

```
config
    — service
        — vpls
            — sap
                — default-msap-policy policy-name
                — no default-msap-policy
                — trigger-packet [dhcp] [pppoe] [arp] [dhcp6] [ppp]
                — no trigger-packet
            — eval-msap {policy msap-policy-name | msap sap-id}
```

VPRN Subscriber Interface Configuration Commands

```
config
    — service
        — vprn service-id [customer customer-id]
        — no vprn service-id
            — subscriber-interface ip-int-name [fwd-service service-id fwd-subscriber-interface ip-int-name] [create]
            — no subscriber-interface ip-int-name
                — address {ip-address/mask | ip-address netmask} [gw-ip-address ip-address] [populate-host-routes]
                — no address
                — [no] allow-unmatching-subnets
                — authentication-policy name
                — no authentication-policy
                — delayed-enable seconds [init-only]
                — no delayed-enable
                — description description-string
                — no description
                — dhcp
                    — client-applications {[dhcp] [pppoe]}
                    — no client-applications
                    — description description-string
                    — no description
                    — gi-address ip-address [src-ip-addr]
                    — no gi-address
                    — lease-populate [nbr-of-entries]
                    — no lease-populate
                    — [no] option
                        — [no] vendor-specific-option
                            — [no] client-mac-address
                            — [no] sap-id
                            — [no] service-id
                            — string text
                            — no string
                            — [no] system-id
                    — python-policy name
                    — no python-policy
                    — proxy-server
                        — emulated-server ip-address
                        — no emulated-server
                        — lease-time [days days] [hrs hours] [min minutes] [sec seconds] [override]
                        — no lease-time
                        — [no] shutdown
                    — relay-unicast-msg [release-update-src-ip]
                    — no relay-unicast-msg
                    — server server1 [server2...(up to 8 max)]
                    — no server
                    — [no] shutdown
                — [no] export-host-routes
                — [no] ipoe-linking
                    — [no] gratuitous-rtr-adv
                — [no] ipoe-session
                    — session-limit session-limit
```

```
            — no session-limit
      — ipv6
            — [no] allow-unmatching-prefixes
            — default-dns ipv6-address [secondary ipv6-address]
            — no default-dns
            — delegated-prefix-length bits
            — delegated-prefix-length variable
            — no delegated-prefix-length
            — link-local-address ipv6-address
            — no link-local-address
            — subscriber-prefixes
                  — prefix ipv6-address/prefix-length [pd] [wan-host]
                    track-srrp srrp-instance [holdup-time milli-seconds]
                  — no prefix ipv6-address/prefix-length
                  — prefix ipv6-address/prefix-length [pd] [wan-host]
            — [no] allow-multiple-wan-addresses
            — [no] dhcp6
                  — [no] override-slaac
                  — [no] pd-managed-route
                  — [no] proxy-server
                    — client-applications [dhcp] [ppp]
                    — no client-applications
                    — preferred-lifetime [days days] [hrs hours] [min
                      minutes] [sec seconds]
                    — preferred-lifetime infinite
                    — no preferred-lifetime
                    — valid-lifetime [days days] [hrs hours] [min min-
                      utes] [sec seconds]
                    — valid-lifetime infinite
                    — no valid-lifetime
                    — rebind-timer [days days] [hrs hours] [min min-
                      utes] [sec seconds]
                    — no rebind-timer
                    — renew-timer [days days] [hrs hours] [min min-
                      utes] [sec seconds]
                    — no renew-timer
                    — server-id duid-en hex hex-string
                    — server-id duid-en string ascii-string
                    — server-id duid-ll
                    — no server-id
                    — no shutdown
                    — python-policy name
                    — no python-policy
                      — [no] relay
                    — description description-string
                    — no description
                          — source-address ipv6-address
                          — no source-address
                          — link-address ipv6-address
                          — no link-address
                  — server ipv6-address [ipv6-address...(upto 8 max)]
                  — no server
                  — client-applications [dhcp] [ppp]
                  — no client-applications
                  — [no] shutdown
```

- [no] ipoe-bridged-mode
- [no] router-advertisements
  - current-hop-limit *limit*
  - no current-hop-limit
  - [no] dns-options
    - [no] include-dns
    - rdnss-lifetime *seconds*
    - rdnss-lifetime infinite
    - no rdnss-lifetime
  - force-mcast [ip] [mac]
  - no force-mcast
  - [no] managed-configuration
  - max-advertisement *seconds*
  - no max-advertisement
  - min-advertisement *seconds*
  - no min-advertisement
  - mtu *bytes*
  - no mtu
  - [no] other-stateful-configuration
  - [no] prefix-options
    - [no] autonomous
    - [no] on-link
    - preferred-lifetime *seconds*>
    - preferred-lifetime infinite
    - no preferred-lifetime
    - valid-lifetime *seconds*
    - valid-lifetime infinite
    - no valid-lifetime
  - reachable-time *milli-seconds*
  - no reachable-time
  - retransmit-time *milli-seconds*
  - no retransmit-time
  - router-lifetime *seconds*
  - router-lifetime no-default-router
  - no router-lifetime
  - [no] shutdown
- [no] router-solicit
  - inactivity-timer [days *days*] [hrs *hours*] [min *minutes*] [sec *seconds*]
  - inactivity-timer infinite
  - no inactivity-timer
- local-address-assignment
  - client-application [ppp-v4]
  - no client-application
  - default-pool *pool-name* [secondary *pool-name*]
  - no default-pool
  - server *server-name*
  - no server
  - [no] shutdown
- [no] private-retail-subnets
- [no] shutdown
- unnumbered [*ip-int-name*|*ip-address*]
- no unnumbered

VPRN Subscriber Interface, Group Interface Commands

```
config
    — service
        — vprn service-id [customer customer-id]
        — no vprn service-id
            — subscriber-interface ip-int-name [fwd-service service-id fwd-subscriber-inter-
              face ip-int-name] [create]
            — no subscriber-interface ip-int-name
                — group-interface ip-int-name [create]
                — group-interface ip-int-name [create] lns
                — group-interface ip-int-name [create] softgre
                — no group-interface ip-int-name
                    — arp-host
                        — host-limit max-num-hosts
                        — no host-limit
                        — min-auth-interval min-auth-interval
                        — no min-auth-interval
                        — sap-host-limit max-num-hosts-sap
                        — no sap-host-limit
                        — [no] shutdown
                    — [no] arp-populate
                    — arp-timeout seconds
                    — no arp-timeout
                    — authentication-policy  name
                    — no authentication-policy
                    — diameter-application-policy policy-name
                    — no diameter-application-policy
                    — diameter-auth-policy name
                    — no diameter-auth-policy
                    — description description-string
                    — no description
                    — dhcp
                        — client-applications {[dhcp] [pppoe]}
                        — no client-applications
                        — description description-string
                        — no description
                        — gi-address ip-address [src-ip-address]
                        — no gi-address
                        — lease-populate nbr-of-leases
                        — no lease-populate
                        — [no] match-circuit-id
                        — [no] option
                            — action {replace | drop | keep}
                            — no action
                            — circuit-id [ascii-tuple | ifindex | sap-id | vlan-
                              ascii-tupl]
                            — no circuit-id
                            — remote-id [mac | string string]
                            — no remote-id
                            — [no] vendor-specific-option
                                — [no] client-mac-address
                                — [no] sap-id
                                — [no] service-id
                                — string text
```

- no string
- [no] system-id
- proxy-server
- emulated-server *ip-address*
- no emulated-server
- lease-time [days *days*] [hrs *hours*] [min *minutes*] [sec *seconds*] [override]
- no lease-time
- [no] shutdown
- relay-unicast-msg [*release-update-src-ip*]
- no relay-unicast-msg
- server *server1* [*server2*...(up to 8 max)]
- no server
- [no] shutdown
- [no] trusted
- diameter-application-policy *policy-name*
- no diameter-application-policy
- [no] enable-ingress-stats
- host-connectivity-verify [interval *interval*] [action {remove|alarm}] [timeout *retry-timeout*] [retry-count *count*] [family *family*]
- host-limit *max-num-hosts*
- no host-limit
- host-connectivity-verify [interval *interval*] [action {remove|alarm}]
- icmp
- [no] mask-reply
- redirects [*number seconds*]
- no redirects
- ttl-expired *number seconds*]
- no ttl-expired
- unreachables [*number seconds*]
- no unreachables
- ingress
- policy-accounting *template-name*
- no policy-accounting
- ip-mtu *octets*
- no ip-mtu
- ipoe-linking
- [no] gratuitous-rtr-adv
- [no] gratuitous-rtr-adv
- [no] shutdown
- ipoe-session
- description *description-string*
- no description
- force-auth [cid-change] [rid-change]
- force-auth disabled
- no force-auth
- ipoe-session-policy *policy-name*
- no ipoe-session-policy
- min-auth-interval [days *days*] [hrs *hours*] [min *minutes*] [sec *seconds*]
- min-auth-interval infinite
- no min-auth-interval
- sap-session-limit *sap-session-limit*

```
                    — no sap-session-limit
                    — session-limit session-limit
                    — no session-limit
                    — user-db local-user-db-name
                    — no user-db
                    — [no] shutdown
          — [no] ipv6
                    — allow-multiple-wan-addresses
                    — no allow-multiple-wan-addresses
                    — dns-options
                    — no dns-options
                        — include-dns
                        — no include-dns
                        — rdnss-lifetime seconds
                        — rdnss-lifetime infinite
                        — no rdnss-lifetime
                    — [no] ipoe-bridged-mode
                    — router-solicit
                        — inactivity-timer [days days] [hrs hours] [min
                          minutes] [sec seconds]
                        — no inactivity-timer
                        — min-auth-interval [days days] [hrs hours] [min
                          minutes] [sec seconds]
                        — no min-auth-interval
                        — shutdown
                        — no shutdown
                        — user-db
                        — no user-db
          — local-address-assignment
                    — client-application [ppp-v4]
                    — no client-application
                    — default-pool pool-name [secondary pool-name]
                    — no default-pool
                    — ipv6
                        — client-application [ppp-slaac] [ipoe-wan] [ipoe-
                          slaac]
                        — no client-application
                        — server server-name
                        — no server
                    — server server-name
                    — no server
                    — [no] shutdown
          — [no] local-proxy-arp
          — [no] mac ieee-address
          — min-auth-interval min-auth-interval
          — no min-auth-interval
          — [no] oper-up-while-empty
          — policy-control diameter-policy-name
          — no policy-control
          — sap-host-limit max-num-hosts-sap
          — no sap-host-limit
          — [no] shutdown
          — [no] ppp
                    — description description-string
                    — no description
```

- **policy** *ppp-policy-name*
- **no policy**
- **session-limit** *session-limit*
- **no session-limit**
- [**no**] **shutdown**
- **user-db** *local-user-db-name*
- **no user-db**

— [**no**] **pppoe**

- **anti-spoof** *pppoe-anti-spoofing-type*
- **no anti-spoof**
- **description** *description-string*
- **no description**
- **dhcp-client**
  - [**no**] **ccag-use-origin-sap**
- **policy** *ppp-policy-name*
- **no policy**
- **sap-session-limit** *sap-session-limit*
- **no sap-session-limit**
- **session-limit** *session-limit*
- **no session-limit**
- [**no**] **shutdown**
- **user-db** *local-user-db-name*
- **no user-db**

— [**no**] **proxy-arp-policy** *policy-name* [*policy-name*...(up to 5 max)]
— [**no**] **qos-route-lookup**
— **redundant-interface** *red-ip-int-name*
— **no redundant-interface**
— [**no**] **remote-proxy-arp**
— [**no**] **sap** *sap-id*

- **accounting-policy** *acct-policy-id*
- **no accounting-policy** [*acct-policy-id*]
- **anti-spoof** {**ip** | **ip-mac** | **nh-mac**}
- **no anti-spoof**
- **app-profile** *app-profile-name*
- **no app-profile**
- **atm**
  - **egress**
    - **traffic-desc** *traffic-desc-profile-id*
    - **no traffic-desc**
  - **encapsulation** *atm-encap-type*
  - **ingress**
    - **traffic-desc** *traffic-desc-profile-id*
  - **oam**
    - [**no**] **alarm-cells**
    - [**no**] **periodic-loopback**
- [**no**] **calling-station-id**
- [**no**] **collect-stats**
- **cpu-protection** *policy-id* [**mac-monitoring**]
- **no cpu-protection**
- **default-host** *ip-address*/*mask* **next-hop** *next-hop-ip*
- **no default-host** *ip-address*/*mask*
- **description** *description-string*
- **no description**
- **egress**

- [no] agg-rate
  - [no] limit-unused-bandwidth
  - [no] queue-frame-based-accounting
  - rate {max | rate}
  - no rate
- filter ip *ip-filter-id*
- filter ipv6 *ipv6-filter-id*
- no filter [ip *ip-filter-id*] [ipv6 *ipv6-filter-id*]
- no filter
- [no] qinq-mark-top-only
- [no] qos *policy-id*
- scheduler-policy *scheduler-policy-name*
- no scheduler-policy

- host ip *ip-address* [mac *ieee-address*] [subscriber *sub-ident-string*] [sub-profile *sub-profile-name*] [sla-profile *sla-profile-name*] [ancp-string *ancp-string*]
- no host {[ip *ip-address*] [mac *ieee-address*]}
- no host all
- igmp-host-tracking
  - [no] disable-router-alert-check
  - expiry-time *expiry-time*
  - no expiry-time
  - import *policy-name*
  - no import
  - max-num-group *max-num-groups*
  - no max-num-group
  - max-num-sources *max-num-sources*
  - no max-num-sources
  - max-num-grp-sources [1..32000]
  - no max-num-grp-sources
- ingress
  - filter ip *ip-filter-id*
  - filter ipv6 *ipv6-filter-id*
  - no filter [ip *ip-filter-id*] [ipv6 *ipv6-filter-id*]
  - no filter
  - match-qinq-dot1p {top|bottom}
  - no match-qinq-dot1p
  - qos *policy-id* [shared-queuing]
  - no qos *policy-id*
  - scheduler-policy *scheduler-policy-name*
  - no scheduler-policy
- multi-service-site *customer-site-name*
- no multi-service-site
- static-host ip *ip/did-address* [mac *ieee-address*] [create]
- no static-host [ip *ip-address*] mac *ieee-address*
- no static-host all [force]
- no static-host ip *ip-address*
  - ancp-string *ancp-string*
  - no ancp-string
  - app-profile *app-profile-name*
  - no app-profile
  - inter-dest-id *intermediate-destination-id*
  - no inter-dest-id
  - managed-routes

- route {*ip-prefix/length* | *ip-prefix netmask*} [**create**]
- **no route** {*ip-prefix/length* | *ip-prefix netmask*}
- **retail-svc-id** *service-id*
- **no retail-svc-id**
- **rip-policy** *policy-name*
- **no rip-policy**
- [**no**] **shutdown**
- **sla-profile** *sla-profile-name*
- **no sla-profile**
- **sub-profile** *sub-profile-name*
- **no sub-profile**
- **subscriber** *sub-ident*
- **no subscriber**
- [**no**] **subscriber-sap-id**

static-host-mgmt

- [**no**] **mac-learning-options**
- [**no**] **data-triggered**
- [**no**] **single-mac**

[**no**] **shutdown**

[**no**] **sub-sla-mgmt**

- **def-app-profile** *default-app-profile-name*
- **no def-app-profile**
- **def-sla-profile** *default-sla-profile-name*
- **no def-sla-profile**
- **def-sub-id string** *sub-ident-string*
- **def-sub-id use-sap-id**
- **no def-sub-id**
- **def-sub-profile** *default-subscriber-profile-name*
- **no def-sub-profile**
- **multi-sub-sap** *subscriber-limit*
- **no multi-sub-sap**
- [**no**] **shutdown**

single-sub-parameters

- **non-sub-traffic** sub-profile *sub-profile-name* sla-profile *sla-profile-name* [subscriber *sub-ident-string*]
- **no non-sub-traffic**
- [**no**] **profiled-traffic-only**

sub-ident-policy *sub-ident-policy-name*

no sub-ident-policy

[**no**] **shutdown**

[**no**] **srrp** *srrp-id*

- **description** *description-string*
- **no description**
- **gw-mac** *mac-address*
- **no gw-mac**
- **keep-alive-interval** *interval*
- **no keep-alive-interval**
- **message-path** *sap-id*
- **no message-path**
- [**no**] **policy** *vrrp-policy-id*
- **priority** *priority*
- **no priority**
- [**no**] **shutdown**

- **srrp-enabled-routing** [**hold-time** *hold-time*]
- **no srrp-enabled-routing**
- **tos-marking-state** {**trusted** | **untrusted**}
- **no tos-marking-state**
- [**no**] **urpf-check**
- **wpp**
  - [**no**] **enable-triggered-hosts**
  - **initial-app-profile** *app-profile-name*
  - **no initial-app-profile**
  - **initial-sla-profile** *sla-profile-name*
  - **no initial-sla-profile**
  - **initial-sub-profile** *sub-profile-name*
  - **no initial-sub-profile**
  - **lease-time** [**days** *days*] [**hrs** hours] [**min** *minutes*] [**sec** *seconds*]
  - **no lease-time**
  - **portal router** *router-instance* **name** *wpp-portal-name*
  - **no portal**
  - **restore-disconnected** {**restore**|**no-restore**}
  - **no restore-disconnected**
  - **user-db** *local-user-db-name*
  - **no user-db**

IES Subscriber Management Configuration Commands


```
config
    — service
        — ies service-id [customer customer-id] [vpn vpn-id]
            — [no] interface ip-int-name
                — address {ip-address/mask | ip-address netmask} [gw-ip-address ip-address] [populate-host-routes]
                — no address
                — [no] allow-directed-broadcast
                — [no] arp-populate
                — arp-timeout seconds
                — no arp-timeout
                — cflowd [acl | interface]
                — no cflowd
                — description description-string
                — no description
                — dhcp
                    — client-applications {[dhcp] [pppoe]}
                    — no client-applications
                    — description description-string
                    — no description
                    — gi-address ip-address [src-ip-addr]
                    — no gi-address
                    — lease-populate nbr-of-leases
                    — no lease-populate
                    — [no] option
                        — action {replace | drop | keep}
                        — no action
                        — circuit-id [ascii-tuple | ifindex | sap-id]
                        — no circuit-id
                        — [no] remote-id
                    — [no] relay-plain-bootp
                    — relay-unicast-msg [release-update-src-ip]
                    — no relay-unicast-msg
                    — server server1 [server2...(up to 8 max)]
                    — no server
                    — [no] shutdown
                    — [no] trusted
                — host-connectivity-verify [source {vrrp|interface}] [interval interval] [action {remove | alarm}]
                — icmp
                    — [no] mask-reply
                    — redirects [number seconds]
                    — no redirects
                    — ttl-expired number seconds]
                    — no ttl-expired
                    — unreachables [number seconds]
```

```
                        — no unreachables
                    — [no] local-proxy-arp
                    — [no] loopback
                    — [no] mac ieee-address
                    — [no] proxy-arp-policy policy-name [policy-name...(up to 5 max)]
                    — [no] remote-proxy-arp
                    — [no] sap sap-id
```

IES Subscriber Interface Commands

```
config
    — service
        — ies service-id [customer customer-id] [vpn vpn-id]
            — [no] subscriber-interface ip-int-name [fwd-service service-id fwd-subscriber-
              interface ip-int-name] [create]
                — [no] address {ip-address/mask | ip-address netmask}
                — [no] allow-unmatching-subnets
                — delayed-enable seconds [init-only]
                — no delayed-enable
                — description description-string
                — no description
                — [no] export-host-routes
                — dhcp
                    — gi-address ip-address [src-ip-addr]
                    — no gi-address
                    — relay-unicast-msg [release-update-src-ip]
                    — no relay-unicast-msg
                — ipoe-linking
                    — [no] gratuitous-rtr-adv
                    — [no] gratuitous-rtr-adv
                    — [no] shutdown
                — [no] ipoe-session
                    — session-limit session-limit
                    — no session-limit
                — ipv6
                    — [no] allow-unmatching-subnets
                    — [no] allow-unmatching-prefixes
                    — default-dns ipv6-address [secondary ipv6-address]
                    — no default-dns
                    — [no] allow-unmatching-prefixes
                    — default-dns ipv6-address [secondary ipv6-address]
                    — no default-dns
                    — delegated-prefix-length bits
                    — delegated-prefix-length variable
                    — no delegated-prefix-length
                    — link-local-address ipv6-address
                    — no link-local-address
                    — subscriber-prefixes
                        — prefix ipv6-address/prefix-length [pd] [wan-host]
                          track-srrp srrp-instance [holdup-time milli-seconds]
                        — no prefix ipv6-address/prefix-length
                        — prefix ipv6-address/prefix-length [pd] [wan-host]
                    — [no] allow-multiple-wan-addresses
                    — [no] dhcp6
                        — [no] override-slaac
```

- [**no**] **pd-managed-route**
- [**no**] **proxy-server**
  - **client-applications** [**dhcp**] [**ppp**]
  - **no client-applications**
  - **preferred-lifetime** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
  - **preferred-lifetime infinite**
  - **no preferred-lifetime**
  - **valid-lifetime** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
  - **valid-lifetime infinite**
  - **no valid-lifetime**
  - **rebind-timer** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
  - **no rebind-timer**
  - **renew-timer** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
  - **no renew-timer**
  - **server-id duid-en hex** *hex-string*
  - **server-id duid-en string** *ascii-string*
  - **server-id duid-ll**
  - **no server-id**
  - **no shutdown**
  - **python-policy** *name*
  - **no python-policy**
    - [**no**] **relay**
  - **description** *description-string*
  - **no description**
    - **source-address** *ipv6-address*
    - **no source-address**
    - **link-address** *ipv6-address*
    - **no link-address**
  - **server** *ipv6-address* [*ipv6-address...*(upto 8 max)]
  - **no server**
  - **client-applications** [**dhcp**] [**ppp**]
  - **no client-applications**
  - [**no**] **shutdown**
- [**no**] **ipoe-bridged-mode**
- [**no**] **router-advertisements**
  - **current-hop-limit** *limit*
  - **no current-hop-limit**
  - [**no**] **dns-options**
    - [**no**] **include-dns**
    - **rdnss-lifetime** *seconds*
    - **rdnss-lifetime infinite**
    - **no rdnss-lifetime**
  - **force-mcast** [**ip**] [**mac**]
  - **no force-mcast**
  - [**no**] **managed-configuration**
  - **max-advertisement** *seconds*
  - **no max-advertisement**
  - **min-advertisement** *seconds*
  - **no min-advertisement**
  - **mtu** *bytes*
  - **no mtu**

```
                                        — [no] other-stateful-configuration
                                        — [no] prefix-options
                                            — [no] autonomous
                                            — [no] on-link
                                            — preferred-lifetime seconds>
                                            — preferred-lifetime infinite
                                            — no preferred-lifetime
                                            — valid-lifetime seconds
                                            — valid-lifetime infinite
                                            — no valid-lifetime
                                        — reachable-time milli-seconds
                                        — no reachable-time
                                        — retransmit-time milli-seconds
                                        — no retransmit-time
                                        — router-lifetime seconds
                                        — router-lifetime no-default-router
                                        — no router-lifetime
                                        — [no] shutdown
                                    — [no] router-solicit
                                        — inactivity-timer [days days] [hrs hours] [min
                                          minutes] [sec seconds]
                                        — inactivity-timer infinite
                                        — no inactivity-timer
                — local-address-assignment
                        — client-application [ppp-v4]
                        — no client-application
                        — default-pool pool-name [secondary pool-name]
                        — no default-pool
                        — server server-name
                        — no server
                        — [no] shutdown
                        — ipv6
                                — client-application [ppp-slaac] [ipoe-wan] [ipoe-
                                  slaac]
```

IES Subscriber Interface Group Interface Commands

```
config
    — service
            — ies service-id [customer customer-id] [vpn vpn-id]
                    — [no] subscriber-interface ip-int-name
                            — [no] group-interface ip-int-name
                                    — arp-host
                                            — host-limit max-num-hosts
                                            — no host-limit
                                            — min-auth-interval min-auth-interval
                                            — no min-auth-interval
                                            — sap-host-limit max-num-hosts-sap
                                            — no sap-host-limit
                                            — [no] shutdown
                                    — [no] arp-populate
                                    — arp-timeout seconds
                                    — no arp-timeout
```

```
— authentication-policy name
— no authentication-policy
— description description-string
— no description
— dhcp
        — client-applications dhcp
        — description description-string
        — no description
        — filter filter-id
        — no filter
        — gi-address ip-address  [src-ip-addr]
        — no gi-address
        — lease-populate nbr-of-leases
        — no lease-populate
        — [no] match-circuit-id
        — option
            — action {replace | drop | keep}
            — no action
            — circuit-id [ascii-tuple | ifindex | sap-id]
            — no circuit-id
            — [no] remote-id
            — [no] vendor-specific-option
                — [no] client-mac-address
                — [no] sap-id
                — [no] service-id
                — string text
                — no string
                — [no] system-id
        — relay-unicast-msg [release-update-src-ip]
        — no relay-unicast-msg
        — server server1 [server2...(up to 8 max)]
        — no server
        — [no] shutdown
        — [no] trusted
— diameter-application-policy policy-name
— no diameter-application-policy
— diameter-auth-policy name
— no diameter-auth-policy
— host-connectivity-verify [interval interval] [action {remove |
  alarm}]
— icmp
        — [no] mask-reply
        — redirects [number seconds]
        — no redirects
        — ttl-expired number seconds]
        — no ttl-expired
        — unreachables [number seconds]
        — no unreachables
— ip-mtu octets
— no ip-mtu
— ipoe-linking
        — [no] gratuitous-rtr-adv
        — [no] gratuitous-rtr-adv
        — [no] shutdown
— ipoe-session
```

- description *description-string*
- no description
- force-auth [cid-change] [rid-change]
- force-auth disabled
- no force-auth
- ipoe-session-policy *policy-name*
- no ipoe-session-policy
- min-auth-interval [days *days*] [hrs *hours*] [min *minutes*] [sec *seconds*]
- min-auth-interval infinite
- no min-auth-interval
- sap-session-limit *sap-session-limit*
- no sap-session-limit
- session-limit *session-limit*
- no session-limit
- user-db *local-user-db-name*
- no user-db
- [no] shutdown

- local-address-assignment
  - client-application [ppp-v4]
  - no client-application
  - default-pool *pool-name* [secondary *pool-name*]
  - no default-pool
  - [no] ipv6
    - client-application [ppp-v4]
    - no client-application
    - server *server-name*
    - no server
  - server *server-name*
  - no server
  - [no] shutdown
- [no] local-proxy-arp
- [no] loopback
- [no] mac *ieee-address*
- [no] oper-up-while-empty
- [no] pppoe
  - description *description-string*
  - no description
  - ppp-policy *pppoe-policy-name*
  - no ppp-policy
  - sap-session-limit *sap-session-limit*
  - no sap-session-limit
  - session-limit *session-limit*
  - no session-limit
  - [no] shutdown
- [no] proxy-arp-policy *policy-name* [*policy-name*...(up to 5 max)]
- [no] remote-proxy-arp
- router-advertisement
  - ipv6
    - dns-options
    - no dns-options
      - include-dns
      - no include-dns
      - rdnss-lifetime *seconds*

```
                    — rdnss-lifetime infinite
                    — no rdnss-lifetime
— [no] sap sap-id
        — accounting-policy acct-policy-id
        — no accounting-policy [acct-policy-id]
        — anti-spoof {ip |  ip-mac | nh-mac}
        — no anti-spoof
        — atm
            — egress
                — traffic-desc traffic-desc-profile-id
                — no traffic-desc
            — encapsulation atm-encap-type
            — ingress
                — traffic-desc traffic-desc-profile-id
            — oam
                — [no] alarm-cells
                — [no] periodic-loopback
        — [no] calling-station-id
        — [no] collect-stats
        — cpu-protection [mac-monitoring] | [eth-cfm-moni-
          toring [aggregate][car]]
        — no cpu-protection
        — default-host ip-address/mask next-hop next-hop-ip
        — no default-host ip-address/mask
        — description description-string
        — no description
        — egress
            — [no] agg-rate
                — [no] limit-unused-bandwidth
                — [no] queue-frame-based-accounting
                — rate {max | rate}
                — no rate
            — filter ip ip-filter-id
            — filter
            — no filter ip ip-filter-id
            — no filter
            — qos policy-id
            — no qos
            — [no] queue-override
                — [no] queue queue-id
                    — adaptation-rule [pir {max | min | clos-
                      est}] [cir {max | min | closest}]
                    — no adaptation-rule
                    — avg-frame-overhead percentage
                    — no avg-frame-overhead
                    — cbs size-in-kbytes
                    — no cbs
                    — high-prio-only percent
                    — no high-prio-only
                    — mbs {size-in-kbytes | default}
                    — no mbs
                    — rate  pir-rate [cir cir-rate]
                    — no rate
            — scheduler-policy scheduler-policy-name
            — no scheduler-policy
```

- **host ip** *ip-address* [**mac** *ieee-address*] [**subscriber** *sub-ident-string*] [**sub-profile** *sub-profile-name*] [**sla-profile** *sla-profile-name*]
- **no host** {[**ip** *ip-address*] [**mac** *ieee-address*]}
- **no host all**
- **ingress**
  - **filter ip** *ip-filter-id*
  - **no filter**
  - **match-qinq-dot1p** {**top**|**bottom**}
  - **no match-qinq-dot1p**
  - **qos** *policy-id* [**shared-queuing**]
  - **no qos**
  - **scheduler-policy** *scheduler-policy-name*
  - **no scheduler-policy**
- [**no**] **multi-service-site** *customer-site-name*
- **static-host ip** *ip/did-address* [**mac** *ieee-address*] [**create**]
- **static-host mac** *ieee-address* [**create**]
- **no static-host** [**ip** *ip-address*] **mac** *ieee-address*
- **no static-host all** [**force**]
- **no static-host ip** *ip-address*
  - **ancp-string** *ancp-string*
  - **no ancp-string**
  - **app-profile** *app-profile-name*
  - **no app-profile**
  - **inter-dest-id** *intermediate-destination-id*
  - **no inter-dest-id**
  - **managed-routes**
    - [**no**] **route** {*ip-prefix*/*length*|*ip-prefix net-mask*}
    - [**no**] **route** *ipv6-prefix*/*prefix-length* [**metric** *metric-value*]
  - **rip-policy** *policy-name*
  - **no rip-policy**
  - [**no**] **shutdown**
  - **sla-profile** *sla-profile-name*
  - **no sla-profile**
  - **sub-profile** *sub-profile-name*
  - **no sub-profile**
  - **subscriber** *sub-ident*
  - **no subscriber**
  - [**no**] **subscriber-sap-id**
- [**no**] **shutdown**

- [**no**] **sub-sla-mgmt**
  - [**no**] **sub-sla-mgmt**
    - **def-app-profile** *default-app-profile-name*
    - **no def-app-profile**
    - **def-sla-profile** *default-sla-profile-name*
    - **no def-sla-profile**
    - **def-sub-id string** *sub-ident-string*
    - **def-sub-id use-sap-id**
    - **no def-sub-id**
    - **def-sub-profile** *default-subscriber-profile-name*
    - **no def-sub-profile**
    - **multi-sub-sap** *subscriber-limit*

```
                    — no multi-sub-sap
                    — [no] shutdown
                    — single-sub-parameters
                        — non-sub-traffic sub-profile sub-profile-name sla-profile sla-profile-name [subscriber sub-ident-string]
                        — no non-sub-traffic
                        — [no] profiled-traffic-only
                    — sub-ident-policy sub-ident-policy-name
                    — no sub-ident-policy
            — [no] shutdown
            — [no] srrp srrp-id
                    — bfd-enable
                    — description description-string
                    — no description
                    — gw-mac mac-address
                    — no gw-mac
                    — keep-alive-interval interval
                    — no keep-alive-interval
                    — message-path sap-id
                    — no message-path
                    — [no] policy vrrp-policy-id
                    — priority priority
                    — no priority
                    — [no] shutdown
            — srrp-enabled-routing [hold-time hold-time]
            — no srrp-enabled-routing
            — tos-marking-state {trusted | untrusted}
            — no tos-marking-state
            — [no] urpf-check
            — wpp
                    — [no] enable-triggered-hosts
                    — initial-app-profile app-profile-name
                    — no initial-app-profile
                    — initial-sla-profile sla-profile-name
                    — no initial-sla-profile
                    — initial-sub-profile sub-profile-name
                    — no initial-sub-profile
                    — lease-time [days days] [hrs hours] [min minutes] [sec seconds]
                    — no lease-time
                    — portal router router-instance name wpp-portal-name
                    — no portal
                    — restore-disconnected {restore|no-restore}
                    — no restore-disconnected
                    — user-db local-user-db-name
                    — no user-db
```

Service Subscriber Interface, Group Interface IPoE Commands

```
config
    — service
            — vprn service-id [customer customer-id]
```

- **no vprn** *service-id*
- **ies** *service-id* [**customer** *customer-id*]
- **no ies** *service-id*
  - **subscriber-interface** *ip-int-name* [**fwd-service** *service-id* **fwd-subscriber-interface** *ip-int-name*] [**create**]
  - **no subscriber-interface** *ip-int-name*
    - **group-interface** *ip-int-name* [**create**]
    - **group-interface** *ip-int-name* [**create**] **lns**
    - **group-interface** *ip-int-name* [**create**] **softgre**
    - **no group-interface** *ip-int-name*
      - [**no**] **ipoe-session**
        - **description** *description-string*
        - **no description**
        - **force-auth** [**cid-change**] [**rid-change**]
        - **force-auth disabled**
        - **no force-auth**
        - **ipoe-session-policy** *policy-name*
        - **no ipoe-session-policy**
        - **min-auth-interval** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec seconds**]
        - **min-auth-interval infinite**
        - **no min-auth-interval**
        - **sap-session-limit** *sap-session-limit*
        - **no sap-session-limit**
        - **session-limit** *session-limit*
        - **no session-limit**
        - [**no**] **shutdown**
        - **user-db** *local-user-db-name*
        - **no user-db**

RIP Commands

```
configure
    — subscriber-mgmt
        — rip-policy policy policy-name [create]
        — no rip-policy policy-name
            — authentication-key authentication-key|hash-key [hash|hash2]
            — no authentication-key
            — authentication-type {none|password|message-digest|message-digest-20}
            — no authentication-type
            — description description-string
            — no description
        — local-user-db local-user-db-name [create]
        — no local-user-db local-user-db-name
            — ppp
                — host host-name [create]
                — no host host-name
                    — rip-policy policy-name
                    — no rip-policy
            — ipoe
                — host host-name [create]
                — no host host-name
                    — rip-policy policy-name
                    — no rip-policy
```

```
configure
    — service
        — ies|vprn
            — [no] subscriber-interface ip-int-name
                — [no] group-interface ip-int-name
                    — [no] sap sap-id
                        — static-host ip ip/did-address [mac ieee-address] [cre-
                          ate]
                        — static-host mac ieee-address [create]
                        — no static-host [ip ip-address] mac ieee-address
                        — no static-host all [force]
                        — no static-host ip ip-address
                          — rip-policy policy-name
                          — no rip-policy
        — vprn
            — [no] rip
                — [no] group name
                    — [no] neighbor ip-int-name
configure
    — router
        — [no] rip
            — [no] group name
                — [no] neighbor ip-int-name
```

VPort Commands

Refer to the SR OS Interfaces Guide for further information on card, Media Dependent Adapter (MDA), MCM (MDA Carrier Module), CMA (Compact Media Adapter) and port provisioning.

config
- **port** *port-id*
  - **ethernet**
    - **access**
      - **egress**
        - **vport** *vport-name* [**create**]
        - **no vport** *vport-name*
          - **agg-rate-limit** *limit*
          - **no agg-rate-limit**
          - **description** *description-string*
          - **no description**
          - [**no**] **egress-rate-modify**
          - **host-match dest** *string* [**create**]
          - **no host-match dest** *string*
          - **port-scheduler-policy** *port-scheduling-policy-name*
          - **no port-scheduler-policy**
          - **scheduler-policy** *scheduler-policy-name*
          - **no scheduler-policy**

Redundant Interface Commands

```
config
    — service
        — ies
            — [no] redundant-interface ip-int-name
                — address {ip-address/mask | ip-address netmask} [remote-ip ip-address]
                — no address
                — [no] description description-string
                — [no] shutdown
                — [no] spoke-sdp sdp-id:vc-id
                    — egress
                        — filter [ip ip-filter-id]
                        — vc-label ingress-vc-label
                        — no vc-label [ingress-vc-label]
                    — ingress
                        — filter [ip ip-filter-id]
                        — no filter
                        — vc-label ingress-vc-label
                        — no vc-label [ingress-vc-label]
                    — [no] shutdown
config
    — service
        — vprn
            — [no] redundant-interface ip-int-name
                — address {ip-address/mask | ip-address netmask} [remote-ip ip-address]
                — no address
                — [no] description description-string
                — [no] shutdown
                — [no] spoke-sdp sdp-id:vc-id
                    — egress
                        — filter [ip ip-filter-id]
                        — vc-label ingress-vc-label
                        — no vc-label [ingress-vc-label]
                    — ingress
                        — filter [ip ip-filter-id]
                        — no filter
                        — vc-label ingress-vc-label
                        — no vc-label [ingress-vc-label]
                    — [no] shutdown
```

```
config
    — service
        — sdp sdp-id [gre | mpls]
        — no sdp sdp-id
            — binding
                — port [port-id | lag-id]
                — no port
                — pw-port pw-port-id [vc-id vc-id] [create]
                — no pw-port pw-port-id
                    — description description-string
                    — no description
                    — egress
```

```
                                        — shaper
                                            — int-dest-id int-dest-id
                                            — no int-dest-id int-dest-id
                                            — vport vport-name
                                            — no vport vport-name
                                    — encap-type {dot1q|qinq}
                                    — no encap-type
                                    — [no] shutdown
                                    — vc-type {ether | vlan}
                                    — no vc-type
                                    — vlan-vc-tag vlan-id
                                    — no vlan-vc-tag
```

```
config
    — service
            — ies service-id [customer customer-id] [vpn vpn-id]
            — vprn service-id [customer customer-id]
            — no vprn service-id
                    — interface ip-int-name [create] [tunnel]
                    — no interface ip-int-name
                            — [no] ipv6
                                    — [no] urpf-check
                                            — mode {strict | loose | strict-no-ecmp}
                                            — no mode
                    — [no] subscriber-interface ip-int-name
                            — group-interface ip-int-name [create]
                            — group-interface ip-int-name [create] lns
                            — group-interface ip-int-name [create] softgre
                            — no group-interface ip-int-name
                                    — [no] ipv6
                                            — [no] urpf-check
                                                — mode {strict | loose | strict-no-ecmp}
                                                — no mode
```

Wireless Portal Protocol (WPP) Commands

```
config
    — router
        — wpp
            — portals
                — portal wpp-portal-name address ip-address [create]
                — portal wpp-portal-name
                — no portal wpp-portal-name
                    — [no] shutdown
                — [no] shutdown
config
    — service
        — vprn service-id [customer customer-id]
        — no vprn service-id
            — wpp
                — portals
                    — portal wpp-portal-name address ip-address [create]
                    — portal wpp-portal-name
                    — no portal wpp-portal-name
                        — [no] shutdown
                — [no] shutdown
```

```
config
    — service
        — ies service-id [customer customer-id] [vpn vpn-id]
        — vprn service-id [customer customer-id]
        — no vprn service-id
            — [no] subscriber-interface ip-int-name
                — group-interface ip-int-name [create]
                — no group-interface ip-int-name
                    — wpp
                        — [no] enable-triggered-hosts
                        — initial-app-profile app-profile-name
                        — no initial-app-profile
                        — initial-sla-profile sla-profile-name
                        — no initial-sla-profile
                        — initial-sub-profile sub-profile-name
                        — no initial-sub-profile
                        — lease-time [days days] [hrs hours] [min minutes] [sec seconds]
                        — no lease-time
                        — portal router router-instance name wpp-portal-name
                        — no portal
                        — restore-disconnected {restore|no-restore}
                        — no restore-disconnected
                        — [no] shutdown
                        — user-db local-user-db-name
                        — no user-db
                        — [no] shutdown
```

```
config
    — subscriber-mgmt
        — local-user-db local-user-db-name [create]
        — no local-user-db local-user-db-name
            — dhcp
                — host host-name [create]
                — no host host-name
                    — wpp
                        — initial-app-profile app-profile-name
                        — no initial-app-profile
                        — initial-sla-profile sla-profile-name
                        — no initial-sla-profile
                        — initial-sub-profile sub-profile-name
                        — no initial-sub-profile
                        — lease-time [days days] [hrs hours] [min minutes] [sec
                          seconds]
                        — no lease-time
                        — portal router router-instance name wpp-portal-name
                        — no portal
                        — restore-disconnected {restore|no-restore}
                        — no restore-disconnected
```

Multiple PPoE Session QoS Commands

```
config
    — qos
        —     sap-egress policy-id
            — parent-location {default | sla}
            — no parent-location

    — scheduler-policy name [create]
        — tier 1
            — parent-location {none | sub | vport}
            — no parent-location

config
    — port
        — ethernet
            — access
                — egress
                    — vport name
                        — scheduler-policy scheduler-policy-name

config
    — subscr-mgmt
        — sla-prof
            — egress$
                — scheduler-policy scheduler-policy-name
                    — scheduler scheduler-name rate pir-rate [cir cir-rate]

configure
    — subscriber-mgmt
        — authentication-policy name
            — include-radius-attribute
                — [no] sap-session-index
```

Multicast Listener Discovery (MLD) Commands

For more information about MLD commands, refer to the SR OS Routing Protocols Guide.

```
config
    — subscr-mgmt
        — mld-policy mld-policy-name [create]
        — no mld-policy mld-policy-name
            — description description-string
            — no description
            — egress-rate-modify agg-rate-limit
            — egress-rate-modify scheduler scheduler-name
            — no egress-rate-modify
            — [no] fast-leave
            — import policy-name
            — no import
            — max-num-groups max-num-groups
            — no max-num-groups
            — max-num-grp-sources [1..32000]
            — no max-num-grp-sources
            — max-num-sources max-num-sources
            — no max-num-sources
            — [no] per-host-replication
            — redirection-policy policy-name
            — no redirection-policy
            — static
                — [no] group grp-ipv6-address
                    — [no] source ipv6-address
                    — [no] starg
            — version version
            — no version
```

Show Commands

```
show
    — service
        — active-subscribers detail
        — active-subscribers mirror
        — active-subscribers [summary]
            — credit-control credit-control [subscriber sub-ident-string]
            — credit-control out-of-credit [action action] [summary]
            — filter [subscriber sub-ident-string] [origin origin]
            — hierarchy [subscriber sub-ident-string]
            — host-tracking [subscriber sub-ident-string]
            — host-tracking [subscriber sub-ident-string] detail
            — host-tracking [subscriber sub-ident-string] summary
            — host-tracking [subscriber sub-ident-string] statistics
                — groups [group group-ip-address]
                — groups group group-ip-address] detail
                — groups group group-ip-address] summary
            — igmp [subscriber sub-ident-string][detail]
            — subscriber sub-ident-string
            — subscriber sub-ident-string detail
            — subscriber sub-ident-string mirror
            — subscriber sub-ident-string sap sap-id sla-profile sla-profile-name
            — subscriber sub-ident-string sap sap-id sla-profile sla-profile-name detail
            — subscriber sub-ident-string sap sap-id sla-profile sla-profile-name mirror
        — id service-id
            — arp-host [wholesaler service-id] [sap sap-id | interface interface-name | ip-address
              ip-address[/mask] | mac ieee-address | {[port port-id] [no-inter-dest-id | inter-
              dest-id inter-dest-id]}] [detail]
            — arp-host statistics [sap sap-id | interface interface-name]
            — arp-host summary [interface interface-name]
            — authentication
                — statistics
            — dhcp
                — lease-state [wholesaler service-id] [sap sap-id | sdp sdp-id:vc-id | inter-
                  face interface-name | ip-address ip-address[/mask] | chaddr ieee-address |
                  mac ieee-address | {[port port-id] [no-inter-dest-id | inter-dest-id inter-
                  dest-id]}] [detail]
                — statistics [sap sap-id] | [ sdp [sdp-id[:vc-id] ]]
                — summary
            — retailers
            — wholesalers
            — subscriber-hosts [sap sap-id] [ip ip-address[/mask]] [mac ieee-address] [sub-pro-
              file sub-profile-name] [sla-profile sla-profile-name] [detail]
            — gsmp
                — neighbors group [name] [ip-address]
                — sessions [group name] neighbor ip-address] [ port port-number] [associ-
                  ation] [statistics]
            — host [sap sap-id] [wholesaler service-id] [port port-id] [inter-dest-id intermediate-
              destination-id] [detail]
            — host [sap sap-id] [wholesaler service-id] [port port-id] no-inter-dest-id [detail]
            — host summary
            — host [detail] wholesaler service-id (VPRN only)
            — interface [{[ip-address|ip-int-name] [interface-type] [detail] [family]}|summary]
```

```
                    — ipoe session [sap sap-id] [mac ieee-address] [circuit-id circuit-id] [remote-id
                      remote-id] [interface ip-int-name|ip-address] [inter-dest-id intermediate-destina-
                      tion-id] [no-inter-dest-id] [ip-address ip-prefix[/prefix-length]] [port port-id] [sub-
                      scriber sub-ident-string] [sap-session-id sap-session-index] [wholesaler service-id]
                    — ipoe session [sap sap-id] [mac ieee-address] [circuit-id circuit-id] [remote-id
                      remote-id] [interface ip-int-name|ip-address] [inter-dest-id intermediate-destina-
                      tion-id] [no-inter-dest-id] [ip-address ip-prefix[/prefix-length]] [port port-id] [sub-
                      scriber sub-ident-string] [sap-session-id sap-session-index] [wholesaler service-id]
                      detail
            — sdp sdp-id pw-port [pw-port-id]
            — sdp sdp-id pw-port
            — sdp sdp-id pw-port [pw-port-id] [statistics]
            — sdp [consistent | inconsistent | na] egressifs
            — sdp sdp-id keep-alive-history
            — sdp far-end ip-address | ipv6-address keep-alive-history
            — sdp [sdp-id] detail
            — sdp far-end ip-address | ipv6-address detail
            — subscriber-using [service-id service-id] [sap-id sap-id] [interface ip-int-name] [ip ip-
              address[/mask]] [mac ieee-address] [sub-profile sub-profile-name] [sla-profile sla-profile-
              name] [app-profile app-profile-name]

show
    — pw-port
            — pw-port [pw-port-id] [detail]
            — pw-port sdp [sdp-id]
            — pw-port sdp none

show
    — qos
            — port-scheduler-policy [port-scheduler-policy-name] [association]
            — port-scheduler-policy port-scheduler-policy-name network-policy network-queue-policy-
              name
            — port-scheduler-policy port-scheduler-policy-name sap-egress policy-id
            — port-scheduler-policy port-scheduler-policy-name scheduler-policy scheduler-policy-name
            — port-scheduler-policy port-scheduler-policy-name scheduler-policy scheduler-policy-name
              sap-egress policy-id
            — sap-egress [policy-id] [association|detail]
            — sap-ingress [policy-id] [association | match-criteria | detail]
            — scheduler-hierarchy
                    — customer customer-id site customer-site-name [scheduler scheduler-name]
                      [ingress|egress] [detail]
                    — port port-id vport name [scheduler scheduler-name] [detail]
                    — sap sap-id [scheduler scheduler-name] [ingress|egress] [detail]
                    — subscriber sub-ident-string [scheduler scheduler-name] [ingress|egress] [detail]
                    — subscriber sub-ident-string sla-profile sla-profile-name sap sap-id [scheduler
                      scheduler-name] [detail]
            — scheduler-name scheduler-name
            — scheduler-policy [scheduler-policy-name] [association|sap-ingress policy-id|sap-egress pol-
              icy-id]
            — scheduler-stats
```

```
                    — customer customer-id site customer-site-name [scheduler scheduler-name]
                      [ingress|egress] [detail]
                    — vport port-id vport name [scheduler scheduler-name]
                    — sap sap-id [scheduler scheduler-name] [ingress|egress] [detail]
                    — sla-profile sub-ident-string sla-profile-name sap sap-id [scheduler
                      scheduler-name]
            — shared-queue shared-queue-policy-name [detail]

show
    — redundancy
            — multi-chassis all
            — multi-chassis mc-lag
            — multi-chassis sync
                    — mc-ipsec addr [tunnel-group grp-id]
                    — mc-ring peer ip-address statistics
                    — mc-ring peer ip-address [ring sync-tag [detail|statistics] ]
                    — mc-ring peer ip-address ring sync-tag ring-node [ring-node-name [detail|statis-
                      tics] ]
                    — mc-ring global-statistics


show
    — router
            — wpp
            — wpp [portal wpp-portal-name] [host ip-address] hosts
            — wpp portal wpp-portal-name
            — wpp statistics
show
    — aaa
            — radius-configuration

show
    — subscriber-mgmt
            — ancp-string [policy-name]
            — ancp-string policy-name association
            — ancp-string
            — ancp-string ancp-string
            — ancp-string customer customer-id site customer-site-name
            — ancp-string sap sap-id
            — authentication policy-name association
            — authentication [policy-name]
            — authentication [policy-name] statistics
            — authentication coa-statistics
            — diameter-application-policy [name]
            — explicit-subscriber-map
            — host-lockout-policy
            — host-lockout-policy policy-name association
            — host-lockout-policy policy-name
            — host-lockout-policy policy-name all
            — host-lockout-policy policy-name sap sap-id [circuit-id | mac | remote-id]
            — igmp-policy
            — igmp-policy policy-name association
            — igmp-policy policy-name
            — ipoe-session-policy ipoe-session-policy-name association
```

- **ipoe-session-policy**
- **local-user-db** *local-user-db-name* **association** [**dhcp**] [**ppp**] [**l2tp**] [**radius**] [**pppoe**] [**dhcp6**] [**capture-sap**] [**rtr-solicit**] [**wpp**] [**ipoe**]
- **local-user-db** *local-user-db-name* **ipoe-host** *ipoe-host-name*
- **local-user-db** *local-user-db-name* **ipoe-all-hosts**
- **local-user-db** *local-user-db-name* **ipoe-unmatched-hosts**
- **local-user-db** [*local-user-db-name*]
- **local-user-db** *local-user-db-name* **ppp-all-hosts**
- **local-user-db** *local-user-db-name* **ppp-host** *pppoe-host-name*
- **local-user-db** *local-user-db-name* **ppp-unmatched-hosts**
- **msap-policy** [*msap-policy-name* [**association**]]
- **sla-profile** [*sla-profile-name* [**association**]]
- **statistics iom** (*slot* | **all**) [**host**|**session**|**subscriber**|**summary**] [**non-zero-value-only**]
- **statistics mda** (*mda* | **all**) [**host**|**session**|**subscriber**|**summary**] [**non-zero-value-only**]
- **statistics port** (*port-id* | **all**) [**host**|**session**|**subscriber**|**summary**] [**non-zero-value-only**]
- **statistics pw-port** (*pw-port* | **all**) [**host**|**session**|**subscriber**|**summary**] [**non-zero-value-only**]
- **statistics system** [**host**|**session**|**subscriber**|**summary**] [**non-zero-value-only**]
- **sub-ident-policy** [*sub-ident-policy-name* [**association**]]
- **sub-ident-policy** *sub-ident-policy-name* **script** {**primary** | **secondary** | **tertiary**}
- **sub-profile** [*sub-profile-name* [**association**]]

Monitor Commands

monitor
- **service**
  - **subscriber** *sub-ident-string* **sap** *sap-id* **sla-profile** *sla-profile-name* [**base** | **ingress-queue-id** *ingress-queue-id* | **egress-queue-id** *egress-queue-id*] [**interval** *seconds*] [**repeat** *repeat*] [**absolute** | **rate**]

Clear Commands

clear
- **subscriber-mgmt**
  - **ancp**
    - **ancp-sub-string** *string*
  - **authentication** [*policy-name*]
  - **authentication coa-statistics**
  - **msap-policy** *msap-policy-name*
  - **peakvalue-stats iom** (*slot* | **all**) [**recursive**]
  - **peakvalue-stats mda** (*mda* | **all**) [**recursive**]
  - **peakvalue-stats port** (*port-id* | **all**)
  - **peakvalue-stats pw-port** (*pw-port* | **all**)
  - **peakvalue-stats system** [**recursive**]
  - **radius-accounting** [*policy-name*]
- **service**
  - **id** *service-id*
    - **arp-host**
    - **arp-host** { **mac** *ieee-address* | **sap** *sap-id* | **ip-address** *ip-address*[/*mask*] }
    - **arp-host** [**port** *port-id*] [**inter-dest-id** *intermediate-destination-id* | **no-inter-dest-id**]
    - **arp-host statistics** [**sap** *sap-id* | **interface** *interface-name*]
    - **authentication**
      - **statistics**
    - **ipoe session** [**sap** *sap-id*] [**interface** *ip-int-name*|*ip-address*] [**mac** *ieee-address*] [**circuit-id** *circuit-id*] [**remote-id** *remote-id*] [**inter-dest-id** *intermediate-destination-id*] [**no-inter-dest-id**] [**ip-address** *ip-prefix*[/*prefix-length*]] [**port** *port-id*] [**subscriber** *sub-ident-string*] [**sap-session-id** *sap-session-index*]
    - **ipoe session all**
    - **msap** *msap-id*
    - **msap-policy** *msap-policy-name*
  - **statistics**
    - **subscriber** *sub-ident-string*
  - **qos**
    - **scheduler-stats**
      - **sla-profile** *sub-ident-string* **sla-profile** *sla-profile-name* **sap** *sap-id* [**scheduler** *scheduler-name*]

clear
- **router**
  - **srrp**
    - **interface** *subscriber-interface* [**id** *srrp-id*]
    - **statistics interface** *subscriber-interface* [**id** *srrp-id*]

clear
- **aaa**
  - **route-downloader** *name* [**vprn** *vprn*] [**family** *family*]

Debug Commands

```
debug
    — [no] diameter
        — dest-realm realm
        — no dest-realm
        — detail-level level
        — no diameter-peer
        — diameter-peer peer [psm-events]
        — no diameter-peer-policy
        — diameter-peer-policy policy
        — message-type [ccr] [cca] [cer] [cea] [dwr] [dwa] [dpr] [dpa] [rar] [raa] [asr] [asa] [aar]
          [aaa]
        — message-type all
        — no message-type
        — origin-realm realm
        — no origin-realm


debug
    — service
        — id service-id
            — arp
            — [no] arp-host
            — one-time-http-redirection
            — [no] ppp
                — [no] circuit-id circuit-id
                — [no] event
                    — dhcp-client [terminate-only]
                    — no dhcp-client
                    — l2tp [terminate-only]
                    — no l2tp
                    — local-address-assignment [terminate-only]
                    — no local-address-assignment
                    — ppp [terminate-only]
                    — no ppp
                — [no] mac ieee-address
                — [no] msap msap-id
                — [no] packet
                    — detail-level {low|medium|high}
                    — no detail-level
                    — [no] dhcp-client
                    — discovery [padi] [pado] [padr] [pads] [padt]
                    — no discovery
                    — mode {dropped-only|ingr-and-dropped|egr-ingr-and-
                      dropped}
                    — no mode
                    — ppp [lcp] [pap] [chap] [ipcp] [ipv6cp]
                    — no ppp
                — [no] remote-id remote-id
                — [no] sap sap-id
                — [no] username username
            —
    — subscriber-mgmt
```

- [**no** **authentication** [**policy** *policy-name*] [**mac-addr** *ieee-address*] [**circuit-id** *circuit-id*]
- [**no** **sub-ident-policy** *policy-name*
  - **script-all-info**
  - [**no**] **script-compile-error**
  - [**no**] **script-export-variables**
  - [**no**] **script-output**
  - [**no**] **script-output-on-error**
  - [**no**] **script-runtime-error**

router

- [**no**] **srrp**
  - [**no**] **events** [**interface** *ip-int-name*]
  - [**no**] **packets** [**interface** *ip-int-name*]
- [**no**] **radius**
  - **detail-level** {**low**|**medium**|**high**}
  - **no detail-level**
  - **packet-type** [**authentication**] [**accounting**] [**coa**]
  - **no packet-type**
  - **radius-attr type** *attribute*-type [**transaction**]
  - **radius-attr type** *attribute*-type [**transaction**] {**address**|**hex**|**integer**|**string**} **value** *attribute-value*
  - **radius-attr vendor** *vendor-id* **type** *attribute-type* [**transaction** *encoding-type*]
  - **radius-attr vendor** *vendor-id* **type** *attribute-type* [**transaction** *encoding-type*] {**address**|**hex**|**integer**|**string**} **value** *attribute-value*
  - **no radius-attr type** *attribute-type*
  - **no radius-attr type** *attribute-type* {**address**|**hex**|**integer**|**string**} **attribute-value**
  - **no radius-attr vendor** *vendor-id* **type** *attribute-type*
  - **no radius-attr vendor** *vendor-id* **type** *attribute-type* {**address** |**string**} **value** *attribute-value*
  - [**no**] **server-address** *ip-address*
- [**no**] **wpp**
  - [**no**] **packet**
    - **detail-level** *detail-level*
  - [**no**] **portal** *wpp-portal-name*
    - [**no**] **packet**
      - **detail-level** *detail-level*

Tools Commands

```
tools
    — dump
        — redundancy
            — multi-chassis
                — force-switchover tunnel-group local-group-id
                — mc-ipsec
                — mc-ring
                — srrp-sync-data [instance instance-id] [peer ip-address]
                — srrp-sync-data pppoe
                — srrp-sync-data dhcp pppoe
                — sync-database [peer ip-address] [port port-id | lag-id] [sync-tag sync-tag] [application {dhcps|igmp|igmp-snooping|mc-ring|srrp|sub-mgmt|mld-snooping}] [detail] [type {alarm-deleted|local-deleted}]
    — perform
        — aaa
            — route-downloader start [force]
        — persistence
            — downgrade target-version target [reboot]
        — subscriber-mgmt
            — credit-reset sap sap-id subscriber sub-ident-string sla-profile sla-profile-name {category category-name|all-categories}
            — credit-reset sap sap-id ip ip-address {category category-name| all-categories}
            — credit-reset svc service-id ip ip-address {category category-name| all-categories}
            — edit-ipoe-session sap sap-id mac mac-address [subscriber sub-ident-string] [sub-profile-string sub-profile-string] [sla-profile-string sla-profile-string] [inter-dest-id intermediate-destination-id] [ancp-string ancp-string] [app-profile-string app-profile-string] [circuit-id circuit-id] [remote-id remote-id]
            — eval-ipoe-session [svc-id service-id] [sap sap-id] [mac mac-address] [circuit-id circuit-id] [remote-id remote-id] [subscriber sub-ident-string]
            — eval-lease-state sap sap-id ip ip-address [subscriber sub-ident-string] [sub-profile-string sub-profile-string] [sla-profile-string sla-profile-string] [app-profile-string app-profile-string] [inter-dest-id intermediate-destination-id] [ancp-string ancp-string]
            — eval-lease-state svc-id service-id ip ip-address [subscriber sub-ident-string] [sub-profile-string sub-profile-string] [sla-profile-string sla-profile-string] [app-profile-string app-profile-string] [inter-dest-id intermediate-destination-id] [ancp-string ancp-string]
            — re-ident-sub old-sub-ident-string to new-sub-ident-string
```

Triple Play Subscriber Management Configuration Commands

Generic Commands

description

Syntax **description** *description-string*
no description

Context config>subscr-mgmt>authentication-policy
config>subscr-mgmt>host-tracking
config>subscr-mgmt>pim-policy
config>subscr-mgmt>sla-profile
config>subscr-mgmt>sla-profile>egress>ip-filter>entry
config>subscr-mgmt>sla-profile>ingress>ip-filter>entry
config>subscr-mgmt>sub-ident-policy
config>subscr-mgmt>sub-profile
config>subscr-mgmt>mld-policy
config>service>vpls>gsmp>group
config>log>accounting-policy
config>service>vprn>redundant-interface
config>service>ies>redundant-interface
config>service>ies>subscriber-interface
config>service>ies>subscriber-interface>group-interface
config>service>ies>subscriber-interface>grp-if>dhcp
config>service>ies>sub-if>grp-if>srrp
config>service>vprn>subscriber-interface
config>service>vprn>sub-if>dhcp
config>service>vprn>subscriber-interface>group-interface
config>service>vprn>subscriber-interface>grp-if>sap
config>service>vprn>sub-if>grp-if>srrp
config>service>vprn>subscriber-interface>grp-if>dhcp
config>service>vprn>gsmp>group
config>service>vprn>gsmp>group>neighbor
config>service>vprn>sub-if>grp-if>ipoe-session
config>redundancy>multi-chassis>peer
config>subscr-mgmt>cat-map
config>subscr-mgmt>ipoe-session-policy
config>service>vpls>sap> ipoe-session
config>sub-mgmt>diameter-policy
config>sub-mgmt>credit-control-policy
config>sub-mgmt>host-lockout>policy
config>subscr-mgmt>sub-mcac-policy
config>aaa>route-downloader
config>aaa>diam-peer-pol
config>port>ethernet>access>egress
config>subscr-mgmt>cat-map>category
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6

Description This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the context in the configuration file.

The **no** form of this command removes any description string from the context.

Default No description is associated with the configuration context.

Parameters *description-string* — A text string describing the entity. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

shutdown

Syntax [**no**] **shutdown**

Context
config>subscr-mgmt>sub-ident-policy>primary
config>subscr-mgmt>sub-ident-policy>secondary
config>subscr-mgmt>sub-ident-policy>tertiary
config>service>vpls>sap>sub-sla-mgmt
config>service>vpls>gsmp
config>service>vpls>gsmp>group
config>service>vpls>gsmp>group>neighbor
config>service>vprn>redundant-interface
config>service>vprn>redundant-interface>spoke-sdp
config>service>vprn>subscriber-interface
config>service>vprn>subscriber-interface>group-interface
config>service>vprn>subscriber-interface>grp-if>dhcp
config>service>vprn>sub-if>grp-if>srrp
config>service>ies>subscriber-interface
config>service>ies>subscriber-interface>grp-if>dhcp
config>service>ies>sub-if>grp-if>srrp
config>service>ies>redundant-interface
config>service>ies>sub-if>grp-if>arp-host
config>service>vprn>gsmp>group>neighbor
config>service>ies>sub-if>grp-if>wpp
config>service>vprn>sub-if>grp-if>wpp
config>service>vprn>sub-if>grp-if>wpp>portals
config>redundancy>multi-chassis>peer
config>redundancy>multi-chassis>peer>mc-lag
config>redundancy>multi-chassis>peer>sync
config>service>ies>sub-if>dhcp
config>subscr-mgmt>sub-mcac-policy
config>aaa>route-downloader
configure>aaa>diam-peer-pol>peer

Description The **shutdown** command administratively disables the entity. When disabled, an entity does not change, reset, or remove any configuration settings or statistics. Many entities must be explicitly enabled using the **no shutdown** command.

The **shutdown** command administratively disables an entity. The operational state of the entity is disabled as well as the operational state of any entities contained within. Many objects must be shut down before they can be deleted.

Unlike other commands and parameters where the default state is not indicated in the configuration file, **shutdown** and **no shutdown** are always indicated in system generated configuration files.

Shutting down a subscriber interface will operationally shut down all child group interfaces and SAPs. Shutting down a group interface will operationally shut down all SAPs that are part of that group-interface.

The **no** form of the command puts an entity into the administratively enabled state.

Default no shutdown

subscriber-mgmt

Syntax **subscriber-mgmt**

Context config

Description This command enables the context to configure subscriber management entities. A subscriber is uniquely identified by a subscriber identification string. Each subscriber can have several DHCP sessions active at any time. Each session is referred to as a subscriber host and is identified by its IP address and MAC address.

All subscriber hosts belonging to the same subscriber are subject to the same hierarchical QoS (HQoS) processing. The HQoS processing is defined in the **sub-profile** (the subscriber profile). A sub-profile refers to an existing scheduler policy (configured in **the configure>qos>scheduler-policy** context) and offers the possibility to overrule the rate of individual schedulers within this policy.

Because all subscriber hosts use the same scheduler policy instance, they must all reside on the same complex.

ANCP and GSMP Commands

ancp

Syntax **ancp**

Context config>subscr-mgmt
config>subscr-mgmt>sub-prof

Description This command enables the context to configure Access Node Control Protocol (ANCP) parameters.

ancp-policy

Syntax **ancp-policy** *name*

Context config>subscr-mgmt>ancp

Description This command creates an Access Node Control Protocol (ANCP) policy. The policy is associated with either the ANCP string (static case) or subscriber-profile (dynamic case) and defines the behavior of the hosts belonging to these profiles.

ANCP polices control rates and subscribers based on port-up/port-down messages from the access node. When configured, the 7750 SR should stop SHCV to a host that is part of a port defined to be down (by port-down message). When the node receives a port-up message for a port that was in port-down, state the node will initiate the SHCV process immediately to verify connectivity.

When ANCP is used with Enhanced Subscriber Management, the ANCP string last associated with the subscriber will be used. All hosts of a subscriber will be updated with the new ANCP string.

Default No policies are defined.

Parameters *name* — Configures the ANCP policy name.

ancp-policy

Syntax **ancp-policy** *name*

Context config>subscr-mgmt>sub-prof>ancp

Description This command specifies an existing Access Node Control Protocol (ANCP) policy to associate with the subscriber profile. The policy is associated with either the ANCP string (static case) or subscriber-profile (dynamic case) and defines the behavior of the hosts belonging to these profiles.

Default No policies are defined.

Parameters *name* — Specifies an existing ANCP policy name.

ingress

Syntax **ingress**

Context config>subscr-mgmt>sla-prof>ingress
config>subscr-mgmt>ancp>ancp-policy

Description This command configures ingress ANCP policy parameters.

rate-adjustment

Syntax **rate-adjustment** *adjusted-percent*
no rate-adjustment

Context config>subscr-mgmt>ancp>ancp-policy>ingress
config>subscr-mgmt>ancp>ancp-policy>egress

Description This command configures a rate adjustment for the scheduler. The **rate-adjustment** command should be used when the rate returned by the DSLAM is calculated with different encapsulation than the 7750 SR. The node will adjust the rate by the percent specified as:

DSLAM_RATE*adjust-rate/100 — rate-reduction.

The **no** form of the command returns the default value.

Default none

Parameters *adjusted-percent* — Specifies a rate adjustment for the scheduler.

Values 1 — 200

Default 100

rate-reduction

Syntax **rate-reduction** *kilobit-per-second*
no rate-reduction

Context config>subscr-mgmt>ancp>ancp-policy>ingress
config>subscr-mgmt>ancp>ancp-policy>egress

Description This command defines a constant rate reduction to the rate specified by the DSLAM. The **rate-reduction** command should be used if the node should adjust the rate to a value that is offset (for example by a fixed multicast dedicated bandwidth) compared to the total available on the DSLAM.

When set, the rate will be:

DSLAM_RATE*adjust-rate/100 — rate-reduction

Default none

rate-monitor

Syntax **rate-monitor** *kilobit-per-second* [**alarm**]
no rate-monitor

Context config>subscr-mgmt>ancp>ancp-policy>ingress
config>subscr-mgmt>ancp>ancp-policy>egress

Description This command configures the rate monitor level.

Default none

Parameters *kilobit-per-second* — Specifies the rate, in kilobits, below which the system will generate an event.

alarm — When the monitored rate is below the configured value the system generates an alarm (trap) to the management system. The trap includes the rate as well as the ANCP policy name and the ANCP string.

rate-modify

Syntax **rate-modify** {**scheduler** *scheduler-name* | **arbiter** *arbiter-name*}
no rate-modify

Context config>subscr-mgmt>ancp>ancp-policy>ingress

Description This command configures ingress rate modify scheduler parameters.

Default none

Parameters **scheduler** *scheduler-name* **—** Specifies a scheduler name.

arbiter *arbiter-name* **—** Specifies an arbiter name

egress

Syntax **egress**

Context config>subscr-mgmt>ancp>ancp-policy

Description This command configures egress ANCP policy parameters.

rate-modify

Syntax **rate-modify** {**scheduler** *scheduler-name* | **arbiter** *arbiter-name*}
rate-modify agg-rate-limit
no rate-modify

Context config>subscr-mgmt>ancp>ancp-policy>egress

Description This command configures egress rate modify scheduler parameters.

Default none

Parameters **agg-rate-limit —** specifies that the maximum total rate for all subscriber egress queues for each subscriber associated with the policy.

scheduler *scheduler-name* — Specify a scheduler name.

arbiter *arbiter-name* **—** Specifies an arbiter name

port-down

Syntax [**no**] **port-down**

Context config>subscr-mgmt>ancp>ancp-policy

Description This command specifies the number of GSMP portdown messages received in this ANCP session.

disable-shcv

Syntax [**no**] **disable-shcv** [**alarm**] [**hold-time** *seconds*]

Context config>subscr-mgmt>ancp>ancp-policy>port-down

Description When this command is configured, the node will suspend SHCV for the hosts defined with this ANCP policy until the access node sends a port-up message. When the hold-time parameter is used, the node will suspend SHCV for the period of time defined. If the hold-time parameter is not defined the node will suspend SHCV until a port-up message is received.

If the optional alarm flag is used the node should send a SHCV alarm before suspending.

Default no disable-shcv

ancp-static-map

Syntax **ancp-static-map**

Context config>subscr-mgmt>ancp

Description This command enables the context to configure a static ANCP name map.

Default ancp-static-map

entry

Syntax **entry key** *ancp-string* **customer** *customer-id* **multi-service-site** *customer-site-name* **ancp-policy** *policy-name*
entry key *ancp-string* **sap** *sap-id* **ancp-policy** *policy-name*
no entry key *ancp-string* **customer** *customer-id* **multi-service-site** *customer-site-name*
no entry key *ancp-string* **sap** *sap-id*

Context config>subscr-mgmt>ancp>static-map

Description This command configures an ANCP name. When ANCP is configured to provide rate adaptation without the use of enhanced subscriber management, this command will define how to map an ANCP key (usually the circuit-id of the DSLAM port) to either a SAP and a scheduler name (when a Multi-Service Site (MSS) is not used) or a customer, site and scheduler name when MSS is used.

Different ANCP names may be used with the same SAPs or customer ID/MSS combinations to allow schedulers within the policy to be mapped to the ANCP names. An ANCP string and SAP combination may reference only one ancp-policy. An ANCP string and customer and site-name combination may reference a single ancp-policy.

Default none

Parameters **key** *ancp-string* — Specify the ASCII representation of the DSLAM circuit-id name.

customer *customer-id* — Specify the associated existing customer name.

multi-service-site *customer-site-name* — Specify the associated customer's configured MSS name.

ancp-policy *policy-name* — Specify an existing ANCP policy name.

sap *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

VPRN GSMP Configuration Commands

gsmp

Syntax **gsmp**

Context config>service>vpls
config>service>vprn

Description This command enables the context to configure GSMP connections maintained in this service.

Default not enabled

group

Syntax [**no**] **group** *name*

Context config>service>vpls>gsmp
config>service>vprn>gsmp

Description This command specifies a GSMP name. A GSMP group name is unique only within the scope of the service in which it is defined.

ancp

Syntax **ancp**

Context config>service>vpls>gsmp>group
config>service>vprn>gsmp>group

Description This command configures ANCP parameters for this GSMP group.

dynamic-topology-discover

Syntax [**no**] **dynamic-topology-discover**

Context config>service>vpls>gsmp>group>ancp
config>service>vprn>gsmp>group>ancp

Description This command enables the ANCP dynamic topology discovery capability.

The **no** form of this command disables the feature.

oam

Syntax **[no] oam**

Context config>service>vpls>gsmp>group>ancp
config>service>vprn>gsmp>group>ancp

Description This command specifies whether or not the GSMP ANCP OAM capability should be negotiated at startup of the GSMP connection.

The **no** form of this command disables the feature.

hold-multiplier

Syntax **hold-multiplier** *multiplier*
no hold-multiplier

Context config>service>vpls>gsmp
config>service>vprn>gsmp

Description This command configures the hold-multiplier for the GSMP connections in this group.

Parameters *multiplier* — Specifies the GSMP hold multiplier value.

Values 1 — 100

idle-filter

Syntax **[no] idle-filter**

Context config>service>vpls>gsmp>group
config>service>vprn>gsmp>group

Description This command when applied will filter out new incoming ANCP messages while subscriber "DSL-line-state" is IDLE. The command takes effect at the time that it is applied. Existing subscriber already in IDLE state are not purged from the database.

Default no idle-filter

keepalive

Syntax **keepalive** *seconds*
no keepalive

Context config>service>vpls>gsmp>group
config>service>vprn>gsmp>group

Description This command configures keepalive values for the GSMP connections in this group.

Parameters *seconds* — Specifies the GSMP keepalive timer value in seconds.

Values 1 — 25

neighbor

Syntax **neighbor** *ip-address* [create]
no neighbor *ip-address*

Context config>service>vpls>gsmp>group
config>service>vprn>gsmp>group

Description This command configures a GSMP ANCP neighbor.

Parameters *ip-address* — Specifies the IP address of the GSMP ANCP neighbor.

local-address

Syntax **local-address** *ip-address*
no local-address

Context config>service>vpls>gsmp>group>neighbor
config>service>vprn>gsmp>group>neighbor

Description This command configures the source ip-address used in the connection towards the neighbor. The local address is optional. If specified the node will accept connections only for that address in the service running ANCP. The address may be created after the reference but connections will not be accepted until it is created. If the local address is not used, the system accepts connections on any interface within the routing context.

Parameters *ip-address* — Specifies the source IP address to be used in the connection toward the neighbor.

priority-marking

Syntax **priority-marking dscp** *dscp-name*
priority-marking prec *ip-prec-value*
no priority-marking

Context config>service>vpls>gsmp>group>neighbor
config>service>vprn>gsmp>group>neighbor

Description This command configures the type of priority marking to be used.

Parameters **dscp** *dscp-name* — Specifies the DSCP code-point to be used.

Values be, cp1, cp2, cp3, cp4, cp5, cp6, cp7, cs1, cp9, af11, cp11, af12, cp13, af13, cp15, cs2, cp17, af21, cp19, af22, cp21, af23, cp23, cs3, cp25, af31, cp27, af32, cp29, af33, cp31, cs4, cp33, af41, cp35, af42, cp37, af43, cp39, cs5, cp41, cp42, cp43, cp44, cp45, ef, cp47, nc1, cp49, cp50, cp51, cp52, cp53, cp54, cp55, nc2, cp57, cp58, cp59, cp60, cp61, cp62, cp63

prec *ip-prec-value* — Specifies the precedence value to be used.

Values 0 — 7

persistency-database

Syntax [**no**] **persistency-**database

Context config>service>vpls>gsmp>group
config>service>vprn>gsmp>group

Description This command enables the system to store DSL line information in memory. If the GSMP connection terminates, the DSL line information will remain in memory and accessible for RADIUS authentication and accounting.

Default no persistency-database

BGP Peering Policy Commands

bgp-peering-policy

Syntax **bgp-peering-policy** *policy-name* [**create**]
no bgp-peering-policy *policy-name*

Context config>subscr-mgmt

Description This command configures the name of the BGP peering policy.

Parameters *policy-name* — Specifies the BGP peer policy name up to 32 characters in length.

advertise-inactive

Syntax [**no**] **advertise-inactive**

Context config>subscr-mgmt>bgp-prng-plcy

Description This command enables or disables the advertising of inactive BGP routers to other BGP peers.

By default, BGP only advertises BGP routes to other BGP peers if a given BGP route is chosen by the route table manager as the most preferred route within the system and is active in the forwarding plane. This command allows system administrators to advertise a BGP route even though it is not the most preferred route within the system for a given destination.

Default no advertise-inactive

aggregator-id-zero

Syntax [**no**] **aggregator-id-zero**

Context config>subscr-mgmt>bgp-prng-plcy

Description This command is used to set the router ID in the BGP aggregator path attribute to zero when BGP aggregates routes. This prevents different routers within an AS from creating aggregate routes that contain different AS paths.

When BGP is aggregating routes, it adds the aggregator path attribute to the BGP update messages. By default, BGP adds the AS number and router ID to the aggregator path attribute.

When this command is enabled, BGP adds the router ID to the aggregator path attribute. The **no** form of the command used at the global level reverts to default where BGP adds the AS number and router ID to the aggregator path attribute.

Default no aggregator-id-zero — BGP adds the AS number and router ID to the aggregator path attribute.

as-override

Syntax **[no] as-override**

Context config>subscr-mgmt>bgp-prng-plcy

Description This command replaces all instances of the peer's AS number with the local AS number in a BGP route's AS_PATH.

This command breaks BGP's loop detection mechanism. It should be used carefully.

Default as-override is not enabled by default.

auth-keychain

Syntax **auth-keychain** *name*
no auth-keychain

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the BGP authentication key for all peers.

The keychain allows the rollover of authentication keys during the lifetime of a session.

Default no auth-keychain

Parameters *name* — Specifies the name of an existing keychain, up to 32 characters, to use for the specified TCP session or sessions.

authentication-key

Syntax **authentication-key** [*authentication-key* | *hash-key*] [**hash** | **hash2**]
no authentication-key

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the BGP authentication key.

Authentication is performed between neighboring routers before setting up the BGP session by verifying the password. Authentication is performed using the MD-5 message-based digest. The authentication key can be any combination of letters or numbers from 1 to 16.

The no form of the command removes the authentication password from the configuration and effectively disables authentication.

Default Authentication is disabled and the authentication password is empty.

Parameters *authentication-key* — The authentication key. The key can be any combination of ASCII characters up to 255 characters in length (unencrypted). If spaces are used in the string, enclose the entire string in quotation marks (“ ”).

hash-key — The hash key. The key can be any combination of ASCII characters up to 342 characters in length (encrypted). If spaces are used in the string, enclose the entire string in quotation marks (“ ”).

This is useful when a user must configure the parameter, but, for security purposes, the actual unencrypted key value is not provided.

hash — Specifies the key is entered in an encrypted form. If the **hash** parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form. If the **hash2** parameter is not used, the less encrypted **hash** form is assumed.

cluster

Syntax **cluster** *cluster-id*
no cluster

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the cluster ID for a route reflector server.

Route reflectors are used to reduce the number of IBGP sessions required within an AS. Normally, all BGP speakers within an AS must have a BGP peering with every other BGP speaker in an AS. A route reflector and its clients form a cluster. Peers that are not part of the cluster are considered to be non-clients.

When a route reflector receives a route, first it must select the best path from all the paths received. If the route was received from a non-client peer, then the route reflector sends the route to all clients in the cluster. If the route came from a client peer, the route reflector sends the route to all non-client peers and to all client peers except the originator.

For redundancy, a cluster can have multiple route reflectors.

Confederations can also be used to remove the full IBGP mesh requirement within an AS.

The **no** form of the command deletes the cluster ID and effectively disables the Route Reflection for the given group.

Default no cluster — No cluster ID is defined.

Parameters *cluster-id* — The route reflector cluster ID is expressed in dot decimal notation.

Values Any 32 bit number in dot decimal notation. (0.0.0.1 — 255.255.255.255)

connect-retry

Syntax **connect-retry** *seconds*
no connect-retry

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the BGP connect retry timer value in seconds.

When this timer expires, BGP tries to reconnect to the configured peer.

The **no** form of the command used at the global level reverts to the default value.

Default 120 seconds

Parameters *seconds* — The BGP Connect Retry timer value in seconds, expressed as a decimal integer.

Values 1 — 65535

damping

Syntax [**no**] **damping**

Context config>subscr-mgmt>bgp-prng-plcy

Description This command enables BGP route damping for learned routes which are defined within the route policy. Use damping to reduce the number of update messages sent between BGP peers and reduce the load on peers without affecting the route convergence time for stable routes. Damping parameters are set via route policy definition.

The **no** form of the command used at the global level disables route damping.

When damping is enabled and the route policy does not specify a damping profile, the default damping profile is used. This profile is always present and consists of the following parameters:

Half-life: 15 minutes
Max-suppress: 60 minutes
Suppress-threshold:3000
Reuse-threshold 750

Default no damping — Learned route damping is disabled.

disable-4byte-asn

Syntax [**no**] **disable-4byte-asn**

Context config>subscr-mgmt>bgp-prng-plcy

Description This command disables the use of 4-byte ASNs. It can be configured at all 3 level of the hierarchy so it can be specified down to the per peer basis.

If this command is enabled 4-byte ASN support should not be negotiated with the associated remote peer(s).

The **no** form of the command resets the behavior to the default which is to enable the use of 4-byte ASN.

disable-client-reflect

Syntax [**no**] **disable-client-reflect**

Context config>subscr-mgmt>bgp-prng-plcy

Description This command disables the reflection of routes by the route reflector to the group or neighbor. This only disables the reflection of routes from other client peers. Routes learned from non-client peers are still reflected to all clients.

The **no** form re-enables client reflection of routes.

Default no disable-client-reflect — Client routes are reflected to all client peers.

disable-communities

Syntax **disable-communities** [**standard**] [**extended**]
no disable-communities

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures BGP to disable sending communities.

Parameters **standard —** Specifies standard communities that existed before VPRNs or 2547.

extended — Specifies BGP communities used were expanded after the concept of 2547 was introduced, to include handling the VRF target.

disable-fast-external-failover

Syntax [**no**] **disable-fast-external-failover**

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures BGP fast external failover.

export

Syntax **export** *policy* [*policy...*]
no export

Context config>subscr-mgmt>bgp-prng-plcy

Description This command specifies the export policies to be used to control routes advertised to BGP neighbors.

When multiple policy names are specified, the policies are evaluated in the order they are specified. A maximum of five (5) policy names can be configured. The first policy that matches is applied.

Note that if a non-existent route policy is applied to a VPRN instance, the CLI generates a warning message. This message is only generated at an interactive CLI session and the route policy association is made. No warning message is generated when a non-existent route policy is applied to a VPRN instance in a configuration file or when SNMP is used.

The **no** form of this command removes all route policy names from the export list.

Default no export — BGP advertises routes from other BGP routes but does not advertise any routes from other protocols unless directed by an export policy.

Parameters *policy* — A route policy statement name.

hold-time

Syntax **hold-time** *seconds*
no hold-time

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the BGP hold time, expressed in seconds.

The BGP hold time specifies the maximum time BGP waits between successive messages (either keepalive or update) from its peer, before closing the connection.

Even though the router OS implementation allows setting the keepalive time separately, the configured keepalive timer is overridden by the hold-time value under the following circumstances:

1. If the specified hold-time is less than the configured keepalive time, then the operational keepalive time is set to a third of the hold-time; the configured keepalive time is not changed.
2. If the hold-time is set to zero, then the operational value of the keepalive time is set to zero; the configured keepalive time is not changed. This means that the connection with the peer is up permanently and no keepalive packets are sent to the peer.

The **no** form of the command used at the global level reverts to the default value.

Default 90 seconds

Parameters *seconds* — The hold-time, in seconds, expressed as a decimal integer. A value of 0 indicates the connection to the peer is up permanently.

Values 0, 3 — 65535

import

Syntax **import** *policy* [*policy...*]
no import

Context config>subscr-mgmt>bgp-prng-plcy

Description This command specifies the import policies to be used to control routes advertised to BGP neighbors. Route policies are configured in the **config>router>policy-options** context. When multiple policy names are specified, the policies are evaluated in the order they are specified. A maximum of five (5)policy names can be specified. The first policy that matches is applied.

The **no** form of this command removes all route policy names from the import list.

Default no import — BGP accepts all routes from configured BGP neighbors. Import policies can be used to limit or modify the routes accepted and their corresponding parameters and metrics.

Parameters *policy* — A route policy statement name.

keepalive

Syntax **keepalive** *seconds*
no keepalive

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the BGP keepalive timer. A keepalive message is sent every time this timer expires.

The keepalive value is generally one-third of the hold-time interval. Even though the OS implementation allows the keepalive value and the hold-time interval to be independently set, under the following circumstances, the configured keepalive value is overridden by the hold-time value:

If the specified keepalive value is greater than the configured hold-time, then the specified value is ignored, and the keepalive is set to one third of the current hold-time value.

If the specified hold-time interval is less than the configured keepalive value, then the keepalive value is reset to one third of the specified hold-time interval.

If the hold-time interval is set to zero, then the configured value of the keepalive value is ignored. This means that the connection with the peer is up permanently and no keepalive packets are sent to the peer.

The **no** form of the command used at the global level reverts to the default value.

Default 30 seconds

Parameters *seconds* — The keepalive timer in seconds, expressed as a decimal integer.

Values 0 — 21845

local-address

Syntax **local-address** *ip-address*
no local-address

Context config>subscr-mgmt>bgp-prng-plcy

Description Configures the local IP address used by the group or neighbor when communicating with BGP peers.

Outgoing connections use the **local-address** as the source of the TCP connection when initiating connections with a peer.

When a local address is not specified, the 7750 SR OS uses the system IP address when communicating with IBGP peers and uses the interface address for directly connected EBGP peers. This command is used at the neighbor level to revert to the value defined under the group level.

The **no** form of the command removes the configured local-address for BGP.
The **no** form of the command used at the group level reverts to the value defined at the global level.
The **no** form of the command used at the neighbor level reverts to the value defined at the group level.

Default **no local-address** — For IPv4, the local address is expressed in dotted decimal notation. Allowed values are a valid routable IP address on the router, either an interface or system IP address. For IPv6, the local address is expressed in semi-colon hexadecimal notation. Allowed values is an interface or a system IP address.

local-as

Syntax **local-as** *as-number* [**private**]
no local-as

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures a BGP virtual autonomous system (AS) number.

In addition to the AS number configured for BGP in the `config>router>autonomous-system` context, a virtual (local) AS number is configured.The virtual AS number is added to the as-path message before the router's AS number makes the virtual AS the second AS in the as-path.

This configuration parameter can be set at three levels: global level (applies to all peers), group level (applies to all peers in peer-group) or neighbor level (only applies to specified peer). Thus, by specifying this at each neighbor level, it is possible to have a separate as-number per EBGP session.

When a command is entered multiple times for the same AS, the last command entered is used in the configuration. The **private** attribute can be added or removed dynamically by reissuing the command.

Changing the local AS at the global level in an active BGP instance causes the BGP instance to restart with the new local AS number. Changing the local AS at the global level in an active BGP instance causes BGP to re-establish the peer relationships with all peers in the group with the new local AS number. Changing the local AS at the neighbor level in an active BGP instance causes BGP to re-establish the peer relationship with the new local AS number.

This is an optional command and can be used in the following circumstance:

Provider router P is moved from AS1 to AS2. The customer router that is connected to P, however, is configured to belong to AS1. To avoid reconfiguring the customer router, the **local-as** value on router P can be set to AS1. Thus, router P adds AS1 to the as-path message for routes it advertises to the customer router.

The **no** form of the command used at the global level will remove any virtual AS number configured. The **no** form of the command used at the group level reverts to the value defined at the global level. The **no** form of the command used at the neighbor level reverts to the value defined at the group level.

Default no local-as

Parameters *as-number* — The virtual autonomous system number, expressed as a decimal integer.

Values 1 — 65535

private — Specifies the local-as is hidden in paths learned from the peering.

local-preference

Syntax **local-preference** *local-preference*
no local-preference

Context config>subscr-mgmt>bgp-prng-plcy

Description This command enables setting the BGP local-preference attribute in incoming routes if not specified and configures the default value for the attribute. This value is used if the BGP route arrives from a BGP peer without the **local-preference** integer set.

The specified value can be overridden by any value set via a route policy.

The **no** form of the command at the global level specifies that incoming routes with local-preference set are not overridden and routes arriving without local-preference set are interpreted as if the route had local-preference value of 100.

Default **no local-preference —** Does not override the local-preference value set in arriving routes and analyze routes without local preference with value of 100.

Parameters *local-preference* — The local preference value to be used as the override value, expressed as a decimal integer.

Values 0 — 4294967295

loop-detect

Syntax **loop-detect** {**drop-peer** | **discard-route** | **ignore-loop**| **off**}
no loop-detect

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures how the BGP peer session handles loop detection in the AS path.

Note that dynamic configuration changes of **loop-detect** are not recognized.

The **no** form of the command used at the global level reverts to default, which is **loop-detect ignore-loop**.

Default loop-detect ignore-loop

Parameters **drop-peer —** Sends a notification to the remote peer and drops the session.

discard-route — Discards routes received with loops in the AS path.

ignore-loop — Ignores routes with loops in the AS path but maintains peering.

off — Disables loop detection.

med-out

Syntax **med-out** {**number** | **igp-cost**}
no med-out

Context config>subscr-mgmt>bgp-prng-plcy

Description This command enables advertising the Multi-Exit Discriminator (MED) and assigns the value used for the path attribute for the MED advertised to BGP peers if the MED is not already set.

The specified value can be overridden by any value set via a route policy.

The **no** form of the command used at the global level reverts to default where the MED is not advertised.

no med-out

Parameters *number* — The MED path attribute value, expressed as a decimal integer.

Values 0 — 4294967295

igp-cost — The MED is set to the IGP cost of the given IP prefix.

min-as-origination

Syntax **min-as-origination** *seconds*
no min-as-origination

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the minimum interval, in seconds, at which a path attribute, originated by the local router, can be advertised to a peer.

The **no** form of the command used at the global level reverts to default.

Default 15 seconds

Parameters *seconds* — The minimum path attribute advertising interval in seconds, expressed as a decimal integer.

Values 2 — 255

min-route-advertisement

Syntax **min-route-advertisement** *seconds*
no min-route-advertisement

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the minimum interval, in seconds, at which a prefix can be advertised to a peer.

The **no** form of the command reverts to default values.

Default 30 seconds

Parameters *seconds* — The minimum route advertising interval, in seconds, expressed as a decimal integer.

Values 1— 255

multihop

Syntax **multihop** *ttl-value*
no multihop

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the time to live (TTL) value entered in the IP header of packets sent to an EBGP peer multiple hops away.

This parameter is meaningful only when configuring EBGP peers. It is ignored if set for an IBGP peer.

The **no** form of the command is used to convey to the BGP instance that the EBGP peers are directly connected.
The **no** form of the command reverts to default values.

Default **1** — EBGP peers are directly connected.

64 — IBGP

Parameters *ttl-value* — The TTL value, expressed as a decimal integer.

Values 1 — 255

next-hop-self

Syntax [**no**] **next-hop-self**

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the neighbor to always set the NEXTHOP path attribute to its own physical interface when advertising to a peer.

The no form of the command disables the command.

Default no next-hop-self

passive

Syntax [**no**] **passive**

Context config>subscr-mgmt>bgp-prng-plcy

Description This command enables the passive mode for the BGP neighbors.

The **no** form of the command disables the passive mode.

Default no passive

peer-as

Syntax **peer-as** *as-number*
no peer-as

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the autonomous system number for the remote peer. The peer AS number must be configured for each configured peer.

The **no** form of the command removes the *as-number* from the configuration.

Default No AS numbers are defined.

Parameters *as-number* — Specifies the AS number for the remote peer.

Values 1 — 4294967295

preference

Syntax [**no**] **preference** *preference*

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the route preference for routes learned from the configured peer(s).

The lower the preference the higher the chance of the route being the active route. The OS assigns BGP routes highest default preference compared to routes that are direct, static or learned via MPLS or OSPF.

The **no** form of the command used at the global level reverts to default value.

Default 170

Parameters *preference* — The route preference, expressed as a decimal integer.

Values 1 — 255

prefix-limit

Syntax **prefix-limit** *limit* [**log-only**] [**threshold** *percent*]
no prefix-limit

Context config>subscr-mgmt>bgp-prng-plcy

Description This command configures the maximum number of routes BGP can learn from a peer.

When the number of routes reaches 90% of this limit, an SNMP trap is sent. When the limit is exceeded, the BGP peering is dropped and disabled.

The **no** form of the command removes the **prefix-limit**.

Parameters **log-only —** Enables the warning message to be sent at the specified threshold percentage, and also when the limit is exceeded. However, the BGP peering is not dropped.

percent — The threshold value (as a percentage) that triggers a warning message to be sent.

Default no prefix-limit

Parameters *limit* — The number of routes that can be learned from a peer, expressed as a decimal integer.

Values 1 — 4294967295

remove-private

Syntax [**no**] **remove-private**

Context config>subscr-mgmt>bgp-prng-plcy

Description This command allows private AS numbers to be removed from the AS path before advertising them to BGP peers.

The OS software recognizes the set of AS numbers that are defined by IANA as private. These are AS numbers in the range 64512 through 65535, inclusive.

The **no** form of the command used at the global level reverts to default value.

Default **no remove-private** — Private AS numbers will be included in the AS path attribute.

type

Syntax [**no**] **type** {**internal** | **external**}

Context config>subscr-mgmt>bgp-prng-plcy

Description This command designates the BGP peer as type internal or external.

The type of **internal** indicates the peer is an IBGP peer while the type of external indicates that the peer is an EBGP peer.

By default, the OS derives the type of neighbor based on the local AS specified. If the local AS specified is the same as the AS of the router, the peer is considered **internal**. If the local AS is different, then the peer is considered **external**.

The **no** form of the command used at the group level reverts to the default value.

Default **no type** — Type of neighbor is derived on the local AS specified.

Parameters **internal —** Configures the peer as internal.

external — Configures the peer as external.

ttl-security

Syntax **ttl-security** *min-ttl-value*
no ttl-security

Context config>subscr-mgmt>bgp-prng-plcy

Description Configure TTL security parameters for incoming packets.

Parameters *min-ttl-value* — Specify the minimum TTL value for an incoming BGP packet.

Values 1 — 255

RADIUS Policy Commands

radius-coa-port

Syntax **radius-coa-port** {1647|1700|1812|3799}
no radius-coa-port

Context config>aaa

Description This command configures the system-wide UDP port number that RADIUS is listening on for CoA and Disconnect messages

The **no** form of the command resets the default UDP port to 3799.

Default 3799

Parameters {**1647**|**1700**|**1812**|**3799**} — Specifies the udp port number for RADIUS CoA and Disconnect Messages.

authentication-policy

Syntax **authentication-policy** *name* [create]
no authentication-policy

Context config>subscr-mgmt

Description This command creates the context to configure RADIUS server parameters for session authentication. The policies can be applied to an IES or VPRN interface, or a VPLS SAP.

The **no** form of the command removes the RADIUS server configuration for session authentication.

RADIUS servers can be configured for three different applications:

1. For authentication of dynamic Triple Play subscriber sessions, under `config>subscr-mgmt>authentication-plcy`
2. For 802.1x port authentication, under `config>system>security>dot1x>radius-plcy`
3. For CLI login users, under `config>system>radius`

Default none

Parameters *name* — The name of the profile. The string is case sensitive and limited to 32 ASCII 7-bit printable characters with no spaces.

pim-policy

Syntax **pim-policy** *policy-name*
no pim-policy *policy-name*

Context config>subscr-mgmt>sub-prof

Description This command adds an existing PIM policy to this subscriber profile.

The **no** form of the command removes the specified PIM policy from this subscriber profile.

Default No PIM policy is added to a subscriber profile by default.

Parameters *policy-name* — The name of the PIM policy. The string is case sensitive and limited to 32 ASCII 7-bit printable characters with no spaces.

radius-accounting-policy

Syntax **radius-accounting-policy** *name*
no radius-accounting-policy

Context config>subscr-mgmt
config>subscr-mgmt>sub-prof

Description This command specifies a subscriber RADIUS based accounting policy.

Parameters *name* — The name of the policy. The string is case sensitive and limited to 32 ASCII 7-bit printable characters with no spaces.

accept-authorization-change

Syntax [**no**] **accept-authorization-change**

Context config>subscr-mgmt>auth-policy

Description This command specifies whether or not the system should handle the CoA messages initiated by the RADIUS server, and provide for mid-session interval changes of policies applicable to subscriber hosts.

Default no accept-authorization-change

accept-script-policy

Syntax **accept-script-policy** *policy-name*
no accept-script-policy

Context config>subscr-mgmt>auth-policy

Description This command configures a RADIUS script policy used to change the RADIUS attributes of the incoming Access-Accept messages.

Parameters *policy-name* — Configures a Python script policy to modify Access-Accept messages.

access-loop-options

Syntax [**no**] **access-loop-options**

Context config>subscr-mgmt>auth-plcy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables inclusion of access loop information: Broadband Forum (BBF) access loop characteristics, DSL line state and DSL type. The BBF access loop characteristics are returned as BBF specific RADIUS attributes where DSL line state and DSL type are returned as Alcatel-Lucent specific RADIUS VSA's.

Information obtained via the ANCP protocol has precedence over information received in PPPoE Vendor Specific BBF tags or DHCP Vendor Specific BBF Options.

If ANCP is utilized and interim accounting update is enabled, any "Port Up" event from GSMP will initiate in an interim update. "Port Up" messages can include information such as an update on the current subscriber actual-upstream-speed. The next interim accounting message will be from "port up" triggering point.

Default no access-loop-options

host-accounting

Syntax [**no**] **host-accounting** [**interim-update**]

Context config>subscr-mgmt>acct-plcy

Description This command enables per host accounting mode. In host accounting mode, the acct-session-id is generated per host. This acct-session-id is uniformly included in all accounting messages (START/INTERIM-UPDTATE/STOP) and it can be included in RADIUS Access-Request message.

Accounting counters are based on the queue counters and as such are aggregated for all host sharing the queues within an sla-profile instance (non HSMDA) or a subscriber (HSMDA). CoA and LI is supported based on the acct-session-id of the host.

Default no host-accounting

Parameters **interim-update** — Without this keyword only START and STOP accounting messages are generated when the host is established/terminated. This is equivalent to a time-based accounting where only the duration of the session is required.

include-radius-attribute

Syntax [**no**] **include-radius-attribute**

Context config>subscr-mgmt>auth-plcy
config>subscr-mgmt>acct-plcy

Description This command enables the context to specify the RADIUS parameters that the system should include into RADIUS authentication-request messages.

acct-authentic

Syntax [**no**] **acct-authentic**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the acct-authentic RADIUS attribute.

acct-delay-time

Syntax [**no**] **acct-delay-time**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the acct-delay-time RADIUS attribute.

all-authorized-session-addresses

Syntax [**no**] **all-authorized-session-addresses**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description Applicable for session-accounting mode only.

With this flag enabled, all IP address attributes explicitly enabled to be included are the following:

- delegated-ipv6-prefix
- framed-ip-address
- framed-ip-netmask
- framed-ipv6-prefix
- ipv6-address

These are included if the corresponding addresses or prefixes are authorized (via access-accept or ludb) and independent if they are used or not.

Default no all-authorized-session-addresses

called-station-id

Syntax [**no**] **called-station-id**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command includes called station id attributes.

The **no** form of the command excludes called station id attributes.

calling-station-id

Syntax **calling-station-id**
calling-station-id {**mac** | **remote-id** | **sap-id** | **sap-string**}
no calling-station-id

Context config>service>ies>if>sap
config>service>ies>sub-if>grp-if>sap
config>service>vpls>sap
config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if>sap
config>subscr-mgmt>auth-plcy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include>include-radius-attribute

Description This command enables the inclusion of the calling-station-id attribute in RADIUS authentication requests and RADIUS accounting messages. The value inserted is set at the SAP level. If no **calling-station-id** value is set at the SAP level, the **calling-station-id** attribute will not be sent.

Default no calling-station-id

Parameters **mac —** Specifies that the mac-address will be sent.

remote-id — Specifies that the remote-id will be sent.

sap-id — Specifies that the sap-id will be sent.

sap-string — Specifies that the value is the inserted value set at the SAP level. If no **calling-station-id** value is set at the SAP level, the **calling-station-id** attribute will not be sent.

access-loop-options

Syntax [**no**] **access-loop-options**

Context config>subscr-mgmt>auth-plcy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables inclusion of access loop information: Broadband Forum (BBF) access loop characteristics, DSL line state and DSL type. The BBF access loop characteristics are returned as BBF specific RADIUS attributes where DSL line state and DSL type are returned as Alcatel-Lucent specific RADIUS VSA's.

Information obtained via the ANCP protocol has precedence over information received in PPPoE Vendor Specific BBF tags or DHCP Vendor Specific BBF Options.

acct-session-id

Syntax [**no**] **acct-session-id**

Context configure>subscr-mgmt>auth-plcy>include-radius-attribute

Description The **acct-session-id** attribute for each subscriber host will be generated at the very beginning of the session initiation. This command will enable or disable sending this attribute to the RADIUS server in

the Access-Request messages regardless of whether the accounting is enabled or not. The **acct-session-id** attribute can be used to address the subscriber hosts from the RADIUS server in the CoA Request.

The `acct-session-id` attribute will be unique per subscriber host network wide. It is a 22bytes long field comprised of the system MAC address along with the creation time and a sequence number in a hex format.

Default Disabled

circuit-id

Syntax [**no**] **circuit-id**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the agent-circuit-id for RADIUS.

delegated-ipv6-prefix

Syntax [**no**] **delegated-ipv6**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the delegated-ipv6-prefix RADIUS attribute.

detailed-acct-attributes

Syntax [**no**] **detailed-acct-attributes**

Context config>subscr-mgmt>auth-plcy>include-radius-attribute

Description This command enables detailed reporting of per queue and per policer octet and packet counters using RADIUS VSAs. Enabled by default. It can be enabled simultaneously with aggregate counters (std-acct-attributes).

The **no** form of the command excludes the detailed counter VSAs from the RADIUS accounting messages.

Default detailed-acct-attributes

dhcp-options

Syntax [**no**] **dhcp-options**

Context config>subscr-mgmt>auth-plcy>include-radius-attribute

Description This command enables insertion of RADIUS VSA containing all dhcp-options from dhcp-discover (or dhcp-request) message. The VSA contains all dhcp-options in a form of the string. If required (the total length of all dhcp-options exceeds 255B), multiple VSAs are included.

Default no dhcp-options

dhcp6-options

Syntax [**no**] **dhcp6-options**

Context configure>subscr-mgmt>auth-policy>include

Description This command will copy DHCPv6 options from received DHCPv6 messages on ingress access and pass them to the RADIUS server in Accept-Request. The messages will be carried in the ALU VSA Alc-ToServer-Dhcp6-Options.

Default no dhcp6-options

dhcp-vendor-class-id

Syntax [**no**] **dhcp-vendor-class-id**

Context config>subscr-mgmt>auth-plcy>include-radius-attribute

Description This command includes the "[26-6527-36] Alc-DHCP-Vendor-Class-Id" attribute in RADIUS accounting messages. The content of the DHCP Vendor-Class-Identifier option (60) is mapped in this attribute.

Default no dhcp-vendor-class-id

framed-interface-id

Syntax [**no**] **framed-interface-id**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the framed-interface-id RADIUS attribute.

framed-ip-addr

Syntax [**no**] **framed-ip-addr**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the inclusion of the framed-ip-addr attribute.

framed-ip-netmask

Syntax [**no**] **framed-ip-netmask**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the inclusion of the framed-ip-netmask attribute.

framed-ipv6-prefix

Syntax [**no**] **framed-ipv6-prefix**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the framed-ipv6-prefix RADIUS attribute.

framed-ipv6-route

Syntax [**no**] **framed-ipv6-route**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description When enabled, all valid [99] Framed-IPv6-Route attributes as received in the RADIUS authentication phase and associated with an instantiated IPv6 wan host will be included in the RADIUS accounting request messages. The state of the Framed-IPv6-Route (installed, shadowed, hostInactive, etc.) is not taken into account for reporting in the accounting request messages.

Default no framed-ipv6-route

framed-route

Syntax [**no**] **framed-route**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description When enabled, all valid [22] Framed-Route attributes as received in the RADIUS authentication phase and associated with an instantiated IPv4 host will be included in the RADIUS accounting request messages. The state of the Framed-Route (installed, shadowed, hostInactive, etc.) is not taken into account for reporting in the accounting request messages.

Default no framed-route

ipv6-address

Syntax [**no**] **framed-ipv6-address**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the ipv6-address RADIUS attribute.

mac-address

Syntax [**no**] **mac-address**
config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the client MAC address RADIUS attribute.

nas-identifier

Syntax [**no**] **nas-identifier**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-identifier RADIUS attribute.

nas-port

Syntax [**no**] **nas-port** *bit-specification binary-spec*

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-port RADIUS attribute. You enter decimal representation of a 32-bit string that indicates your port information. This 32-bit string can be compiled based on different information from the port (data types). By using syntax number-of-bits data-type you indicate how many bits from the 32 bits are used for the specific data type. These data types can be combined up to 32 bits in total. In between the different data types 0's and/or 1's as bits can be added.

The **no** form of this command disables your nas-port configuration.

Parameters *bit-specification binary-spec* — Specifies the NAS-Port attribute

Values

binary-spec	<bit-specification> <binary-spec>
bit-specification	0 | 1 | <bit-origin>
bit-origin	*<number-of-bits><origin>
number-of-bits	1 — 32
origin	o | i | s | m | p

o outer VLAN ID
i inner VLAN ID
s slot number
m MDA number
p port number or lag-id

Sample

```
*12o*12i00*2s*2m*2p => oooo oooo oooo iiii iiii iiii 00ss mmpp
If outer vlan = 0 & inner vlan = 1 & slot = 3 & mda = 1 & port = 1
=>  0000 0000 0000 0000 0000 0001 0011 0101 => nas-port = 309
```

nas-port-id

Syntax **[no] nas-port-id [prefix-string *string*] [suffix *suffix-option*]**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-port-id RADIUS attribute. Optionally, the value of this attribute (the SAP-id) can be prefixed by a fixed string and suffixed by the circuit-id or the remote-id of the client connection. If a suffix is configured, but no corresponding data is available, the suffix used will be 0/0/0/0/0/0.

Parameters **prefix-string** *string* — Specifies that a user configurable string will be added to the RADIUS NAS port attribute, up to 8 characters in length.

suffix *suffix-option* — Specifies the suffix type to be added to the RADIUS NAS oort attribute.

Values circuit-id, remote-id

nas-port-type

Syntax **nas-port-type**
nas-port-type [0..255]
no nas-port-type

Context config>subscr-mgmt>auth-plcy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the nas-port-type RADIUS attribute. If set to **nas-port-type**, the following will be sent: values: 32 (null-encap), 33 (dot1q), 34 (qinq), 15 (DHCP hosts). The **nas-port-type** can also be set as a specified value, with an integer from 0 to 255.

The **no** form of the command reverts to the default.

Default no nas-port-type

Parameters **0 — 255** — Specifies an enumerated integer that specifies the value that will be put in the RADIUS nas-port-type attribute.

nat-port-range

Syntax [**no**] **nat-port-range**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the of nat-port-range attribute.

Default no nat-port-range

pppoe-service-name

Syntax [**no**] **pppoe-service-name**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the pppoe-service-name RADIUS attribute.

remote-id

Syntax [**no**] **remote-id**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the agent-remote-id for RADIUS.

sap-session-index

Syntax [**no**] **sap-session-index**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the per-SAP unique session index.

The **no** form of the command excludes **sap-sesion-index** attributes.

tunnel-server-attrs

Syntax [**no**] **tunnel-server-attrs**

Context config>subscr-mgmt>auth-policy>include-radius-attribute

Description This command includes tunnel-server attribute.

sla-profile

Syntax [**no**] **sla-profile**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command specifies that SLA profile attributes should be included into RADIUS accounting messages.

std-acct-attributes

Syntax [**no**] **std-acct-attributes**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables reporting of aggregated forwarded octet and packet counters using standard Radius attributes. Disabled by default. It can be enabled simultaneously with detailed per queue/ policer counters (detailed-acct-attributes).

Default no std-acct-attributes

sub-profile

Syntax [**no**] **sub-profile**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command specifies that subscriber profile attributes should be included into RADIUS accounting messages.

subscriber-id

Syntax [**no**] **subscriber-id**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command specifies that subscriber ID attributes should be included into RADIUS accounting messages.

tunnel-server

Syntax [**no**] **tunnel-server**

Context config>subscr-mgmt>auth-policy>include-radius-attribute
config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the generation of the tunnel-server RADIUS attribute.

user-name

Syntax [**no**] user-name

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the inclusion of the user-name attribute.

The **no** form of the command disables the inclusion of the user-name attribute.

Default no user-name

v6-aggregate-stats

Syntax [**no**] **v6-aggregate-stats**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables reporting of IPv6 aggregated forwarded octet and packet counters using RADIUS VSAs. Disabled by default. It requires **stat-mode v4-v6** for policers and queues for which the IPv6 aggregate forwarded packets should be counted.

Default no v6-aggregate-stats

wifi-rssi

Syntax [**no**] **wifi-rssi**

Context config>subscr-mgmt>acct-plcy>include-radius-attribute

Description This command enables the inclusion of the 802.11 Received Signal Strength Indication attribute.

password

Syntax **password** *password* [**hash** | **hash2**]
no password

Context config>subscr-mgmt>auth-policy

Description This command sets a password that is sent with **user-name** in every RADIUS authentication request sent to the RADIUS server upon receipt of DHCP discover or request messages. If no password is configured, no password AVP will be sent.

The **no** form of the command reverts to the default value.

Default none

Parameters *password* — A text string containing the password. Allowed values are any string up to 64 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

hash — Specifies the key is entered in an encrypted form. If the **hash** parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form. If the **hash2** parameter is not used, the less encrypted **hash** form is assumed.

password

Syntax **password** *password* [**hash** | **hash2**]
no password

Context config>subscr-mgmt>diam-appl-plcy>nasreq

Description This command sets a password that is sent with **user-name** in every RADIUS authentication request sent to the RADIUS server upon receipt of DHCP discover or request messages. If no password is provided, an empty password will be sent.

The **no** form of the command reverts to the default value.

Default no password

Parameters *password* — A text string containing the password. Allowed values are any string up to 64 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

hash — Specifies the key is entered in an encrypted form. If the **hash** or **hash2** parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** or **hash2** parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form that involves more variables then the key value alone, this means that a **hash2** encrypted variable cannot be copied and pasted. If the **hash** or **hash2** parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** or **hash2** parameter specified.

ppp-user-name

Syntax **ppp-user-name append** *domain-name*
ppp-user-name default-domain *domain-name*
ppp-user-name replace *domain-name*
ppp-user-name strip
no ppp-user-name

Context config>subscr-mgmt>auth-plcy

Description This command configures the password that is sent with the User-Name in Diameter NASREQ AA-Requests for IPoE hosts.

When no password is configured, an empty password will be sent.

Default no ppp-user-name

Parameters **append** *domain-name* — Astring specified by tmnxSubAuthPlcyPppDomain, preceded with a '@', is appended to the PAP/CHAP user name.

default-domain *domain-name* **—** The same action is performed as with appendDomain, but only if the PAP/CHAP user name does not already contain a domain name.

replace *domain-name* — All characters after a '@' delimiter are replaced with the string specified by tmnxSubAuthPlcyPppDomain.

strip — Any '@' character and all subsequent characters are removed from the PAP/CHAP user name.

pppoe-access-method

Syntax **pppoe-access-method** {**none** | **padi** | **pap-chap**}
no pppoe-access-method

Context config>subscr-mgmt>auth-plcy

Description This command indicates the authentication method used towards the RADIUS server in case the policy is used for PPPoE.

Parameters **none —** Indicates that the client will be authenticated by the local user database defined under the group interface and not through RADIUS.

padi — Indicates that the client will be authenticated by RADIUS as soon as the PADI packet comes in (there is no PPP authentication done in the session in this case).

pap-chap — Indicates that the RADIUS authentication of the client will be delayed until the authentication protocol phase in the PPP session (PAP or CHAP) and authentication will be performed with the user name and PAP password / CHAP response supplied by the client.

queue-instance-accounting

Syntax **queue-instance-accounting [interim-update]**
no queue-instance-accounting

Context config>subscr-mgmt>acct-plcy

Description This command enables per queue-instance-accounting. A stream of accounting messages (START/INTERIM-UPDATE/STOP) is generated per queuing instance. A queuing instance is equivalent to an sla-profile instance on non HSMDA based hardware and to subscriber on HSMDA based hardware. Accounting session id is generated per queuing instance and this accounting session id CANNOT be included in RADIUS Access-Request message. Queue instance counters represent volume based aggregation for all hosts sharing the queuing instance.

CoA and LI is supported based on the acct-session-id of the queuing instance.

Default interim-update

Parameters **interim-update —** specifies whether accounting messages are sent for the queue-instance. The queue-instance is the subscriber on High Scale MDA (HSMDA), or the SLA profile instance otherwise.

radius-authentication-server

Syntax **radius-authentication-server**

Context config>subscr-mgmt>acct-plcy

Description This command creates the context for defining RADIUS authentication server attributes under a given session authentication policy.

access-algorithm

Syntax **access-algorithm** {**direct** | **round-robin**}
no access-algorithm

Context config>subscr-mgmt>auth-plcy-srvr
config>subscr-mgmt>acct-plcy>server

Description This command configures the algorithm used to access the list of configured RADIUS servers.

Parameters **direct —** Specifies that the first server will be used as primary server for all requests, the second as secondary and so on.

round-robin — Specifies that the first server will be used as primary server for the first request, the second server as primary for the second request, and so on. If the router gets to the end of the list, it starts again with the first server.

fallback-action

Syntax **fallback-action accept**
fallback-action user-db *local-user-db-name*
no fallback-action

Context config>subscr-mgmt>auth-plcy-srvr
config>subscr-mgmt>auth-plcy

Description This command configures the action when no RADIUS server is available.

The no form of the command removes the action from the configuration.

Default no fallback-action

hold-down-time

Syntax **hold-down-time** ***seconds***
no hold-down-time

Context config>subscr-mgmt>auth-plcy>radius-auth-server

Description This command determines the interval during which no new communication attempts will be made to a RADIUS server that is marked **down** to prevent immediately overloading the server when it is start-

ing up. The only exception is when all servers in the authentication policy are marked **down**; in that case they will all be used again to prevent failures on new client connections.

Default 30

Parameters *seconds* — Specifies the hold time before re-using a RADIUS server that was down.

Values 30 — 900

router

Syntax **router** *router-instance*
router *service-name*
no router

Context config>subscr-mgmt>auth-plcy-srvr
config>subscr-mgmt>acct-plcy>server

Description This command specifies the virtual router instance applicable for the set of configured RADIUS servers. This value cannot be changed once a RADIUS server is configured for this policy. When the value is zero, both base and management router instances are matched.

Parameters *router-instance* — Specifies the virtual router instance.

Values

router-name:	Base, management
service-id:	1 — 2147483647
service-name:	Specifies the service name up to 64 characters in length.

retry

Syntax **retry** *count*
no retry

Context config>subscr-mgmt>auth-plcy-srvr
config>subscr-mgmt>acct-plcy>server

Description This command configures the number of times the router attempts to contact the RADIUS server for authentication, if not successful the first time.

The **no** form of the command reverts to the default value.

Default 3

Parameters *count* — The retry count.

Values 1 — 10

radius-server-policy

Syntax **radius-server-policy** ***radius-server-policy-name***
no radius-server-policy

Context config>subscr-mgmt>auth-plcy
config>subscr-mgmt>acct-plcy

Description This command references an existing radius-server-policy (available under the config>aaa context) for use in subscriber management authentication and accounting.

When configured in an authentication-policy, following CLI commands are ignored in the policy to avoid conflicts:

- all commands in the radius-authentication-server context
- accept-authorization-change
- coa-script-policy
- accept-script-policy
- request-script-policy

When configured in a radius-accounting-policy, following CLI commands are ignored in the policy to avoid conflicts:

- all commands in the radius-accounting-server context
- acct-request-script-policy

The **no** form of the command removes the radius-server-policy reference from the configuration

Default no radius-server-policy

Parameters *radius-server-policy-name* — Specifies the RADIUS server policy.

server

Syntax **server** *server-index* **address** *ip-address* **secret** *key* [**hash** | **hash2**] [**port** *port-num*] [coa-only] [**pending-requests-limit** ***limit***]
no server *index*

Context config> subscr-mgmt>auth-policy>radius-auth-server
config>subscr-mgmt>acct-plcy>server

Description This command adds a RADIUS server and configures the RADIUS server IP address, index, and key values.

Up to sixteen RADIUS servers can be configured at any one time in a RADIUS authentication policy. Only five can be used for authentication, all other servers should be configured as coa-only servers. In a RADIUS accounting policy, up to five RADIUS servers can be configured. RADIUS servers are accessed in order from lowest to highest index for authentication or accounting requests until a response from a server is received. A higher indexed server is only queried if no response is received from a lower indexed server (which implies that the server is not available). If a response from a server is received, no other RADIUS servers are queried.

The **no** form of the command removes the server from the configuration.

Default No RADIUS servers are configured.

Parameters *server-index* — The index for the RADIUS server. The index determines the sequence in which the servers are queried for authentication requests. Servers are queried in order from lowest to highest index.

Values 1 — 16 (a maximum of 5 authentication servers)

address *ip-address* **—** The IP address of the RADIUS server. Two RADIUS servers cannot have the same IP address. An error message is generated if the server address is a duplicate.

secret *key* **—** The secret key to access the RADIUS server. This secret key must match the password on the RADIUS server.

Values secret-key: Up to 20 characters in length.
hash-key: Up to 33 characters in length.
hash2-ke: Up to 55 characters in length.

hash — Specifies the key is entered in an encrypted form. If the **hash** parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form. If the **hash2** parameter is not used, the less encrypted **hash** form is assumed.

port *port-num* **—** Specifies the UDP port number on which to contact the RADIUS server for authentication.

Values 1 — 65535

coa-only — Specifies Change-of-Authorization Messages only. Servers that are marked with the coa-only flag will not be used for authentication, but they will be able to accept RADIUS CoA messages, independent of the accept-authorization-change setting in the authentication policy.

For authentication purposes, the maximum number of servers is 5. All other servers may only be used as coa-only servers.

pending-requests-limit *limit* **—** Specifies the maximum number of outstanding RADIUS authentication requests for this authentication server.

Default The default value when not configured is 4096.

Values 1 — 4096

hold-down-time

Syntax **hold-down-time**
no hold-down-time

Context config>aaa>radius-server-policy>servers

Description This command determines the interval during which no new communication attempts will be made to a RADIUS server that is marked down to prevent immediately overloading the server when it is starting up. The only exception is when all servers in the authentication policy are marked down; in that case, they will all be used again to prevent failures on new client connections.

Default 30s

Parameters *days* — Specifies the hold time in days before re-using a RADIUS server that was down.

Values 0 — 3650

hours — Specifies the hold time in hours before re-using a RADIUS server that was down.

Values 0 — 23

minutes — Specifies the hold time in minutes before re-using a RADIUS server that was down.

Values 0 — 59

seconds — Specifies the hold time in seconds before re-using a RADIUS server that was down.

source-address

Syntax **source-address** *ip-address*
no source-address

Context config>subscr-mgmt>auth-plcy-srvr
config>subscr-mgmt>acct-plcy>server

Description This command configures the source address of the RADIUS packet.

The system IP address must be configured in order for the RADIUS client to work. See Configuring a System Interface in the 7750 SR OS Router Configuration Guide. Note that the system IP address must only be configured if the source-address is not specified. When the **no source-address** command is executed, the source address is determined at the moment the request is sent. This address is also used in the nas-ip-address attribute: over there it is set to the system IP address if **no source-address** was given.

The **no** form of the command reverts to the default value.

Default System IP address

Parameters *ip-address* — The IP prefix for the IP match criterion in dotted decimal notation.

Values 0.0.0.0 - 255.255.255.255

timeout

Syntax **timeout** *seconds*
no timeout

Context config>subscr-mgmt>auth-plcy-srvr
config>subscr-mgmt>acct-plcy>server

This command configures the number of seconds the router waits for a response from a RADIUS server.

The **no** form of the command reverts to the default value.

Default 3 seconds

Parameters *seconds* — The number of seconds the router waits for a response from a RADIUS server, expressed as a decimal integer.

Values 1 — 90

session-accounting

Syntax **session-accounting [interim-update] [host-update]**
no session-accounting

Context config>subscr-mgmt>acct-plcy

Description This command enables per session accounting mode. In per session accounting mode, the acct-session-id is generated per session. This acct-session-id is uniformly included in all accounting messages (START/INTERIM-UPDTATE/STOP) and it can be included in RADIUS Access-Request message.

This accounting mode of operation can be used only in PPPoE environment with dual-stack host in which case both hosts (IPv4 and IPv6) are considered part of the same session. In addition to regular interim-updates, *triggered* interim-updates are sent by a host joining or leaving the session.

When an IPv4/v6 address is allocated, or released from a dual-stack host, a triggered interim-update message is immediately sent. This triggered interim-update message reflects the change in the IP address. The triggered interim-update has no effect on the interval at which the regular interim updates are scheduled.

Accounting counters are based on the queue counters and as such are aggregated for all host sharing the queues within an sla-profile instance (non HSMDA) or a subscriber (HSMDA).

CoA and LI is supported based on the acct-session-id of the session.

Default no session-accounting

Parameters **interim-update —** Without this keyword only START and STOP accounting messages are generated when the session is established/terminated. This is equivalent to a time-based accounting where only the duration of the session is required.

host-update — This keyword indicates that host updates messages are sent. INTERIM-UPDATE messages can be generated (volume based accounting) by selecting this keyword..

session-id-format

Syntax **session-id-format {description | number}**
no session-id-format

Context config>subscr-mgmt>acct-plcy

Description This command specifies the format for the acct-session-id attribute used in RADIUS accounting requests.

Parameters **description —** Specifies to use a string containing following information <subscriber>@<sap-id>@<SLA-profile>_<creation-time>.

number — Specifies to use a unique number generated by the OS to identify a given session.

update-interval

Syntax **update-interval** *minutes*
no update-interval

Context config>subscr-mgmt>acct-plcy

Description This command specifies the interval at which accounting data of subscriber hosts will be updated in a RADIUS Accounting Interim-Update message. Requires interim-update to be enabled when specifying the accounting mode in the radius accounting policy.

A RADIUS specified interim interval (attribute [85] Acct-Interim-Interval) overrides the CLI configured value.

Parameters *minutes* — Specifies the interval, in minutes, at which accounting data of subscriber hosts will be updated.

Values 5 — 259200

update-interval-jitter

Syntax **update-interval-jitter absolute** ***seconds***
no update-interval-jitterl

Context config>subscr-mgmt>acct-plcy

Description This command specifies the absolute maximum random delay introduced on the update interval between two accounting interim update messages. The effective maximum random delay value is the minimum of the configured absolute jitter value and 10% of the configured update-interval.

A value of zero will send the accounting interim update message without introducing an additional random delay.

The **no** form of the command sets the default to 10% of the configured update-interval.

Default no update-interval-jitter

This corresponds with 10% of the configured update-interval

Parameters **absolute** *seconds* **—** specifies the absolute maximum jitter value in seconds.

Values 0 — 36000

re-authentication

Syntax [**no**] **re-authentication**

Context config>subscr-mgmt>auth-policy

Description This command enables authentication process at every DHCP address lease renewal s only if RADIUS did not reply any special attributes (for example, authentication only, no authorization).

The **no** form of the command reverts to the default value.

Default disabled

request-script-policy

Syntax **request-script-policy** *policy-name*
no request-script-policy

Context config>subscr-mgmt>auth-policy

Description This command specifies the RADIUS script policy used to change the RADIUS attributes of the outgoing Access-Request messages.

Default none

Parameters *policy-name* — Configures a Python script policy to modify Access-Request messages.

send-acct-stop-on-fail

Syntax **send-acct-stop-on-fail** {[**on-request-failure**] [**on-reject**] [**on-accept-failure**]}
no send-acct-stop-on-fail

Context config>subscr-mgmt>auth-policy

Description This command activates the reporting of RADIUS authentication failures of a PPPoE session to a RADIUS accounting server with an Accounting Stop message.

Three failure categories can be enabled separately:

- **on-request-failure**: All failure conditions between the sending of an Access-Request and the reception of an Access-Accept or Access-Reject.
- **on-reject**: When an Access-Reject is received
- **on-accept-failure**: All failure conditions that appear after receiving an Access-Accept and before successful instantiation of the host or session.

The RADIUS accounting policy to be used for sending the Accounting Stop messages must be obtained prior to RADIUS authentication via local user database pre-authentication.

Default no send-acct-stop-on-fail

user-name-format

Syntax **user-name-format** *format* [**mac-format** *mac-format*]
user-name-format *format* **append** [*domain-name*] [**mac-format** *mac-format*]
user-name-format *format* **append** *domain-name*
user-name-format *format* **default-domain** *domain-name* [**mac-format** *mac-format*]
user-name-format *format* **replace** *domain-name* [**mac-format** *mac-format*]
user-name-format *format* **strip** [**mac-format** *mac-format*]
no user-name-format

Context config>subscr-mgmt>auth-policy
config>subscr-mgmt>diam-appl-plcy>nasreq

Description This command defines the format of the "user-name" field in the session authentication request sent to the RADIUS server.

The **no** form of the command switches to the default format, **mac**.

Default By default, the MAC source address of the DHCP DISCOVER message is used in the user-name field.

Parameters *format* — Specifies the user name format in RADIUS message.

Values ascii-converted-circuit-id, ascii-converted-tuple, circuit-id, dhcp-client-vendor-opts, mac, mac-giaddr, tuple

ascii-converted-circuit-id — Identical to circuit-id, but the user name will be sent to the RADIUS server as a string of hex digits, for use if there is binary data in the circuit-id.

ascii-converted-tuple — Identical to tuple, but the circuit-id part of the user name will be sent to the RADIUS server as a string of hex digits, for use if there is binary data in the circuit-id.

circuit-id — If the system serves as a DHCP relay server which inserts option 82 info, the user name will be formatted as defined under DHCP information option. If the system is not a DHCP relay server, the circuit-id will be taken from option 82 in the received DHCP message. If no circuit-id can be found, the DHCP-msg is rejected.

dhcp-client-vendor-opts — Creates a concatenation of the DHCP client-identifier option (option 60), a "@" delimiter and the DHCP vendor-class identifier options. The two option strings are parsed for any characters which are non-printing are considered invalid and must be converted to underscore "_" characters. In addition, any space character (hex 20) and @ character (hex 40) are also converted to underscore. The character set considered valid is ASCII hex 21 through hex 3F, and hex 41 through hex 7E. Any character outside this set will be converted into an underscore (hex 5F) character.

mac — The MAC source address of the DHCP DISCOVER message is used in the user-name field. The format of the MAC address string used as the user name in the RADIUS authentication requests uses lowercase hex digits, and ":" as the inter-digit separator, for example, 00:11:22:aa:bb:cc is valid but 00-11-22-AA-BB-CC will return an error. The RADIUS server must be configured accordingly, otherwise the authentication request will fail.

mac-giaddr — Specifies that MAC giaddr indicates the format used to identify the user towards the RADIUS server.

tuple — The concatenation of MAC source address and circuit-ID are used in the user-name field.

mac-format — Specifies how a MAC address is represented when contacting a RADIUS server. This is only used while the value of is equal to the DHCP client vendor options and if the MAC address is used by default of the DHCP client vendor options.

Examples:	ab:	00:0c:f1:99:85:b8 Alcatel-Lucent 7xxx style
	XY-	00-0C-F1-99-85-B8 IEEE canonical style
	mmmm.	0002.03aa.abff Cisco style

append — Specifies the data type which is is an enumerated integer that indicates what needs to be appended to the user-name sent to the RADIUS server.

Values 1 — nothing
2 — domain name

domain — In some instances it is desired to add a domain only to usernames which have omitted the domain (@domain). In these instances a default-domain can be appended to usernames which lack a @domain

append — Adds a "@" delimiter and the specified string after the PAP/CHAP username. No allowance is made for the presence of an existing domain or @ delimited.

replace — Replaces the character-string after the "@" delimiter with the string specified.

strip — Removes all characters after and including the "@" delimiter.

Example:

```
Command: append
String: domainA-1.com
PAP/CHAP User:someuser
Resulting User:someuser@domainA-1.com

Command: append
String: domainA-1.com
PAP/CHAP User:someuser@existing-domain.net
Resulting User:someuser@existing-domain.net@domainA-1.com

Command: strip
String:
PAP/CHAP User:someuser@existing-domain.net
Resulting User:someuser

Command: replace
String: domainA-1.com
PAP/CHAP User:someuser@existing-domain.net
Resulting User:someuser@domainA-1.com

Command: default-domain
String:domainA-1.com
PAP/CHAP User:someuser@existing-domain.net
Resulting User:someuser@existing-domain.net

Command: default-domain
String: domainA-1.com
PAP/CHAP User:someuser
Resulting User:someuser@domainA-1.com
```

user-name-format

Syntax **user-name-format** *format*
no user-name-format

Context config>subscr-mgmt>diam-appl-plcy>nasreq

Description This command defines the format of the User-Name AVP value in Diameter NASREQ AA-Requests for IPoE hosts.

Parameters *format* — Specifies the format of the User-Name AVP value.

Values
mac — The MAC source address of the DHCP DISCOVER message is used in the user-name field. The format of the MAC address string is defined with the mac-format CLI command.
circuit-id — If the system serves as a DHCP relay server which inserts option 82 info, the user name will be formatted as defined under DHCP information option. If the system is not a DHCP relay server, the circuit-id will be taken from option 82 in the received DHCP message. If no circuit-id can be found, the DHCP-msg is rejected.
tuple — A concatenation of MAC source address and circuit-ID.
ascii-converted-circuit-id — Identical to circuit-id, but the user name is a string of hex digits, for use if there is binary data in the circuit-id.
ascii-converted-tuple — Identical to tuple, but the circuit-id part of the user name is a string of hex digits, for use if there is binary data in the circuit-id.
dhcp-client-vendor-opts — A concatenation of the DHCP client-identifier option (option 60), "@" as delimiter and the DHCP vendor-class identifier options. Spaces (hex 20), @ character (hex 40) and non printable characters (all character outside range hex 21 through hex 7E) are converted to underscore "_" (hex 5F).
mac-giaddr — A concatenation of MAC source address and DHCP gi address.
nas-port-id — the value of the nas-port-id with format defined in the include-avp section.

user-name-operation

Syntax **user-name-operation operation** [**domain** *domain-name*]
no user-name-operation

Context config>subscr-mgmt>diam-appl-plcy>nasreq

Description This command enables domain name manipulation of the user name, such as append, strip, replace or add as default.

For IPoE, this command only applies when **user-name-format** is configured to **dhcp-client-vendor-opts**.

Default no user-name-operation

Parameters **operation —** Specifies the user name manipulations with respect to domain name values.

Values
append-domain – appends an "@" delimiter with the specified domain-name at the end of the user-name, independent if a domain name was already present.
strip-domain – removes all characters after and including the "@" delimiter.
default-domain – adds an "@" delimiter and the specified domain name to user-names that have no domain name present.
replace-domain – replaces the characters after the "@" delimiter with the specified domain-name.

domain *domain-name* — Specifies the domain name string to be used in the specified operation. Maximum 128 characters.

RADIUS Accounting Policy Custom Record Commands

custom-record

Syntax [**no**] **custom-record**

Context config>subscr-mgmt>acct-plcy

Description This command enables the context to configure the layout and setting for a custom accounting record associated with this accounting policy.

The **no** form of the command reverts the configured values to the defaults.

override-counter

Syntax [**no**] **override-counter** *override-counter-id*

Context config>log>acct-policy>cr

Description This command enables the context to configure Application Assurance override counter parameters.

The **no** form of the command removes the ID from the configuration.

Parameters *override-counter-id* — Specifies the override counter ID.

Values 1 — 8

e-counters

Syntax **e-counters** [**all**]
no e-counters

Context config>log>acct-policy>cr>override-cntr
config>log>acct-policy>cr>queue
config>log>acct-policy>cr>ref-override-cntr
config>log>acct-policy>cr>ref-queue

Description This command configures egress counter parameters for this custom record.

The **no** form of the command

Parameters **all —** Includes all counters.

i-counters

Syntax **i-counters** [**all**]
no i-counters

Context config>log>acct-policy>cr>override-cntr
config>log>acct-policy>cr>ref-override-cntr
config>log>acct-policy>cr>ref-queue

Description This command configures ingress counter parameters for this custom record.

The **no** form of the command

Parameters **all —** Includes all counters.

queue

Syntax [**no**] **queue** *queue-id*

Context config>log>acct-policy>cr

Description This command specifies the queue-id for which counters will be collected in this custom record. The counters that will be collected are defined in egress and ingress counters.

The **no** form of the command reverts to the default value

Parameters *queue-id* — Specifies the queue-id for which counters will be collected in this custom record.

in-profile-octets-discarded-count

Syntax [**no**] **in-profile-octets-discarded-count**

Context config>log>acct-policy>cr>oc>e-count
config>log>acct-policy>cr>roc>e-count
config>log>acct-policy>cr>queue>e-count
config>log>acct-policy>cr>ref-queue>e-count

Description This command includes the in-profile octets discarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv4 octets discarded count instead.

The **no** form of the command excludes the in-profile octets discarded count.

in-profile-octets-forwarded-count

Syntax [**no**] **in-profile-octets-forwarded-count**

Context config>log>acct-policy>cr>oc>e-count
config>log>acct-policy>cr>roc>e-count
config>log>acct-policy>cr>queue>e-count
config>log>acct-policy>cr>ref-queue>e-count

Description This command includes the in-profile octets forwarded count. For queues with **stat-mode v4-v6**, this command includes the IPv4 octets forwarded count instead.

The **no** form of the command excludes the in-profile octets forwarded count.

in-profile-packets-discarded-count

Syntax [**no**] **in-profile-packets-discarded-count**

Context config>log>acct-policy>cr>oc>e-count
config>log>acct-policy>cr>roc>e-count
config>log>acct-policy>cr>queue>e-count
config>log>acct-policy>cr>ref-queue>e-count

Description This command includes the in-profile packets discarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv4 packets discarded count instead.

The **no** form of the command excludes the in-profile packets discarded count.

in-profile-packets-forwarded-count

Syntax [**no**] **in-profile-packets-forwarded-count**

Context config>log>acct-policy>cr>oc>e-count
config>log>acct-policy>cr>roc>e-count
config>log>acct-policy>cr>queue>e-count
config>log>acct-policy>cr>ref-queue>e-count

Description This command includes the in-profile packets forwarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv4 packets forwarded count instead.

The **no** form of the command excludes the in-profile packets forwarded count.

out-profile-octets-discarded-count

Syntax [**no**] **out-profile-octets-discarded-count**

Context config>log>acct-policy>cr>oc>e-count
config>log>acct-policy>cr>roc>e-count
config>log>acct-policy>cr>queue>e-count
config>log>acct-policy>cr>ref-queue>e-count

Description This command includes the out of profile packets discarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv6 octets discarded count instead.

The **no** form of the command excludes the out of profile packets discarded count.

out-profile-octets-forwarded-count

Syntax [**no**] **out-profile-octets-forwarded-count**

Context config>log>acct-policy>cr>oc>e-count
config>log>acct-policy>cr>roc>e-count
config>log>acct-policy>cr>queue>e-count
config>log>acct-policy>cr>ref-queue>e-count

Description This command includes the out of profile octets forwarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv6 octets forwarded count instead.

The **no** form of the command excludes the out of profile octets forwarded count.

out-profile-packets-discarded-count

Syntax [**no**] **out-profile-packets-discarded-count**

Context config>log>acct-policy>cr>oc>e-count
config>log>acct-policy>cr>roc>e-count
config>log>acct-policy>cr>queue>e-count
config>log>acct-policy>cr>ref-queue>e-count

Description This command includes the out of profile packets discarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv6 packets discarded count instead.

The **no** form of the command excludes the out of profile packets discarded count.

out-profile-packets-forwarded-count

Syntax [**no**] **out-profile-packets-forwarded-count**

Context config>log>acct-policy>cr>oc>e-count
config>log>acct-policy>cr>roc>e-count
config>log>acct-policy>cr>queue>e-count
config>log>acct-policy>cr>ref-queue>e-count

Description This command includes the out of profile packets forwarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv6 packets forwarded count instead.

The **no** form of the command excludes the out of profile packets forwarded count.

all-octets-offered-count

Syntax [**no**] **all-octets-offered-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count

config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes all octets offered in the count.

The **no** form of the command excludes the octets offered in the count.

Default no all-octets-offered-count

all-packets-offered-count

Syntax [**no**] **all-packets-offered-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes all packets offered in the count.

The **no** form of the command excludes the packets offered in the count.

Default no all-packets-offered-count

high-octets-discarded-count

Syntax [**no**] **high-octets-discarded-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the high octets discarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv4 octets discarded count instead.

The **no** form of the command excludes the high octets discarded count.

Default no high-octets-discarded-count

high-octets-offered-count

Syntax [**no**] **high-octets-offered-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the high octets offered count.

The **no** form of the command excludes the high octets offered count.

high-packets-discarded-count

Syntax [**no**] **high-packets-discarded-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the high packets discarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv4 packets discarded count instead.

The **no** form of the command excludes the high packets discarded count.

Default no high-packets-discarded-count

high-packets-offered-count

Syntax [**no**] **high-packets-offered-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the high packets offered count.

The **no** form of the command excludes the high packets offered count.

Default no high-packets-offered -count

in-profile-octets-forwarded-count

Syntax [**no**] **in-profile-octets-forwarded-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the in profile octets forwarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv4 octets forwarded count instead.

The **no** form of the command excludes the in profile octets forwarded count.

Default no in-profile-octets-forwarded-count

in-profile-packets-forwarded-count

Syntax [**no**] **in-profile-packets-forwarded-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the in profile packets forwarded count.

For queues with **stat-mode v4-v6**, this command includes IPv4 packets forwarded count instead.

The **no** form of the command excludes the in profile packets forwarded count.

Default no in-profile-packets-forwarded-count

low-octets-discarded-count

Syntax [**no**] **low-octets-discarded-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the low octets discarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv6 octets discarded count instead.

The **no** form of the command excludes the low octets discarded count.

Default no low-octets-discarded-count

low-packets-discarded-count

Syntax [**no**] **low-packets-discarded-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the low packets discarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv6 packets discarded count instead.

The **no** form of the command excludes the low packets discarded count.

Default no low-packets-discarded-count

low-octets-offered-count

Syntax [**no**] **low-octets-offered-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the low octets discarded count.

The **no** form of the command excludes the low octets discarded count.

low-packets-offered-count

Syntax [**no**] **low-packets-offered-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the low packets discarded count.

The **no** form of the command excludes the low packets discarded count.

out-profile-octets-forwarded-count

Syntax [**no**] **out-profile-octets-forwarded-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the out of profile octets forwarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv6 octets forwarded count instead.

The **no** form of the command excludes the out of profile octets forwarded count.

Default no out-profile-octets-forwarded-count

out-profile-packets-forwarded-count

Syntax [**no**] **out-profile-packets-forwarded-count**

Context config>log>acct-policy>cr>oc>i-count
config>log>acct-policy>cr>roc>i-count
config>log>acct-policy>cr>queue>i-count

config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the out of profile packets forwarded count.

For queues with **stat-mode v4-v6**, this command includes the IPv6 packets forwarded count instead.

The **no** form of the command excludes the out of profile packets forwarded count.

Default no out-profile-packets-forwarded-count

uncoloured-octets-offered-count

Syntax [**no**] **uncoloured-packets-offered-count**

Context config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the uncoloured octets offered in the count.

The **no** form of the command excludes the uncoloured octets offered in the count.

uncoloured-packets-offered-count

Syntax [**no**] **uncoloured-packets-offered-count**

Context config>log>acct-policy>cr>queue>i-count
config>log>acct-policy>cr>ref-queue>i-count

Description This command includes the uncoloured packets offered count.

The **no** form of the command excludes the uncoloured packets offered count.

ref-aa-specific-counter

Syntax [**no**] **ref-aa-specific-counter any**

Context config>log>acct-policy>cr

Description This command

The **no** form of the command

ref-override-counter

Syntax **ref-override-counter** *ref-override-counter-id*
ref-override-counter all
no ref-override-counter

Context config>log>acct-policy>cr

Description This command configures a reference override counter.

The **no** form of the command reverts to the default value.

Default no ref-override-counter

ref-queue

Syntax **ref-queue** *queue-id*
ref-queue all
no ref-queue

Context config>log>acct-policy>cr

Description This command configures a reference queue.

The **no** form of the command reverts to the default value.

Default no ref-queue

significant-change

Syntax **significant-change** *delta*
no significant-change

Context config>log>acct-policy>cr

Description This command configures the significant change required to generate the record.

Parameters *delta* — Specifies the delta change (significant change) that is required for the custom record to be written to the xml file.

Values 0 — 4294967295

RADIUS Route Download Commands

route-downloader

Syntax **route-downloader** *name* [**create**]
no route-downloader ***name***

Context config>aaa

Description This command creates or enters the configuration of a route-downloader instance. The route-downloader is a process that uses radius access-request messages to a particular server. The server returns either an access-accept or access-deny message. Access-accept messages also contain the prefixes (in the form of static blackhole routes in various formats)

The **no** form of the command removes the name from the configuration. The object must be shutdown prior to deletion. No prefix is needed to delete an existing route-download object.

Default None. Only a single route-downloader object can be created.

Parameters *name* — Specifies the name of this RADIUS route downloader.

create — This keyword is mandatory while creating an instance of the route-download object.

base-user-name

Syntax **base-user-name** *user-name*
no base-user-name

Context config>aaa>route-downloader

Description This command sets the prefix for the user name that shall be used as access requests. The actual name used will be a concatenation of this string, the "-" (dash) character and a monotonically increasing integer.

The **no** form of the command removes the user-name from the configuration.

Default The system's configured name (system-name).

Parameters *user-name* — Specifies the prefix of the username that is used in the RADIUS access requests. The username used in the RADIUS access requests is a concatenation of this string, the dash character and an increasing integer.

default-metric

Syntax **default-metric** *metric*
no default-metric

Context config>aaa>route-downloader

Description This command sets the default metric that routes imported by the RTM will acquire.

The no form of the command removes the metric

Default 2

Parameters *metric* — Specifies the default metric of the routes imported.

Values 0 — 254

default-tag

Syntax **default-tag** *tag*
no default-tag

Context config>aaa>route-downloader

Description This command sets the default tag that routes processed by the AAA route downloader will take. Note that any route received with a specific tag retains the specific tag. The tag value is passed to the Route Table Manager and is available as match condition on the export statement of other routing protocols.

The **no** form of the command reverts to the default.

Default 0

Parameters *tag* — Specifies the default tag of the routes imported.

Values 0 — 4294967295

download-interval

Syntax **download-interval** *minutes*
no download-interval

Context config>aaa>route-downloader

Description This command sets the time interval, in minutes, that the system waits for between two consecutive runs of the route-download process. The time is counted from the start-time of the run, thus, if an route-download process is still ongoing by the time the timer expires, the process will restart from count=1.

The no form of the command reverts to the default value.

Default 720

Parameters *minutes* — Specifies the time interval, in minutes, between the start of the last route downloader run and the start of the next route downloader run.

Values 1 — 1440

max-routes

max-routes *routes*
no max-routes

Context config>aaa>route-downloader

Description This command determines the upper limits for total number of routes to be received and accepted by the system. The total number is inclusive of both IPv4 and IPv6 addresses and no differentiation is needed across protocols. It includes the sum of both. Once this limit is reached, the download process stops sending new access-requests until the next download-interval expires.

The no form of the command reverts to the default value.

Default 200000

Parameters *routes* — Specifies the maximum number of the routes imported.

Values 1 — 200000

password

password *password* [**hash**|**hash2**]
no password

Context config>aaa>route-downloader

Description This command specifies the password that is used in the RADIUS access requests.It shall be specified as a string of up to 32 characters in length.

The **no** form of the command resets the password to its default of **ALU** and will be stored using hash/hash2 encryption.

Default ALU

Parameters *password* — Specifies a password string up to 32 characters in length.

hash — Specifies the key is entered in an encrypted form. If the **hash** parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form. If the **hash2** parameter is not used, the less encrypted **hash** form is assumed.

radius-server-policy

Syntax **radius-server-policy** *policy-name*
no radius-server-policy

Context config>aaa>route-downloader

Description This command references an existing radius-server-policy (available under the **config>aaa** context). The server (or servers) referenced by the policy will be used as the targets for the access-request message.

The **no** form of the command removes the policy name from the route-downloader configuration.

Default none

Parameters *policy-name* — Specifies the RADIUS server policy.

retry-interval

Syntax **retry-interval min** *minimum* **max** *maximum*
no retry-interval

Context config>aaa>route-downloader

Description This command sets the duration, in minutes, of the retry interval. The retry interval is the interval meant for the system to retry sending an Access Request message after the previous one was unanswered (not with an access reject but rather just a RADIUS failure or ICMP port unreachable). This timer is actually an exponential backoff timer that starts at **min** and is capped at **max** minutes.

The **no** form of the command reverts to the default values.

Default retry-interval min 10 max 20

Parameters **min** *minimum* **—** Specifies the duration, in minutes, of the retry interval. This duration grows exponentially after each sequential failure.

Values 1 — 1440

Default 10

max *maximum* **—** Specifies the maximum duration, in minutes, of the retry interval.

Values 1 — 1440

Default 20

Category Map Commands

category-map

Syntax **category-map** *category-map-name* [**create**]
no category-map *category-map-name*

Context config>subscr-mgmt
config>subscr-mgmt>sla-prof

Description This command specifies the category map name.

Default none

Parameters *category-map-name* — Specifies the category map name up to 32 characters in length.

create — Mandatory keyword when creating a new category map.

credit-control-policy

Syntax **credit-control-policy** *policy-name* [**create**]
no credit-control-policy *policy-name*

Context config>subscr-mgmt

Description This command creates, configures or deletes a credit control policy.

Parameters *policy-name* — Specifies the policy name, 32 characters max.

credit-control-server

Syntax **credit-control-server** radius
credit-control-server diameter *policy-name*
no credit-control-server

Context config>subscr-mgmt>credit-control-policy

Description This command configures the credit control server to use. In case of RADIUS, the servers defined in the authentication policy are used. For Diameter, the peers defined in the specified Diameter policy are used.

Default no credit-control-server

Parameters **radius —** Use the RADIUS authentication servers defined in the RADIUS authentication policy in the group-interface to report credit usage and obtain new credit.

diameter *policy-name* **—** Use the diameter peers specified in the diameter **policy** *policy-name* to report credit usage and obtain new credit.

default-category-map

Syntax **default-category-map** *category-map-name*
no default-category-map

Context config>subscr-mgmt>credit-control-policy

Description This command configures the default category map.

Parameters *category-map-name* — Specifies the category map name, 32 chars max.

error-handling-action

Syntax **error-handling-action** {**continue | block**}
no error-handling-action

Context config>subscr-mgmt>credit-control-policy

Description This command configures the error handling action for the policy.

out-of-credit-action

Syntax **out-of-credit-action** {**continue | disconnect-host | block-category | change-service-level}**
no out-of-credit-action

Context config>subscr-mgmt>credit-control-policy

Description This command configures the action to be performed when out of credit is reached.

Parameters {**continue** | **disconnect-host** | **block-category** |**change-service-level**} — Specifies the action to be taken when out of credit is reached.

activity-threshold

Syntax **activity-threshold** *kilobits-per-second*
no activity-threshold

Context config>subscr-mgmt>cat-map

Description This command configures the threshold that is applied to determine whether or not there is activity. This is only valid for credit-type = time (not volume).

Default 0

Parameters *kilobits-per-second* — Specifies the activity threshold value in kilobits per second.

Values 1 — 100000000

category

Syntax **category** *category-name* [**create**]
no category ***category-name***

Context config>subscr-mgmt>cat-map

Description This command specifies the category name.

Default none

Parameters *category-name* — Specifies the category name up to 32 characters in length.

create — Mandatory keyword when creating a new category.

category-map

Syntax **category-map** *category-map-name*
no category-map

Context config>subscr-mgmt>sla-prof

Description This command references the category-map to be used for the idle-timeout monitoring of subscriber hosts associated with this sla-profile. The **category-map** must already exist in the **config>subscr-mgmt** context.

Parameters *category-map-name* — Specifies the name of the category map (up to 32 characters in length) where the activity-threshold and the category is defined for idle-timeout monitoring of subscriber hosts.

category

Syntax **category** *category-name* [**create**]
no category *category-name*

Context config>subscr-mgmt>sla-prof>cat-map

Description This command defines the category in the category-map to be used for the idle-timeout monitoring of subscriber hosts.

Parameters *category-name* — Specifies the name (up to 32 characters in length) of the category where the queues and policers are defined for idle-timeout monitoring of subscriber hosts.

create — Mandatory keyword when creating a new category

idle-timeout

Syntax **idle-timeout** *timeout*
no idle-timeout

Context config>subscr-mgmt>sla-prof>cat-map>category

Description This command defines the idle-timeout value.

Default no idle-timeout – corresponds with an infinite idle-timeout

Parameters *timeout* — Specifies the idle-timeout in seconds.

Values 60 — 15552000

idle-timeout-action

Syntax **idle-timeout-action** {**shcv-check** | **terminate**}
no idle-timeout-action

Context config>subscr-mgmt>sla-prof>cat-map>category

Description This command defines the action to be executed when the idle-timeout is reached. The action is performed for all hosts associated with the sla-profile instance.

Default terminate

Parameters **shcv-check** — performs a subscriber host connectivity verification check (IPoE hosts only). Note that host connectivity verification must be enabled on the group-interface where the host is connected.

If the check is successful, the hosts are not disconnected and the idle-timeout timer is reset.

If the check fails, the hosts are deleted, similar as for "idle-timeout-action=terminate".

terminate — Deletes the subscriber host from the system: for PPP hosts, a terminate request is send; for IPoE hosts a DHCP release is send to the DHCP server.

credit-type-override

Syntax **credit-type-override** {**volume** | **time**}
no credit-type-override

Context config>subscr-mgmt>cat-map>category

Description This command overrides the **credit-type** configured in the **config>subscr-mgmt>cat-map** context for the given category.

Default no credit-type-override

Parameters **volume —** If different than the value specified in the **credit-type** command, the value overrides the credit-type.

time — If different than the value specified in the **credit-type** command, the value overrides the credit-type.

default-credit

Syntax **default-credit volume** *credits* bytes | kilobytes | megabytes | gigabytes

default-credit time *seconds*
no default-credit

Context config>subscr-mgmt>cat-map>category

Description This command configures the default credit used by this category.

Default no default-credit

Parameters **volume** *credits* **bytes|kilobytes|megabytes|gigabytes —** Specifies the default value for the volume credit and the unit in which the default value is expressed.

Values 1 — 4294967295 (minimum 100 megabytes)

time *seconds* **—** Specifies the default value for the time credit, in seconds.

Values 900 — 4294967295 (minimum 900 seconds)

exhausted-credit-service-level

Syntax [**no**] **exhausted-credit-service-level**

Context config>subscr-mgmt>cat-map>category

Description This command enables the context to configure the exhausted credit service level

Default exhausted-credit-service-level

egress-ip-filter-entries

Syntax [**no**] **egress-ip-filter-entries**

Context config>subscr-mgmt>cat-map>category>exh-lvl

Description This command configures the egress IP filter entries.

egress-ipv6-filter-entries

Syntax [**no**] **egress-ipv6-filter-entries**

Context config>subscr-mgmt>cat-map>category>exh-lvl

Description This command configures the egress IPv6 filter entries.

ingress-ip-filter-entries

Syntax [**no**] **ingress-ip-filter-entries**

Context config>subscr-mgmt>cat-map>category>exh-lvl

Description This command configures the ingress IP filter entries.

ingress-ipv6-filter-entries

Syntax [**no**] **ingress-ipv6-filter-entries**

Context config>subscr-mgmt>cat-map>category>exh-lvl

Description This command configures the ingress IPv6 filter entries.

pir

Syntax [**no**] **pir**

Context config>subscr-mgmt>cat-map>category>exh-lvl

Description This command configures the PIR.

entry

Syntax **entry** *entry-id* [**create**]

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6

Description This command configures the IP filter entry.

Parameters *entry-id* — Specifies the entry ID.

Values 1..65535

action

Syntax **action drop**
action forward
action http-redirect *url*
no action

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6>entry
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6>entry

Description This command configures the action for the filter entry.

Parameters **drop —** Specifies to drop the IP filter entry.

forward — Specifies to forward the IP filter entry.

http-redirect *url* **—** Specifies the HTTP web address that will be sent to the user's browser. Note that http-redirect is not supported on 7750 SR-1 or 7450 ESS-1 models.

The following displays information that can optionally be added as variables in the portal URL (http-redirect url):

- $IP – Customer's IP address
- $MAC – Customer's MAC address
- $URL – Original requested URL
- $SAP – Customer's SAP
- $SUB – Customer's subscriber identification string
- $CID – string that represents the circuit-id or interface-id of the subscriber host (hexadecimal format)
- $RID – string that represents the remote-id of the subscriber host (hexadecimal format)

Values 255 characters maximum

match

Syntax **match** [**next-header** *next-header*]
no match

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6>entry
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6>entry

Description This command configures the match criteria for this IP filter entry.

Parameters *protocol-id* — Specifies the protocol number accepted in DHB.

Values 0..255

dscp

Syntax **dscp** *dscp-name*
no dscp

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6>entry>match

Description This command configures DSCP match conditions.

Parameters *dscp-name* — Specifies the DSCP name.

Values 32 chars max

dst-ip

Syntax **dst-ip** {*ip-address/mask* | *ip-address netmask*}
no dst-ip

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6>entry>match

Description This command configures the destination IP match condition.

Parameters *ip-address/mask* — Specifies the IPv4 address and mask.

Values ip-address a.b.c.d
mask 0..32

ipv6-address/prefix-length — Specifies the IPv6 address and length.

Values ipv6-address x:x:x:x:x:x:x:x (where x is [0..FFFFH])
x:x:x:x:x:x:d.d.d.d (where d is [0..255]D)

prefix-length — Specifies the prefix length.

Values 1..128

netmask — Specifies the mask, expressed as a dotted quad.

Values a.b.c.d

dst-port

Syntax **dst-port** {**lt | gt | eq**} *dst-port-number*
dst-port range *start end*
no dst-port

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6>entry>match

Description This command configures the destination port match condition.

Parameters *lt*|*gt*|*eq* — Specifies the operator.

dst-port-number — Specifies the destination port number as a decimal hex or binary.

Values 0..65535

fragment

Syntax **fragment** {**true | false**}

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match

Description This command configures the fragmentation match condition.

Parameters **true**|**false —** Sets/resets fragmentation check.

icmp-code

Syntax **icmp-code** *icmp-code*
no icmp-code

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6>entry>match

Description This command configures the ICMP code match condition.

Parameters *icmp-code* — Specifies the ICMP code numbers accepted in DHB.

Values 0..255

icmp-type

Syntax **icmp-type** *icmp-type*
no icmp-type

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6>entry>match

Description This command configures the ICMP type match condition.

Parameters *icmp-type* — Specifies the ICMP type numbers accepted in DHB.

Values 0..255

ip-option

Syntax **ip-option** *ip-option-value* [*ip-option-mask*]
no ip-option

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match

Description This command configures the IP option match condition.

Parameters *ip-option-value* — Specifies the IP option value as a decimal hex or binary.

Values 0..255

ip-option-mask — Specifies the IP opition mask as a decimal hex or binary.

Values 0..255

multiple-option

Syntax **multiple-option** {**true | false**}

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match

Description This command configures the multiple-option match condition.

Parameters **true**|**false —** Sets or resets the multiple option check.

option-present

Syntax **option-present** {**true | false**}

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match

Description This command configures the option-present match condition.

Parameters **true | false —** Sets or resets the option present check.

src-ip

Syntax **src-ip** {*ip-address/mask* | *ip-address netmask*}
no src-ip

Context config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6>entry>match

Description This command configures the source IP match condition.

Parameters *ip-address/mask* — Specifies the IPv4 address and mask.

Values

ip-address	a.b.c.d
mask	0 — 32

netmask — Specifies the mask, expressed as a dotted quad.

Values a.b.c.d

ipv6-address/prefix-length — Specifies the IPv6 address and length.

Values

ipv6-address	x:x:x:x:x:x:x:x (where x is [0..FFFFH])
	x:x:x:x:x:x:d.d.d.d (where d is [0..255]D)

prefix-length — Specifies the prefix length.

Values 1..128

src-port

Syntax **src-port** {**lt | gt | eq**} *src-port-number*
src-port range *start end*
no src-port

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6>entry>match

Description This command configures the source port match condition.

Parameters **lt|gt|eq —** Specifies the operators.

src-port-number — Specifies the source port number as a decimal hex or binary.

Values 0..65535

dst-port-number — Specifies the destination port number as a decimal hex or binary.

Values 0..65535

tcp-ack

Syntax **tcp-ack** {**true | false**}
no tcp-ack

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6>entry>match

Description This command configures the TCP ACK match condition. The **no** tcp-ack command disables the checking on the presence or absence of the tcp-ack flag.

Parameters **true|false —** True|false indicates that the entry will match on the presence resp. absence of the tcp-ack flag in the received packet. .

tcp-syn

Syntax **tcp-syn** {**true | false**}
no tcp-syn

Context config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>ingr-ipv6>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ip>entry>match
config>subscr-mgmt>cat-map>category>exh-lvl>egr-ipv6>entry>match

Description This command configures the TCP SYN match condition. The **no** tcp-syn command disables the checking on the presence or absence of the tcp-syn flag.

Parameters **true|false —** True|false indicates that the entry will match on the presence resp. absence of the tcp-syn flag in the received packet.

pir

Syntax **pir** *pir-rate*
pir max
no pir

Context config>subscr-mgmt>cat-map>category>svc-lvl

Description This command configures the PIR which will be enforced for all queues pertaining to this category.

Default no pir

Parameters *pir-rate* — Specifies the amount of bandwidth in kilobits per second (thousand bits per second).

Values 1 — 40000000

max — Specifies to use the maximum amount of bandwidth.

out-of-credit-action-override

Syntax **out-of-credit-action-override** {**continue** | **block-category** | **change-service-level**}
no out-of-credit-action-override

Context config>subscr-mgmt>cat-map>category

Description This command specifies the action to be taken if the credit is exhausted.

Default no out-of-credit-action-override

Parameters **continue —** Specifies to continue when running out of credit.

block-category — Specifies to block the category when running out of credit.

change-service-level — Specifies to change the service level when running out of credit.

policer

Syntax **policer** *policer-id* {**ingress-only**|**egress-only**|**ingress-egress**}
no policer *policer-id*

Context config>subscr-mgmt>cat-map>category

Description This command configures a policer in this category.

Parameters *policer-id* — Specifies a policer identifier. The parameter *policer-id* references a *policer-id* that must be previously created within the SAP QoS policy.

Values 1 — 63

ingress-only — Specifies that ingress policers are defined in this category.

egress-only — Specifies that egress policers are defined in this category.

ingress-egress — Specifies that ingress and egress policers are defined in this category.

queue

Syntax **queue** *queue-id* {**ingress-only** | **egress-only** | **ingress-egress**}
no queue *queue-id*

Context config>subscr-mgmt>cat-map>category

Description This command configures a queue in this category.

Default none

Parameters *queue-id* — Specifies the queue ID for this instances. Each queue nominated in the category map is monitored for activity (over a period of approximately 60 seconds), should the activity fall below the threshold value then a time is started. Whenever this timer exceeds the configured timeout under the idle-timeout the action (currently disconnect) is executed for that subscriber and all hosts under that given SLA-profile-instance.

Values 1 — 32

ingress-only — Specifies that ingress queues are defined in this category.

egress-only — Specifies that egress queues are defined in this category.

ingress-egress — Specifies that ingress and egress queues are defined in this category.

rating-group

Syntax **rating-group** *rating-group-id*
no rating-group

Context config>subscr-mgmt>cat-map>category

Description This command configures the rating group applicable for this category.

Default no rating group

Parameters *rating-group-id* — Specifies the rating group applicable for this category.

credit-exhaust-threshold

credit-exhaust-threshold *threshold-percentage*
no credit-exhaust-threshold

Context config>subscr-mgmt>cat-map

Description This command specifies the credit exhaust threshold taken into account to take action as depicted in Figure 128.

The **no** form of the command reverts the configured value to the default.

Default 100

Parameters *threshold-percentage* — Specifies the percent to use for the credit exhaust threshold.

Values 50 — 100

credit-type

Syntax **credit-type** {**volume** | **time**}
no credit-type

Context config>subscr-mgmt>cat-map

Description This command specifies whether volume or time based accounting is performed.

Default volume

Parameters **volume —** specifies volume-based accounting.

time — Specifies time-based accounting.

Diameter Commands

diameter-peer-policy

Syntax **diameter-peer-policy** *policy-definition-name*
no diameter-peer-policy

Context configure>aaa

Description This command creates a base diameter policy with up to 5 peers. There is a (TCP) connection created to each peer while only two peers can be active (used by applications) simultaneously. Various diameter applications can reference this policy.

Default none

Parameters *policy-definition-name* — Specifies the name of the policy that is created.

diameter-application-policy

Syntax **diameter-application-policy** *application-policy-name* [**create**]
no diameter-application-policy *application-policy-name*

Context configure>subscr-mgmt

Description This command creates diameter application policy.

Default none

Parameters *application-policy-name* — Specifies the name of the diameter policy up to 32 characters in length.

diameter-peer-policy

Syntax **diameter-peer-policy** *referenced-policy-name*
no diameter-peer-policy

Context configure>subscr-mgmt>diam-app-pol

Description This command is used by an application (DCCA, Gx, policy-management application, etc.) to reference a base diameter peer policy that the application will use.

Default none

Parameters *referenced-policy-name* — Specifies the name of the referenced policy.

applications

Syntax **applications** {[**gx**] [**gy**] [**nasreq**]}

no application

Context configure>aaa>diam-peer-plcy

Description This command specifies which applications are advertised in the Capability Exchange Request (CER) messages sent on the peers.

Applications that can be configured on a Diameter peer policy:

- client and proxy role:
  - → gx
  - → nasreq
  - → gx nasreq
- client role only:
  - → gy

Note: gx and nasreq applications can be enabled simultaneously on a single diameter peer.

Default none

Parameters **gx** — Gx application support will be advertised in CER.

gy — Gy (DCCA) application support will be advertised in CER.

nasreq — NASREQ application support will be advertised in CER.

application

Syntax **application** {**gx** | **gy** | **nasreq**}
no application

Context configure>aaa>diam-appl-pol

Description This command specifies the Diameter application for which this policy contains the configuration details, such as AVPs to include and their format.

Applications are mutually exclusive.

Default none

Parameters **gx** — This policy contains Gx application configuration options.

gy — This policy contains Gy application configuration options.

nasreq — This policy contains NASREQ application configuration options.

connection-timer

Syntax [**no**] **connection-timer** *connection-time*

Context configure>aaa>diam-peer-pol
configure>aaa>diam-peer-pol>peer

Description This command sets maximum amount of time the node attempts to reconnect to a diameter peer after a connection to the peer has been brought down due to a transport failure. There are certain exceptions to this rule, such as peer which terminated the transport connection indicating that it does not wish to communicate. A value of 0 means that the connection will not be retried. The configuration at peer level overrules the value configured at diameter-base level for the given peer.

Default 30 seconds at diameter-base level

The default value at peer is taken from diameter-base.

Parameters *connection-time* — Specifies the amount of time, in seconds.

Values 1 — 1000

origin-host

Syntax **origin-host** *origin-host-string*
no origin-host

Context configure>aaa>diam-peer-pol

Description This command configures the origin-realm AVP that will be sent in CER messages and all application based messages. Together with the Origin-Host AVP, these two AVPs form a Diameter Identity.

Parameters *origin-host-string* — Specifies the Origin-Host AVP (Attribute Value Pair) used by this policy up to 80 characters in length.

origin-realm

Syntax **origin-realm** *origin-realm-string*
no origin-realm

Context configure>aaa>diam-peer-pol
configure>aaa>diam-peer-pol>peer
config>sub-mgmt>diameter-policy>diameter-base>peer

Description This command configures the *origin-realm* AVP that will be sent in CER messages and all application based messages. Together with the Origin-Host AVP, these two AVPs form a Diameter Identity.

Parameters *origin-realm-string* — Specifies the *origin-realm* AVP (Attribute Value Pair) used by this policy. up to 80 characters in length.

peer

Syntax **peer** *name* [**create**]
no peer name

Context configure>aaa>diam-peer-pol

Description This command enables the context to configure diameter peer parameters. Up to five diameter peers can be defined inside of a diameter peer policy.

Default none

Parameters *name* — Specifies the peer name, up to a maximum of 32 characters.

address

Syntax **address** *ip-address*
no address

Context configure>aaa>diam-peer-pol>peer

Description This command configures the address.

Parameters *ip-address* — Specifies the IPv4 or IPv6 address of the diameter peer.

destination-host

Syntax **destination-host** *destination-host-string*
no destination-host

Context configure>aaa>diam-peer-pol>peer

Description This command configures the destination-host AVP that will be sent in CCR-i/u and RAA messages. If the destination-host is not explicitly set via configuration, it will be learned from CCA or RAR messages. In other words, the origin-host received in the CCA or RAR message will be used to populate or replace the destination-host for the DCAA or GX session in 7x50.

Parameters *destination-host-string* — Specifies the destination host name up 80 characters in length.

preference

Syntax **preference** *preference*
no preference

Context config>sub-mgmt>diameter-policy>diameter-base>peer
config>sub-mgmt>diameter-policy>diameter-base
configure>aaa>diam-peer-pol>peer

Description This command configured preference per peer. Only the two peers with the highest preference in the peer table are considered for use (primary and secondary). Other peers can be the Open state and they just run keepalives (watchdog-request/answer messages).Once the primary peer fails, the secondary peer will be used as long as the last transaction on it has succeeded (stickiness). Another peer in the Open state will become secondary. Load balancing between peers is not supported.

The **no** form of the command reverts to the default value.

Default none

Parameters *preference* — Specifies the preference of this DIAMETER policy peer.

Values 1 — 100

transaction-timer

Syntax **transaction-timer** *seconds*
no transaction-timer

Context configure>aaa>diam-peer-pol
configure>aaa>diam-peer-pol>peer

Description This command defines the time-out value for the Base Diameter messages (DWR, CER, DPR). Once the transaction-timer expires, an appropriate action will be taken for each message type.

This timer is used in the following cases:

- Opening the TCP connection (and completing the 3-way handshake) - if the TCP ACK is not received within the time specified by the transaction-timer, the TCP connection is closed and the connection-timer is started waiting for the new connection to be initiated.
- Capability Exchange – if the response to the CER message (CEA) is not received within the time specified by the transaction-timer, the peer connection is closed and the connection-timer is started waiting for the new connection to be initiated.
- Peer disconnect Request- if the response to the DPR message is not received (DPA) within the time specified by the transaction-timer, the peer connection is closed.
- DWR Timeout - if the response to the DWR message is not received (DWA) within the time specified by the transaction-timer, the peer connection is NOT closed. Instead the peer will transition into a peer suspended mode and at the same time the watchdog timer is restarted.

Default none

Parameters *seconds* — Specifies the policy peer transaction timer value in seconds.

Values 1 — 1000

transport

Syntax **transport tcp port** *port*
no transport

Context configure>aaa>diam-peer-pol>peer

Description This command defines source tcp port of the connection channel. Only TCP transport is currently supported

Default 3868

Parameters **port** *port* — Specifies the transport protocol port number used towards this policy peer.

Values 1 — 65535

destination-realm

Syntax **destination-realm** *destination-realm-string*
no destination-realm

Context configure>aaa>diam-peer-pol>peer

Description This command configures the destination-realm AVP that will be sent in CCR-i/u and RAA messages. The Destination-Realm cannot be learned dynamically from the CCA or RAR messages and therefore it should be explicitly configured in 7x50. Once configured, it cannot be changed while peers are open.

Parameters *destination-realm-string* — Specifies the destination realm name, maximum 80 displayable characters.

watchdog-timer

Syntax **watchdog-timer** *seconds*
no watchdog-timer

Context configure>aaa>diam-peer-pol
configure>aaa>diam-peer-pol>peer

Description This command configures the interval between consecutive watchdog messages.

On the first timeout of the DWR, 7x50 will resend the DWR message. The peer is still operation during this time.

On the second timeout, the peer will transition into a suspended mode and the peer-failover procedure will be initiated (if the peer-failover is enabled via configuration). In this state the peer is not used for new transactions. At the same time, the cooldown procedure is started which means that it would take 3 successful DWR/DWA message exchanges to re-instate the peer in a fully operation state.

On the third timeout, the peer is removed and its connection is closed.

This behavior is described in RFC 3539, §3.4.1)

Default 30

Parameters *seconds* — specifies the device watchdog timer in seconds used by this policy peer.

Values 1 — 1000

python-policy

Syntax **python-policy** [32 chars max]
no python-policy

Context configure>aaa>diam-peer-pol

Description This command specified the python-policy for Diameter messages received or transmitted on the Diameter peers defined in the diameter-peer-policy.

Default none

Parameters *name* — Specifies the name of the Python policy, up to 32 characters long.

router

Syntax **router** *router-instance*
router service *service-name*
no router

Context configure>aaa>diam-peer-pol

Description This command references the routing instance from which diameter peering is instantiated.

router-instance — Specify one of the following parameters for the router instance:

router-name — Specifies a router name up to 32 characters to be used in the match criteria.

Values Base, management

Default Base

service-id — Specifies an existing service ID to be used in the match criteria.

Values 1 — 2147483647

service-name *service-name* — Specifies an existing service name up to 64 characters in length.

source-address

Syntax **source-address** *ip-address*
no source-address

Context configure>aaa>diam-peer-pol

Description This command configures the IPv4 source-address of all diameter messages sent to peers.

Parameters *ip-address* — The IP prefix for the IP match criterion in dotted decimal notation.

Values 0.0.0.0 — 255.255.255.255

vendor-support

Syntax **vendor-support** [**three-gpp** | **vodafone**]
no vendor-support

Context config>subscr-mgmt>diam-appl-plcy>gy
config>aaa>diam-peer-plcyconfig

Description In a diameter peer policy, this command specifies the vendor support announced in the capability exchange. In a Gy diameter application policy, this command specifies the vendor specific attributes for the user sessions.

The **no** form of the command reverts to the default value.

Default three-gpp

Parameters **three-gpp —** Specifies the 3GPP diameter policy vendor type.

vodafone — Specifies the vodafone diameter policy vendor type.

include-avp

Syntax [**no**] **include-avp**

Context config>subscr-mgmt>diam-appl-plcy>gy
config>subscr-mgmt>diam-appl-plcy>gx
config>subscr-mgmt>diam-appl-plcy>nasreq

Description This command enables the context to configure AVPs and their format to be included in Diameter Gx, Gy or NASREQ application messages.

an-gw-address

Syntax [**no**] **an-gw-address**

Context config>subscr-mgmt>diam-appl-plcy>gx>include-avp

Description This command configures the IPv4 address of the 7x50.

called-station-id

Syntax [**no**] **called-station-id**

Context config>subscr-mgmt>diam-appl-plcy>gx>include-avp
config>subscr-mgmt>diam-appl-plcy>nasreq>avp

Default no called-station-id

Description This command configures the MAC address of AP in WiFi.

calling-station-id

Syntax **calling-station-id** [**type** {**llid** | **mac** | **remote-id** | **sap-id** | **sap-string**}]
no calling-station-id

Context config>subscr-mgmt>diam-appl-plcy>gx>include-avp
config>subscr-mgmt>diam-appl-plcy>nasreq>avp

Description This command includes the calling-station-id AVP in the specified format.

Default no calling-station-id

Parameters **type —** Specifies the format of the Calling-Station-ID AVP.

Values **llid** — The LLID (logical link identifier) is the mapping from a physical to logical identification of a subscriber line and supplied by a RADIUS llid-server.
mac — Specifies that the mac-address will be sent.
remote-id — Specifies that the remote-id will be sent.
sap-id — Specifies that the sap-id will be sent.
sap-string — Specifies that the value is the inserted value set at the SAP level. If no calling-station-id value is set at the SAP level, the calling-station-id attribute will not be sent.

circuit-id

Syntax [**no**] **circuit-id**

Context config>subscr-mgmt>diam-appl-plcy>nasreq>avp

Description This command includes the Agent-Circuit-Id AVP.

ip-can-type

Syntax [**no**] **ip-can-type**

Context config>subscr-mgmt>diam-appl-plcy>gx>include-avp

Description This command includes the ip-can-type.

logical-access-id

Syntax [**no**] **logical-access-id**

Context config>subscr-mgmt>diam-appl-plcy>gx>include-avp

Description This command includes the logical-access-id.

nas-port

Syntax **nas-port** *binary-spec*
no nas-port

Context config>subscr-mgmt>diam-appl-plcy>gx>avp
config>subscr-mgmt>diam-appl-plcy>nasreq>avp

Description This command specifies the format of the 32 bit string used as value for the Nas-Port AVP.

Default no nas-port

Parameters *binary-spec* — Specifies the NAS-Port AVP format.

Values

binary-spec	<bit-specification> <binary-spec>
bit-specification	0 | 1 | <bit-origin>
bit-origin	*<number-of-bits><origin>
number-of-bits	1 — 32
origin	s | m | p | o | i | v | c s - slot number m - MDA number p - port number or lag-id o - outer VLAN ID i - inner VLAN ID v - ATM VPI c - ATM VCI

nas-port-id

Syntax **nas-port-id** [**prefix-type** {**none** | **user-string**}] [**prefix-string** *prefix-string*] [**suffix-type** {**circuit-id** | **none** | **remote-id | user-string**}] [**suffix-string** *suffix-string*]
no nas-port-id

Context config>subscr-mgmt>diam-appl-plcy>gx>avp
config>subscr-mgmt>diam-appl-plcy>nasreq>avp

Description This command includes the Nas-Port-Id AVP.

Default no nas-port-id

Parameters **pr efix-type —** Specifies what type of prefix will be added to the NAS-Port-Id attribute if included in Nas-Port-Id AVP messages.

Values **none** — No prefix is added.
user-string — Specifies the user configurable string to be added as prefix to the NAS-Port-Id attribute if included in DIAMETER Gx messages.

prefix-string — Specifies the user configurable string to be added as a prefix.

suffix-type} **—** specifies the suffix to be added to the NAS-Port attribute NAS-Port AVP.

Values **one** — No suffix is added.
circuit-id — the circuit-id is added as suffix-string.
remote-id — the remote-id is added as suffix-string.
user-string — a user configurable suffix-string is added.

suffix-string — Specifies the string to be added as suffix. Max. 64 characters.

nas-port-type

Syntax **nas-port-type**
nas-port-type [[0..255]]
no nas-port-type

Context config>subscr-mgmt>diam-appl-plcy>gx>avp
config>subscr-mgmt>diam-appl-plcy>nasreq>include-avp

Description This command includes the Nas-Port-Type AVP.

Default no nas-port-type

Parameters **none —** Values as defined in RFC 2865, *Remote Authentication Dial In User Service (RADIUS)*, and RFC 4603, *Additional Values for the NAS-Port-Type Attribute*.

0..255 — Specifies the integer value between 0..255 for the Nas-Port-Type AVP.

remote-id

Syntax [**no**] **remote-id**

Context config>subscr-mgmt>diam-appl-plcy>gx>include-avp
config>subscr-mgmt>diam-appl-plcy>nasreq>include-avp

Description This command enables the generation of the agent-remote-id for RADIUS.

physical-access-id

Syntax [**no**] **physical-access-id**

Context config>subscr-mgmt>diam-appl-plcy>gx>include-avp

Description This command includes the physical access ID.

rat-type

Syntax [**no**] **rat-type**

Context config>subscr-mgmt>diam-appl-plcy>gx>include-avp

Description This command includes the RAT type.

supported-features

Syntax [**no**] **supported-features**

Context config>subscr-mgmt>diam-appl-plcy>gx>include-avp

Description This command includes the supported-features.

user-equipment-info

Syntax **user-equipment-info** [**type** *ue-info-type*]
no user-equipment-info

Context config>subscr-mgmt>diam-appl-plcy>gx>include-avp

Description This command includes the user-equipment-info.

mac-format

Syntax **mac-format** *mac-format*
no mac-format

Context config>subscr-mgmt>diam-appl-plcy>gx
config>subscr-mgmt>diam-appl-plcy>nasreq

Description This command configures the format of the MAC address when reported in Gx or NASREQ application message AVPs such as Calling-Station-Id or User-Name.

Default mac-format “aa:”

Parameters *mac-format* — Specifies the MAC address format.

Values like aa: for 00:0c:f1:99:85:b8
or XY- for 00-0C-F1-99-85-B8
or mmmm. for 0002.03aa.abff
or xx for 000cf19985b8

report-ip-address-event

Syntax [**no**] **report-ip-address-event**

Context config>subscr-mgmt>diam-appl-plcy>gx

Description This command enables triggered CCR-u messages based on IP address allocation/de-allocation for the subscriber-host.

In case that the requests for both IP address families (IPv4 and IPv6) arrive at approximately the same time, a single CCR-i will be sent containing the IP addresses from both address families - IPv4 and IPv6 (NA, PD or SLAAC). Otherwise, in case that the requests for IP addresses are not nearly simultaneous, the CCR-i will contain only the IP address that was allocated first (the one that triggered the session creation). The request for the second IP address family will, depending on configuration, trigger an additional CCR-u that will carry the IP address allocation update to the PCRF along with the UE_IP_ADDRESS_ALLOCATE (18) event. Apart from that, the CCR-u content should mirror the content of the CCR-i with exception of already allocated IP address(es).

In case that this command is disabled, IP address triggered CCR-u messages will not be sent.

Default report-ip-addr-event (enabled)

3gpp-imsi

Syntax **3gpp-imsi** {**circuit-id**|**imsi**|**subscriber-id**}
no 3gpp-imsi

Context config>subscr-mgmt>diam-appl-plcy>gy>include-avp

Description This command specifies the origin of the information to send in the DCCA IMSI AVP.

The no form of the command reverts to the default value.

Default subscriber-id

Parameters **circuit-id —** Specifies the circuit-id as DCCA IMSI AVP value.

subscriber-id — Specifies the subscriber-id as DCCA IMSI AVP value.

imsi — Specifies the imsi as DCCA IMSI AVP value.

called-station-id

Syntax **called-station-id** [64 chars max]
no called-station-id

Context config>subscr-mgmt>diam-appl-plcy>gy>include-avp

Description This command configures the value of the called station ID AVP.

Default no called-station-id

Parameters *64 chars max* — Specifies the called station ID up to 64 characters.

radius-user-name

Syntax [**no**] **radius-user-name**

Context config>subscr-mgmt>diam-appl-plcy>gy>include-avp

Description This command includes the RADIUS user name AVP in the Diameter gy messages.

Default no radius-user-name

service-context-id

Syntax **service-context-id** *name*
no service-context-id

Context config>subscr-mgmt>diam-appl-plcy>gy>include-avp

Description This command configure the value of the service context ID AVP.

Default no service-context-id

Parameters *name* — Specifies the service context ID AVP value up to 32 displayable characters.

preference

Syntax **preference** *preference*
no preference

Context configure>aaa>diam-peer-pol>peer

Description This command configures the preference given to this policy peer with respect to the other peers associated with this policy.

If multiple peers are available for this policy, only the available peer with the highest preference will be used.

If multiple peers with the same preference are available, one of them will be used.

The **no** form of the command reverts to the default value.

Default 50

Parameters *preference* — Specifies the preference of this policy peer.

Values 1 — 100

transaction-timer

Syntax [**no**] **transaction-timer** *transatcion-time*

Context configure>aaa>diam-peer-pol

Description This command sets maximum amount of time the node waits for a diameter peer to respond before trying another peer. The configuration at peer level overrules the value configured at diameter-base level for the given peer.

Default 30 seconds at diameter-base level

Default value at peer is taken from diameter-base.

Parameters *transaction* — Specifies the DIAMETER peer policy transaction timer in seconds.

Values 1-1000

router

Syntax **router service** s*ervice-name*
router *router-instance*
no router

Context config>sub-mgmt>diameter-policy>diameter-base

Description This command specifies the virtual router in which the diameter connection(s) will be established by this diameter policy.

Parameters *router-instance* — Specifies the router name.

Values router-instance: *router-name*|*service-id*
router-name: Base, management
service-id: 1 — 2147483647

Default Base

service-name — Specifies the VPRN service ID.

source-address

Syntax **source-address** *ip-address*
no source-address

Context config>sub-mgmt>diameter-policy>diameter-base

Description This command configures the source address.

Default no source-address; system-ip address is used instead

Parameters *ip-address* — Specifies the UC IPv4 or IPv6 IP address.

gx

Syntax **gx**

Context config>sub-mgmt>diameter-policy>diameter-base

Description This command enables the context to configure Gx parameters.

gy

Syntax **gy**

Context config>sub-mgmt>diameter-policy

Description This command enables the context to configure Diameter Credit Control Application or Gy-specific options.

nasreq

Syntax **nasreq**

Context config>sub-mgmt>diameter-policy

Description This command enables the context to configure NASREQ application-specific attributes.

avp-subscription-id

Syntax **avp-subscription-id origin** [**type** *type*]
no avp-subscription-id

Context config>subscr-mgmt>diam-appl-plcy>gx
config>subscr-mgmt>diam-appl-plcy>gy

Description This command is used to provide identification information to the PCRF for the end user. Subscription-id is a grouped AVP. In case that parameter designated to be the subscription-id is not available, the subscription-avp will not be sent.

The **no** form of the command reverts to the default value.

Default none

Default **avp-subscription-id subscriber-id type private**

Parameters **origin —** Specifies the origin of the information to send in the Subscription-Id-Data AVP.

Values **circuit-id** — The circuit ID.
dual-stack-remote-id — The remote-id for IPv4 and IPv6. The enterprise-id field is stripped off from IPv6 remote-id before it is passed to the PCRF in Gx message.
imei — The physical ID of the end device.
imsi — The SIM ID.
mac — The MAC address of the end device.
msisdn — The phone number of the end device.
nas-port-id — nas-port-id can be a prefix or suffix with a custom string to make it unique network wide.
subscriber-id — The subscriber ID.
username — The username identifier can be of type **private** or **nai**. The username is a ppp-username (PAP/CHAP). In case that ppp-username is not available, the string in the Username attribute returned via RADIUS or NASREQ will be used.

type — Specifies the type of the identifier stored in the Subscription-Id-Data AVP.

Values **e164** — The identifier is in international E.164 format (e.g., MSISDN).
imsi — The identifier is in international IMSI format according to the ITU-T E.212 numbering plan.
nai — The identifier is in the form of a Network Access Identifier as defined in RFC 2486.
private — The identifier is a private type identifier.

out-of-credit-reporting

Syntax **out-of-credit-reporting** {**final**|**quota-exhausted**}
no out-of-credit-reporting

Context config>subscr-mgmt>diam-peer-plcy>gy

Description This command changes the reporting reason in an intermediate interrogation when the final granted units have been consumed and a corresponding out-of-credit-action different from "disconnect-host" is started.

The no form of the command reverts to the default value

Default out-of-credit-reporting final

Parameters **final —** Specifies the reporting reason in an intermediate interrogation when the final granted units have been consumed and a corresponding out-of-credit-action different from **disconnect-host** is started.

quota-exhausted — Specifies the reporting reason in an intermediate interrogation when the final granted units have been consumed and a corresponding out-of-credit-action different from **disconnect-host** is started.

on-failure

Syntax **on-failure** [**failover** {**enabled**|**disabled**}] [**handling** {**continue** | **retry-and-terminate** | **terminate**}]
no on-failure

Context config>subscr-mgmt>diam-peer-plcy

Description Behavior of the application's session in case of a peer failure can be controlled by the Diameter server through two AVPs carried in CCA messages that are defined in RFC4006:

- CC-Session-Failover AVP
  - → FAILOVER_NOT_SUPPORTED
  - → FAILOVER_SUPPORTED
- Credit-Control-Failure-Handling AVP
  - → TERMINATE
  - → CONTINUE
  - → RETRY_AND_TERMINATE

In case that those AVPs are not provided by the Diameter server, the local configuration provided by this command will take effect. This command defines the following:

- Peer-failover behavior to a secondary peer in case that the primary peer is unresponsive. The primary peer is considered unresponsive in case that the application message sent to it, times out. The failover mechanism defined by this command is only applicable to CCR messages (and not to RAA messages since there is no response expected).The time out of the message is determined by the tx-timer command.

  The peer-failover action based on the message timeout is defined per session. In other words, a message timeout for one session cannot cause the failover for some other session.

  The maximum number of transmissions per session is hardcoded to 2 and the same message is never re-transmitted to the same TCP socket (a TCP socket is defined as a current peering connection defined by the TCP source/destination IP addresses/ports; closing and then reopening a connection to the same peer will result in creation of a new TCP socket). Once the original message for the session times out on the primary peer, the message will be re-transmitted to the

secondary peer, provided that the secondary peer is available and the failover is enabled with the corresponding handling mechanism. In case that the secondary peer is unavailable, the original message will not be re-transmitted to the same primary peer again.

Once the reply from a peer is received, the session will be tied to that peer until the next timeout. In other words, the session always sticks to the peer from which it received the last response.

- Handling behavior in case that the response from the peer is not received or the peers are not available at all (all peering connections are closed). This behavior is applicable to CCR-i messages in Gx and CCR-i/u messages in Gy. In case of Gx, if the response to a session initiation message (CCR-i) is not received, the fate of the session will depend on the configuration (the session can be terminated or continue to exist with default parameters).

Default on-failure failover enabled handling terminate

Parameters **failover enabled —** The session is allowed to switch to the secondary peer.

failover disabled — The session is NOT allowed to switch to the secondary peer.

handling continue — The sessions will continue to exist if the response to a transmitted CCR message is not received. Whether the transmitted message will be re-transmitted depends on the failover configuration. In case of session initiation procedure in the Gx case (CCR-i timeout), the subscriber host will be instantiated with the default parameters, assuming that they are provided. In the default parameter are not provided, the subscriber host initiation will fail.

handling retry-and-terminate — The message will be re-transmitted in case that the peer-failover is enabled and the secondary peer is available. Once the retransmitted message (CCR-i in Gx; CCR-i/u in Gy) is timed-out, the application session will be terminated.

handling terminate — The session will be terminated if the response to the original message (CCR-I in Gx; CCR-i/u in Gy) is not received. No re-transmissions will be attempted, regardless of whether the failover is enabled or not.

tx-timer

Syntax **tx-timer** *seconds*
no tx-timer

Context configure>subscr-mgmt>diam-app-pol

Description This command defines the time-out period for the application's CCR-i/u messages that are waiting for a reply from a peer (message is in a pending state). Peer-failover behavior determines the action that will be taken once the message times out. Peer-failover behavior can be dictated by the PCRF or can be locally configured in 7x50.

Per RFC 4006, sec 13, *Diameter Credit-Control Application*, *Credit-Control Application Related Parameters*, When real-time credit-control is required, the credit-control client contacts the credit-control server before and while the service is provided to an end user. Due to the real-time nature of the application, the communication delays SHOULD be minimized; e.g., to avoid an overly long service setup time experienced by the end user. The Tx timer is introduced to control the waiting time in the client in the Pending state. When the Tx timer elapses, the credit-control client takes an action to the end user according to the value of the Credit-Control-Failure-Handling AVP or Direct-Debiting-Failure-Handling AVP. The recommended value is 10 seconds.

Default 10

Parameters *seconds* — specifies the Tx Timer value (in seconds) for this policy.

Values 10 — 1000

diameter-application-policy

Syntax **diameter-application-policy** *application-policy-name*
no diameter-application-policy

Context configure>service>vpls>sap
configure>service>vprn>sub-if>grp-if
configure>service>ies>sub-if>grp-if
configure>subscr-mgmt>loc-user-db>ipoe>host
configure>subscr-mgmt>loc-user-db>pppoe>host

Description This command associates the specified diameter-application-policy with the processing of the host attachment requests.

Default none

Parameters *application-policy-name* — Specifies the name of the diameter policy up to 32 characters in length.

Filter Commands

filter

Syntax **filter**

Context configure

Description This command manages the configuration of filters.

copy

Syntax **copy** {**ip-filter | mac-filter | ipv6-filter**} *src-filter-id* [**src-entry** *src-entry-id*] **to** *dst-filter-id* [**dst-entry** *dst-entry-id*] [**overwrite**]

Context configure>filter

Description This command copies filters and its entries.

Parameters *src-filter-id* — Specifies the source filter ID.

Values 1..65535

src-entry-id — Specifies the source entry ID.

Values 1..65535

dst-filter-id — Specifies the destination filter ID.

Values 1..65535

dst-entry-id — Specifies the destination entry ID.

Values 1..65535

overwrite — Specifies an overwrite.

ip-filter

Syntax **ip-filter** *filter-id* [**create**]
no ip-filter *filter-id*

Context configure>filter

Description This command configures an IP filter.

Parameters *filter-id* — Specifies the filter ID.

Values 1..65535

ipv6-filter

Syntax **ipv6-filter** *ipv6-filter-id* [**create**]
no ipv6-filter *ipv6-filter-id*

Context configure>filter

Description This command configures an IPv6 filter.

Parameters *filter-id* — Specifies the filter ID.

Values 1..65535

default-action

Syntax **default-action** *drop* |*forward*

Context configure>filter>ip-filter
configure>filter>ipv6-filter

Description This command configures default-action for the IP or IPv6 filter.

Parameters *drop*|*forward* — This keyword specifies the filter action.

entry

Syntax **entry** *entry-id* [**time-range** *time-range-name*] [**create**]
no entry *entry-id*

Context configure>filter>ip-filter
configure>filter>ipv6-filter

Description This command configures an IP or IPv6 filter entry.

Parameters *entry-id* — Specifies the entry ID.

Values 1..65535

time-range-name — Specifies the time range name.

Values 32 charas max

action

Syntax **action** *drop*|*forward*
no action

Context config>filter>ip-filter>entry
config>filter>ipv6-filter>entry

Description This command configures actions for the IP or IPv6 filter entry.

Parameters *drop|forward* — Specifies the filter action.

log

Syntax **log** *log-id*
no log

Context config>filter>ip-filter>entry
config>filter>ipv6-filter>entry

Description This command configures the log for the IP or IPv6 filter entry.

Parameters *log-id* — Specifies the log ID.

Values 101..199

match

Syntax **match** [**next-header** *next-header*]
no match

Context config>filter>ip-filter>entry
config>filter>ipv6-filter>entry

Description This command configures the match criteria for the IP or IPv6 filter entry.

Parameters *next-header* — Specifies the protocol numbers accepted in DHB.

Values [1..42|45..49|52..29|61..255]

Values none | crtp | crudp | egp | eigrp | encap | ether-i p | gre | icmp | idrp | igmp | igp | ip | ipv6 | ipv6-icmp | ipv6-no-nxt | isis | iso-ip | l2tp | ospf-igp | pim | pnni | ptp | rdp | rsvp | stp | tcp | udp | vrrp * udp/tcp wildcard

dscp

Syntax [**no**] **dscp**

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures DSCP match condition.

dst-ip

Syntax [**no**] **dst-ip**

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures the destination IP or IPv6 address match condition.

dst-port

Syntax [**no**] **dst-port**

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures the destination port match condition.

icmp-code

Syntax [**no**] **icmp-code**

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures the ICMP code match condition.

icmp-type

Syntax [**no**] **icmp-type**

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures the ICMP type match condition.

src-ip

Syntax [**no**] **src-ip**

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures the source IP or IPv6 address match condition.

src-port

Syntax [**no**] **src-port**

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures the source port match condition.

tcp-ack

Syntax [**no**] **tcp-ack**

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures the TCP ACK match condition.

tcp-syn

Syntax [**no**] **tcp-syn**

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures the TCP SYN match condition.

group-inserted-entries

Syntax **group-inserted-entries application** *application* **location** *location*

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command groups auto-inserted entries.

Parameters *application* — Specifies the application.

Values radius | credit-control

location — Specifies the location.

Values top | bottom

renum

Syntax **renum** *old-entry-id new-entry-id*

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command renumbers an IP or IPv6 filter entry.

Parameters *old-entry-id* — Specifies the old entry ID to be renumbered.

Values 1..65535

new-entry-id — Specifies the new entry ID.

Values 1..65535

scope

Syntax **scope exclusive | template**
no scope

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command configures the scope for the IP or IPv6 filter.

Parameters **exclusive | template** — Specifies the type of policy.

shared-radius-filter-wmark

Syntax **shared-radius-filter-wmark low** *low-watermark* **high** *high-watermark*
no shared-radius-filter-wmark

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command defines the thresholds that will be used to raise a respective alarm when the number of shared filter copies increases.

Default no shared-radius-filter-wmark

Parameters *low-watermark* — specifies low threshold for the number of shared filter copies

Values 0-8000

high-watermark — specifies high threshold for the number of shared filter copies

Values 0-8000

sub-insert-radius

Syntax **sub-insert-radius start-entry** *entry-id* **count** *count*
no sub-insert-radius

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command defines the range of filter entries which will be reserved for entries created based on information (match criteria and action) from RADIUS auth-response messages.

The **no** version of the command disables the insertion, which means that information from auth-response messages cannot be stored in the filter, and the corresponding host will not be created in the system.

Default per default insertion is disabled

Parameters *entry-id* — An integer defining the lowest entry of the range.

count — An integer defining the number of entries in the range.

sub-insert-credit-control

Syntax **sub-insert-credit-control start-entry** *entry-id* **count** *count*
no sub-insert-credit-control

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command defines the range of filter entries that will be reserved for entries created based on information (match criteria and action) configured under the category-map configuration tree to enforce reduced-service level in case of credit exhaustion.

The **no** version of the command disables the insertion, which means that entries will not be installed even though the credit for the given category and subscriber-host has been exhausted.

Default per default insertion is disabled

Parameters *entry-id* — An integer defining the lowest entry of the range.

count — An integer defining the number of entries in the range.

sub-insert-shared-radius

Syntax **sub-insert-shared-radius start-entry** *entry-id* **count** *count*
no sub-insert-shared-radius

Context config>filter>ip-filter
config>filter>ipv6-filter
config>filter>ip-filter
config>filter>ipv6-filter

Description This command defines the range of filter entries that will be reserved for shared filter entries received in RADIUS messages.

The no version of the command disables the insertion resulting in a host setup failure when shared filter attributes are received in a RADIUS authentication response.

Default no sub-insert-shared-radius

Parameters *entry-id* — specifies the lowest entry of the range.

Values 1-65535

count — specifies the number of entries in the range.

Values 1-65535

sub-insert-wmark

Syntax **sub-insert-wmark** [**low** *percentage*] [**high** *percentage*]
no sub-insert-wmark

Context config>filter>ip-filter

config>filter>ipv6-filter

Description This command defines the thresholds that will be used to raise a respective alarm to provide monitoring of the resources for subscriber-specific filter insertion.

The **no** version of the command sets the default values for the respective thresholds.

Default low - 90%

high - 95%

Parameters *percentage* — Defines in percentage the threshold used to raise an alarm.

Values 1-100, integer

IGMP Policy Commands

igmp-policy

Syntax **igmp-policy** *policy-name* [**create**]
no igmp-policy

Context config>sub-mgmt

Description This command configures an IGMP policy.

Parameters *policy-name* — Specifies the policy name.

Values 32 chars max

egress-rate-modify

Syntax **egress-rate-modify** [**egress-rate-limit** | **scheduler** *scheduler-name*]
no egress-rate-modify

Context configure>subscr-mgmt>igmp-policy

Description This command is used to apply HQoS Adjustment to a subscriber. HQoS Adjustment is needed when multicast traffic flow for the subscriber is dissociated from subscriber host queues. Multicast redirection is typical such case although it can be applied in direct IPoE subscriber per-sap replication mode.

The channel bandwidth definition policy is defined in the mcac policy under the configure>router>mcac>policy hierarchy. The policy is applied under the redirected interface or under the group-interface.

In order for HQoS Adjustment to take effect, sub-mcac-policy must be in a no shutdown mode and applied under the sub-profile even if mcac is not deployed.

Parameters **egress-rate-limit —** Subscriber's bandwidth is capped via the aggregate-rate-limit command in the sub-profile or via a Change of Authorization (CoA) request. This bandwidth cap will be dynamically adjusted according to the multicast channel definition and channel association with the host via IGMP.

scheduler *scheduler-name* — Subscriber's bandwidth is capped via the scheduling-policy in the sub-profile or via a Change of Authorization (CoA) request . HQoS Adjustment will modify the rate of the scheduler (scheduler-name) defined in the scheduling-policy or configured via CoA.

Default HQoS Adjustment is disabled.

import

Syntax **import** *policy-name*
no import

Context config>sub-mgmt>igmp-policy

Description This command specifies the import policy to filter IGMP packets.

Parameters *policy-name* — Specifies the policy name.

Values 32 chars max

max-num-groups

Syntax **max-num-groups** ***b***
no max-num-groups

Context config>sub-mgmt>igmp-policy

Description This command configures the max number of multicast groups.

Parameters *max-num-groups* — Specifies the maximum number of multicast groups.

Values 0 — 16000

max-num-sources

Syntax **max-num-sources** *max-num-sources*
no max-num-sources

Context config>sub-mgmt>igmp-policy

Description This command configures the max number of multicast sources.

The **no** form of the command disables the command.

Default no max-num-sources

Parameters *max-num-sources* —

Values 1 — 1000

max-num-grp-sources

Syntax **max-num-grp-sources** [1..32000]
no max-num-grp-sources

Context config>sub-mgmt>igmp-policy
config>sub-mgmt>msap-policy>igmp-host-tracking

Description This command configures the maximum number of group sources for which IGMP can have local receiver information based on received IGMP reports on this interface. When this configuration is changed dynamically to a value lower than currently accepted number of group sources, the group sources that are already accepted are not deleted. Only new group sources will not be allowed. When this object has a value of 0, there is no limit to the number of group sources.

The **no** form of the command removes the value from the configuration.

Default no max-num-grp-sources

Parameters **1..32000 —** Specifies the maximum number of multicast sources allowed to be tracked per group

mcast-reporting

Syntax [**no**] **mcast-reporting**

Context config>sub-mgmt>igmp-policy

Description This command configures mcast reporting.

mcast-reporting-dest

Syntax **mcast-reporting-dest** *dest-name*
no mcast-reporting-dest

Context configure>subscriber-mgmt>igmp-policy>mcast-reporting>
configure>subscriber-mgmt>host-tracking-policy>mcast-reporting>

Description This command references Multicast Reporting Destination to which IGMP related events are exported.

The Multicast Reporting Destination is referenced with the subscriber itself or within the Host-Tracking-Policy.

Parameters *dest-name* — Name of the Multicast Reporting Destination.

Default no mcast-reporting-dest is referenced.

opt-reporting-fields

Syntax **opt-reporting-fields** [**host-mac**] [**pppoe-session-id**] [**svc-id**] [**sap-id**]
no opt-reporting-fields

Context configure>subscriber-mgmt>igmp-policy>mcast-reporting>
configure>subscriber-mgmt>host-tracking-policy>mcast-reporting>

Description This command will specify optional data relevant to the IGMP event that can be exported. This optional data includes:

- Host MAC address
- PPPoE session-ID
- Service ID
- SAP

Parameters **host-mac —** Specifies the host-mac optional field should be included into the multicast reporting messages.

pppoe-session-id — Specifies the pppoe-session-id optional field should be included into the multicast reporting messages.

svc-id — Specifies the svc-id optional field should be included into the multicast reporting messages.

sap-id — Specifies the sap-id optional field should be included into the multicast reporting messages.

Default Optional data is disabled.

Sample Output

```
configure
     system
          security
               source-address
                    application <app> <ip-int-name | ip-address>

<app>                 : cflowd|dns|ftp|ntp|ping|radius|snmptrap|sntp|ssh|
                        syslog|tacplus|telnet|traceroute|mcreporter
 <ip-int-name|ip-ad*> : ip-int-name    - 32 chars max
                        ip-address     - a.b.c.d
```

sub-mcac-policy

Syntax **sub-mcac-policy** *policy-name*
no sub-mcac-policy

Context configure>subscr-mgmt

Description This command will create a policy template with mcac bandwidth limits that will be applied to the subscriber.

Per interface mcac bandwidth limits will be set directly under the interface (regular interface or group-interface) and no such policy templates are needed.

The need for a separate policy template for subscribers is due to the fact that sub-groups of subscribers under the group-interface can share certain settings that can be configured via templates.

To summarize, the mcac bandwidth constraints for subscribers are defined in the sub-mcac-policy while the mcac bandwidth constraints for the interface are configured directly under the **igmp>interface>mcac** or **igmp>group-interface>mcac** context without the need for policy templates.

Note that the sub-mcac-policy only deals with the mcac bandwidth limits and not the channel bandwidth definitions. Channels bandwidth is defined in a different policy (under the configure>router>mcac hierarchy) and that policy is applied on the interface level as follows:

In case of HQoS Adjustment, it is mandatory that the sub-mcac-policy be created and applied to the subscriber. The sub-mac-policy does not have to contain any bandwidth constrains, but it has to be in a no shutdown state in order for HQoS Adjustment to work.

Parameters *policy-name* — Name of the policy.

Default No sub-mcac-policy is created.

sub-mcac-policy

Syntax **sub-mcac-policy** *policy-name*
no sub-mcac-policy

Context configure>subscr-mgmt>sub-profile

Description This command references the policy template in which the mcac bandwidth limits are defined. Mcac for the subscriber is effectively enabled with this command when the sub-profile is applied to the subscriber. The bandwidth of the channels is defined in a different policy (under the configure>router>mcac hierarchy) and this policy is applied on the interface level as follows:

for regular interfacs under the configure>service/router>igmp>interface>mcac hierarchy

In case of HQoS Adjustment, it is mandatory that the sub-mcac-policy be created and applied to the subscriber. The sub-mac-policy does not have to contain any bandwidth constrains, but it has to be in a no shutdown state in order for HQoS Adjustment to work.

Parameters *policy-name* — Name of the policy.

Default No policy is referenced.

version

Syntax **version** *version*
no version

Context config>sub-mgmt>igmp-policy

Description This command configures the version of IGMP.

Parameters *version* — Specifies the version of IGMP.

Values 1, 2 or 3

fast-leave

Syntax [**no**] **fast-leave**

Context config>sub-mgmt>igmp-policy

Description This command enables/disables IGMP fast-leave processing.

Default fast-leave

static

Syntax **static**

Context config>sub-mgmt>igmp-policy

Description This command adds or removes IGMP static group membership.

per-host-replication

Syntax **per-host-replication** [**uni-mac**|**mcast-mac**]
no per-host-replication

Context configure>subscr-mgmt>igmp-policy

Description This command enables per-host-replication in IPoE model. For PPPoX, per-host-replication is the only mode of operation. In the per-host-replication mode, multicast traffic is replicated per each host within the subscriber irrespective of the fact that some hosts may be subscribed to the same multicast stream. As a result, in case that multiple hosts within the subscriber are registered for the same multicast group, the multicast streams of that group will be generated. The destination MAC address of multicast streams will be changed to unicast so that each host receives its own copy of the stream. Multicast traffic in the per-host-replication mode can be classified via the existing QoS CLI structure. As such the multicast traffic will flow through the subscriber queues. HQoS Adjustment is not needed in this case.

The alternative behavior for multicast replication in IPoE environment is per-SAP- replication. In this model, only a single copy of the multicast stream is sent per SAP, irrespective of the number of hosts that are subscribed to the same multicast group. This behavior applies to 1:1 connectivity model as well as on 1:N connectivity model (SAP centric behavior as opposed to subscriber centric behavior).

In the per-SAP-replication model the destination MAC address is multicast (as opposed to unicast in the per-host-replication model). Multicast traffic is flowing via the SAP queue which is outside of the subscriber context. The consequence is that multicast traffic is not accounted in the subscriber HQoS. In addition, HQoS Adaptation is not supported in the per SAP replication model.

Default By default there is no per host replication and replication is done per SAP. This mode utilizes the SAP queues. With per-host-replication it will allow the use of the subscriber queues. Per-host-replication uses unicast MAC and multicast IP to deliver multicast content to end hosts. This is useful for multi host per SAP cases. To interoperate with end devices that do not support unicast MAC, there is an option to use per-host-replication with a multicast MAC. The traffic will be the same as replication per SAP but the difference of using the subscriber queues.

Parameters **uni-mac —** Specifies that multicast traffic is sent with a unicast MAC and multicast IP.

mcast-mac — Specifies that multicast traffic is sent with a multicast MAC and IP.

redirection-policy

Syntax **redirection-policy** *policy-name*
no redirection-policy

Context config>sub-mgmt>igmp-policy

Description This command will apply multicast redirection action to the subscriber. The redirection action along with the redirected interface (and possibly service id) is defined in the referenced policy-name. IGMP messages will be redirected to an alternate interface if that alternate interface has IGMP enabled. The alternate interface does not have to have any multicast groups registered via IGMP. Currently all IGMP messages are redirected and there is no ability to selectively redirect IGMP messages based on match conditions (multicast-group address, source IP address, etc.). Multicast redirection is supported between VPRN services and also between interfaces within the Global Routing Context. Multicast Redirection is not supported between the VRPN services and the Global Routing Table (GRT).

IGMP state is maintained per subscriber host and per redirected interface. Traffic is however forwarded only on the redirected interface.

Default none

Parameters *policy-name* — This is a regular policy defined under the **configure>router>policy-option>policy-statement** context.

group

Syntax [**no**] **group** *ip-address*

Context config>sub-mgmt>igmp-policy>static

Description This command adds or removes a static multicast group.

Parameters *ip-address* — Specifies the IP address.

Values a.b.c.d

Host Lockout Commands

host-key

Syntax **host-key** {**mac**}
no host-key

Context config>subscr-mgmt>host-lockout-plcy

Description This command specifies the parameters used in host identification for lockout on a given SAP or capture SAP:

no host-key – include (MAC address, Circuit-Id, Remote-Id)

host-key mac – include MAC address only

"host-key mac" should be used in DHCPv4 scenarios where Circuit-Id and Remote-Id are changed with "dhcp option action replace" configuration: a host lockout context is created with the replaced Circuit-Id/Remote-Id; with the default host-key (including Circuit-Id and Remote-Id), lockout does not kick in on the original trigger packet when it is retransmitted by the client.

Changing the host-key to mac should be used with care: all hosts with the same MAC address on a given SAP or capture SAP are identified as a single host with respect to host-lockout.

The host-key command cannot be changed when the host-lockout-policy is referenced (i.e. configured under a SAP context).

Default no host-key

Parameters **mac —** Specifies to use the MAC address only for host identification for lockout.

host-lockout-policy

Syntax **host-lockout-policy** *policy-name* [**create**]
no host-lockout-policy *policy-name*

Context config>subscriber-mgmt

Description This command creates a host lockout policy. The policy contains set of host lockout configuration parameters. It is applied to SAP or MSAPs (by a MSAP-policy). Any change does not impact existing locked-out hosts, but only new incoming hosts that enter lockout.

The **no** form of the command removes the policy name from the configuration. The policy must not be associated with any entity.

Default none

Parameters *policy-name* — Specifies an existing host lockout policy to associate with the SAP.

create — Keyword used to create the host lockout policy. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

host-lockout-policy

Syntax **host-lockout-policy** *policy-name*
no host-lockout-policy

Context config>service>ies>interface>sap
config>service>ies>subscriber-interface>sap
config>service>vpls>sap
config>service>vprn>interface>sap
config>service>vprn>subscriber-interface>sap

Description This command selects an existing host lockout policy. The **host-lockout-policy** *policy-name* is created in the **config>subscriber-mgmt** context.

The **no** form of the command removes the policy name from the SAP configuration.

Default none

Parameters *policy-name* — Specifies an existing host lockout policy to associate with the SAP.

lockout-time

Syntax **lockout-time** [**min** *seconds*] [**max** *seconds*]
no lockout-time

Context config>subscriber-mgmt>host-lockout-policy

Description This command configures the time for which a client stays in the lockout state during which authentication and ESM host creation is suppressed. The range for the min and max lockout times is 1 second to 86400 seconds. The min time defaults to 10 seconds, and max time defaults to 3600 seconds.

The no form of the command reverts to the default value.

Parameters **min** *seconds* **—** specifies the minimum lockout-time for this host lockout policy.

Values 1 — 86400

Default 10 seconds

max *seconds* **—** specifies the maximum lockout-time for this host lockout policy.

Values 1 — 86400

Default 3600 seconds

lockout-reset-time

Syntax **lockout-reset-time** *seconds*
no lockout-reset-time

Context config>subscriber-mgmt>host-lockout-policy

Description This command configures the time that needs to elapse from the point a client enters lockout to when the client's lockout time can be reset to the configured minimum value. The range is 1 sec

The **no** form of the command reverts to the default value.

Parameters *seconds* — Specifies the lockout reset time in seconds.

Values 1 — 86400

Default 60 seconds

max-lockout-hosts

Syntax **max-lockout-hosts** *hosts*
no max-lockout-hosts

Context config>subscriber-mgmt>host-lockout-policy

Description When a client enters lockout, authentication and ESM host creation is suppressed. A lightweight context maintains the lockout state and the timeouts for the client in lockout. This command allows the number of lockout contexts to be configured per SAP. If the number of existing contexts reaches the configured count, incoming hosts that fail authentication or creation are not subject to lockout, and are retired as normal.

The **no** form of the command reverts to the default value.

Parameters *hosts* — Specifies the maximum number of lockout hosts.

Values 1 — 1000

Default 100

host-tracking-policy

Syntax **host-tracking-policy** *policy-name* [**create**]
no host-tracking-policy *policy-name*

Context config>subscr-mgmt
config>subscr-mgmt>sub-prof

Description This command configures a host tracking policy. IGMP host tracking is an option in the subscriber profile that allows the factoring in of a subscriber's (multicast) video traffic by reducing the unicast operational egress aggregate rate or the rate of the scheduler specified in the ANCP policy to account for a subscriber's multicast traffic. If no ANCP policy is defined, the egress aggregate rate configured in the subscriber profile is reduced. If an ANCP policy is defined, the "rate-modify" parameter in the policy specifies whether the egress aggregate rate or the rate of the egress policer specified in the policy is to be reduced to account for the subscriber's multicast traffic.

Default disabled

egress-rate-modify

Syntax **egress-rate-modify agg-rate-limit**
egress-rate-modify scheduler *scheduler-name*

no egress-rate-modify

Context config>subscr-mgmt>trk-plcy

Description This command specifies the egress-rate modification that is to be applied.

agg-rate-limit — Specifies the egress rate limit.

scheduler *scheduler-name* **—** Specifies the scheduler name to use.

PIM Policy Commands

pim-policy

Syntax **pim-policy** *pim-policy-name* [**create**]
no pim-policy *pim-policy-name*

Context config>subscr-mgmt

Description This command creates a PIM policy or enables the context to configure a PIM policy.

The **no** form of this command deletes the specified PIM policy.

Default none

Parameters *pim-policy-name* — Specifies the PIM policy name.

Values Valid names consist of any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

create — Keyword used to create the PIM policy. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

Managed SAP Policy Commands

msap-policy

Syntax **msap-policy** *msap-policy-name* [**create**]
no msap-policy *msap-policy-name*

Context config>subscr-mgmt

Description This command configures a managed SAP policy. Managed SAPs allow the use of policies and a SAP template for the creation of a SAP.

Default none

Parameters *msap-policy-name* — Specifies the managed SAP policy name.

Values Valid names consist of any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

create — Keyword used to create the managed SAP policy. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

cpu-protection

Syntax **cpu-protection**

Context config>sys>security
config>service>vprn>sub-if>grp-if>sap

Description This command enables the context to configure CPU protection policies.

cpu-protection

Syntax **cpu-protection** *policy-id* [**mac-monitoring**]
no cpu-protection

Context config>subscr-mgmt>msap-policy [mac-monitoring]
config>service>ies>sub-if>grp-if>sap [mac-monitoring]
config>service>vpls>sap [mac-monitoring]
config>service>vprn>sub-if>grp-if>sap [mac-monitoring]

Description This command assigns an existing CPU protection policy to the SAP or interface.

CPU protection policies are configured in the **config>sys>security>cpu-protection** context.

The **no** form of the command removes the policy ID from the SAP or interface configuration.

Default none

Parameters *policy-id* — Specifies an existing CPU protection policy to assign to the SAP or interface.

mac-monitoring — Specifies that the per-source rate limit be applied.

cpu-protection

Syntax **cpu-protection** *policy-id*
no cpu-protection

Context config>router>if
config>service>ies>if
config>service>vprn>if

Description This command assigns an existing CPU protection policy to the SAP or interface.

CPU protection policies are configured in the **config>sys>security>cpu-protection** context.

The **no** form of the command removes the policy ID from the SAP or interface configuration.

Default none

Parameters *policy-id* — Specifies an existing CPU protection policy to assign to the SAP.

default-host

Syntax **default-host** *ip-address*/*mask* **next-hop** *next-hop-ip*
no default-hostb

Context config>service>ies>sub-if>grp-if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command configures the default-host to be used. More than one default-host can be configured per SAP.

The **no** form of the command removes the values from the configuration.

Parameters *ip-address/mask* — Assigns an IP address/IP subnet format to the interface.

next-hop *next-hop-ip* **—** Assigns the next hop IP address.

dist-cpu-protection

Syntax **dist-cpu-protection** *policy-name*
no dist-cpu-protection

Context config>subscriber-management>msap-policy

Description This command assigns a Distributed CPU Protection (DCP) policy to the MSAP policy. The DCP policy will automatically get assigned to any MSAPs created with this policy. A non-existant DCP policy can be assigned to an msap-policy since an msap-policy is effectively a template that gets applied at some point in the future during msap creation. The existence of the DCP policy will be

validated at the time that the msap is created, and the msap creation will be blocked (and an appropriate log event created) if the DCP policy does not exist. Note that for other types of objects (for example, normal non-msap SAPs and network interfaces) the DCP policy must exist before it can be assigned to the SAP.

Default. no dist-cpu-protection

ies-vprn-only-sap-parameters

Syntax **ies-vprn-only-sap-parameters**

Context config>subscr-mgmt>msap-policy

Description This command configures Managed SAP IES and VPRN properties.

igmp-host-tracking

Syntax **igmp-host-tracking**

Context config>subscr-mgmt>msap-policy

Description This command enables the context to configure IGMP host tracking parameters.

expiry-time

Syntax **expiry-time** *expiry-time*
no expiry-time

Context config>subscr-mgmt>msap-policy>igmp-host-tracking

Description This command configures the time that the system continues to track inactive hosts.

The **no** form of the command removes the values from the configuration.

Default no expiry-time

Parameters *expiry-time* — Specifies the time, in seconds, that this system continues to track an inactive host.

Values 1 — 65535

import

Syntax **import** *policy-name*
no import

Context config>subscr-mgmt>msap-policy>igmp-host-tracking

Description This command specifies the import routing policy to be used for IGMP packets to be used on this SAP or SDP. Only a single policy can be imported on a single SAP at any time.

The **no** form of the command removes the policy association from the SAP or SDP.

Default no import (No import policy is specified)

Parameters *policy-name* — The routing policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes. Routing policies are configured in the config>router>policy-options context The router policy must be defined before it can be imported.

max-num-group

Syntax **max-num-groups** *max-num-groups*
no max-num-groups

Context config>subscr-mgmt>msap-policy>igmp-host-tracking

Description This command configures the maximum number of multicast groups allowed to be tracked.

The **no** form of the command removes the values from the configuration.

Default no max-num-groups

Parameters *max-num-groups* — Specifies the maximum number of multicast groups allowed to be tracked.

Values 1 — 196607

max-num-sources

Syntax **max-num-sources** *max-num-sources*
no max-num-sources

Context config>subscr-mgmt>msap-policy>igmp-host-tracking

Description This command configures the maximum number of multicast sources allowedto be tracked per group.

The no form of the command removes the value from the configuration.

Parameters *max-num-sources* — Specifies the maximum number of multicast sources allowedto be tracked per group.

Values 1 — 1000

max-num-grp-sources

Syntax **max-num-grp-sources** [1..32000]
no max-num-grp-sources

Context config>subscr-mgmt>msap-policy>igmp-host-tracking

Description This command configures the maximum number of group sources for which IGMP can have local receiver information based on received IGMP reports on this interface. When this configuration is

changed dynamically to a value lower than currently accepted number of group sources, the group sources that are already accepted are not deleted. Only new group sources will not be allowed. When this object has a value of 0, there is no limit to the number of group sources.

The **no** form of the command removes the value from the configuration.

Default no max-num-grp-sources

Parameters **1..32000 —** Specifies the maximum number of multicast sources allowed to be tracked per group

lag-link-map-profile

Syntax **lag-link-map-profile** *link-map-profile-id*
no lag-link-map-profile

Context config>subscr-mgmt>msap-policy

Description This command assigns a pre-configured lag link map profile to a SAP/network interface configured on a LAG or a PW port that exists on a LAG. Once assigned/de-assigned, the SAP/network interface egress traffic will be re-hashed over LAG as required by the new configuration.

The **no** form of this command reverts the SAP/network interface to use per-flow, service or link hash as configured for the service/LAG.

Default **no lag-link-map-profile**

Parameters *link-map-profile-id* — An integer from 1 to 32 that defines a unique lag link map profile on which the LAG the SAP/network interface exist.

sub-sla-mgmt

Syntax [**no**] **sub-sla-mgmt**

Context config>subscr-mgmt>msap-policy
config>service>vprn>sub-if>grp-if>sap>sub-sla-mgmt
config>service>vpls>sap>sub-sla-mgmt

Description This command enables the context to configure subscriber management parameters for an MSAP.

Default no sub-sla-mgmt

def-app-profile

Syntax **def-app-profile** *app-profile-name*
no def-app-profile

Context config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt
config>service>vprn>sub-if>grp-if>sap>sub-sla-mgmt
config>service>vpls>sap>sub-sla-mgmt

Description This command specifies the application profile to be used by a subscriber host.

The **no** form of the command removes the application profile name from the configuration.

Default no def-app-profile

Parameters *app-profile-name* — specifies an existing application profile to be mapped to the subscriber profile by default.

def-inter-dest-id

Syntax **def-inter-dest-id** {**string** *string* | **use-top-q**}
no def-inter-dest-id

Context config>subscr-mgmt>msap-policy>sub-sla-mgmt

Description This command specifies a default destination string for all subscribers associated with the SAP. The command also accepts the **use-top-q** flag that automatically derives the string based on the top most delineating Dot1Q tag from the SAP's encapsulation.

The **no** form of the command removes the default subscriber identification string from the configuration.

no def-sub-id

Default no def-inter-dest-id

Parameters **use-top-q —** Derives the string based on the top most delineating Dot1Q tag from the SAP's encapsulation.

string *string* **—** Specifies the subscriber identification applicable for a subscriber host.

def-sub-id

Syntax **def-sub-id use-auto-id**
def-sub-id use-sap-id
def-sub-id string *sub-id*
no def-sub-id

Context config>subscr-mgmt>msap-policy>sub-sla-mgmt
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt
config>service>vprn>sub-if>grp-if>sap>sub-sla-mgmt
config>service>vpls>sap>sub-sla-mgmt

Description This command specifies the explicit default sub-id for dynamic subscriber hosts (including ARP hosts) in case that the sub-id string is NOT supplied through RADIUS or LUDB.

The sub-id is assigned to a new subscriber host in the following order of priority:

- RADIUS
- LUDB

- Explicit default – with the def-sub-id command we explicitly set the sub-id name of the host to be one of the following:
  - → The sap-id to which the new host is associated with
  - → Explicit string
  - → Auto-generated string consisting of the concatenated subscriber identification fields defined under the **subscr-mgmt>auto-sub-id-key** node. The fields are taken in the order in which they are configured and are separated by a '|'character. The subscriber host identification fields are separately defined for IPoE and PPPoE host types.
- Implicit default – in case that the sub-id string is not returned via RADIUS or LUDB and there is no def-sub-id configured, the sub-id name will be generated as a random 10 character encoded string based on the auto-sub-id-keys. This 10 characters encoded string will be unique per chassis as well as in dual-homed environment. It is generated based on auto-sub-id-keys. If auto-sub-id-keys are not explicitly configured, the default ones are:
  - → <mac, sap-id, session-id> for PPP type hosts
  - → <mac, sap-id> for IPoE type hosts.

This command does not apply to static subscribers.

Parameters **use-sap-id** — Specifies the sub-id name -id on which the original request for host creation arrived (DHCP Discover, or PADI or ARP Request).

string *sub-id* — Explicitly configured sub-id name.

use-auto-id — The sub-id name is the concatenated string of auto-sub-id-keys separated by a "|" character.

Default no def-sub-id

Implicit default – If the sub-id string is not supplied through RADIUS, LUDB orby configuration (def-sub-id), then a random 10 character encoded sub-id name will be generated. This random sub-id name will be based on the subscriber identification keys defined under the subscr-mgmt>auto-sub-id-key node. In case that the auto-sub-id-keys are not defined explicitly, the default ones are:

- <mac, sap-id, session-id>for PPPoE type hosts
- <mac, sap-id>for IPoE type hosts

def-sla-profile

Syntax **def-sla-profile** *default-sla-profile-name*
no def-sla-profile

Context config>subscr-mgmt>msap-policy>sub-sla-mgmt

Description This command specifies a default SLA profile for an MSAP.

An SLA profile is a named group of QoS parameters used to define per service QoS for all subscriber hosts common to the same subscriber within a provider service offering. A single SLA profile may define the QoS parameters for multiple subscriber hosts.

The **no** form of the command removes the default SLA profile from the MSAP configuration.

Default no def-sla-profile

Parameters *default-sla-profile-name* — Specifies a default SLA profile for an MSAP.

def-sub-profile

Syntax **def-sub-profile** *default-subscriber-profile-name*

Context config>subscr-mgmt>msap-policy>sub-sla-mgmt

Description This command specifies a default subscriber profile for an MSAP.

A subscriber profile defines the aggregate QoS for all hosts within a subscriber context. This is done through the definition of the egress and ingress scheduler policies that govern the aggregate SLA for subscriber using the subscriber profile.

The **no** form of the command removes the default SLA profile from the SAP configuration.

Parameters *default-sub-profile* — Specifies a default subscriber profile for this SAP.

multi-sub-sap

Syntax **multi-sub-sap** [**limit** *limit*]
no multi-sub-sap

Context config>subscr-mgmt>msap-policy>sub-sla-mgmt

Description This command defines the maximum number of subscribers (dynamic + static) that can be simultaneously active on an MSAP.

If the limit is reached, a new host will be denied access and the corresponding DHCP ACK will be dropped.

The **no** form of the command reverts back to the default setting.

Default 1

Parameters **limit** *limit* — Specifies the maximum allowed.

Values 2 — 8000

single-sub-parameters

Syntax **single-sub-parameters**

Context config>subscr-mgmt>msap-policy>sub-sla-mgmt

Description This command enables the context to configure single subscriber MSAP parameters.

non-sub-traffic

Syntax **non-sub-traffic sub-profile** *sub-profile-name* **sla-profile** *sla-profile-name* [**subscriber** *sub-ident-string*] [**app-profile** *app-profile-name*]
no non-sub-traffic

Context config>subscr-mgmt>msap-policy>sub-sla-mgmt>single-sub

Description This command configures traffic profiles for non-IP traffic such as PPPoE.It is used in conjunction with the profiled-traffic-only on single subscriber SAPs and creates a subscriber host which is used to forward non-IP traffic through the single subscriber SAP without the need for SAP queues.

The **no** form of the command removes any configured profile.

Default no non-sub-traffic

Parameters *sub-profile-name* — Identifies the subscriber profile name.

Values 32 characters maximum

sla-profile-name — Identifies the SLA profile name.

Values 32 characters maximum

profiled-traffic-only

Syntax [**no**] **profiled-traffic-only**

Context config>subscr-mgmt>msap-policy>sub-sla-mgmt>single-sub

Description This command specifies whether only profiled traffic is applicable for an MSAP. When enabled, all queues will be deleted.

The **no** form of the command reverts to the default setting.

Default no profiled-traffic-only

sub-ident-policy

Syntax [**no**] **sub-ident-policy** *sub-ident-policy-name*

Context config>subscr-mgmt>msap-policy>sub-sla-mgmt

Description This command specifies an existing subscriber identification policy. Each subscriber identification policy can have a default subscriber profile defined. The subscriber identification policy default subscriber profile overrides the system default and the subscriber SAP default subscriber profiles. Defining a subscriber identification policy default subscriber profile is optional.

Defining a subscriber profile as a subscriber identification policy default subscriber profile will cause all active subscribers currently associated with a subscriber SAP using the policy and associated with a subscriber policy through the system default or subscriber SAP default subscriber profiles to be reassigned to the subscriber policy defined as default on the subscriber identification policy.

Attempting to delete a subscriber profile that is currently defined as a default for a subscriber identification policy will fail.

When attempting to remove a subscriber identification policy default subscriber profile definition, the system will evaluate each active subscriber on all subscriber SAPs the subscriber identification policy is currently associated with that are using the default definition to determine whether the active subscriber can be either reassigned to a subscriber SAP default or the system default subscriber profile. If all active subscribers cannot be reassigned, the removal attempt will fail.

Parameters *sub-ident-policy-name* — Specifies the name of the subscriber identification policy.

vpls-only-sap-parameters

Syntax **vpls-only-sap-parameters**

Context config>subscr-mgmt>msap-policy

Description This command enables the context to configure MSAP VPLS properties.

arp-host

Syntax **arp-host**

Context config>subscr-mgmt>msap-policy>vpls-only
config>service>vpls>sap>arp-host
config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command enables the context to configure ARP host parameters.

host-limit

Syntax **host-limit** *max-num-hosts*
no host-limit

Context config>subscr-mgmt>msap-policy>vpls-only
config>service>vpls>sap>arp-host
config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if>arp-host

Description This command configures the maximum number of ARP hosts.

Parameters *max-num-hosts* — Specifies the maximum number of ARP hosts.

Values 1 — 32767

min-auth-interval

Syntax **min-auth-interval** *min-auth-interval*
no min-auth-interval

Context config>subscr-mgmt>msap-policy>vpls-only
config>service>vpls>sap>arp-host
config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if>arp-host

Description This command configures the minimum authentication interval.

Parameters *min-auth-interval* — Specifies the minimum authentication interval.

Values 1 — 6000

sap-host-limit

Syntax **sap-host-limit** *max-num-hosts-sap*
no sap-host-limit

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if>arp-host

Description This command configures the maximum number of ARP hosts per SAP.

Parameters *max-num-hosts-sap* — Specifies the maximum number of ARP hosts per SAP allowed on this IES interface.

Values 1 — 32767

arp-reply-agent

Syntax **arp-reply-agent** [**sub-ident**]
no arp-reply-agent

Context config>subscr-mgmt>msap-policy>vpls-only

Description This command enables a special ARP response mechanism in the system for ARP requests destined to static or dynamic hosts associated with the SAP. The system responds to each ARP request using the hosts MAC address as the both the source MAC address in the Ethernet header and the target hardware address in the ARP header.

ARP replies and requests received on an MSAP with **arp-reply-agent** enabled will be evaluated by the system against the anti-spoof filter entries associated with the ingress SAP (if the SAP has anti-spoof filtering enabled). ARPs from unknown hosts on the SAP will be discarded when anti-spoof filtering is enabled.

The ARP reply agent only responds if the ARP request enters an interface (SAP, spoke-SDP or mesh-SDP) associated with the VPLS instance of the MSAP.

A received ARP request that is not in the ARP reply agent table is flooded to all forwarding interfaces of the VPLS capable of broadcast except the ingress interface while honoring split-horizon constraints.

Static hosts can be defined using the **host** command. Dynamic hosts are enabled on the system by enabling the **lease-populate** command in the **dhcp** context. In the event that both a static host and a dynamic host share the same IP and MAC address, the VPLS ARP reply agent will retain the host

information until both the static and dynamic information are removed. In the event that both a static and dynamic host share the same IP address, but different MAC addresses, the VPLS ARP reply agent is populated with the static host information.

The **arp-reply-agent** command will fail if an existing static host does not have both MAC and IP addresses specified. Once the ARP reply agent is enabled, creating a static host on the MSAP without both an IP address and MAC address will fail.

The ARP-reply-agent may only be enabled on SAPs supporting Ethernet encapsulation.

The **no** form of the command disables ARP-reply-agent functions for static and dynamic hosts on the MSAP.

Default not enabled

Parameters **sub-ident** — Configures the arp-reply-agent to discard ARP requests received on the MSAP that are targeted for a known host on the same MSAP with the same subscriber identification.

Hosts are identified by their subscriber information. For DHCP subscriber hosts, the subscriber hosts, the subscriber information is configured using the optional subscriber parameter string.

When arp-reply-agent is enabled with **sub-ident**:

- If the subscriber information for the destination host exactly matches the subscriber information for the originating host and the destination host is known on the same MSAP as the source, the ARP request is silently discarded.
- If the subscriber information for the destination host or originating host is unknown or undefined, the source and destination hosts are not considered to be the same subscriber. The ARP request is forwarded outside the MSAP's Split Horizon Group.
- When **sub-ident** is not configured, the arp-reply-agent does not attempt to identify the subscriber information for the destination or originating host and will not discard an ARP request based on subscriber information.

dhcp

Syntax **dhcp**

Context config>subscr-mgmt>msap-policy>vpls-only

Description This command enables the context to configure DHCP parameters.

option

Syntax [**no**] **option**

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp
config>service>ies>sub-if>dhcp

Description This command enables DHCP Option 82 (Relay Agent Information Option) parameters processing and enters the context for configuring Option 82 sub-options.

The **no** form of this command returns the system to the default.

Default no option

action

Syntax **action** {**replace** | **drop** | **keep**}
no action

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp>option

Description This command configures the Relay Agent Information Option (Option 82) processing.

The **no** form of this command returns the system to the default value.

Default The default is to keep the existing information intact.

Parameters **replace —** In the upstream direction (from the user), the Option 82 field from the router is inserted in the packet (overwriting any existing Option 82 field). In the downstream direction (towards the user) the Option 82 field is stripped (in accordance with RFC 3046).

drop — The DHCP packet is dropped if an Option 82 field is present, and a counter is incremented.

keep — The existing information is kept in the packet and the router does not add any additional information. In the downstream direction the Option 82 field is not stripped and is forwarded towards the client.

circuit-id

Syntax **circuit-id** [**ascii-tuple** | **vlan-ascii-tuple**]
no circuit-id

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp>option

Description When enabled, the router sends an ASCII-encoded tuple in the **circuit-id** sub-option of the DHCP packet. This ASCII-tuple consists of the access-node-identifier, service-id, and SAP-ID, separated by "|".

If disabled, the **circuit-id** sub-option of the DHCP packet will be left empty.

The **no** form of this command returns the system to the default.

Default circuit-id

Parameters **ascii-tuple —** Specifies that the ASCII-encoded concatenated tuple consisting of the access-node-identifier, service-id, and interface-name is used.

vlan-ascii-tuple — Specifies that the format will include VLAN-id and dot1p bits in addition to what is included in ascii-tuple already. The format is supported on dot1q and qinq ports only. Thus, when the option 82 bits are stripped, dot1p bits will be copied to the Ethernet header of an outgoing packet.

vendor-specific-option

Syntax [**no**] **vendor-specific-option**

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp>option
config>service>ies>sub-if>dhcp

Description This command configures the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

client-mac-address

Syntax [**no**] **client-mac-address**

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp>option>vendor
config>service>ies>sub-if>dhcp>option

Description This command enables the sending of the MAC address in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

The **no** form of the command disables the sending of the MAC address in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

sap-id

Syntax [**no**] **sap-id**

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp>option>vendor
config>service>ies>sub-if>dhcp>option

Description This command enables the sending of the SAP ID in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

The **no** form of the command disables the sending of the SAP ID in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

service-id

Syntax [**no**] **service-id**

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp>option>vendor
config>service>ies>sub-if>dhcp>option

Description This command enables the sending of the service ID in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

The **no** form of the command disables the sending of the service ID in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

string

Syntax [**no**] **string** *text*

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp>option>vendor
config>service>ies>sub-if>dhcp>option

Description This command specifies the string in the Alcatel-Lucent vendor specific sub-option of the DHCP relay packet.

The **no** form of the command returns the default value.

Parameters *text* — The string can be any combination of ASCII characters up to 32 characters in length. If spaces are used in the string, enclose the entire string in quotation marks (“ ”).

system-id

Syntax [**no**] **system-id**

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp>option>vendor
config>service>ies>sub-if>dhcp>option

Description This command specifies whether the system-id is encoded in the Alcatel-Lucent vendor specific sub-option of Option 82.

emulated-server

Syntax **emulated-server** *ip-address*
no emulated-server

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp>proxy
config>service>ies>sub-if>dhcp

Description This command configures the IP address which will be used as the DHCP server address in the context of the MSAP. Typically, the configured address should be in the context of the subnet represented by the service.

The **no** form of this command reverts to the default setting. The local proxy server will not become operational without the emulated-server address being specified.

Parameters *ip-address* — Specifies the emulated server’s IP address. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

lease-time

Syntax **lease-time** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*] [**override**]
no lease-time

Context config>subscr-mgmt>msap-policy>vpls-only>dhcp>proxy
config>service>ies>sub-if>dhcp

Description This command defines the length of lease-time that will be provided to DHCP clients. By default the local-proxy-server will always make use of the lease-time information provide by either a RADIUS or DHCP server.

The no form of this command disables the use of the lease-time command. The local-proxy-server will use the lease-time offered by either a RADIUS or DHCP server.

Default 7 days 0 hours 0 seconds

Parameters **override —** Specifies that the local-proxy-server will use the configured lease-time information to provide DHCP clients.

days — Specifies the number of days that the given IP address is valid.

Values 0 — 3650

hours — Specifies the number of hours that the given IP address is valid.

Values 0 — 23

minutes — Specifies the number of minutes that the given IP address is valid.

Values 0 — 59

seconds — Specifies the number of seconds that the given IP address is valid.

Values 0 — 59

egress

Syntax **egress**

Context config>subscr-mgmt>msap-policy>vpls-only

Description This command configures egress policies for MSAPs.

multicast-group

Syntax **multicast-group** *group-name*
no multicast-group

Context config>subscr-mgmt>msap-policy>vpls-only>egress

Description This command specifies an existing egress multicast group (EMG). An EMG is created as an object used to group VPLS SAPs that are allowed to participate in efficient multicast replication (EMR). EMR is a method to increase the performance of egress multipoint forwarding by sacrificing some destination-based features. Eliminating the requirement to perform unique features for each destination allows the egress forwarding plane to chain together multiple destinations into a batch replication process. In order to perform this batch replication function, similar characteristics are required on each SAP within the EMG.

Only SAPs defined on Ethernet access ports are allowed into an egress-multicast-group.

In order to understand the purpose of an egress-multicast-group, an understanding of the system's use of flooding lists is required. A flooding list is maintained at the egress forwarding plane to define a set

of destinations to which a packet must be replicated. Multipoint services make use of flooding lists to enable forwarding a single packet to many destinations. Examples of multipoint services that use flooding lists are VPLS, IGMP snooping and IP multicast routing. Currently, the egress forwarding plane will only use efficient multicast replication for VPLS and IGMP snooping flooding lists.

In VPLS services, a unique flooding list is created for each VPLS context. The flooding list is used when a packet has a broadcast, multicast or unknown destination MAC address. From a system perspective, proper VPLS handling requires that a broadcast, multicast or unknown destined packet be sent to all destinations that are in the forwarding state. The ingress forwarding plane ensures the packet gets to all egress forwarding planes that include a destination in the VPLS context. It is the egress forwarding plane's job to replicate the packet to the subset of the destinations that are reached through its interfaces and each of these destinations are included in the VPLS context's flooding list.

For IGMP snooping, a unique flooding list is created for each IP multicast (s,g) record. This (s,g) record is associated with an ingress VPLS context and may be associated with VPLS destinations in the source VPLS instance or other VPLS instances (in the case of MVR). Again, the ingress forwarding plane ensures that an ingress IP multicast packet matching the (s,g) record gets to all egress forwarding planes that have a VPLS destination associated with the (s,g) record. The egress forwarding plane uses the flooding list owned by the (s,g) record to replicate the packet to all VPLS destinations in the flooding list. The IGMP Snooping function identifies which VPLS destinations should be associated with the (s,g) record.

With normal multicast replication, the egress forwarding plane examines which features are enabled for each destination. This includes ACL filtering, mirroring, encapsulation and queuing. The resources used to perform this per destination multicast processing are very expensive to the egress forwarding plane when high replication bandwidth is required. If destinations with similar egress functions can be grouped together, the egress forwarding plane can process them in a more efficient manner and maximize replication bandwidth.

The egress-multicast-group object is designed to allow the identification of SAPs with similar egress characteristics. When a SAP is successfully provisioned into an egress-multicast-group, the system is ensured that it may be batched together with other SAPs in the same group at the egress forwarding plane for efficient multicast replication. A SAP that does not meet the common requirements is not allowed into the egress-multicast-group.

At the forwarding plane level, a VPLS flooding list is categorized into chainable and non-chainable destinations. Currently, the only chainable destinations are SAPs within an egress-multicast-group. The chainable destinations are further separated by egress-multicast-group association. Chains are then created following the rules below:

- A replication batch chain may only contain SAPs from the same egress-multicast-group
- A replication batch chain length may not exceed the dest-chain-limit of the egress-multicast-group to which the SAPs are members

Further subcategories are created for an IGMP (s,g) flooding list. A Layer 2 (s,g) record is created in a specific VPLS instance (the instance the (s,g) flow ingresses). SAPs within that VPLS context that join the (s,g) record are considered native SAPs within the flooding list. SAPs that join the (s,g) flooding list through the multicast VPLS registration process (MVR) from another VPLS context using the **from-vpls** command are considered alien SAPs. The distinction between native and alien in the list is maintained to allow the forwarding plane to enforce or suspend split-horizon-group (SHG) squelching. When the source of the (s,g) matching packet is in the same SHG as a native SAP, the packet must not be replicated to that SAP. For a SAP in another VPLS context, the source SHG of the packet has no meaning and the forwarding plane must disregard SHG matching between the native source of the packet and the alien destination. Because the SHG squelch decision is done for the

whole chain based on the first SAP in the chain, all SAPs in the chain must be all native or all alien SAPs. Chains for IGMP (s,g) flooding lists are created using the following rules:

1. A replication batch chain may only contain SAPs from the same egress-multicast-group.
2. A replication batch chain may only contain all alien or all native SAPs.
3. A replication batch chain length may not exceed the dest-chain-limit of the egress-multicast-group to which the SAPs are members

When a packet associated with a flooding list is received by the egress forwarding plane, it processes the packet by evaluating each destination on the list sequentially in a replication context. If the current entry being processed in the list is a non-chained destination, the forwarding plane processes the packet for that destination and then moves on to process other packets currently in the forwarding plane before returning to process the next destination in the list. If the current entry being processed is a chained destination, the forwarding plane remains in the replication context until it has forwarded to each entry in that chain. Once the replication context finishes with the last entry in the chain, it moves on to process other packets waiting for egress processing before returning to the replication context. Processing continues in this manner until the packet has been forwarded to all destinations in the list.

Batch chain processing of a chain of SAPs improves replication efficiency by bypassing the functions that perform egress mirroring decisions on SAPs within the chain and making a single ACL filtering decision for the whole chain. Each destination in the chain may have a unique egress QoS policy and per destination queuing is still performed for each destination in the chain. Also, while each SAP in the chain must be on access ports with the same encap-type, if the encap-type is dot1q, each SAP may have a unique dot1q tag.

One caveat to each SAP having a unique egress QoS policy in the chain is that only the Dot1P marking decisions for the first SAP in the list is enforced. If the first SAP's QoS policy forwarding class action states that the packet should not be remarked, none of the replicated packets in the chain will have the dot1P bits remarked. If the first SAP's QoS policy forwarding class action states that the packet should be remarked with a specific dot1P value, all the replicated packets for the remaining SAPs in the chain will have the same dot1P marking.

While the system supports 32 egress multicast groups, a single group would usually suffice. An instance where multiple groups would be needed is when all the SAPs requiring efficient multicast replication cannot share the same common requirements. In this case, an egress multicast group would be created for each set of common requirements. An egress multicast group may contain SAPs from many different VPLS instances. It should be understood that an egress multicast group is not equivalent to an egress forwarding plane flooding list. An egress multicast group only identifies which SAPs may participate in efficient multicast replication. As stated above, entries in a flooding list are populated due to VPLS destination creation or IGMP snooping events.

The **no** form of the command removes a specific egress multicast group. Deleting an egress multicast group will only succeed when the group has no SAP members. To remove SAP members, use the **no multicast-group** *group-name* command under each SAP's egress context.

Note: Efficient multicast replication will only be performed on IOMs that support chassis mode b If an IOM does not support mode b operation, egress-multicast-group membership is ignored on that IOM's egress forwarding planes. The chassis need not be placed into mode b for efficient multicast replication to be performed on the capable IOMs.

Parameters *group-name* — Multiple egress multicast groups may be created on the system. Each must have a unique name. The egress-multicast-group-name is an ASCII string up to 16 characters in length and follows all the naming rules as other named policies in the system. The group's name is used

throughout the system to uniquely identify the Egress Multicast Group and is used to provision a SAP into the group.

Default None, each egress multicast group must be explicitly configured.

Values Up to 32 egress multicast groups may be created on the system.

igmp-snooping

Syntax **igmp-snooping**

Context config>subscr-mgmt>msap-policy>vpls-only

Description This command enables the Internet Group Management Protocol (IGMP) snooping context.

Default none

fast-leave

Syntax [**no**] **fast-leave**

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command enables fast leave.

When IGMP fast leave processing is enabled, the 7750 SR% will immediately remove a SAP or SDP from the IP multicast group when it detects an IGMP 'leave' on that SAP or SDP. Fast leave processing allows the switch to remove a SAP or SDP that sends a 'leave' from the forwarding table without first sending out group-specific queries to the SAP or SDP, and thus speeds up the process of changing channels ('zapping').

Fast leave should only be enabled when there is a single receiver present on the SAP or SDP.

When fast leave is enabled, the configured last-member-query-interval value is ignored.

Default no fast-leave

import

Syntax **import** *policy-name*
no import

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command specifies the import routing policy to be used for IGMP packets to be used on this SAP or SDP. Only a single policy can be imported on a single SAP at any time.

The **no** form of the command removes the policy association from the SAP or SDP.

Default no import (No import policy is specified)

Parameters *policy-name* — The routing policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes. Routing policies are configured in the config>router>policy-options context The router policy must be defined before it can be imported.

last-member-query-interval

Syntax **last-member-query-interval** *tenths-of-seconds*
no last-member-query-interval

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command configures the maximum response time used in group-specific queries sent in response to 'leave' messages, and is also the amount of time between 2 consecutive group-specific queries. This value may be tuned to modify the leave latency of the network. A reduced value results in reduced time to detect the loss of the last member of a group.

The configured last-member-query-interval is ignored when fast-leave is enabled on the SAP or SDP.

Default 10

Parameters *seconds* — Specifies the frequency, in tenths of seconds, at which query messages are sent.

Values 1 — 50

max-num-groups

Syntax **max-num-groups** *max-num-groups*
no max-num-groups

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command defines the maximum number of multicast groups that can be joined on an MSAP or SDP. If the router receives an IGMP join message that would exceed the configured number of groups, the request is ignored.

Default no max-num-groups

Parameters *max-num-groups* — Specifies the maximum number of groups that can be joined on an MSAP or SDP.

Values 1 — 1000

mcac

Syntax **mcac**

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp>

Description This command enables the context to configure multicast CAC parameters.

Default none

mc-constraints

Syntax **mc-constraints**

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp>mcac

Description This command enables the context to configure the level and its associated bandwidth for a bundle or a logical interface.

Default none

level

Syntax **level** *level-id* **bw** *bandwidth*
no level *level-id*

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp>mcac

Description This command configures levels and their associated bandwidth for multicast CAC policy on an interface.

Parameters *level-id* — Specifies has an entry for each multicast CAC policy constraint level configured on a system.

Values 1 — 8

bandwidth — Specifies the bandwidth in kilobits per second (kbps) for the level.

Values 1 — 2147483647

number-down

Syntax **number-down** *number-lag-port-down* **level** *level-id*
no number-down *number-lag-port-down*

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp>mcac

Description This command configures the number of ports down along with level for multicast CAC policy on an MSAP

Parameters *number-lag-port-down* — If the number of ports available in the LAG is reduced by the number of ports configured in this command here then bandwidth allowed for bundle and/or interface will be as per the levels configured in this context.

Values 1 — 64 (for 64-link LAG)
1 — 32 (for other LAGs)

level *level-id* **—** Specifies the amount of bandwidth available within a given bundle for MC traffic for a specified level.

policy

Syntax **policy** *policy-name*
no policy

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp>mcac

Description This command configures the multicast CAC policy name.

Parameters *policy-name* — The multicast CAC policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

unconstrained-bw

Syntax **unconstrained-bw** *bandwidth* **mandatory-bw** *mandatory-bw*
no unconstrained-bw

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp>mcac

Description This command configures the bandwidth for the interface's multicast CAC policy traffic. When disabled (**no unconstrained-bw**) there will be no checking of bandwidth constraints on the interface level. When enabled and a policy is defined, enforcement is performed. The allocated bandwidth for optional channels should not exceed the **unconstrained-bw** minus the **mandatory-bw** and the mandatory channels have to stay below the specified value for the **mandatory-bw**. After this interface check, the bundle checks are performed.

Parameters *bandwidth* — The bandwidth assigned for interface's MCAC policy traffic, in kilo-bits per second (kbps).

Values 0 — 2147483647

mandatory-bw *mandatory-bw* **—** Specifies the bandwidth pre-reserved for all the mandatory channels on a given interface in kilo-bits per second (kbps).

If the *bandwidth* value is 0, no mandatory channels are allowed. If the value of *bandwidth* is '-1', then all mandatory and optional channels are allowed.

If the value of *mandatory-bw* is equal to the value of *bandwidth*, then all the unconstrained bandwidth on a given interface is allocated to mandatory channels configured through multicast CAC policy on that interface and no optional groups (channels) are allowed.

The value of *mandatory-bw* should always be less than or equal to that of *bandwidth*, An attempt to set the value of *mandatory-bw* greater than that of *bandwidth*, will result in inconsistent value error.

Values 0 — 2147483647

sub-mcac-policy

Syntax **sub-mcac-policy** *sub-mcac-policy-name* [**create**]
no sub-mcac-policy ***b***

Context config>subscr-mgmt

Description This command will create a policy template with mcac bandwidth limits that will be applied to the subscriber.

Per interface mcac bandwidth limits will be set directly under the interface (regular interface or group-interface) and no such policy templates are needed.

The need for a separate policy template for subscribers is due to the fact that groups of subscribers under the same group-interface can share certain settings that can be configured via this template.

To summarize, the mcac bandwidth constraints for subscribers are defined in the sub-mcac-policy while the mcac bandwidth constraints for the interface are configured directly under the **igmp>interface>mcac** or **igmp>group-interface>mcac** context without the need for policy templates.

Note that the sub-mcac-policy only deals with the mcac bandwidth limits and not the channel bandwidth definitions. Channels bandwidth is defined in a different policy (under the configure>router>mcac hierarchy) and that policy is applied on the interface level as follows:

- For group-interface: under the **configure>service>vprn>igmp>group-interface>mcac** context
- For regular interface: under the **configure>service/router>igmp>interface>mcac** context.

In case of HQoS Adjustment, it is mandatory that the sub-mcac-policy be created and applied to the subscriber. The sub-mac-policy does not have to contain any bandwidth constrains, but it has to be in a no shutdown state in order for HQoS Adjustment to work.

Parameters *policy-name* — Specifies the name of the policy.

mvr

Syntax **mvr**

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command enables the context to configure Multicast VPLS Registration (MVR) parameters.

from-vpls

Syntax **from-vpls** *service-id*
no from-vpls

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp>mvr

Description This command configures the VPLS from which multicast traffic is copied upon receipt of an IGMP join request.

IGMP snooping must be enabled on the MVR VPLS.

Default no from-vpls

Parameters *service-id* — Specifies the MVR VPLS from which multicast channels should be copied into an MSAP.

Values *service-id*: 1 — 2147483647
svc-name: 64 characters maximum

query-interval

Syntax **query-interval** *seconds*
no query-interval

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command configures the IGMP query interval. If the **send-queries** command is enabled, this parameter specifies the interval between two consecutive general queries sent by the system on an MSAP or SDP.

The configured query-interval must be greater than the configured query-response-interval.

If send-queries is not enabled on an MSAP or SDP, the configured query-interval value is ignored.

Default 125

Parameters *seconds* — The time interval, in seconds, that the router transmits general host-query messages.

Values 2 — 1024

query-response-interval

Syntax **query-response-interval** *seconds*

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command configures the IGMP query response interval. If the **send-queries** command is enabled, this parameter specifies the maximum response time advertised in IGMPv2/v3 queries.

The configured query-response-interval must be smaller than the configured query-interval.

If send-queries is not enabled on an MSAP or SDP, the configured query-response-interval value is ignored.

Default 10

Parameters *seconds* — Specifies the length of time to wait to receive a response to the host-query message from the host.

Values 1 — 1023

robust-count

Syntax **robust-count** *robust-count*
no robust-count

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command configures the IGMP robustness variable. If the **send-queries** command is enabled, this parameter allows tuning for the expected packet loss on a SAP or SDP. The robust-count variable allows tuning for the expected packet loss on a subnet and is comparable to a retry count. If an MSAP or SDP is expected to be "lossy", this parameter may be increased. IGMP snooping on an MSAP or SDP is robust to (robust-count-1) packet losses.

If send-queries is not enabled, this parameter will be ignored.

Default 2

Parameters *robust-count* — Specifies the robust count for the SAP or SDP.

Values 2 — 7

send-queries

Syntax [**no**] **send-queries**

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command specifies whether to send IGMP general query messages on the managed SAP. When send-queries is configured, all type of queries generate ourselves are of the configured version. If a report of a version higher than the configured version is received, the report will get dropped and a new wrong version counter will get incremented.

If send-queries is not configured, the version command has no effect. The version used on that SAP/SDP will be the version of the querier. This implies that, for example, when there is a v2 querier, a v3 group or group-source specific query is never sent when a host wants to leave a certain group.

Default no send-queries

version

Syntax **version** *version*
no version

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command specifies the version of IGMP which is running on an MSAP. This object can be used to configure a router capable of running either value. For IGMP to function correctly, all routers on a LAN must be configured to run the same version of IGMP on that LAN.

When the **send-query** command is configured, all type of queries generate ourselves are of the configured **version**. If a report of a version higher than the configured version is received, the report gets dropped and a new "wrong version" counter is incremented.

If the **send-query** command is not configured, the **version** command has no effect. The version used on that SAP or SDP will be the version of the querier. This implies that, for example, when there is a v2 querier, a v3 group or group-source specific query when a host wants to leave a certain group will never be sent.

Parameters *version* — Specify the IGMP version.

Values 1, 2, 3

mac-da-hashing

[no] mac-da-hashing

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command specifies whether subscriber traffic egressing a LAG SAP has its egress LAG link selected by a function of the MAC destination address instead of the subscriber ID.

This command is only meaningful if subscriber management is enabled and can be configured for a VPLS service.

split-horizon-group

Syntax **split-horizon-group** *group-name*

Context config>subscr-mgmt>msap-policy>vpls-only>igmp-snp

Description This command specifies the name of the split horizon group to which the MSAP belongs.

default-msap-policy

Syntax **default-msap-policy** *policy-name*
no default-msap-policy

Context config>service>vpls>sap

Description This command specifies the default managed SAP policy to use to create MSAPs when the response from the RADIUS server does not specify a managed SAP policy.

The *policy-name* parameter is only valid for a SAP with the keywords **capture-sap** specified in the SAP's configuration. The **capture-sap** keyword in the SAP configuration captures the SAP where triggering packets will be sent to the CPM. Non-triggering packets captured by the capture SAP will be dropped.

The managed SAP policy must already be defined in the **config>subscr-mgmt>msap-policy** context

The **no** form of the command removes the policy-name from the configuration.

Default no default-msap-policy

Parameters *policy-name* — /Specifies an existing default managed SAP policy.

trigger-packet

Syntax **trigger-packet** [**dhcp**] [**pppoe**] [**arp**] [**dhcp6**] [**ppp**]
no trigger-packet

Context config>service>vpls>sap

Description This command enables triggering packet to initiate RADIUS authentication that provides a service context. The authentication, together with the service context for this request, creates a managed SAP. The VLAN is the same as the triggering packet. This SAP behaves as a regular SAP but the configuration is not user-editable and not maintained in the configuration file. The managed SAP remains active as long as the session is active.

Default none

Parameters **dhcp —** Specifies whether the receipt of DHCP trigger packets on this VPLS SAP when the keyword **capture-sap** is specified in the **sap** command creation string, will result in a RADIUS authentication that will provide a service context and the creation of a SAP with a value of 'managed'.

pppoe — Specifies whether the receipt of PPPoE trigger packets on this VPLS SAP when the keyword **capture-sap** is specified in the **sap** command creation string, will result in a RADIUS authentication that will provide a service context and the creation of a SAP with a value of 'managed'.

arp — Indicates that ARP is the type of trigger packets for this entry.

dhcp6 — Indicates that DHCP6 is the type of trigger packets for this entry.

ppp — Indicates that PPP is the type of trigger packets for this entry.

eval-msap

Syntax **eval-msap** {**policy** *msap-policy-name* | **msap** *sap-id*}

Context tools>perform>subscr-mgmt

Description This command evaluates managed SAP policies.

Parameters **policy** *msap-policy-name* — Specifies an existing MSAP policy.

msap *sap-id* — Specifies an MSAP sap-id.

Values [*port-id*|lag-*id*]:*qtag1*
[*port-id*|lag-*id*]:*qtag1.qtag2*

Multi-Chassis Redundancy Commands

redundancy

Syntax **redundancy**

Context config

Description This command allows the user to perform redundancy operations.

Parameters **force-switchover** — Forces a switchover to the standby CPM card

Values **now** keyword - switch to standby CPM)

NOTE: Switching to the standby displays the following message.

```
WARNING: Configuration and/or Boot options may have changed since the last save.
Are you sure you want to switchover (y/n)?
```

synchronize — Synchronizes the secondary CPM.

Values **boot-env**|**config** : keywords

synchronize

Syntax **synchronize** {**boot-env** | **config**}

Context config>redundancy

Description This command performs a synchronization of the standby CPM images and/or config files to the active CPM. Either the **boot-env** or **config** parameter must be specified.

In the **config>redundancy** context, this command performs an automatically triggered standby CPM synchronization.

When the standby CPM takes over operation following a failure or reset of the active CPM, it is important to ensure that the active and standby CPM have identical operational parameters. This includes the saved configuration, CPM and IOM images.

The active CPM ensures that the active configuration is maintained on the standby CPM. However, to ensure smooth operation under all circumstances, runtime images and system initialization configurations must also be automatically synchronized between the active and standby CPM.

If synchronization fails, alarms and log messages that indicate the type of error that caused the failure of the synchronization operation are generated. When the error condition ceases to exist, the alarm is cleared.

Only files stored on the router are synchronized. If a configuration file or image is stored in a location other than on a local compact flash, the file is not synchronized (for example, storing a configuration file on an FTP server).

Default enabled

Parameters **boot-env —** Synchronizes all files required for the boot process (loader, BOF, images, and configuration files.

config — Synchronize only the primary, secondary, and tertiary configuration files.

Default config

multi-chassis

Syntax **multi-chassis**

Context config>redundancy

Description This command enables the context to configure multi-chassis parameters.

peer

Syntax **[no] peer *ip-address***

Context config>redundancy>multi-chassis

Description This command configures a multi-chassis redundancy peer.

Parameters *ip-address* — Specifies a peer IP address. Multicast address are not allowed.

authentication-key

Syntax **authentication-key** [*authentication-key* | *hash-key*] [**hash** | **hash2**]
no authentication-key

Context config>redundancy>multi-chassis>peer

Description This command configures the authentication key used between this node and the multi-chassis peer. The authentication key can be any combination of letters or numbers.

Parameters *authentication-key* — Specifies the authentication key. Allowed values are any string up to 20 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

hash-key — The hash key. The key can be any combination of ASCII characters up to 33 (hash1-key) or 55 (hash2-key) characters in length (encrypted). If spaces are used in the string, enclose the entire string in quotation marks (“ ”).

hash — Specifies the key is entered in an encrypted form. If the hash or hash2 parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the hash or hash2 parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form that involves more variables then the key value alone, this means that hash2 encrypted variable cannot be copied and pasted. If the hash or hash2 parameter is not used, the key is assumed to be in a non-encrypted, clear text

form. For security, all keys are stored in encrypted form in the configuration file with the hash or hash2 parameter specified.

mc-ipsec

Syntax **mc-ipsec**

Context config>redundancy>multi-chassis>peer

Description This command enters the configuration context of multi-chassis IPsec.

discovery-interval

Syntax **discovery-interval** *interval-1* [**boot** *interval-2*]
no discovery-interval

Context config>redundancy>multi-chassis>peer>mc-ipsec

Description This command specifies the time interval of tunnel-group stays in "Discovery" state. Interval-1 is used as discovery-interval when a new tunnel-group is added to multi-chassis redundancy (mp-ipsec); interval-2 is used as discovery-interval at system boot-up. It is optional and when it is not specified, interval-1 will be used.

Default 300

Parameters *interval-1/2* — Specifies the interval in seconds.

Values 1..1800 seconds

keep-alive-interval

Syntax **keep-alive-interval** *time-interval*
no keep-alive-interval

Context config>redundancy>multi-chassis>peer>mc-ipsec

Description This command specifies the time interval of the mastership election protocol sending the keep-alive packet.

Default 10

Parameters *time-interval* — Specifies the time interval in tenths of a second.

Values 5..500

hold-on-neighbor-failure

Syntax **hold-on-neighbor-failure** *multiplier*

no hold-on-neighbor-failure

Context config>redundancy>multi-chassis>peer>mc-ipsec

Description This command specifies the number of keep-alive failures before the peer is considered down.

Default 3

Parameters *multiplier* — Specifies the multiplier.

Values 2..25

bfd-enable

Syntax **bfd-enable service** *service-id* **interface** *interface-name* **dst-ip** *ip-address*
no bfd-enable

Context config>redundancy>multi-chassis>peer>mc-ipsec

Description This command enables tracking a central BFD session. If the BFD session goes down, then the system considers the peer down and changes the mc-ipsec status of the configured tunnel-group accordingly.

The BFD session uses the specified loopback interface (in the specified service) address as the source address and uses the specified dst-ip as the destination address. Other BFD parameters are configured with the "bfd" command on the specified interface.

Parameters *interface-name* — Specifies the name of the loopback interface.

service-id — Specifies the ID of the service.

dst-id — Specifies the destination address of the BFD packet.

tunnel-group

Syntax **tunnel-group** *group-id* [**create**]
no tunnel-group ***group-id***

Context config>redundancy>multi-chassis>peer>mc-ipsec

Description This command enables multi-chassis redundancy for the specified tunnel-group or enters an already configured tunnel-group context. The configured tunnel-group could failover independently.

Parameters *group-id* — Specifies the tunnel-group ID.

Values 1..16

create — Enables multi-chassis redundancy for the specified tunnel-group.

peer-group

Syntax **peer-group** *group-id*

no peer-group

Context config>redundancy>multi-chassis>peer>mc-ipsec>tunnel-group

Description This command specifies the corresponding tunnel-group ID on the peer node. The peer tunnel-group ID does not necessarily equal the local tunnel-group ID.

Parameters *group-id* — Specifies the tunnel-group ID.

Values 1..16

priority

Syntax **priority** *priority*
no priority

Context config>redundancy>multi-chassis>peer>mc-ipsec>tunnel-group

Description This command specifies the local priority of the tunnel-group. This is used to elect the master (higher number is the master). If priorities are the same, then the peer with the more active ISA becomes the master. If the priority and the number of active ISAs are the same, then the peer with the higher IP address is the master.

Parameters *priority* — Specifies the priority of the tunnel-group.

Values 0..255

preempt

Syntax [**no**] **preempt**

Context config>redundancy>multi-chassis>peer>mc-ipsec>tunnel-group

Description This command enables the preempt behavior of local node.

mc-lag

Syntax [**no**] **mc-lag**

Context config>redundancy>multi-chassis>peer>mc-lag

Description This command enables the context to configure multi-chassis LAG operations and related parameters.

The **no** form of this command administratively disables multi-chassis LAG. MC-LAG can only be issued only when mc-lag is shutdown.

hold-on-neighbor-failure

Syntax **hold-on-neighbor-failure** *multiplier*

no hold-on-neighbor-failure

Context config>redundancy>multi-chassis>peer>mc-lag

Description This command specifies the interval that the standby node will wait for packets from the active node before assuming a redundant-neighbor node failure. This delay in switch-over operation is required to accommodate different factors influencing node failure detection rate, such as IGP convergence, or HA switch-over times and to prevent the standby node to take action prematurely.

The **no** form of this command sets this parameter to default value.

Default 3

Parameters *multiplier* — The time interval that the standby node will wait for packets from the active node before assuming a redundant-neighbor node failure.

Values 2 — 25

keep-alive-interval

Syntax **keep-alive-interval** *interval*
no keep-alive-interval

Context config>redundancy>multi-chassis>peer>mc-lag

Description This command sets the interval at which keep-alive messages are exchanged between two systems participating in MC-LAG. These keep-alive messages are used to determine remote-node failure and the interval is set in deci-seconds.

The no form of this command sets the interval to default value

Default 1s (10 hundreds of milliseconds means interval value of 10)

Parameters *interval* — The time interval expressed in deci-seconds

Values 5 — 500

lag

Syntax **lag** *lag-id* **lacp-key** *admin-key* **system-id** *system-id* [**remote-lag** *lag-id*] **system-priority** *system-priority*
no lag *lag-id*

Context config>redundancy>multi-chassis>peer>mc-lag

Description This command defines a LAG which is forming a redundant-pair for MC-LAG with a LAG configured on the given peer. The same LAG group can be defined only in the scope of 1 peer.

The same **lacp-key**, **system-id**, and **system-priority** must be configured on both nodes of the redundant pair in order to MC-LAG to become operational. In order MC-LAG to become operational, all parameters (**lacp-key**, **system-id**, **system-priority**) must be configured the same on both nodes of the same redundant pair.

The partner system (the system connected to all links forming MC-LAG) will consider all ports using the same **lacp-key**, **system-id**, **system-priority** as the part of the same LAG. In order to achieve this in MC operation, both redundant-pair nodes have to be configured with the same values. In case of the mismatch, MC-LAG is kept in oper-down status.

Default none

Parameters *lag-id* — The LAG identifier, expressed as a decimal integer. Specifying the *lag-id* allows the mismatch between lag-id on redundant-pair. If no **lag-id** is specified it is assumed that neighbor system uses the same *lag-id* as a part of the given MC-LAG. If no matching MC-LAG group can be found between neighbor systems, the individual LAGs will operate as usual (no MC-LAG operation is established.).

Values 1 — 800

lacp-key ***admin-key*** **—** Specifies a 16 bit key that needs to be configured in the same manner on both sides of the MC-LAG in order for the MC-LAG to come up.

Values 1 — 65535

system-id ***system-id*** **—** Specifies a 6 byte value expressed in the same notation as MAC address

Values xx:xx:xx:xx:xx:xx - xx [00..FF]

remote-lag ***lag-id*** **—** Specifies the LAG ID on the remote system.

Values 1 — 800

system-priority ***system-priority*** **—** Specifies the system priority to be used in the context of the MC-LAG. The partner system will consider all ports using the same **lacp-key**, **system-id**, and **system-priority** as part of the same LAG.

Values 1 — 65535

source-address

Syntax **source-address** *ip-address*
no source-address

Context config>redundancy>multi-chassis>peer

Description This command specifies the source address used to communicate with the multi-chassis peer.

Parameters *ip-address* — Specifies the source address used to communicate with the multi-chassis peer.

sync

Syntax **[no] sync**

Context config>redundancy>multi-chassis>peer

Description This command enables the context to configure synchronization parameters.

igmp

Syntax [**no**] **igmp**

Context config>redundancy>multi-chassis>peer>sync

Description This command specifies whether IGMP protocol information should be synchronized with the multi-chassis peer.

Default no igmp

igmp-snooping

Syntax [**no**] **igmp-snooping**

Context config>redundancy>multi-chassis>peer>sync

Description This command specifies whether IGMP snooping information should be synchronized with the multi-chassis peer.

Default no igmp-snooping

local-dhcp-server

Syntax [**no**] **local-dhcp-server**

Context config>redundancy>multi-chassis>peer>sync

Description This command synchronizes DHCP server information.

mc-ring

Syntax [**no**] **mc-ring**

Context config>redundancy>multi-chassis>peer>sync

Description This command synchronizes mc-ring information.

mld-snooping

Syntax [**no**] **mld-snooping**

Context config>redundancy>multi-chassis>peer>sync

Description This command synchronizes MLD snooping information.

port

Syntax **port** [*port-id* | *lag-id*] [**sync-tag** *sync-tag*] [**create**]
no port [*port-id* | *lag-id*]

Context config>redundancy>multi-chassis>peer>sync

Description This command specifies the port to be synchronized with the multi-chassis peer and a synchronization tag to be used while synchronizing this port with the multi-chassis peer.

Parameters *port-id* — Specifies the port to be synchronized with the multi-chassis peer.

lag-id — Specifies the LAG ID to be synchronized with the multi-chassis peer.

sync-tag *sync-tag* **—** Specifies a synchronization tag to be used while synchronizing this port with the multi-chassis peer.

range

Syntax **range** *encap-range* **sync-tag** *sync-tag*
no range *encap-range*

Context config>redundancy>multi-chassis>peer>sync>port

Description This command configures a range of encapsulation values.

Parameters *encap-range* — Specifies a range of encapsulation values on a port to be synchronized with a multi-chassis peer.

Values	Dot1Q	*start-vlan-end-vlan*
	QinQ	Q1.*start-vlan*-Q1.*end-vlan*

sync-tag *sync-tag* — specifies a synchronization tag up to 32 characters in length to be used while synchronizing this encapsulation value range with the multi-chassis peer.

srrp

Syntax [**no**] **srrp**

Context config>redundancy>multi-chassis>peer>sync

Description This command specifies whether subscriber routed redundancy protocol (SRRP) information should be synchronized with the multi-chassis peer.

Default no srrp

sub-host-trk

Syntax [**no**] **sub-host-trk**

Context config>redundancy>multi-chassis>peer>sync

Description This command synchronizes subscriber host tracking information.

sub-mgmt

Syntax **sub-mgmt** [**ipoe** | **pppoe**]
no sub-mgmt

Context config>redundancy>multi-chassis>peer>sync

Description This command will enable synchronization of subscriber states between chassis. Synchronization will be enabled per protocol type (IPoE or PPPoE).

The keywords (**ipoe**, **pppoe**) must match on both nodes. If not, subscriber synchronization will fail.

For example if one node is configured with:

configure>multi-chassis>peer>sync>sub-mgmt ipoe

but the other node is configured with:

configure>multi-chassis>peer>sync>sub-mgmt ipoe pppoe

synchronization will fail even for ipoe application.

Default no sub-mgmt

Parameters **ipoe —** ipoe subscribers will be synchronized

pppoe — pppoe subscribers will be synchronized

tunnel-group

Syntax **tunnel-group** *tunnel-group-id* **sync-tag** *tag-name* [**create**]
no tunnel-group

Context config>redundancy>multi-chassis>peer>sync

Description This command enables multi-chassis synchronization of IPsec states of a specified tunnel-group with its peer. Sync-tag is used to match corresponding tunnel-groups on both peers. IPsec states will be synchronized between tunnel-groups with the same sync-tag.

Parameters *tunnel-group-id* — Specifies the ID of the tunnel-group

tag-name — Specifies the name of sync-tag.

ipsec

Syntax [**no**] **ipsec**

Context config>redundancy>multi-chassis>peer>sync

Description This command enables multi-chassis synchronization of IPsec states on system level.

mc-ring

Syntax **mc-ring**

Context config>redundancy>multi-chassis>peer

Description This command enables the context to configure the multi-chassis ring parameters.

Default mc-ring

ring

Syntax [**no**] **ring** *sync-tag* [**create**]

Context config>redundancy>multi-chassis>peer>mcr

Description This command configures a multi-chassis ring.

The **no** form of the command removes the sync-tag from the configuration.

Default none

l3-ring

Syntax [**no**] **l3-ring name** [**create**]

Context config>redundancy>multi-chassis>peer>mcr

Parameters This command configures a layer 3 multi-chassis ring.

in-band-control-path

Syntax **in-band-control-path**

Context config>redundancy>multi-chassis>peer>mcr>ring
config>redundancy>multi-chassis>peer>mc>l3-ring

Description This command enables the context to configure control path parameters.

Default none

debounce

Syntax [**no**] **debounce**

Context config>redundancy>multi-chassis>peer>mcr>ring>in-band-control-path
config>redundancy>multi-chassis>peer>mc>l3-ring>in-band-control-path

Description This command enables the inband control path debouncing. The **no** form of the command disables inband control path debouncing.

dst-ip

Syntax **dst-ip** *ip-address*
no dst-ip

Context config>redundancy>multi-chassis>peer>mcr>ring>in-band-control-path
config>redundancy>multi-chassis>peer>mc>l3-ring>in-band-control-path

Description This command specifies the destination IP address used in the inband control connection.

If the destination IP address is not configured, the ring cannot become operational.

Default none

Parameters *ip-address* — The destination IP address.

interface

Syntax **interface** *ip-int-name*
no interface

Context config>redundancy>multi-chassis>peer>mcr>ring>in-band-control-path
config>redundancy>multi-chassis>peer>mc>l3-ring>in-band-control-path

Description This command specifies the name of the IP interface used for the inband control connection.

If an interface name is not configured, the ring cannot become operational.

Parameters *ip-int-name* — Specifies an interface name up to 32 characters in length.

max-debounce-time

Syntax **max-debounce-time** *max-debounce-time*
no max-debounce-time

Context config>redundancy>multi-chassis>peer>mcr>ring>in-band-control-path
config>redundancy>multi-chassis>peer>mc>l3-ring>in-band-control-path

Description This command configures the inband control path maximum debounce time.

Parameters *max-debounce-time* — Specifies the maximum debounce time on the transition of the operational state of the inband control connection.

Values 5 — 200 seconds

service-id

Syntax **service-id** *service-id*
no service-id

Context config>redundancy>multi-chassis>peer>mcr>ring>in-band-control-path
config>redundancy>multi-chassis>peer>mc>l3-ring>in-band-control-path

Description This command configures the service ID of the SAP used for the Ring-Node Connectivity Verification of this ring node.

Parameters *service-id* — [Specifies an existing service ID or service name.

Values service-id: 1 — 214748364
svc-name: A string up to 64 characters in length.

path-b

Syntax [**no**] **path-b**

Context config>redundancy>multi-chassis>peer>mcr>ring

Description This command specifies the set of upper-VLAN IDs associated with the SAPs that belong to path B with respect to load-sharing. All other SAPs belong to path A.

Default If not specified, the default is an empty set.

range

Syntax [**no**] **range** *vlan-range*

Context config>redundancy>multi-chassis>peer>mcr>ring>path-b
config>redundancy>multi-chassis>peer>mcr>ring>path-excl

Description This command specifies the set of VLAN IDs associated with the SAPs that are controlled by the remote peer. It is a bitmap that associates bit i with VLAN ID i, with i in [0..4094]. Setting the value to the empty string is equivalent to setting it to 512 zeroes.

ring-node

Syntax [**no**] **ring-node** *ring-node-name*

Context config>redundancy>mc>peer>mcr>ring

Description This command specifies the unique name of a multi-chassis ring access node.

path-excl

Syntax **[no] path-excl**

Context config>redundancy>multi-chassis>peer>mcr>ring

Description This command specifies the set of upper-VLAN IDs associated with the SAPs that are to be excluded from control by the multi-chassis ring.

Default If not specified, the default is an empty set.

connectivity-verify

Syntax **connectivity-verify**

Context config>redundancy>multi-chassis>peer>mcr>ring
config>redundancy>multi-chassis>peer>mc>l3-ring

Description This command configures the node connectivity check.

interval

Syntax **interval** *interval*

Context config>redundancy>multi-chassis>peer>mcr>ring>>connectivity-verify
config>redundancy>multi-chassis>peer>mc>l3-ring>connectivity-verify

Description This command specifies the polling interval of the ring-node connectivity verification of this ring node.

Parameters *interval* — Specifies the polling interval of the ring-node connectivity verification of this ring node.

Values 1 — 6000

service-id

Syntax **service-id** *service-id*
no service-id

Context config>redundancy>mc>peer>mcr>ring-node>connect-verify
config>redundancy>multi-chassis>peer>mc>l3-ring>connectivity-verify

Description This command specifies the service ID of the SAP used for ring-node connectivity verification of this ring node.

Parameters *service-id* — Specifies the service ID or service name.

Values service-id: 1 — 214748364
svc-name: A string up to 64 characters in length.

src-ip

Syntax **src-ip** *ip-address*
no src-ip

Context config>redundancy>mc>peer>mcr>ring-node>connect-verify
config>redundancy>multi-chassis>peer>mc>l3-ring>connectivity-verify

Description This command specifies the source IP address used in ring-node connectivity verification of this ring node.

Parameters *ip-address* — Specifies the source IP address used in ring-node connectivity verification of this ring node.

src-mac

Syntax **src-mac** *ieee-address*
no src-mac

Context config>redundancy>mc>peer>mcr>ring-node>connect-verify
config>redundancy>multi-chassis>peer>mc>l3-ring>connectivity-verify

Description This command specifies the source MAC address used for the Ring-Node Connectivity Verification of this ring node.

If all zeros are specified, then the MAC address of the system management processor (CPM) is used.

Parameters *ieee-address* — Specifies the 48-bit MAC address for the static ARP in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

vlan

Syntax **vlan** [**0**..**4094**]

Context config>redundancy>mc>peer>mcr>ring-node>connect-verify
config>redundancy>mc>peer>mcr>l3ring>node>cv

Description This command specifies the VLAN tag of the SAP used for ring-node connectivity verification of this ring node. It is only meaningful if the value of is not zero.

srrp-instance

Syntax **[no] srrp-instance *srrp-id***

Context config>redundancy>multi-chassis>peer>mc>l3-ring

Description This command configures an SRRP instance for layer 3 ring.

Parameters *srrp-id* — Specifies the SRRP ID of this SRRP instance.

Values 1 — 4294967295

SLA Profile Commands

sla-profile

Syntax **sla-profile** *sla-profile-name*

Context config>subscr-mgmt

Description This command configures an SLA profile mapping. Hosts associated with a subscriber are subdivided into Service Level Agreement (SLA) profiles. For each subscriber host an SLA profile can be specified. For a subscriber host, the SLA profile determines:

- The QoS-policies to use

  –The classification

  –The queues

  –The queue mapping

- The IP filters to use

The SLA profile also has the attribute host-limit which limits the total number of hosts (belonging to the same subscriber) on a certain SAP that can be using this SLA profile.

Default none

Parameters *sla-profile-name* — Specifies the name of the SLA profile.

egress

Syntax **egress**

Context config>subscr-mgmt>sla-profile

Description This command configures egress parameters for the SLA profile.

ingress

Syntax **ingress**

Context config>subscr-mgmt>sla-profile

Description This command configures ingress parameters for the SLA profile.

host-limits

Syntax [**no**] **no host-limits**

Context config>subscr-mgmt>sla-profile

Description This command specifies the maximum number of hosts for this SLA profile.

Parameters *max-number-of-hosts* — Specifies the host limit for this SLA profile.

Values 1 — 100

remove-oldest — When the keywords **remove-oldest** are specified, the oldest subscriber host will be removed when the host limit is reached.

ipv4-arp

Syntax **ipv4-arp** *max-nr-of-hosts*
no ipv4-arp

Context config>subscr-mgmt>sla-profile>host-limits

Description This command configures the maximum number of IPv4 ARP hosts.

The **no** form of the command removes the number of IPv4 ARP hosts from the SLA profile.

Default no ipv4-arp

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPv4 ARP hosts.

Values 0 — 32767

ipv4-dhcp

Syntax **ipv4-dhcp** *max-nr-of-hosts*
no ipv4-dhcp

Context config>subscr-mgmt>sla-profile>host-limits

Description This command limits the number of IPv4 DHCP hosts.

The **no** form of the command removes the number of IPv4 DHCP hosts from the SLA profile.

Default no ipv4-dhcp

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPv4 DHCP hosts.

Values 0 — 32767

ipv4-overall

Syntax **ipv4-overall** *max-nr-of-hosts*
no ipv4-overall

Context config>subscr-mgmt>sla-profile>host-limits

Description This command limits the total number of IPv4 hosts.

The **no** form of the command removes the number of IPv4 hosts from the SLA profile.

Default no ipv4-overall

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPv4 hosts.

Values 0 — 32767

ipv4-ppp

Syntax **ipv4-ppp** *max-nr-of-hosts*
no ipv4-ppp

Context config>subscr-mgmt>sla-profile>host-limits

Description This command limits the total number of IPv4 PPP hosts.

The **no** form of the command removes the number of IPv4 PPP hosts from the SLA profile.

Default no ipv4-ppp

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPv4 PPP hosts.

Values 0 — 32767

ipv6-overall

Syntax **ipv6-overall** *max-nr-of-hosts*
no ipv6-overall

Context config>subscr-mgmt>sla-profile>host-limits

Description This command limits the total number of IPv6 hosts.

The **no** form of the command removes the number of IPv6 hosts from the SLA profile.

Default no ipv6-overall

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPv6 hosts.

Values 0 — 32767

ipv6-pd-ipoe-dhcp

Syntax **ipv6-pd-ipoe-dhcp** *max-nr-of-hosts*
no ipv6-pd-ipoe-dhcp

Context config>subscr-mgmt>sla-profile>host-limits

Description This command configures the total number of IPv6 DHCP PD hosts.

The **no** form of the command removes the number of IPv6 DHCP hosts from the SLA profile.

Default no ipv6-dhcp

Parameters *max-nr-of-hosts* — Specifies the total number of IPv6 DHCP PD hosts.

Values 0 — 32767

ipv6-pd-overall

Syntax **ipv6-pd-overall** max-nr-of-hosts
no ipv6-pd-overall

Context config>subscr-mgmt>sla-profile>host-limits

Description This command limits the total number of IPv6-PD hosts.

The **no** form of the command removes the number of IPv6-PD hosts from the SLA profile.

Default no ipv6-pd-overall

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPv6-PD hosts overall.

Values 0 — 32767

ipv6-pd-ppp-dhcp

Syntax **ipv6-pd-ppp-dhcp** *max-nr-of-hosts*
no ipv6-pd-ppp-dhcp

Context config>subscr-mgmt>sla-profile>host-limits

Description This command configures the maximum number of IPv6-WAN PPP DHCP hosts.

The **no** form of the command removes the number of IPv6-WAN PPP DHCP hosts from the SLA profile.

Default no ipv6-pd-ppp-dhcp

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPv6-WAN PPP DHCP hosts.

Values 0 — 32767

ipv6-wan-ipoe-dhcp

Syntax **ipv6-wan-ipoe-dhcp** *max-nr-of-hosts*
no ipv6-wan-ipoe-dhcp

Context config>subscr-mgmt>sla-profile>host-limits

Description This command configures the maximum number of IPv6-WAN PPP DHCP hosts.

The **no** form of the command removes the number of IPv6-WAN PPP DHCP hosts from the SLA profile.

Default no ipv6-wan-ipoe-dhcp

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPv6-WAN PPP DHCP hosts.

Values 0 — 32767

ipv6-wan-ipoe-slaac

Syntax **ipv6-wan-ipoe-slaac** *max-nr-of-hosts*
no ipv6-wan-ipoe-slaac

Context config>subscr-mgmt>sla-profile>host-limits

Description This command configures the maximum number of IIPv6-WAN IPOE SLAAC hosts.

The **no** form of the command removes the number of IPv6-WAN IPOE SLAAC hosts from the SLA profile.

Default no ipv6-wan-ipoe-slaac

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPv6-WAN IPOE SLAAC hosts.

Values 0 — 32767

ipv6-wan-overall

Syntax **ipv6-wan-overall** *max-nr-of-hosts*
no ipv6-wan-overall

Context config>subscr-mgmt>sla-profile>host-limits

Description This command configures the total number of IPV6 WAN hosts.

The **no** form of the command removes the number of IPV6 WAN hosts from the SLA profile.

Default no ipv6-wan-overall

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPV6 WAN hosts.

Values 0 — 32767

ipv6-wan-ppp-dhcp

Syntax **ipv6-wan-ppp-dhcp** *max-nr-of-hosts*
no ipv6-wan-ppp-dhcp

Context config>subscr-mgmt>sla-profile>host-limits

Description This command configures the total number of IPV6 PPP DHCP WAN hosts.

The **no** form of the command removes the number of IPV6 PPP DHCP WAN hosts from the SLA profile.

Default no ipv6-wan-ppp-dhcp

Parameters *max-nr-of-hosts* — Specifies the maximum number of IPV6 PPP DHCP WAN hosts.

Values 0 — 32767

ipv6-wan-ppp-slaac

Syntax **ipv6-wan-ppp-slaac** *max-nr-of-hosts*
no ipv6-wan-ppp-slaac

Context config>subscr-mgmt>sla-profile>host-limits

Description This command configures the total number of SLAAC hosts.

The **no** form of the command removes the number of SLAAC hosts from the SLA profile.

Default no ipv6-wan-ppp-slaac

Parameters *max-nr-of-hosts* — Specifies the maximum number of SLAAC hosts.

Values 0 — 32767

lac-overall

Syntax **lac-overall** *max-nr-of-hosts*
no lac-overall

Context config>subscr-mgmt>sla-profile>host-limits

Description This command configures the total number of L2TP LAC hosts

The **no** form of the command removes the number of L2TP LAC from the SLA profile.

Default no lac-overall

Parameters *max-nr-of-hosts* — Specifies the maximum number of L2TP LAC hosts.

Values 0 — 32767

overall

Syntax **overall** *max-nr-of-hosts*
no overall

Context config>subscr-mgmt>sla-profile>host-limits

Description This command configures the total number of hosts.

The **no** form of the command reverts to the default.

Default no overall

Parameters *max-nr-of-hosts* — Specifies the maximum number of hosts.

Values 0 — 32767

remove-oldest

Syntax [**no**] **remove-oldest**

Context config>subscr-mgmt>sla-profile>host-limits

Description This command removes the oldest subscriber host when the host limit is reached.

The **no** form of the command maintains the oldest subscriber host when the host limit is reached.

Default no remove-oldest

ip-filter

Syntax [**no**] **ip-filter** *filter-id*

Context config>subscr-mgmt>sla-profile>egress
config>subscr-mgmt>sla-profile>ingress

Description This command configures an egress or ingress IP filter.

Parameters *filter-id* — Specify an existing IP filter policy ID.

Values 1 — 65535

SLA Profile QoS Commands

qos

Syntax **qos** *sap-egress-policy-id* [*vport-scheduler*|*port-scheduler*] [**force**]
no qos

Context config>subscr-mgmt>sla-prof>egress

Description This command specifies the egress QoS policy applicable to this SLA profile. The policy must already be defined in the **configure>qos>sap-egress** context.

Default 1

Parameters *sap-egress-policy-id* — Specifies the egress policy to be applied to the egress SLA profile.

Values 1 — 65535

vport-scheduler | *port-scheduler* — Specifies if a host queue with the port-parent option enabled should be scheduled within the context of a vport port scheduler policy or a the port's port scheduler policy.

force — Forces a policy change.

qos

Syntax **qos** *policy-id* [**shared-queuing** | **multipoint-shared** | **service-queuing**] [**force**]
no qos

Context config>subscr-mgmt>sla-prof>ingress

Description This command specifies the ingress QoS policy applicable to this SLA profile. The policy must already be defined in the **configure>qos>sap-ingress** context.

Default qos 1

Parameters *sap-ingress-policy-id* — Specifies the policy to be applied to the ingress SLA profile.

Values 1 — 65535

shared-queuing — This keyword is mutually exclusive with the **multipoint-shared** and **service-queuing** keywords to specify the policy used by this SAP. When the value of this object is null it means that the SAP will use individual ingress QoS queues, instead of the shared ones.

multipoint-shared — This keyword is mutually exclusive with the **shared-queuing** and **service-queuing** keywords. When multipoint-shared is specified, the ingress forwarding plane will conserve hardware queues by performing two tier queuing on ingress unicast and multipoint packets through the SAP. Unicast service queues defined in the SAP ingress QoS policy are created for the SAP on the ingress forwarding plane without regard for the switch fabric destinations to which the SAP may need to forward (other destinations in the VPLS context). The multipoint queues defined in the SAP ingress QoS policy are not created for the SAP. Instead, all multipoint traffic is mapped to the unicast queues based on forwarding class in the first pass. In

the second pass the unicast packets will be mapped to the unicast shared queues while the multipoint traffic will be mapped to the multipoint shared queues.

service-queuing — This keyword is mutually exclusive with the **multipoint-shared** and **shared-queuing** keywords to state that service queueing is needed.

force — Forces a policy change.

queue

Syntax [**no**] **queue** *queue-id*

Context config>subscr-mgmt>sla-prof>egress>qos
config>subscr-mgmt>sla-prof>ingress>qos

Description This command configures the context to configure egress or ingress queue parameters. Parameters defined in the **config>qos>sap-egress** *policy-id* or the **config>qos>sap-ingress** *policy-id* context are overridden by parameters specified in the subscriber management SLA profile context.

The classification and the queue mapping are shared by all the hosts on the same complex that use the same QoS policy (specified in the **sla-profile** SAP egress and SAP ingress policy IDs).

The queues are shared by all the hosts (of the same subscriber) on the same SAP that are using the same SLA profile. Queues are instantiated when, on a given SAP, a host of a subscriber is the first to use a certain SLA profile. This instantiation is referred to as an SLA profile instance.

The **no** form of the command removes the *queue-id* from the SLA profile.

Default none

Parameters *queue-id* — Specifies the *queue-id* for the SAP egress or ingress queue, expressed as a decimal integer. The *queue-id* uniquely identifies the queue within the profile.

Default none

avg-frame-overhead

Syntax **avg-frame-overhead** *percent*
no avg-frame-overhead

Context config>subscr-mgmt>sla-prof>egress>qos>queue

Description This command configures the average frame overhead to define the average percentage that the offered load to a queue will expand during the frame encapsulation process before sending traffic on-the-wire. While the avg-frame-overhead value may be defined on any queue, it is only used by the system for queues that egress a SONET or SDH port or channel. Queues operating on egress Ethernet ports automatically calculate the frame encapsulation overhead based on a 20 byte per packet rule (8 bytes for preamble and 12 bytes for Inter-Frame Gap).

When calculating the frame encapsulation overhead for port scheduling purposes, the system determines the following values:

- Offered-load — The offered-load of a queue is calculated by starting with the queue depth in octets, adding the received octets at the queue and subtracting queue discard octets. The result is the number of octets the queue has available to transmit. This is the packet based offered-load.
- Frame encapsulation overhead — Using the avg-frame-overhead parameter, the frame encapsulation overhead is simply the queues current offered-load (how much has been received by the queue) multiplied by the avg-frame-overhead. If a queue had an offered load of 10000 octets and the avg-frame-overhead equals 10%, the frame encapsulation overhead would be 10000 x 0.1 or 1000 octets.

  For egress Ethernet queues, the frame encapsulation overhead is calculated by multiplying the number of offered-packets for the queue by 20 bytes. If a queue was offered 50 packets then the frame encapsulation overhead would be 50 x 20 or 1000 octets.
- Frame based offered-load — The frame based offered-load is calculated by adding the offered-load to the frame encapsulation overhead. If the offered-load is 10000 octets and the encapsulation overhead was 1000 octets, the frame based offered-load would equal 11000 octets.
- Packet to frame factor — The packet to frame factor is calculated by dividing the frame encapsulation overhead by the queues offered-load (packet based). If the frame encapsulation overhead is 1000 octets and the offered-load is 10000 octets then the packet to frame factor would be 1000 / 10000 or 0.1. When in use, the avg-frame-overhead will be the same as the packet to frame factor making this calculation unnecessary.
- Frame based CIR — The frame based CIR is calculated by multiplying the packet to frame factor with the queues configured CIR and then adding that result to that CIR. If the queue CIR is set at 500 octets and the packet to frame factor equals 0.1, the frame based CIR would be 500 x 1.1 or 550 octets.
- Frame based within-cir offered-load — The frame based within-cir offered-load is the portion of the frame based offered-load considered to be within the frame-based CIR. The frame based within-cir offered-load is the lesser of the frame based offered-load and the frame based CIR. If the frame based offered-load equaled 11000 octets and the frame based CIR equaled 550 octets, the frame based within-cir offered-load would be limited to 550 octets. If the frame based offered-load equaled 450 octets and the frame based CIR equaled 550 octets, the frame based within-cir offered-load would equal 450 octets (or the entire frame based offered-load).

  As a special case, when a queue or associated intermediate scheduler is configured with a CIR-weight equal to 0, the system automatically sets the queue's frame based within-cir offered-load to 0, preventing it from receiving bandwidth during the port scheduler's within-cir pass.
- Frame based PIR — The frame based PIR is calculated by multiplying the packet to frame factor with the queue's configured PIR and then adding the result to that PIR. If the queue PIR is set to 7500 octets and the packet to frame factor equals 0.1, the frame based PIR would be 7500 x 1.1 or 8250 octets.
- Frame based within-pir offered-load — The frame based within-pir offered-load is the portion of the frame based offered-load considered to be within the frame based PIR. The frame based within-pir offered-load is the lesser of the frame based offered-load and the frame based PIR. If the frame based offered-load equaled 11000 octets and the frame based PIR equaled 8250 octets, the frame based within-pir offered-load would be limited to 8250 octets. If the frame based offered-load equaled 7000 octets and the frame based PIR equaled 8250 octets, the frame based within-pir offered load would equal 7000 octets.

Port scheduler operation using frame transformed rates — The port scheduler uses the frame based rates to determine the maximum rates that each queue may receive during the within-cir and above-cir

bandwidth allocation passes. During the within-cir pass, a queue may receive up to its frame based within-cir offered-load. The maximum it may receive during the above-cir pass is the difference between the frame based within-pir offered load and the amount of actual bandwidth allocated during the within-cir pass.

SAP and subscriber SLA-profile average frame overhead override — The average frame overhead parameter on a sap-egress may be overridden at an individual egress queue basis. On each SAP and within the sla-profile policy used by subscribers an avg-frame-overhead command may be defined under the queue-override context for each queue. When overridden, the queue instance will use its local value for the average frame overhead instead of the sap-egress defined overhead.

The **no** form of this command restores the average frame overhead parameter for the queue to the default value of 0 percent. When set to 0, the system uses the packet based queue statistics for calculating port scheduler priority bandwidth allocation. If the no avg-frame-overhead command is executed in a queue-override queue id context, the avg-frame-overhead setting for the queue within the sap-egress QoS policy takes effect.

Default 0

Parameters *percent* — This parameter sets the average amount of packet-to-frame encapsulation overhead expected for the queue. This value is not used by the system for egress Ethernet queues.

Values 0 — 100

burst-limit

Syntax **burst-limit** {**default** | *size* [**byte** | **kilobyte**]}
no burst-limit

Context config>subscr-mgmt>sla-prof>egress>qos>queue
config>subscr-mgmt>sla-prof>ingress>qos>queue

Description The `queue burst-limit` command is used to define an explicit shaping burst size for a queue. The configured size defines the shaping leaky bucket threshold level that indicates the maximum burst over the queue's shaping rate.

The `burst-limit` command is supported under the sap-ingress and sap-egress QoS policy queues. The command is also supported under the ingress and egress queue-group-templates queues.

The **no** form of this command is used to restore the default burst limit to the specified queue. This is equivalent to specifying burst-limit default within the QoS policies or queue group templates. When specified within a queue-override queue context, any current burst limit override for the queue will be removed and the queue's burst limit will be controlled by its defining policy or template.

Parameters **default —** The default parameter is mutually exclusive to specifying an explicit size value. When burst-limit default is executed, the queue is returned to the system default value.

size — When a numeric value is specified (size), the system interprets the value as an explicit burst limit size. The value is expressed as an integer and by default is interpreted as the burst limit in Kilobytes. If the value is intended to be interpreted in bytes, the byte qualifier must be added following size.

Values 1 to 14,000 (14,000 or 14,000,000 depending on bytes or kilobytes)

Default No default for size, use the default keyword to specify default burst limit

byte — The **bytes** qualifier is used to specify that the value given for size must be interpreted as the burst limit in bytes. The byte qualifier is optional and mutually exclusive with the kilobytes qualifier.

kilobyte — The **kilobyte** qualifier is used to specify that the value given for size must be interpreted as the burst limit in Kilobytes. The kilobyte qualifier is optional and mutually exclusive with the bytes qualifier. If neither bytes nor kilobytes is specified, the default qualifier is kilobytes.

cbs

Syntax **cbs** *size-in-kbytes*
no cbs

Context config>subscr-mgmt>sla-prof>egress>qos>queue
config>subscr-mgmt>sla-prof>ingress>qos>queue

Description This command can be used to override specific attributes of the specified queue's CBS parameters. It is permissible, and possibly desirable, to oversubscribe the total CBS reserved buffers for a given access port egress buffer pool. Oversubscription may be desirable due to the potential large number of service queues and the economy of statistical multiplexing the individual queues' CBS settings into the defined reserved total.

When oversubscribing the reserved total, it is possible for a queue depth to be lower than its CBS setting and still not receive a buffer from the buffer pool for an ingress frame. As more queues are using their CBS buffers and the total in use exceeds the defined reserved total, essentially the buffers are being removed from the shared portion of the pool without the shared in use average and total counts being decremented. This can affect the operation of the high and low priority RED slopes on the pool, causing them to miscalculate when to start randomly drop packets.

If the CBS value is larger than the MBS value, an error will occur, preventing the CBS change.

The **no** form of this command returns the CBS size to the size as configured in the QoS policy.

Default no cbs

Parameters *size-in-kbytes* — The size parameter is an integer expression of the number of kilobytes reserved for the queue. If a value of 10KBytes is desired, enter the value 10. A value of 0 specifies that no reserved buffers are required by the queue (a minimal reserved size can still be applied for scheduling purposes).

Values 0 — 131072 or default

high-prio-only

Syntax **high-prio-only** *percent*
no high-prio-only

Context config>subscr-mgmt>sla-prof>egress>qos>queue
config>subscr-mgmt>sla-prof>ingress>qos>queue

Description This command configures the value of the percentage of buffer space for the queue, used exclusively by high priority packets. The specified value overrides the default value for the context.

The priority of a packet can only be set in the SAP ingress QoS policy and is only applicable on the ingress queues for a SAP. The **high-prio-only** parameter is used to override the default value derived from the **network-queue** command.

The defined **high-prio-only** value cannot be greater than the MBS size of the queue. Attempting to change the MBS to a value smaller than the high priority reserve will generate an error and fail execution. Attempting to set the **high-prio-only** value larger than the current MBS size will also result in an error and fail execution.

The **no** form of this command returns high-prio-only to the size as configured in the QoS policy.

Default no high-prio-only

Parameters *percent* — The *percent* parameter is the percentage reserved for high priority traffic on the queue. If a value of 10KBytes is desired, enter the value 10. A value of 0 specifies that none of the MBS of the queue will be reserved for high priority traffic. This does not affect RED slope operation for packets attempting to be queued.

Values 0 — 100 | default

mbs

Syntax **mbs** *size-in-kbytes*
no mbs

Context config>subscr-mgmt>sla-prof>egress>qos>queue

Description This command configures the maximum size for the queue.

The sum of the MBS for all queues on an egress access port can oversubscribe the total amount of buffering available. When congestion occurs and buffers become scarce, access to buffers is controlled by the RED slope a packet is associated with. A queue that has not exceeded its MBS size is not guaranteed that a buffer will be available when needed or that the packet's RED slope will not force the discard of the packet. Setting proper CBS parameters and controlling CBS oversubscription is one major safeguard to queue starvation (when a queue does not receive its fair share of buffers). Another is properly setting the RED slope parameters for the needs of services on this port or channel.

If the CBS value is larger than the MBS value, an error will occur, preventing the MBS change.

The **no** form of this command returns the MBS size to the size as configured in the QoS policy.

Default no mbs

Parameters *size-in-kbytes* — The size parameter is an integer expression of the maximum number of kilobytes of buffering allowed for the queue.For a value of 100 kbps, enter the value 100. A value of 0 causes the queue to discard all packets.

Values 0 — 131072 or default

mbs

Syntax **mbs** *size* [**bytes** | **kilobytes**]
no mbs

Context config>subscr-mgmt>sla-prof>ingress>qos>queue

Description The Maximum Burst Size (MBS) command configures the explicit definition of the maximum amount of buffers allowed for a specific queue.

The MBS value is used by a queue to determine whether it has exhausted all of its buffers while enqueuing packets. Once the queue has exceeded the amount of buffers allowed by MBS, all packets are discarded until packets have been drained from the queue.

The sap-ingress context for mbs provides a mechanism for overriding the default maximum size for the queue.

The sum of the MBS for all queues on an ingress access port can oversubscribe the total amount of buffering available. When congestion occurs and buffers become scarce, access to buffers is controlled by the RED slope a packet is associated with. A queue that has not exceeded its MBS size is not guaranteed that a buffer will be available when needed or that the packet's RED slope will not force the discard of the packet. Setting proper CBS parameters and controlling CBS oversubscription is one major safeguard to queue starvation (when a queue does not receive its fair share of buffers). Another is properly setting the RED slope parameters for the needs of services on this port or channel.

If the CBS value is larger than the MBS value, an error will occur, preventing the MBS change.

The defined high-prio-only value cannot be greater than the MBS size of the queue. Attempting to change the MBS to a value smaller than the high priority reserve will generate an error and fail execution. Attempting to set the high-prio-only value larger than the current MBS size will also result in an error and fail execution.

The **no** form of this command returns the MBS size to the size as configured in the QoS policy.

Default no mbs

Parameters *size* [**bytes** | **kilobytes**] — The size parameter is an integer expression of the maximum number of bytes or kilobytes of buffering allowed for the queue. For a value of 100 kbps enter the value 100 and specify the **kilobytes** parameter. A value of 0 causes the queue to discard all packets.

Values 0 — 131072 or default

rate

Syntax **rate** *pir-rate* [**cir** *cir-rate*]
no rate

Context config>subscr-mgmt>sla-prof>egress>qos>queue

Description This command defines the administrative Peak Information Rate (PIR) and the administrative Committed Information Rate (CIR) parameters for the queue. The PIR defines the maximum rate that the queue can transmit packets out an egress interface (for SAP egress queues). Defining a PIR does not necessarily guarantee that the queue can transmit at the intended rate. The actual rate sustained by the queue can be limited by oversubscription factors or available egress bandwidth.

The CIR defines the rate at which the system prioritizes the queue over other queues competing for the same bandwidth. In-profile packets are preferentially queued by the system at egress and at subsequent next hop nodes where the packet can traverse. To be properly handled as in- or out-of-profile throughout the network, the packets must be marked accordingly for profiling at each hop.

The CIR can be used by the queue's parent command's *cir-level* and *cir-weight* parameters to define the amount of bandwidth considered to be committed for the child queue during bandwidth allocation by the parent scheduler.

The **rate** command can be executed at anytime, altering the PIR and CIR rates for all queues created through the association of the SAP egress QoS policy with the *queue-id*.

The **no** form of the command returns all queues created with the *queue-id* by association with the QoS policy to the default PIR and CIR parameters (**max**, 0).

Default no rate

Parameters *pir-rate* — Defines the administrative PIR rate, in kilobits, for the queue. When the **rate** command is executed, a valid PIR setting must be explicitly defined. When the **rate** command has not been executed, the default PIR of **max** is assumed.
Fractional values are not allowed and must be given as a positive integer.

The actual PIR rate is dependent on the queues **adaptation-rule** parameters and the actual hardware where the queue is provisioned.

Values 1 — 100000000, max

Default **max**

cir-rate — The **cir** parameter overrides the default administrative CIR used by the queue. When the **rate** command is executed, a CIR setting is optional. When the **rate** command has not been executed or the **cir** parameter is not explicitly specified, the default CIR (0) is assumed.
Fractional values are not allowed and must be given as a positive integer.

Values 0 — 100000000, **max**

Default 0

qos-marking-from-sap

Syntax [**no**] **qos-marking-from-sap**

Context configure>subscr-mgmt>sla-profile>egress

Description This command sets the QoS policy from which the egress QoS marking rules are applied. Note that if applied to a managed SAP, the default SAP-egress qos-policy (sap-egress 1) cannot be changed.

The **no** form of the command reverts to the egress QoS marking defined in SAP-egress policy defined at sla-profile level.

Default qos-marking-from-sap

report-rate

Syntax **report-rate agg-rate-limit**
report-rate scheduler *scheduler-name*
report-rate pppoe-actual-rate
report-rate rfc5515-actual-rate
no report-rate

Context config>subscr-mgmt>sla-prof>ingress
config>subscr-mgmt>sla-prof>egress

Description This command configures the source for Tx and Rx connect speeds in AVP 38 (Rx Connect Speed) and AVP 24 (Tx Connect Speed) of an L2TP session established on a LAC.

Default no report-rate – Rates takes from the physical port speed.

Parameters **agg-rate-limit —** (egress only) rate taken from:

1. The agg-rate RADIUS override (RADIUS VSA "Alc-Subscriber-QoS-Override" in a RADIUS Access-Accept message) if present.
2. The configured agg-rate-limit in the **config>subscr-mgmt>sub-prof>egr** context.
3. Fall back to the default (no report-rate).

scheduler *scheduler-name* **—** Specifies the rate taken from the **scheduler** *scheduler-name*. If the **scheduler** *scheduler-name* is not present in the scheduler-policy configured in the **config>subscr-mgmt>sub-prof>egr** context, fall back to the default (no report-rate)

pppoe-actual-rate — Specifies rates taken from the "DSL Line characteristics" PPPoE tags (Actual Data Rate Upstream/Downstream) if present; otherwise fall back to the default (no report-rate).

report-rate rfc5515-actual-rate — Puts the same value as the transmitted Actual-Data-Rate-Upstream AVP in the Rx-Connect-Speed AVP, and the same value as the transmitted Actual-Data-Rate-Downstream AVP in the Tx-Connect-Speed AVP.

scheduler-policy

Syntax **scheduler-policy** *scheduler-policy-name*
no scheduler-policy

Context config>subscr-mgmt>sla-prof>egress

Description This command specifies a scheduler policy to associate to the sla profile. Scheduler policies are configured in the **configure>qos>scheduler>policy** context. Each scheduler policy is divided up into groups of schedulers based on the tier each scheduler is created under. A tier is used to give structure to the schedulers within a policy and define rules for parent scheduler associations. The policy defines the hierarchy and operating parameters for virtual schedulers.

The **no** form of the command removes the scheduler-policy-name from the configuration.

Default no scheduler-policy

Parameters *scheduler-policy-name* — Specify an existing scheduler policy name.

scheduler

Syntax **scheduler** *scheduler-name* **rate** *pir-rate* **[cir** *cir-rate***]**
no scheduler *scheduler-name*

Context config>subscr-mgmt>sla-prof>egress>sched

Description This command provides a way to override parameters of the existing scheduler associated with the egress scheduler policy. A scheduler defines bandwidth controls that limit each child (other schedulers and queues) associated with the scheduler. Scheduler objects are created within the hierarchical tiers of the policy. It is assumed that each scheduler created will have queues or other schedulers defined as child associations. The scheduler can be a child (take bandwidth from a scheduler in a higher tier).

Parameters **scheduler** *scheduler-name* **—** Specify an existing scheduler policy name.

pir-rate — The pir-rate parameter, in kilobits, overrides the administrative PIR used by the scheduler. When the rate command is executed, a valid PIR setting must be explicitly defined. Fractional values are not allowed and must be given as a positive integer.

Values 1 — 3200000000, max

Default none

cir-rate — The cir parameter, in kilobits, overrides the administrative CIR used by the scheduler. When the rate command is executed, a CIR setting is optional. The sum keyword specifies that the CIR be used as the summed CIR values of the children schedulers or queues. Fractional values are not allowed and must be given as a positive integer.

Values 0 — 3200000000, sum, max

Default sum

use-ingress-l2tp-dscp

Syntax [**no**] **use-ingress-l2tp-dscp**

Context config>subscr-mgmt>sla-prof>egress

Description This command enables the use of the DSCP marking taken from the L2TP header received on an L2TP Access Concentrator (LAC) for egress classification for the subscriber host using the associated sla-profile.

This command is ignored if the ingress packet is not identified as an L2TP packet.

Default no use-ingress-l2tp-dscp

one-time-http-redirection

Syntax **one-time-http-redirection** *filter-id*
one-time-http-redirection

Context config>subscr-mgmt>sla-prof

Description This command specify the one-time http redirection filter id. This filter will apply to the host when host is created, and will be replaced by the sla-profile ingress filter (configured in the **config>subscr-mgmt>sla-prof>ingress** context) after first HTTP request from host has been redirected.

Note: system does not check if the configured filter include http-redirection entry. If the filter does not include the http-redirection then it will not be replaced in future.

If 7750 receives filter insertion via CoA or access-accept when one-time redirection filter is still active then the received filter entries will only be applied to the sla-profile ingress filter. And after 1st http redirection, the original sla-profile ingress filter + received filter will replace the redirection filter.

Default no

Parameters *filter-id* — Specifies the id of filter that is used for HTTP redirection.

rate

Syntax **rate** *pir-rate* [**cir** *cir-rate*]
no rate

Context config>subscr-mgmt>sla-prof>ingress>qos>queue

Description This command defines the administrative Peak Information Rate (PIR) and the administrative Committed Information Rate (CIR) parameters for the queue. The PIR defines the maximum rate that the queue can transmit packets through the switch fabric (for SAP ingress queues). Defining a PIR does not necessarily guarantee that the queue can transmit at the intended rate. The actual rate sustained by the queue can be limited by oversubscription factors or available egress bandwidth.

The CIR defines the rate at which the system prioritizes the queue over other queues competing for the same bandwidth. For SAP ingress, the CIR also defines the rate that packets are considered in-profile by the system. In-profile packets are preferentially queued by the system at egress and at subsequent next hop nodes where the packet can traverse. To be properly handled as in- or out-of-profile throughout the network, the packets must be marked accordingly for profiling at each hop.

The CIR can be used by the queue's parent command's *cir-level* and *cir-weight* parameters to define the amount of bandwidth considered to be committed for the child queue during bandwidth allocation by the parent scheduler.

The **rate** command can be executed at anytime, altering the PIR and CIR rates for all queues created through the association of the SAP ingress or SAP egress QoS policy with the *queue-id*.

The **no** form of the command returns all queues created with the *queue-id* by association with the QoS policy to the default PIR and CIR parameters (**max**, 0).

Default no rate

Parameters *pir-rate* — Defines the administrative PIR rate, in kilobits, for the queue. When the **rate** command is executed, a valid PIR setting must be explicitly defined. When the **rate** command has not been executed, the default PIR of **max** is assumed.
Fractional values are not allowed and must be given as a positive integer.

The actual PIR rate is dependent on the queues **adaptation-rule** parameters and the actual hardware where the queue is provisioned.

Values 1 — 100000000, max

Default **max**

cir-rate — Specifies the **cir** parameter used by the queue. When the **rate** command is executed, a CIR setting is optional. When the **rate** command has not been executed or the **cir** parameter is not

explicitly specified, the default CIR (0) is assumed.
Fractional values are not allowed and must be given as a positive integer.

Values 0 — 100000000, **max**

Default 0

policer

Syntax **policer** *policer-id* [**create**]
no policer *policer-id*

Context config>subscr-mgmt>sla-prof>ingress>qos
config>subscr-mgmt>sla-prof>egress>qos
config>subscr-mgmt>sub-profile>hsmda>ingress-qos>qos>policer

Description This command is used in the sap-ingress and sap-egress QoS policies to create, modify or delete a policer. Policers are created and used in a similar manner to queues. The policer ID space is separate from the queue ID space, allowing both a queue and a policer to share the same ID. The sap-ingress policy may have up to 32 policers (numbered 1 through 32) may be defined while the sap-egress QoS policy supports a maximum of 8 (numbered 1 through 8). While a policer may be defined within a QoS policy, it is not actually created on SAPs or subscribers associated with the policy until a forwarding class is mapped to the policer's ID.

All policers must be created within the QoS policies. A default policer is not created when a sap-ingress or sap-egress QoS policy is created.

Once a policer is created, the policer's metering rate and profiling rates may be defined as well as the policer's maximum and committed burst sizes (MBS and CBS respectively). Unlike queues which have dedicated counters, policers allow various stat-mode settings that define the counters that will be associated with the policer. Another supported feature—packet-byte-offset—provides a policer with the ability to modify the size of each packet based on a defined number of bytes.

Once a policer is created, it cannot be deleted from the QoS policy unless any forwarding classes that are mapped to the policer are first moved to other policers or queues.

The system will allow a policer to be created on a SAP QoS policy regardless of the ability to support policers on objects where the policy is currently applied. The system only scans the current objects for policer support and sufficient resources to create the policer when a forwarding class is first mapped to the policer ID. If the policer cannot be created due to one or more instances of the policy not supporting policing or having insufficient resources to create the policer, the forwarding class mapping will fail.

The **no** form of this command is used to delete a policer from a sap-ingress or sap-egress QoS policy. The specified policer cannot currently have any forwarding class mappings for the removal of the policer to succeed. It is not necessary to actually delete the policer ID for the policer instances to be removed from SAPs or subscribers associated with the QoS policy once all forwarding classes have been moved away from the policer. It is automatically deleted from each policing instance although it still appears in the QoS policy.

Parameters *policer-id* — The *policer-id* must be specified when executing the policer command. If the specified ID already exists, the system enters that policer's context to allow the policer's parameters to be modified. If the ID does not exist and is within the allowed range for the QoS policy type, a context for the policer ID will be created (depending on the system's current create keyword

requirements which may require the create keyword to actually add the new policer ID to the QoS policy) and the system will enter that new policer's context for possible parameter modification.

Values 1—63

cbs

Syntax **cbs** {*size* [**bytes** | **kilobytes**] | **default**}
no cbs

Context config>subscr-mgmt>sla-prof>ingress>qos>policer
config>subscr-mgmt>sla-prof>egress>qos>policer
config>subscr-mgmt>sub-profile>hsmda>ingress-qos>qos>policer

Description This command is used to configure the policer's CIR leaky bucket's exceed threshold. The CIR bucket's exceed threshold represents the committed burst tolerance allowed by the policer. If the policer's forwarding rate is equal to or less than the policer's defined CIR, the CIR bucket depth hovers around the 0 depth with spikes up to the maximum packet size in the offered load. If the forwarding rate increases beyond the profiling rate, the amount of data allowed to be in-profile above the rate is capped by the threshold.

The policer's **cbs** size defined in the QoS policy may be overridden on an **sla-profile** or SAP where the policy is applied.

The **no** form of this command returns the policer to its default CBS size.

Default **none**

Parameters *size* [**bytes** | **kilobytes**] — The *size* parameter is required when specifying **cbs** and is expressed as an integer representing the required size in either bytes or kilobytes. The default is kilobytes. The optional **byte** and **kilobyte** keywords are mutually exclusive and are used to explicitly define whether size represents bytes or kilobytes.

byte — When **byte** is defined, the value given for size is interpreted as the queue's MBS value given in bytes.

kilobyte — When **kilobytes** is defined, the value is interpreted as the queue's MBS value given in kilobytes.

Values 0 — 16777216

Default **kilobyte**

cbs

Syntax **cbs** {*size* [**bytes** | **kilobytes**] | **default**}
no cbs

Context config>subscr-mgmt>sub-profile>hsmda>egress-qos>qos>queue
config>subscr-mgmt>sub-profile>hsmda>ingress-qos>qos>queue

Description This command is used to configure the policer's CIR leaky bucket's exceed threshold. The CIR bucket's exceed threshold represents the committed burst tolerance allowed by the policer. If the policer's forwarding rate is equal to or less than the policer's defined CIR, the CIR bucket depth hovers around the 0 depth with spikes up to the maximum packet size in the offered load. If the forwarding rate increases beyond the profiling rate, the amount of data allowed to be in-profile above the rate is capped by the threshold.

The policer's **cbs** size defined in the QoS policy may be overridden on an **sla-profile** or SAP where the policy is applied.

The **no** form of this command returns the policer to its default CBS size.

Default **none**

Parameters *size* [**bytes** | **kilobytes**] — The *size* parameter is required when specifying **cbs** and is expressed as an integer representing the required size in either bytes or kilobytes. The default is kilobytes. The optional **byte** and **kilobyte** keywords are mutually exclusive and are used to explicitly define whether size represents bytes or kilobytes.

byte — When **byte** is defined, the value given for size is interpreted as the queue's MBS value given in bytes.

kilobyte — When **kilobytes** is defined, the value is interpreted as the queue's MBS value given in kilobytes.

Values 1 — 4194304

Default **kilobyte**

mbs

Syntax **mbs** {*size* [**bytes** | **kilobytes**] | **default**}
no mbs

Context config>subscr-mgmt>sla-prof>ingress>qos>policer
config>subscr-mgmt>sla-prof>egress>qos>policer
config>subscr-mgmt>sub-profile>hsmda>ingress-qos>qos>policer

Description This command is used to configure the policer's PIR leaky bucket's high priority violate threshold. The **high-prio-only** command is applied to the MBS value to derive the bucket's low priority violate threshold. For ingress, trusted in-profile packets and un-trusted high priority packets use the policer's high priority violate threshold while trusted out-of-profile and un-trusted low priority packets use the policer's low priority violate threshold. At egress, in-profile packets use the policer's high priority violate threshold and out-of-profile packets use the policer's low priority violate threshold.

The PIR bucket's violate threshold represent the maximum burst tolerance allowed by the policer. If the policer's offered rate is equal to or less than the policer's defined rate, the PIR bucket depth hovers around the 0 depth with spikes up to the maximum packet size in the offered load. If the offered rate increases beyond the metering rate, the amount of data allowed above the rate is capped by the threshold. The low priority violate threshold provides a smaller burst size for the lower priority traffic associated with the policer. Since all lower priority traffic is discarded at the lower burst tolerance size, the remaining burst tolerance defined by **high-prio-only** is available for the higher priority traffic.

The policer's mbs size defined in the QoS policy may be overridden on an sla-profile or SAP where the policy is applied.

The no form of this command returns the policer to its default MBS size.

Default None

Parameters *size* [**bytes** | **kilobytes**] — The *size* parameter is required when specifying **mbs** and is expressed as an integer representing the required size in either bytes or kilobytes. The default is kilobytes. The optional **byte** and **kilobyte** keywords are mutually exclusive and are used to explicitly define whether size represents bytes or kilobytes.

byte — When **byte** is defined, the value given for size is interpreted as the queue's MBS value given in bytes.

kilobyte — When **kilobytes** is defined, the value is interpreted as the queue's MBS value given in kilobytes.

Values 0 — 16777216

Default **kilobyte**

mbs

Syntax **mbs** {*size* [**bytes** | **kilobytes**] | **default**}
no mbs

Context config>subscr-mgmt>sub-profile>hsmda>egress-qos>qos>queue
config>subscr-mgmt>sub-profile>hsmda>ingress-qos>qos>queue

Description This command is used to configure the policer's PIR leaky bucket's high priority violate threshold. The **high-prio-only** command is applied to the MBS value to derive the bucket's low priority violate threshold. For ingress, trusted in-profile packets and un-trusted high priority packets use the policer's high priority violate threshold while trusted out-of-profile and un-trusted low priority packets use the policer's low priority violate threshold. At egress, in-profile packets use the policer's high priority violate threshold and out-of-profile packets use the policer's low priority violate threshold.

The PIR bucket's violate threshold represent the maximum burst tolerance allowed by the policer. If the policer's offered rate is equal to or less than the policer's defined rate, the PIR bucket depth hovers around the 0 depth with spikes up to the maximum packet size in the offered load. If the offered rate increases beyond the metering rate, the amount of data allowed above the rate is capped by the threshold. The low priority violate threshold provides a smaller burst size for the lower priority traffic associated with the policer. Since all lower priority traffic is discarded at the lower burst tolerance size, the remaining burst tolerance defined by **high-prio-only** is available for the higher priority traffic.

The policer's mbs size defined in the QoS policy may be overridden on an sla-profile or SAP where the policy is applied.

The no form of this command returns the policer to its default MBS size.

Default None

Parameters *size* [**bytes** | **kilobytes**] — The *size* parameter is required when specifying **mbs** and is expressed as an integer representing the required size in either bytes or kilobytes. The default is kilobytes. The optional **byte** and **kilobyte** keywords are mutually exclusive and are used to explicitly define whether size represents bytes or kilobytes.

byte — When **byte** is defined, the value given for size is interpreted as the queue's MBS value given in bytes.

kilobyte — When **kilobytes** is defined, the value is interpreted as the queue's MBS value given in kilobytes.

Values 1 — 4194304

Default **kilobyte**

packet-byte-offset

Syntax **packet-byte-offset** {**add** *bytes* | **subtract** *bytes*}
no packet-byte-offset

Context config>subscr-mgmt>sla-prof>ingress>qos>policer
config>subscr-mgmt>sla-prof>egress>qos>policer

Description This command is used to modify the size of each packet handled by the policer by adding or subtracting a number of bytes. The actual packet size is not modified; only the size used to determine the bucket depth impact is changed. The **packet-byte-offset** command is meant to be an arbitrary mechanism the can be used to either add downstream frame encapsulation or remove portions of packet headers. Both the policing metering and profiling throughput is affected by the offset as well as the stats associated with the policer.

When child policers are adding to or subtracting from the size of each packet, the parent policer's **min-thresh-separation** value should also need to be modified by the same amount.

The policer's **packet-byte-offset** defined in the QoS policy may be overridden on an **sla-profile** or SAP where the policy is applied.

The **no** version of this command is used to remove per packet size modifications from the policer.

Parameters **add** *bytes* — The **add** keyword is mutually exclusive to the **subtract** keyword. Either **add** or **subtract** must be specified. When **add** is defined the corresponding bytes parameter specifies the number of bytes that is added to the size each packet associated with the policer for rate metering, profiling and accounting purposes. From the policer's perspective, the maximum packet size is increased by the amount being added to the size of each packet.

Values 0 — 31

Default None

subtract *bytes* — The **subtract** keyword is mutually exclusive to the **add** keyword. Either **add** or **subtract** must be specified. When b is defined the corresponding bytes parameter specifies the number of bytes that is subtracted from the size of each packet associated with the policer for rate metering, profiling and accounting purposes. From the policer's perspective, the maximum packet size is reduced by the amount being subtracted from the size of each packet. Note that the minimum resulting packet size used by the system is 1 byte.

Values ingress 1—32
egress: 1—64

Default None

rate

Syntax **rate** {**max** | **kilobits-per-second**} [**cir** {**max** | **kilobits-per-second**}]
no rate

Context config>subscr-mgmt>sla-prof>ingress>qos>policer
config>subscr-mgmt>sla-prof>egress>qos>policer

Description This command is used to configure the policer's metering and optional profiling rates. The metering rate is used by the system to configure the policer's PIR leaky bucket's decrement rate while the profiling rate configures the policer's CIR leaky bucket's decrement rate. The decrement function empties the bucket while packets applied to the bucket attempt to fill it based on the each packets size. If the bucket fills faster than how much is decremented per packet, the bucket's depth eventually reaches it's exceed (CIR) or violate (PIR) threshold. The **cbs**, **mbs**, and **high-prio-only** commands are used to configure the policer's PIR and CIR thresholds.

If a packet arrives at the policer while the bucket's depth is less than the threshold associated with the packet, the packet is considered to be conforming to the bucket's rate. If the bucket depth is equal to or greater than the threshold, the packet is considered to be in the exception state. For the CIR bucket, the exception state is exceeding the CIR rate while the PIR bucket's exception state is violating the PIR bucket rate. If the packet is violating the PIR, the packet is marked red and will be discarded. If the packet is not red, it may be green or yellow based on the conforming or exceeding state from the CIR bucket.

When a packet is red neither the PIR or CIR bucket depths are incremented by the packets size. When the packet is yellow the PIR bucket is incremented by the packet size, but the CIR bucket is not. When the packet is green, both the PIR and CIR buckets are incremented by the packet size. This ensures that conforming packets impact the bucket depth while exceeding or violating packets do not.

The policer's **adaptation-rule** command settings are used by the system to convert the specified rates into hardware timers and decrement values for the policer's buckets.

By default, the policer's metering rate is **max** and the profiling rate is 0 Kbps (all packets out-of-profile).

The **rate** settings defined for the policer in the QoS policy may be overridden on an **sla-profile** or SAP where the policy is applied.

The **no** form of this command is used to restore the default metering and profiling rate to a policer.

Parameters {**max** | *kilobits-per-second*} — Specifying the keyword **max** or an explicit *kilobits-per-second* parameter directly following the rate command is required and identifies the policer's metering rate for the PIR leaky bucket. When the policer is first created, the metering rate defaults to max. The *kilobits-per-second* value must be expressed as an integer and defines the rate in kilobits-per-second. The integer value is multiplied by 1,000 to derive the actual rate in bits-per-second. When max is specified, the maximum policer rate used will be equal to the maximum capacity of the card on which the policer is configured. If the policer rate is set to a value larger than the maximum rate possible for the card, then the PIR used is equivalent to max.

Values **max** or 1—2000000000

cir {**max** | *kilobits-per-second*} — The optional **cir** keyword is used to override the default CIR rate of the policer. Specifying the keyword max or an explicit *kilobits-per-second* parameter directly following the cir keyword is required and identifies the policer's profiling rate for the CIR leaky bucket. When the policer is first created, the profiling rate defaults to 0 Kbps. The *kilobits-per-second* value must be expressed as an integer and defines the rate in kilobits-per-second. The

integer value is multiplied by 1,000 to derive the actual rate in bits-per-second. When max is specified, the maximum policer rate used will be equal to the maximum capacity of the card on which the policer is configured. If the policer rate is set to a value larger than the maximum rate possible for the card, then the CIR used is equivalent to max.

Values **max** or 0—2000000000

stat-mode

Syntax **stat-mode** *stat-mode*
no stat mode

Context config>subscr-mgmt>sla-prof>ingress>qos>policer
config>subscr-mgmt>sla-prof>ingress>qos>queue
config>subscr-mgmt>sla-prof>egress>qos>policer
config>subscr-mgmt>sla-prof>egress>qos>queue

Description This command is used to configure the forwarding plane octet and packet counters of a policer or queue to count packets of a specific type or state. For example separate counters for IPv4/IPv6 or separate counters for offered high and low priority policed traffic.

For policers, this command overrides the policer stat-mode configuration as defined in the sap-ingress or sap-egress qos policy. For details on sap-ingress and sap-egress policer stat-mode, refer to the 7750 SR OS Quality of Service Guide. For use in Enhanced Subscriber Management (ESM) context only, an additional stat-mode enables separate counters for IPv4 and IPv6 packets.

When a policer's stat-mode is changed while the sla profile is in use, any previous counter values are lost and any new counters are set to zero.

For queues, this command sets the stat-mode. Queue stat-mode is only available for use in Enhanced Subscriber Management (ESM) context to enable separate IPv4/IPv6 counters.

A queue's stat-mode cannot be changed while the SLA profile is in use.

Default no stat-mode

For policers, the default is **no stat-mode override**. The **sap-ingress** or **sap-egress stat-mode** is used instead.

For queues, the default is to count in-/out-of-profile octets and packets.

Parameters For ingress and egress qos queue stat-mode overrides:

statmode — {v4-v6}

For ingress qos policer stat-mode overrides:

stat-mode — **Values** no-stats, minimal, offered-profile-no-cir, offered-priority-no-cir, offered-profile-cir, offered-priority-cir, offered-total-cir, offered-limited-profile-cir, offered-profile-capped-cir, offered-limited-capped-cir, v4-v6

For egress qos policer stat-mode overrides:

stat-mode — **Values** no-stats, minimal, offered-profile-no-cir, offered-profile-cir, offered-total-cir, offered-limited-capped-cir, offered-profile-capped-cir, v4-v6

Refer to the 7750 SR OS Quality of Service Guide for details on the **sap-ingress** and **sap-egress policer stat-mode** parameters:

no-stats
minimal
offered-profile-no-cir
offered-priority-no-cir
offered-limited-profile-cir
offered-profile-cir
offered-priority-cir
offered-total-cir
offered-limited-capped-cir
offered-profile-capped-cir

For use in Enhanced Subscriber Management (ESM) context only:

v4-v6 — Count IPv4 and IPv6 forwarded/dropped Octets and Packets separately

Subscriber Identification Policy Commands

sub-ident-policy

Syntax [**no**] **sub-ident-policy** *sub-ident-policy-name*

Context config>subscr-mgmt

Description This command configures a subscriber identification policy. Each subscriber identification policy can have a default subscriber profile defined. The subscriber identification policy default subscriber profile overrides the system default and the subscriber SAP default subscriber profiles. Defining a subscriber identification policy default subscriber profile is optional.

The subscriber identification policy default subscriber profile cannot be defined with the subscriber profile name default.

Defining a subscriber profile as a subscriber identification policy default subscriber profile will cause all active subscribers currently associated with a subscriber SAP using the policy and associated with a subscriber policy through the system default or subscriber SAP default subscriber profiles to be reassigned to the subscriber policy defined as default on the subscriber identification policy.

Attempting to delete a subscriber profile that is currently defined as a default for a subscriber identification policy will fail.

When attempting to remove a subscriber identification policy default subscriber profile definition, the system will evaluate each active subscriber on all subscriber SAPs the subscriber identification policy is currently associated with that are using the default definition to determine whether the active subscriber can be either reassigned to a subscriber SAP default or the system default subscriber profile. If all active subscribers cannot be reassigned, the removal attempt will fail.

Parameters *sub-ident-policy-name* — Specifies the name of the subscriber identification policy.

app-profile-map

Syntax **app-profile-map**

Context config>subscr-mgmt>sub-ident-pol

Description This command enables the context to configure an application profile mapping.

entry

Syntax **entry key** *app-profile-string* **app-profile** *app-profile-name*
no entry key *app-profile-string*

Context config>subscr-mgmt>sub-ident-pol>app-profile-map

Description This command configures an application profile string.

The **no** form of the command removes the values from the configuration.

Parameters *app-profile-string* — Specifies the application profile string.

app-profile-name — Specifies the application profile name.

use-direct-map-as-default

Syntax [**no**] **use-direct-map-as-default**

Context config>subscr-mgmt>sub-ident-pol>app-profile-map
config>subscr-mgmt>sub-ident-pol>sla-profile-map

Description This command enables direct mapping of application profile as default. With this flag, a script returned string will be used as the named profile. If the named profiled cannot be found, the default profile will be used.

The **no** form of the command disables the direct mapping.

Default no use-direct-map-as-default

primary

Syntax **primary**

Context config>subscr-mgmt>sub-ident-pol

Description This command configures a primary identification script.

script-url

Syntax **script-url** *dhcp-script-url*

Context config>subscr-mgmt>sub-ident-pol>primary
config>subscr-mgmt>sub-ident-pol>secondary
config>subscr-mgmt>sub-ident-pol>tertiary

Description This command specifies the URL of the identification scripts.

Parameters *dhcp-primary-script-url* — Specifies the URL of the primary identification script.

dhcp-secondary-script-url — Specifies the URL of the secondary identification script.

dhcp-tertiary-script-url — Specifies the URL of the tertiary identification script.

secondary

Syntax **secondary**

Context config>subscr-mgmt>sub-ident-pol

Description This command configures a secondary identification script.

sla-profile-map

Syntax **sla-profile-map**

Context config>subscr-mgmt>sub-ident-pol

Description This command configures an SLA profile mapping.

sub-profile-map

Syntax **sla-profile-map**

Context config>subscr-mgmt>sub-ident-pol

Description This command configures a subscriber profile mapping.

entry

Syntax **entry key** *sla-profile-string* **sla-profile** *sla-profile-name*
no entry key *sla-profile-string*

Context config>subscr-mgmt>sub-ident-pol>sla-profile-map

Description This command configures an SLA profile string. Each subscriber identification string can be provisioned into a subscriber mapping table providing an explicit mapping of the string to a specific subscriber profile. This allows certain subscribers to be directly mapped to the appropriate subscriber profile in the event that the default mappings are not desired for the subscriber.

An explicit mapping of a subscriber identification string to a subscriber profile cannot be defined with the subscriber profile name default. It is possible for the subscriber identification string to be entered in the mapping table without a defined subscriber profile which can result in the explicitly defined subscriber to be associated with the subscriber profile named default.

Explicitly mapping a subscriber identification string to a subscriber profile will cause an existing active subscriber associated with the string to be reassigned to the newly mapped subscriber profile. An explicit mapping overrides all default subscriber profile definitions.

Attempting to delete a subscriber profile that is currently defined as in an explicit subscriber identification string mapping will fail.

The system will fail the removal attempt of an explicit subscriber identification string mapping to a subscriber profile definition when an active subscriber is using the mapping and cannot be reassigned to a defined default non-provisioned subscriber profile.

Parameters *sla-profile-string* — Identifies the SLA profile string.

Values 16 characters maximum

sla-profile-name — Identifies the SLA profile name.

Values 32 characters maximum

entry

Syntax **entry key** *sub-profile-string* **sub-profile** *sub-profile-name*
no entry key *sub-profile-string*

Context config>subscr-mgmt>sub-ident-pol>sub-profile-map

Description This command configures a subscriber profile string.

Parameters *sub-profile-string* — Specifies the subscriber profile string.

Values 16 characters maximum

sub-profile-name — Specifies the subscriber profile name.

Values 32 characters maximum

tertiary

Syntax **tertiary**

Context config>subscr-mgmt>sub-ident-pol

Description This command configures a tertiary identification script.

Auto-Generated Subscriber Identification Key Commands

auto-sub-id-key

Syntax **auto-sub-id-key**

Context config>subscr-mgmt

ipoe-sub-id-key

Syntax **ipoe-sub-id-key** *sub-id-key* [*sub-id-key*...(up to 4 max)]
no ipoe-sub-id-key

Context config>subscr-mgmt>>auto-sub-id-key

Description This command enables certain fields to become the base for auto-generation of the default sub-id name. The sub-id name will be auto generated if there is not a more specific method available. Such more specific methods would be a default sub-id name as a sap-id, a preconfigured static string or explicit mappings based on RADIUS/LUDB returned strings.

In case that a more specific sub-id name generation method is not available AND the auto-id keyword is defined under the def-sub-id hierarchy, the sub-id name will be generated by concatenating fields defined in this command separated by a "|" character.

The maximum sub-id name length is 32 characters while the concatenation of subscriber identification fields can easily exceed 32 characters. Subscriber host instantiation will fail in case that the sub-id name is based on subscriber identification fields whose concatenated length exceeds 32 characters. Failing the host creation rather than truncating sub-id name on a 32 character boundary will prevent collision of sub-ids (subscriber name duplication).

In case that a more specific sub-id name generation method is not available AND the auto-id keyword is NOT defined under the def-sub-id hierarchy, the sub-id name will be a random 10 character encoded string based on the fields defined under this command.

There is only one set of identification fields allowed per host type (IPoE or PPP) per chassis.

Parameters *sub-id-key* — Specifies the auto-generated sub-id keys for IPoE hosts.

Values **mac** — The MAC address can be combined with other subscriber host identification fields (circuit-id, remote-id, session-id or sap-id) to form a sub-id name in a user readable format or as a random 10 character encoded value.

In case that the mac address is used as a concatenation field in the sub-id name, then its format becomes a string xx:xx:xx:xx:xx:xx with the length 17B.

The MAC address as the subscriber host identification field is not applicable to PPPoA hosts or static hosts.

circuit-id — The circuit-id can be combined with other subscriber host identification fields (mac, remote-id, session-id or sap-id) to form a sub-id name in a user readable format or as a random 10 character encoded value.

In case that the circuit-id is used as a concatenation field in the sub-id name, then its format becomes access-node-id eth slot/port:[vlan-id] or access-node-id atm slot/port:vpi.vci with a variable length.

Note that if circuit-id contains any non printable ASCI characters, the entire circuit-id string will be formatted in hex in the sub-id name output. Otherwise all characters in circuit-id will be converted to ASCII. ASCII printable characters contain bytes in range 0x20..0x7E.

The circuit-id as the subscriber identification field is not applicable to PPPoA hosts, ARP hosts or static hosts.

remote-id — The remote-id can be combined with other subscriber host identification fields (mac, circuit-id, session-id or sap-id) to form a sub-id name in a user readable format or as a random 10 character encoded value.

In case that the remote-id is used as a concatenation field in the sub-id name, then its format becomes a remote-id string with a variable length.

Note that if remote-id contains any non printable ASCI characters, the entire remote-id string will be formatted in hex in the sub-id name output. Otherwise all characters in remote-id will be converted to ASCII. ASCII printable characters contain bytes in range 0x20..0x7E.

The remote-id as the subscriber identification field is not applicable to PPPoA hosts, ARP hosts or static hosts.

sap-id — The sap-id can be combined with other subscriber host identification fields (mac, circuit-id, remote-id, or session-id) to form a sub-id name in a user readable format or as a random 10 character encoded value.

In case that the circuit-id is used as a concatenation field in the sub-id name, then its format becomes : slot/mda:[outer-vlan].[inner-vlan] with a variable length.

The sap-id as the subscriber identification field is applicable to all hosts types with exception of static hosts.

Default ipoe-sub-id-key mac sap-id

ppp-sub-id-key

Syntax **ppp-sub-id-key** *sub-id-key* [*sub-id-key*...(up to 5 max)]
no ppp-sub-id-key

Context config>subscr-mgmt>>auto-sub-id-key

Description This command enable certain fields to become the base for auto-generation of default sub-id name. The sub-id name will be auto-generated if there is not a more specific method available. Examples of these specific methods would be a default sub-id name as a sap-id, a preconfigured static string or explicit mappings based on RADIUS/LUDB returned strings.

In case that a more specific sub-id name generation method is not available and the **auto-id** keyword is defined under the def-sub-id hierarchy, the sub-id name will be generated by concatenating fields defined in this command separated by a "|" character.

The maximum sub-id name length is 32 characters while the concatenation of subscriber identification fields can easily exceed 32 characters. The subscriber host instantiation will fail if the sub-id name is based on subscriber identification fields whose concatenated length exceeds 32 characters. Failing the host creation rather than truncating sub-id name on a 32 character boundary will prevent collision of sub-ids (subscriber name duplication).

In case that a more specific sub-id name generation method is not available and the **auto-id** keyword is not defined under the def-sub-id hierarchy, the sub-id name will be a random 10 character encoded string based on the fields defined under this command.

There is only one set of identification fields allowed per host type (IPoE or PPP) per chassis.

Parameters *sub-id-key* — Specifies the auto-generated sub-id keys for PPP hosts.

Values **mac** — The MAC address can be combined with other subscriber host identification fields (circuit-id, remote-id, session-id or sap-id) to form a sub-id name in a user readable format or as a random 10 character encoded value.

In case that the mac address is used as a concatenation field in the sub-id name, then its format becomes a string xx:xx:xx:xx:xx:xx with the length 17B.

The MAC address as the subscriber host identification field is not applicable to PPPoA hosts or static hosts.

circuit-id — The circuit-id can be combined with other subscriber host identification fields (mac, remote-id, session-id or sap-id) to form a sub-id name in a user readable format or as a random 10 character encoded value.

In case that the circuit-id is used as a concatenation field in the sub-id name, then its format becomes access-node-id eth slot/port:[vlan-id] or access-node-id atm slot/port:vpi.vci with a variable length.

Note that if circuit-id contains any non printable ASCI characters, the entire circuit-id string will be formatted in hex in the sub-id name output. Otherwise all characters in circuit-id will be converted to ASCII. ASCII printable characters contain bytes in range 0x20..0x7E.

.The circuit-id as the subscriber identification field is not applicable to PPPoA hosts, ARP hosts or static hosts.

remote-id — The remote-id can be combined with other subscriber host identification fields (mac, circuit-id, session-id or sap-id) to form a sub-id name in a user readable format or as a random 10 character encoded value.

In case that the remote-id is used as a concatenation field in the sub-id name, then its format becomes a remote-id string with a variable length.

Please note that if remote-id contains any non printable ASCI characters, the entire remote-id string will be formatted in hex in the sub-id name output. Otherwise all characters in remote-id will be converted to ASCII. ASCII printable characters contain bytes in range 0x20..0x7E.

The remote-id as the subscriber identification field is not applicable to PPPoA hosts, ARP hosts or static hosts.

sap-id — The sap-id can be combined with other subscriber host identification fields (mac, circuit-id, remote-id, or session-id) to form a sub-id name in a user readable format or as a random 10 character encoded value.

In case that the circuit-id is used as a concatenation field in the sub-id name, then its format becomes : slot/mda:[outer-vlan].[inner-vlan] with a variable length.

The sap-id as the subscriber identification field is applicable to all hosts types with exception of static hosts.

session-id — The session-id can be combined with other subscriber host identification fields (mac, circuit-id, remote-id, or sap-id) to form a sub-id name in a user readable format or as a random 10 character encoded value.

In case that the circuit-id is used as a concatenation field in the sub-id name, then its format becomes a decimal number with variable length.

The session-id as the subscriber identification field is applicable only to PPPoE/ PPPoEoA type hosts.

Default ppp-sub-id-key mac sap-id session-id

Subscriber Profile Commands

sub-profile

Syntax [**no**] **sub-profile** *subscriber-profile-name*

Context config>subscr-mgmt

Description This command enables the context to configure a subscriber profile. A subscriber profile is a template used to define the aggregate QoS for all hosts within a subscriber context. This is done through the definition of the egress and ingress scheduler policies that govern the aggregate SLA for subscribers using the subscriber profile. Subscriber profiles also allow for specific SLA profile definitions when the default definitions from the subscriber identification policy must be overridden.

Subscribers are either explicitly mapped to a subscriber profile template or are dynamically associated by one of various non-provisioned subscriber profile definitions.

A subscriber host can be associated with a subscriber profile in the following ways, listed from lowest to highest precedence:

1. The subscriber profile named default.
2. The subscriber profile defined as the subscriber SAP default.
3. The subscriber profile found by the subscriber identification policy sub-profile-map.
4. The subscriber profile found by the subscriber identification policy explicit map.

In the event that no defaults are defined and the subscriber identification string is not explicitly provisioned to map to a subscriber profile, either the static subscriber host creation will fail or the dynamic subscriber host DHCP ACK will be discarded.

Default Subscriber profile:

When a subscriber profile is created with the *subscriber-profile-name* default, it will be used when no other subscriber profile is associated with the subscriber host by the system. Creating a subscriber profile with the *subscriber-profile-name* default is optional. If a default subscriber profile is not created, all subscriber hosts subscriber identification strings must match either a non-provisioned default or be provisioned as an explicit match to a subscriber profile.

The default profile has no effect on existing active subscriber on the system as they exist due to higher precedence mappings.

Attempting to delete any subscriber profile (including the profile named default) while in use by existing active subscribers will fail.

Parameters *subscriber-profile-name* — Specify the name of the subscriber profile.

Values 32 characters maximum, default

accounting-policy

Syntax **accounting-policy** *acct-policy-id*
no accounting-policy

Context config>subscr-mgmt>sub-prof

Description This command specifies the policy to use to collect accounting statistics on this subscriber profile.

A maximum of one accounting policy can be associated with a profile at one time. Accounting policies are configured in the **config>log** context.

The **no** form of this command removes the accounting policy association.

Default no accounting policy

Parameters *acct-policy-id* — Enter the accounting *policy-id* as configured in the **config>log>accounting-policy** context.

Values 1 — 99

collect-stats

Syntax [**no**] **collect-stats**

Context config>subscr-mgmt>sub-prof

Description When enabled, the agent collects non-RADIUS accounting statistics.

When the **no collect-stats** command is issued the statistics are still accumulated by the IOM cards. However, the CPU will not obtain the results and write them to the billing file. If a subsequent **collect-stats** command is issued then the counters written to the billing file include all the traffic while the **no collect-stats** command was in effect.

Default collect-stats

agg-rate-limit

Syntax **agg-rate-limit** {**max** | *kilobits-per-second*} [**queue-frame-based-accounting**]
no agg-rate-limit

Context config>subscr-mgmt>sub-prof>egress

Description This command define a subscriber aggregate limit when the subscriber profile is directly associated with an egress port based scheduler instead of a scheduler policy. The optional queue-frame-based-accounting keyword allows the subscriber queues to operate in the frame based accounting mode.

Once egress frame based accounting is enabled on the subscriber profile, all queues associated with the subscriber (created through the sla-profile associated with each subscriber host) will have their rate and CIR values interpreted as frame based values. When shaping, the queues will include the 12 byte Inter-Frame Gap (IFG) and 8 byte preamble for each packet scheduled out the queue. The profiling CIR threshold will also include the 20 byte frame encapsulation overhead. Statistics associated with the queue do not include the frame encapsulation overhead.

The queue-frame-based-accounting keyword does not change the behavior of the egress-agg-rate-limit rate value. Since egress-agg-rate-limit is always associated with egress port based scheduling and egress port based scheduling is dependant on frame based operation, the egress-agg-rate-limit rate is always interpreted as a frame based value.

Enabling queue-frame-based-accounting will not cause statistics for queues associated with the subscriber to be cleared.

The **no** form of the command removes both an egress aggregate rate limit and egress frame based accounting for all subscribers associated with the sub-profile. If a subscriber's accounting mode is changed, the subscriber's queue statistics are cleared.

Parameters {**max** | *kilobits-per-second*} **—** The **max** keyword and *kilobits-per-second* parameter are mutually exclusive. Either max or a value for kilobits-per-second must follow the egress-agg-rate-limit command.

max — The max keyword specifies that the egress aggregate rate limit for the subscriber is unlimited. Scheduling for the subscriber queues will only be governed by the individual queue parameters and any congestion on the port relative to each queues scheduling priority.

kilobits-per-second — The kilobits-per-second parameter defines an actual egress aggregate rate to which all queues associated with the sub-profile will be limited. The limit will be managed per subscriber associated with the sub-profile. The value must be defined as an integer and is representative of increments of 1000 bits per second.

Values 1 to 40000000

Default max

queue-frame-based-accounting — The optional queue-frame-based-accounting keyword enables frame based accounting on all queues associated with the subscriber profile. If frame based accounting is required when a subscriber aggregate limit is not necessary, the max keyword should precede the queue-frame-based-accounting keyword. If frame based accounting must be disabled, execute egress-agg-rate-limit without the queue-frame-based-accounting keyword present.

Default Frame based accounting is disabled by default

queue-frame-based-accounting — Specifies whether to use frame-based accounting when evaluating the aggregation rate limit for the egress queues for this SAP.

avg-frame-size

Syntax **avg-frame-size** *bytes*
no avg-frame-size

Context config>subscriber-managemet>sub-profile>egress

Description This command specifies the average frame size used in the calculation of the fixed and variable encapsulation offset when the command encap-offset is enabled in the egress context of a subscriber profile.

If the user does not explicitly configure a value for the avg-frame-size parameter, then it will also be assumed the offset is zero.

The **no** form of the command removes the avg-frame-size parameter from the subscriber profile.

Default 0

Parameters *bytes* — specifies the average frame size value to be used in the adjustment of the subscriber aggregate rate to account for the per packet variable expansion of the last mile for the specific session used by the subscriber host.

Values 64 — 4096

encap-offset

Syntax **encap-offset** [**type** *type*]
no encap-offset

Context config>subscriber-managemet>sub-profile>egress

Description This command enables the adjustment of the queue and subscriber aggregate rate based on the last mile Ethernet or ATM encapsulation.

In R9.0, the data path computes the adjusted frame size real-time for each serviced packet from a queue by adding the actual packet size to the fixed offset provided by CPM for this queue and variable AAL5 padding.

When this command is enabled, the fixed packet offset is derived from the encapsulation type value signaled in the Access-loop-encapsulation sub-TLV in the Vendor-Specific PPPoE Tags or DHCP Relay Options as per RFC 4679. If the user specifies an encapsulation type with the command, this value is used as the default value for all hosts of this subscriber until a host session signaled a valid value. The signaled value is applied to this host only and the remaining hosts of this subscriber continue to use the user entered default type value if configured, or no offset is applied. Note that however, hosts of the same subscriber using the same SLA profile and which are on the same SAP will share the same instance of FC queues. In this case, the last valid encapsulation value signaled by a host of that same instance of the SAP egress QoS policy will override any previous signaled or configured value.

If the user manually applied a constant byte offset to each packet serviced by the queue by configuring the packet-byte-offset, it will have no effect on the net offset computed for the packet. This net offset is stored in the subscriber host table.

The procedures for handling signaling changes or configuration changes affecting the subscriber profile are as follows:

1. The avg-frame-size parameter in the subscriber profile is ignored.
2. If the user specifies an encapsulation type with the command, this value is used as the default value for all hosts of this subscriber until a host session signaled a valid value. The signaled value is applied to this host and other hosts of the same subscriber sharing the same SLA profile and which are on the same SAP. The remaining hosts of this subscriber continue to use the user entered default type value if configured, or no offset is applied.
3. If the user enables/disables the encap-offset option, or changes the parameter value of the encap-offset option, CPM immediately triggers a re-evaluation of subscribers hosts using the corresponding subscriber profile and an update the IOM with the new fixed offset value.
4. If a subscriber has a static host or an ARP host, the subscriber host continues to use the user-configured default encapsulation type value or the last valid encapsulation value signaled in the

PPPoE tags or DHCP relay options by other hosts of the same subscriber which use the same SLA profile instance. If none was signaled or configured, then no rate adjustment is applied.

When the encap-offset option is configured in the subscriber profile, the subscriber host queue rates, that is, CLI and operational PIR and CIR as well as queue bucket updates, the queue statistics, that is, forwarded, dropped, and HQoS offered counters use the last-mile frame-over-the-wire format. The scheduler policy CLI and operational rates also use LM-FoW format. The port scheduler max-rate and the priority level rates and weights, if a Weighted Scheduler Group is used, are always entered in CLI and interpreted as local port frame-over-the-wire rates. The same is true for an agg-rate-limit applied to a vport. Finally the subscriber agg-rate-limit is entered in CLI as last-mile frame-over-the-wire rate. The system maintains a running average frame expansion ratio for each queue to convert queue rates between these two formats.

Parameters **type** *type* — The name of the default encapsulation used for all host queues of a subscriber in the absence of a valid value signaled in the PPPoE tags.

Values pppoa-llc|pppoa-null|pppoeoa-llc|pppoeoa-llc-fcs|pppoeoa-llc-tagged|pppoeoa-llc-tagged-fcs|pppoeoa-null|pppoeoa-null-fcs|pppoeoa-null-tagged|pppoeoa-null-tagged-fcs|ipoa-llc|ipoa-null|ipoeoa-llc|ipoeoa-llc-fcs|ipoeoa-llc-tagged|ipoeoa-llc-tagged-fcs|ipoeoa-null|ipoeoa-null-fcs|ipoeoa-null-tagged|ipoeoa-null-tagged-fcs|pppoe|pppoe-tagged|ipoe|ipoe-tagged

scheduler

Syntax **scheduler** *scheduler-name* **rate** *pir-rate* [**cir** *cir-rate*]
no scheduler *scheduler-name*

Context config>subscr-mgmt>sub-prof>egress>sched
config>subscr-mgmt>sub-prof>ingress>sched

Description This command provides a way to override parameters of the existing scheduler associated with the egress or ingress scheduler policy. A scheduler defines bandwidth controls that limit each child (other schedulers and queues) associated with the scheduler. Scheduler objects are created within the hierarchical tiers of the policy. It is assumed that each scheduler created will have queues or other schedulers defined as child associations. The scheduler can be a child (take bandwidth from a scheduler in a higher tier).

Parameters **scheduler** *scheduler-policy-name* — Specify an existing scheduler policy name.

pir-rate — Specify the pir-rate, in kilobits, to override the administrative PIR used by the scheduler. When the **rate** command is executed, a valid PIR setting must be explicitly defined
Fractional values are not allowed and must be given as a positive integer.

Values 1 — 3200000000, max

Default none

cir-rate — The **cir** parameter overrides the administrative CIR used by the scheduler. When the **rate** command is executed, a CIR setting is optional. The sum keyword specifies that the CIR be used as the summed CIR values of the children schedulers or queues.
Fractional values are not allowed and must be given as a positive integer.

Values 0 — 3200000000, **sum**, **max**

Default sum

scheduler-policy

Syntax **scheduler-policy** *scheduler-policy-name*
no scheduler-policy

Context config>subscriber-mgmt>sub-profile>egress
config>subscriber-mgmt>sub-profile>ingress

Description This command specifies a scheduler policy to associate to the subscriber profile. Scheduler policies are configured in the **configure>qos>scheduler>policy** context. Each scheduler policy is divided up into groups of schedulers based on the tier each scheduler is created under. A tier is used to give structure to the schedulers within a policy and define rules for parent scheduler associations. The policy defines the hierarchy and operating parameters for virtual schedulers.

Parameters *scheduler-policy-name* — Specify an existing scheduler policy name.

lag-per-link-hash

Syntax **lag-per-link-hash class {1 | 2 | 3} weight 1..1024**
no lag-per-link-hash

Special Cases config>subscr-mgmt>sub-profile>egress

Description This command configures weight and class to be used on LAG egress when the LAG uses weighted per-link-hash by subscribers with the profile assigned. Subscribers using profile with lag-per-link-hash default configuration, inherit weight and class from the SAP configuration (1 and 1 respectively if none configured under SAP).

The no form of this command restores default configuration.

Default no lag-per-link-hash

policer-control-policy

Syntax **policer-control-policy** *policy-name* [**create**]
no policer-control-policy

Context config>subscr-mgmt>sub-prof>ingress
config>subscr-mgmt>sub-prof>egress

Description This command is used to create, delete, or modify policer control policies. The **policer-control-policy** controls the aggregate bandwidth available to a set of child policers. Once created, the policy can be applied to ingress or egress SAPs. The policy can also be applied to the ingress or egress context of a sub-profile.

Default no policer-control-policy

Parameters *policy-name* — Each policer-control-policy must be created with a unique policy name. The name must given as *policy-name* must adhere to the system policy ASCII naming requirements. If the defined policy-name already exists, the system will enter that policy's context for editing

purposes. If policy-name does not exist, the system will attempt to create a policy with the specified name. Creating a policy may require use of the create parameter when the system is configured for explicit object creation mode.

Default None

create — The **create** keyword is required when a new policy is being created and the system is configured for explicit object creation mode.

max-rate

Syntax **max-rate** {*kilobits-per-second* | **max**}
no max-rate

Context config>subscr-mgmt>sub-prof>ingress>policer-control-policy
config>subscr-mgmt>sub-prof>egress>policer-control-policy

Description The **max-rate** command defines the parent policer's PIR leaky bucket's decrement rate. A parent policer is created for each time the policer-control-policy is applied to either a SAP or subscriber instance. Packets that are not discarded by the child policers associated with the SAP or subscriber instance are evaluated against the parent policer's PIR leaky bucket.

For each packet, the bucket is first decremented by the correct amount based on the decrement rate to derive the current bucket depth. The current depth is then compared to one of two discard thresholds associated with the packet. The first discard threshold (discard-unfair) is applied if the FIR (Fair Information Rate) leaky bucket in the packet's child policer is in the confirming state. The second discard threshold (discard-all) is applied if the child policer's FIR leaky bucket is in the exceed state. Only one of the two thresholds is applied per packet. If the current depth of the parent policer PIR bucket is less than the threshold value, the parent PIR bucket is in the conform state for that particular packet. If the depth is equal to or greater than the applied threshold, the bucket is in the violate state for the packet.

If the result is "conform," the bucket depth is increased by the size of the packet (plus or minus the per-packet-offset setting in the child policer) and the packet is not discarded by the parent policer. If the result is "violate," the bucket depth is not increased and the packet is discarded by the parent policer. When the parent policer discards a packet, any bucket depth increases (PIR, CIR and FIR) in the parent policer caused by the packet are canceled. This prevents packets that are discarded by the parent policer from consuming the child policers PIR, CIR and FIR bandwidth.

The **policer-control-policy root max-rate** setting may be overridden on each SAP or sub-profile where the policy is applied.

Default max

Parameters *kilobits-per-second* — Defining a kilobits-per-second value is mutually exclusive with the max parameter. The kilobits-per-second value must be defined as an integer that represents the number of kilobytes that the parent policer will be decremented per second. The actual decrement is performed per packet based on the time that has elapsed since the last packet associated with the parent policer.

Values Integer 0 – 2000000000

max — The **max** parameter is mutually exclusive with defining a **kilobits-per-second** value. When max is specified, the parent policer does not enforce a maximum rate on the aggregate throughput

of the child policers. This is the default setting when the **policer-control-policy** is first created and is the value that the parent policer returns to when no max-rate is executed. In order for the parent policer to be effective, a kilobits-per-second value should be specified.

no max-rate — The **no max-rate** command returns the policer-control-policy's parent policer maximum rate to max.

priority-mbs-thresholds

Syntax **priority-mbs-thresholds**

Context config>subscr-mgmt>sub-prof>ingress>policer-control-policy
config>subscr-mgmt>sub-prof>egress>policer-control-policy

Description The **priority-mbs-thresholds** command contains the root arbiter parent policer's **min-thresh-separation** command and each priority level's **mbs-contribution** command that is used to internally derive each priority level's shared-portion and fair-portion values. The system uses each priority level's shared-portion and fair-portion value to calculate each priority level's discard-unfair and discard-all MBS thresholds that enforce priority sensitive rate-based discards within the root arbiter's parent policer.

The **priority-mbs-thresholds** CLI node always exists and does not need to be created.

Default None.

min-thresh-separation

Syntax **min-thresh-separation** *size* [**bytes** | **kilobytes**]
no min-thresh-separation

Context config>subscr-mgmt>sub-prof>ingress>policer-control-policy>priority-mbs-thresholds
config>subscr-mgmt>sub-prof>egress>policer-control-policy>priority-mbs-thresholds

Description The **min-thresh-separation** command defines the minimum required separation between each in-use discard threshold maintained for each parent policer context associated with the policer-control-policy. The min-thresh-separation value may be overridden on each SAP or sub-profile to which the policy is applied.

The system uses the default or specified min-thresh-separation value in order to determine the minimum separation required between each of the of the parent policer discard thresholds. The system enforces the minimum separation based on the following behavior in two ways. The first is determining the size of the shared-portion for each priority level (when the **mbs-contribution** command's optional fixed keyword is not specified):

- When a parent policer instance's priority level has less than two child policers associated, the shared-portion for the level will be zero.
- When a parent policer instance's priority level has two or more child policers associated, the shared-portion for the level will be equal to the current value of **min-thresh-separation**.

The second function the system uses the **min-thresh-separation** value for is determining the value per priority level for the fair-portion:

- When a parent policer instance's priority level has no child policers associated, the fair-portion for the level will be zero.
- When a parent policer instance's priority level has one child policer associated, the fair-portion will be equal to the maximum of the min-thresh-separation value and the priority level's mbs-contribution value.
- When a parent policer instance's priority level has two or more child policers associated, the fair-portion will be equal to the maximum of the following:

  –**min-thresh-separation** value

  –The priority level's **mbs-contribution** value less **min-thresh-separation** value

When the **mbs-contribution** command's optional fixed keyword is defined for a priority level within the policy, the system will treat the defined **mbs-contribution** value as an explicit definition of the priority level's MBS. While the system will continue to track child policer associations with the parent policer priority levels, the association counters will have no effect. Instead the following rules will be used to determine a fixed priority level's shared-portion and fair-portion:

- If a fixed priority level's **mbs-contribution** value is set to zero, both the shared-portion and fair-portion will be set to zero
- If the **mbs-contribution** value is not set to zero:

  –The shared-portion will be set to the current **min-thresh-separation** value

  –The fair-portion will be set to the maximum of the following:

  min-thresh-separation value

  mbs-contribution value less **min-thresh-separation value**

Each time the **min-thresh-separation** value is modified, the thresholds for all instances of the parent policer created through association with this **policer-control-policy** are reevaluated.

Determining the Correct Value for the Minimum Threshold Separation Value

The minimum value for **min-thresh-separation** should be set equal to the maximum size packet that will be handled by the parent policer. This ensures that when a lower priority packet is incrementing the bucket, the size of the increment will not cause the bucket's depth to equal or exceed a higher priority threshold. It also ensures that an unfair packet within a priority level cannot cause the PIR bucket to increment to the discard-all threshold within the priority.

When evaluating maximum packet size, each child policer's per-packet-offset setting should be taken into consideration. If the maximum size packet is 1518 bytes and a per-packet-offset parameter is configured to add 20 bytes per packet, min-thresh-separation should be set to 1538 due to the fact that the parent policer will increment its PIR bucket using the extra 20 bytes.

In most circumstances, a value larger than the maximum packet size is not necessary. Management of priority level aggregate burst tolerance is intended to be implemented using the priority level **mbs-contribution** command. Setting a value larger than the maximum packet size will not adversely affect the policer performance, but it may increase the aggregate burst tolerance for each priority level.

NOTE: One thing to note is that a priority level's shared-portion of the parent policer's PIR bucket depth is only necessary to provide some separation between a lower priority's discard-all threshold and this priority's discard-unfair threshold. It is expected that the burst tolerance for the unfair packets is relatively minimal since the child policers feeding the parent policer priority level all have some amount of fair burst before entering into an FIR exceed or unfair state. The fair burst amount for a priority level is defined using the mbs-contribution command.

The **no** form of this command returns the policy's **min-thresh-separation** value to the default value.

Default **no min-thresh-separation**

Parameters *size* [**bytes** | **kilobytes**] — The size parameter is required when executing the **min-thresh-separation** command. It is expressed as an integer and specifies the shared portion in bytes or kilobytes that is selected by the trailing bytes or kilobytes keywords. If both bytes and kilobytes are missing, kilobytes is the assumed value. Setting this value has no effect on parent policer instances where the **min-thresh-separation** value has been overridden.

Values 0 – 16777216

Default none

[**bytes** | **kilobytes**] — The **bytes** keyword is optional and is mutually exclusive with the **kilobytes** keyword. When specified, size is interpreted as specifying the size of **min-thresh-separation** in bytes.

The **kilobytes** keyword is optional and is mutually exclusive with the **bytes** keyword. When specified, size is interpreted as specifying the size of **min-thresh-separation** in kilobytes.

Values **bytes** or **kilobytes**

Default **kilobytes**

priority

Syntax **priority** *level*

Context config>subscr-mgmt>sub-prof>ingress>policer-control-policy>priority-mbs-thresholds
config>subscr-mgmt>sub-prof>egress>policer-control-policy>priority-mbs-thresholds

Description The **priority** level command contains the **mbs-contribution** configuration command for a given strict priority level. Eight levels are supported numbered 1 through 8 with 8 being the highest strict priority.

Each of the eight priority CLI nodes always exists and do not need to be created. While parameters exist for each priority level, the parameters are only applied when the priority level within a parent policer instance is currently supporting child policers.

Default None.

mbs-contribution

Syntax **mbs-contribution** *size* [**bytes | kilobytes**] [**fixed**]
no mbs-contribution

Context config>subscr-mgmt>sub-prof>ingress>policer-control-policy>priority-mbs-thresholds>priority
config>subscr-mgmt>sub-prof>egress>policer-control-policy>priority-mbs-thresholds>priority

Description

The **mbs-contribution** command is used to configure the policy-based burst tolerance for a parent policer instance created when the policy is applied to a SAP or subscriber context. The system uses the parent policer's **min-thresh-separation** value, the priority level's **mbs-contribution** value and the number of child policers currently attached to the priority level to derive the priority level's shared-portion and fair-portion of burst tolerance within the local priority level. The shared-portion and fair-portions for each priority level are then used by the system to calculate each priority level's discard-unfair threshold and discard-all threshold.

The value for a priority level's **mbs-contribution** within the policer-control-policy may be overridden on the SAP or subscriber sub-profile where the policy is applied in order to allow fine tuning of the discard-unfair and discard-all thresholds relevant to the needs of the local child policers on the object.

Accumulative Nature of Burst Tolerance for a Parent Policer Priority Level

When defining **mbs-contribution**, the specified size may only be a portion of the burst tolerance associated with the priority level. The packets associated with the priority level share the burst tolerance of lower within the parent policer. As the parent policer PIR bucket depth increases during congestion, the lower priority packets eventually experience discard based on each priority's discard-unfair and discard-all thresholds. Assuming congestion continues once all the lower priority packets have been prevented from consuming bucket depth, the burst tolerance for the priority level will be consumed by its own packets and any packets associated with higher priorities.

The Effect of Fair and Unfair Child Policer Traffic at a Parent Policer Priority Level

The system continually monitors the offered rate of each child policer on each parent policer priority level and detects when the policer is in a congested state (the aggregate offered load is greater than the decrement rate defined on the parent policer). As previously stated, the result of congestion is that the parent policer's bucket depth will increase until it eventually hovers around either a discard-unfair or discard-all threshold belonging to one of the priority levels. This threshold is the point where enough packets are being discarded that the increment rate and decrement rate begin to even out. If only a single child policer is associated to the priority level, the discard-unfair threshold is not used since fairness is only applicable when multiple child policers are competing at the same priority level.

When multiple child policers are sharing the congested priority level, the system uses the offered rates and the parenting parameters of each child to determine the fair rate per child when the parent policer is unable to meet the bandwidth needs of each child. The fair rate represents the amount of bandwidth that each child at the priority level should receive relative to the other children at the same level according to the policer control policy instance managing the child policers. This fair rate is applied as the decrement rate for each child's FIR bucket. Changing a child's FIR rate does not modify the amount of packets forwarded by the parent policer for the child's priority level. It simply modifies the forwarded ratio between the children on that priority level. Since each child FIR bucket has some level of burst tolerance before marking its packets as unfair, the current parent policer bucket depth may at times rise above the discard-unfair threshold. The mbs-contribution value provides a means to define how much separation is provided between the priority level's discard-unfair and discard-all threshold to allow the parent policer to absorb some amount of FIR burst before reaching the priority's discard-all threshold.

This level of fair aggregate burst tolerance is based on the decrement rate of the parent policer's PIR bucket while the individual fair bursts making up the aggregate are based on each child's FIR decrement rate. The aggregate fair rate of the priority level is managed by the system with consideration of the current rate of traffic in higher priority levels. In essence, the system ensures that for each iteration of the child FIR rate calculation, the sum of the child FIR decrement rates plus the sum of the higher priority traffic increment rates equals the parent policers decrement rate. This means that dynamic

amounts of higher priority traffic can be ignored when sizing a lower priority's fair aggregate burst tolerance. Consider the following:

- The parent policer decrement rate is set to 20 Mbps (max-rate 20,000).
- A priority level's fair burst size is set to 30 Kbytes (mbs-contribution 30 kilobytes).
- Higher priority traffic is currently taking 12 Mbps.
- The priority level has three child policers attached.
- Each child's PIR MBS is set to 10 Kbytes, which makes each child's FIR MBS 10 Kbytes.
- The children want 10 Mbps, but only 8 Mbps is available,
- Based on weights, the children's FIR rates are set as follows:

	FIR Rate	FIR MBS
Child 1	4 Mbps	10 Kbytes
Child 2	3 Mbps	10 Kbytes
Child 3	1 Mbps	10 Kbytes

The 12 Mbps of the higher priority traffic and the 8 Mbps of fair traffic equal the 20 Mbps decrement rate of the parent policer.

It is clear that the higher priority traffic is consuming 12 Mbps of the parent policer's decrement rate, leaving 8 Mbps of decrement rate for the lower priority's fair traffic.

- The burst tolerance of child 1 is based on 10 Kbytes above 4 Mbps,
- The burst tolerance of child 2 is based on 10 Kbytes above 3 Mbps,
- The burst tolerance of child 3 is based on 10 Kbytes above 1 Mbps.

If all three children burst simultaneously (unlikely), they will consume 30 Kbytes above 8 Mbps. This is the same as the remaining decrement rate after the higher priority traffic.

Parent Policer Total Burst Tolerance and Downstream Buffering

The highest in-use priority level's discard-all threshold is the total burst tolerance of the parent policer. In some cases the parent policer represents downstream bandwidth capacity and the max-rate of the parent policer is set to prevent overrunning the downstream bandwidth. The burst tolerance of the parent policer defines how much more traffic may be sent beyond the downstream scheduling capacity. In the worst case scenario, when the downstream buffering is insufficient to handle the total possible burst from the parent policer, downstream discards based on lack of buffering may occur. However, in all likelihood, this is not the case.

In most cases, lower priority traffic in the policer will be responsible for the greater part of congestion above the parent policer rate. Since this traffic is discarded with a lower threshold, this lowers the effective burst tolerance even while the highest priority traffic is present.

Configuring a Priority Level's MBS Contribution Value

In the most conservative case, a priority level's **mbs-contribution** value may be set to be greater than the sum of child policer's mbs and one max-size-frame per child policer. This ensures that even in the absolute worst case where all the lower priority levels are simultaneously bursting to the maximum capacity of each child, enough burst tolerance for the priority's children will exist if they also burst to their maximum capacity.

Since simply adding up all the child policer's PIR MBS values may result in large overall burst tolerances that are not ever likely to be needed, you should consider some level of burst oversubscription when configuring the **mbs-contribution** value for each priority level. The amount of oversubscription should be determined based on the needs of each priority level.

Using the Fixed Keyword to Create Deterministic Parent Policer Discard Thresholds

In the default behavior, the system ignores the **mbs-contribution** values for a priority level on a subscriber or SAP parent policer when a child policer is not currently associated with the level. This prevents additional burst tolerance from being added to higher priority traffic within the parent policer.

This does cause fluctuations in the defined threshold values when child policers are added or removed from a parent policer instance. If this behavior is undesirable, the fixed keyword may be used which causes the **mbs-contribution** value to always be included in the calculation of parent policer's discard thresholds. The defined **mbs-contribution** value may be overridden on a subscriber sla-profile or on a SAP instance, but the fixed nature of the contribution cannot be overridden.

If the defined **mbs-contribution** value for the priority level is zero, the priority level will have no effect on the parent policer's defined discard thresholds. A packet associated with the priority level will use the next lower priority level's discard-unfair and discard-all thresholds.

Parameters *size* [**bytes** | **kilobytes**] — The size parameter is required when executing the **mbs-contribution** command. It is expressed as an integer and specifies the priority's specific portion amount of accumulative MBS for the priority level in bytes or kilobytes which is selected by the trailing **bytes** or **kilobytes** keywords. If both **bytes** and **kilobytes** are missing, **kilobytes** is assumed. Setting this value has no effect on parent policer instances where the priority level's **mbs-contribution** value has been overridden.

Values 0 — 16777216

Default none

bytes | **kilobytes**: — The **bytes** keyword is optional and is mutually exclusive with the **kilobytes** keyword. When specified, size is interpreted as specifying the size of **min-thresh-separation** in bytes.

The **kilobytes** keyword is optional and is mutually exclusive with the **bytes** keyword. When specified, size is interpreted as specifying the size of min-thresh-separation in kilobytes.

Default **kilobytes**

fixed — The optional fixed keyword is used to force the inclusion of the defined **mbs-contribution** value in the parent policer's discard threshold calculations. If the **mbs-contribution** command is executed without the **fixed** keyword, the fixed calculation behavior for the priority level is removed.

Default **no mbs-contribution**

The **no mbs-contribution** command returns the policy's priority level's MBS contribution to the default value. When changed, the thresholds for the priority level and all higher priority levels for all instances of the parent policer will be recalculated.

radius-accounting-policy

Syntax **radius-accounting-policy** *acct-policy-name* [**duplicate** *acct-policy-name*]
no radius-accounting-policy

Context config>subscr-mgmt>sub-prof

Description This command specifies an existing RADIUS accounting policy to use to collect accounting statistics on this subscriber profile by RADIUS. This command is used independently of the **collect-stats** command.

Parameters *acct-policy-name* — Specifies an existing RADIUS based accounting policy.

duplicate *acct-policy-name* **—** Specifies the RADIUS accounting policy to be used to generate duplicate accounting information.

sla-profile-map

Syntax **sla-profile-map**

Context config>subscr-mgmt>sub-prof

Description This command enables the context to configure SLA profile mapping.

entry

Syntax **entry key** *sub-profile-string* **sub-profile** *sub-profile-name*
no entry key *sub-profile-string*

Context config>subscr-mgmt>sub-prof>sla-prof-map

Description This command configures SLA profile string mappings.

Parameters *sub-profile-string* — Specifies the subscriber profile string.

Values 16 characters maximum

sub-profile-name — Specifies the subscriber profile name.

Values 32 characters maximum

use-direct-map-as-default

Syntax [**no**] **use-direct-map-as-default**

Context config>subscr-mgmt>sub-prof>sla-prof-map

Description This command enables direct mapping of the SLA profile as default.

The **no** form of the command disables direct mapping,

sub-mcac-policy

Syntax **sub-mcac-policy** *policy-name*
no sub-mcac-policy

Context config>subscr-mgmt>sub-prof

Description This command references the policy template in which the mcac bandwidth limits are defined. Mcac for the subscriber is effectively enabled with this command when the sub-profile is applied to the subscriber. The bandwidth of the channels is defined in a different policy (under the **configure>router>mcac** context) and this policy is applied on the interface level as follows:

- For group-interfaces under the **configure>service>vrf>igmp>group-interface>mcac** context
- For regular interfaces under the **configure>service/router>igmp>interface>mcac** context

In case of HQoS Adjustment, it is mandatory that the sub-mcac-policy be created and applied to the subscriber. The sub-mac-policy does not have to contain any bandwidth constrains, but it has to be in a no shutdown state in order for HQoS Adjustment to work.

Default none

Parameters *policy-name* — Specifies the policy name configured in the config>subscr-mgmt>sub-mcac-policy context.

volume-stats-type

Syntax **volume-stats-type** {**ip**|**default**}
no volume-stats-type

Context config>subscr-mgmt>sub-prof

Description This command enables the reporting of layer 3 (IP) based subscriber host volume accounting data.

By default, subscriber host volume accounting data includes Layer 2 header octets and can be configured to include a fixed packet byte offset or last-mile encapsulation overhead.

Default **volume-stats-type default**

Parameters **default** — subscriber host volume accounting data is reported including the Layer 2 header octets and optional delta's introduced by configuration (for example: packet byte offset, last mile aware shaping, etc.)

ip — subscriber host volume accounting data reporting is based on Layer 3 (IP) packet sizes. This includes subscriber host ingress/egress queue and policer stats in snmp, CLI show commands, RADIUS and XML accounting, and Diameter Gx usage monitoring. RADIUS and Diameter (DCCA) based credit control volume quota are interpreted as Layer 3 (IP).

igmp-policy

Syntax **igmp-policy** *policy-name*
no igmp-policy

Context config>subscr-mgmt>sub-prof

Description This command will enable IGMP processing per subscriber host. Without this command IGMP states will not be maintained per subscriber hosts. The referenced policy is defined under the **configure>subscr-mgmt** context and can be only applied via the sub-profile.

The referenced policy contains entries such as:

- description statement
- import statement — IGMP filters
- egress-rate-modify statement—HQoS Adjustment
- mcast-redirection statement—redirection to alternate interface
- static statement—definition of static IGMP groups
- version statement —IGMP version
- fast-leave statement
- max-num-groups statement—t max number of multicast groups allowed

Parameters *policy-name* — Name of the IGMP policy for the subscriber. The policy itself is defined under the **configure>sub-mgmt** context.

hsmda

Syntax **hsmda**

Context config>subscr-mgmt>sub-prof

Description This command enables the context to configure egress and ingress HSMDA queue parameters.

egress-qos

Syntax **egress-queues**

Context config>subscr-mgmt>sub-prof>hsmda

Description This command enables the context to configure SAP egress QOS policy for the HSMDA egress queue.

ingress-qos

Syntax **ingress-queues**

Context config>subscr-mgmt>sub-prof>hsmda>egress-queues

Description This command enables the context to configure SAP egress QOS policy for the HSMDA ingress queue

agg-rate

Syntax **agg-rate** *rate*
no agg-rate

Context config>port>sonet-sdh>path>access>egress>vport

config>port>ethernet>access>egress>vport

Description This command configures an aggregate rate for the vport.The **agg-rate** *rate*, **port-scheduler-policy** and **scheduler-policy** commands are mutually exclusive. Changing between the use of a scheduler policy and the use of an agg-rate/port-scheduler-policy involves removing the existing command and applying the new command. Applying a **scheduler-policy** to a VPORT is only applicable to Ethernet interfaces.

Parameters *rate* — Specifies the rate limit for the vport.

Values 1 — 800000000, max

limit-unused-bandwidth

Syntax **limit-unused-bandwidth**

Context config>port>sonet-sdh>path>access>egress>vport
config>port>ethernet>access>egress>vport

Description Optional command used to enable (or disable) aggregate rate overrun protection on the agg-rate context.

agg-rate-limit

Syntax **agg-rate-limit** *agg-rate*
no agg-rate-limit

Context config>subscr-mgmt>sub-prof>hsmda>egress-qos

Description This command defines a maximum total rate for all subscriber egress queues for each subscriber associated with the sub-profile. The egress-agg-rate-limit command is mutually exclusive with the egress-scheduler-policy. When an egress-scheduler-policy is defined on the sub-profile, the egress-agg-rate-limit command will fail. If the egress-agg-rate-limit command is specified, at attempt to bind an egress-scheduler-policy to the sub-profile will fail.

A port scheduler policy must be applied on the egress port or channel the subscriber instance is bound to in order for the defined egress-agg-rate-limit to take effect. The egress port scheduler enforces the aggregate queue rate as it distributes its bandwidth at the various port priority levels. The port scheduler stops offering bandwidth to member queues once it has detected that the aggregate rate limit has been reached.

If a port scheduler is not defined on the egress port, the queues are allowed to operate based on their own bandwidth parameters.

The **no** form of the command removes the aggregate rate limit from the sub-profile.

Default no agg-rate-limit

Parameters *agg-rate* — Defines the maximum aggregate rate the egress queues associated with the subscriber profile may operate. The value is specified in kilobits per second in a base 10 context. A value of 1 indicates a rate of 1000 bits per second.

Values 1 — 40000000, max Kbps

qos

Syntax **qos** *policy-id*
no qos

Context config>subscr-mgmt>sub-prof>hsmda>egress-qos

Description This command assigns a SAP egress QOS policy to the HSMDA egress queue.

Parameters *policy-id* — Specifies the policy ID of an existing QoS SAP egress policy.

Values 1 — 65535

qos

Syntax **qos** *policy-id*
no qos

Context config>subscr-mgmt>sub-prof>hsmda>ingress-qos

Description This command assigns a SAP ingress QOS policy to the HSMDA ingress queue.

Parameters *policy-id* — Specifies the policy ID of an existing QoS SAP egress policy.

Values 1 — 65535

packet-byte-offset

Syntax **packet-byte-offset** {**add** *add-bytes* | **subtract** *sub-bytes*}
no packet-byte-offset

Context config>subscr-mgmt>sub-prof>hsmda>egress-qos

Description This command adds or subtracts the specified number of bytes to the accounting function for each packet handled by the HSMDA queue. Normally, the accounting and leaky bucket functions are based on the Ethernet DLC header, payload and the 4 byte CRC (everything except the preamble and inter-frame gap). As an example, the packet-byte-offset command can be used to add the frame encapsulation overhead (20 bytes) to the queues accounting functions.

The accounting functions affected include:

- Offered High Priority / In-Profile Octet Counter
- Offered Low Priority / Out-of-Profile Octet Counter
- Discarded High Priority / In-Profile Octet Counter
- Discarded Low Priority / Out-of-Profile Octet Counter
- Forwarded In-Profile Octet Counter
- Forwarded Out-of-Profile Octet Counter
- Peak Information Rate (PIR) Leaky Bucket Updates
- Committed Information Rate (CIR) Leaky Bucket Updates

- Queue Group Aggregate Rate Limit Leaky Bucket Updates

The secondary shaper leaky bucket, scheduler priority level leaky bucket and the port maximum rate updates are not affected by the configured packet-byte-offset. Each of these accounting functions are frame based and always include the preamble, DLC header, payload and the CRC regardless of the configured byte offset.

The packet-byte-offset command accepts either add or subtract as valid keywords which define whether bytes are being added or removed from each packet traversing the queue. An example use case for subtracting bytes from each packet is an IP based accounting function. Given a Dot1Q encapsulation, the command packet-byte-offset subtract 14 would remove the DLC header and the Dot1Q header from the size of each packet for accounting functions only. The 14 bytes are not actually removed from the packet, only the accounting size of the packet is affected.

As inferred above, the variable accounting size offered by the packet-byte-offset command is targeted at the queue and queue group level. The packet-byte-offset, when set, applies to all queues in the queue group. The accounting size of the packet is ignored by the secondary shapers, the scheduling priority level shapers and the scheduler maximum rate. The actual on-the-wire frame size is used for these functions to allow an accurate representation of the behavior of the subscriber's packets on an Ethernet aggregation network.

The packet-byte-offset value may be overridden at the queue-group level.

Parameters **add** *add-bytes* — Indicates that the byte value should be added to the packet for queue and queue group level accounting functions. Either the **add** or **subtract** keyword must be specified. The corresponding byte value must be specified when executing the packet-byte-offset command. The **add** keyword is mutually exclusive with the **subtract** keyword.

Values 0 — 31

subtract *sub-bytes* — Indicates that the byte value should be subtracted from the packet for queue and queue group level accounting functions. The **subtract** keyword is mutually exclusive with the **add** keyword. Either the **add** or **subtract** keyword must be specified. The corresponding byte value must be specified when executing the packet-byte-offset command. Note that the minimum resulting packet size used by the system is 1 byte.

Values 1 — 64

queue

Syntax **queue** *queue-id* [**create**]
no queue *queue-id*

Context config>subscr-mgmt>sub-prof>hsmda>ingress-qos>qos

Description This command specifies the HSMDA queue mapping for all packets in point-to-point services and unicast destined packets in multipoint services. Point-to-point services include epipe and other VLL type services. Multipoint services include IES, VPLS and VPRN services. The queue command does not apply to multicast, broadcast or unknown unicast packets within multipoint services (the multicast, broadcast and unknown commands must be used to define the queue mapping for non-unicast packets within a forwarding class). For Epipe services, the **queue** *queue-id* mapping applies to all packets, regardless of the packets destination MAC address.

Each forwarding class has a default queue ID based on the intrinsic hierarchy between the forwarding classes. Executing the queue command within the HSMDA context of a forwarding class with a dif-

ferent queue ID than the default overrides the default mapping. Multiple forwarding classes may be mapped to the same HSMDA queue ID.

The **no** form of the command returns the HSMDA queue mapping for queue to the default mapping for the forwarding class.

Parameters *queue-id* — Specifies the queue ID to override.

Values 1 — 8

create — This keyword is mandatory while creating a new queue override.

rate

Syntax **rate** *pir-rate* [**cir** *cir-rate*]
no rate

Context config>subscr-mgmt>sub-prof>hsmda>egress-qos>qos>queue
config>subscr-mgmt>sub-prof>hsmda>ingress-qos>queue
config>subscr-mgmt>sub-prof>hsmda>ingress-qos>policer

Description This command can be used to override specific attributes of the specified queue's Peak Information Rate (PIR) and the Committed Information Rate (CIR) parameters. The PIR defines the maximum rate that the queue can transmit packets out an egress interface (for SAP egress queues). Defining a PIR does not necessarily guarantee that the queue can transmit at the intended rate. The actual rate sustained by the queue can be limited by oversubscription factors or available egress bandwidth.

The CIR defines the rate at which the system prioritizes the queue over other queues competing for the same bandwidth. In-profile packets are preferentially queued by the system at egress and at subsequent next hop nodes where the packet can traverse. To be properly handled as in- or out-of-profile throughout the network, the packets must be marked accordingly for profiling at each hop.

The CIR can be used by the queue's parent commands *cir-level* and *cir-weight* parameters to define the amount of bandwidth considered to be committed for the child queue during bandwidth allocation by the parent scheduler.

The **rate** command can be executed at any time, altering the PIR and CIR rates for all queues created through the association of the SAP egress QoS policy with the *queue-id*.

The **no** form of the command returns all queues created with the *queue-id* by association with the QoS policy to the default PIR and CIR parameters (**max**, 0).

Default **rate max cir 0 —** The **max** default specifies the amount of bandwidth in kilobits per second (thousand bits per second). The **max** value is mutually exclusive to the **pir-rate** value.

Parameters *pir-rate* — Defines the administrative PIR rate, in kilobits, for the queue. When the **rate** command is executed, a valid PIR setting must be explicitly defined. When the **rate** command has not been executed, the default PIR of **max** is assumed.
Fractional values are not allowed and must be given as a positive integer.

The actual PIR rate is dependent on the queue's **adaptation-rule** parameters and the actual hardware where the queue is provisioned.

Values 1 — 100000000

Default max

cir-rate — The **cir** parameter overrides the default administrative CIR used by the queue. When the **rate** command is executed, a CIR setting is optional. When the **rate** command has not been executed or the **cir** parameter is not explicitly specified, the default CIR (0) is assumed. Fractional values are not allowed and must be given as a positive integer. The **sum** keyword specifies that the CIR be used as the summed CIR values of the children schedulers or queues.

Values 0 — 100000000, **max**, **sum**

Default 0

slope-policy

Syntax **slope-policy** *hsmda-slope-policy-name*
no slope-policy

Context config>subscr-mgmt>sub-prof>hsmda>egress-qos>qos>queue

Description This command specifies an existing slope policy name. The policy contains the Maximum Buffer Size (MBS) that will be applied to the queue and the high and low priority RED slope definitions. The function of the MBS and RED slopes is to provide congestion control for an HSMDA queue. The MBS parameter defines the maximum depth a queue may reach when accepting packets. The low and high priority RED slopes provides for random early detection of congestion and slope based discards based on queue depth.

An hsmda-slope-policy can be applied to queues defined in the sap-ingress and sap-egress QoS policy hsmda-queues context. Once an HSMDA slope policy is applied to a SAP QoS policy queue, it cannot be deleted. Any edits to the policy are updated to all HSMDA queues indirectly associated with the policy.

Default HSMDA Slope Policy

An hsmda-slope-policy named **default** always exists on the system and does not need to be created. The default policy is automatically applied to all HSMDA queues unless another HSMDA slope policy is specified for the queue. The default policy cannot be modified or deleted. Attempting to execute no hsmda-slope-policy default will result in an error.

The **no** form of the command removes the slope policy from the subscriber profile HSMDA configuration.

stat-mode

Syntax **stat-mode** {**v4-v6**}
no stat-mode

Context config>subscr-mgmt>sub-prof>hsmda>ingress-qos>qos>policer
config>subscr-mgmt>sub-prof>hsmda>ingress-qos>qos>queue
config>subscr-mgmt>sub-prof>hsmda>egress-qos>qos>queue

Description This command configures the forwarding plane octet and packet counters of a policer or queue to count packets of a specific type or state. For example separate counters for IPv4/IPv6.

For HSMDA ingress policers, this command overrides the policer stat-mode configuration as defined in the sap-ingress qos policy. For details on sap-ingress and sap-egress policer stat-mode, refer to the

7750 SR OS Quality of Service Guide. For use in Enhanced Subscriber Management (ESM) context only, an additional stat-mode enables separate counters for IPv4 and IPv6 packets. **tat-mode v4-v6** is the only mode that can be configured as an HSMDA ingress policer override.

An HSMDA policer's stat-mode cannot be changed while the sub profile is in use.

For queues, this command sets the stat-mode. Queue stat-mode is only available for use in ESM context to enable separate IPv4/IPv6 counters.

An HSMDA queue's stat-mode cannot be changed while the sub profile is in use.

Default no stat-mode

For policers, the default is no stat-mode override. The **sap-ingress stat-mode** is used instead.

For queues, the default is to **count in-/out-of-profile** octets and packets.

Parameters **v4-v6 —** Count IPv4 and IPv6 forwarded/dropped octets and packets separately

wrr-weight

Syntax **wrr-weight** *value*
no wrr-weight

Context config>subscr-mgmt>sub-prof>hsmda>egress-qos>qos>queue

Description This command assigns the weight value to the HSMDA queue.

The **no** form of the command returns the weight value for the queue to the default value.

Parameters *percentage* — Specifies the weight for the HSMDA queue.

Values 1— 32

wrr-policy

Syntax **wrr-policy** *hsmda-wrr-policy-name*
no wrr-policy

Context config>subscr-mgmt>sub-prof>hsmda>egress-qos>qos

Description This command associates an existing HSMDA weighted-round-robin (WRR) scheduling loop policy to the HSMDA queue.

Parameters *hsmda-wrr-policy-name* — Specifies the existing HSMDA WRR policy name to associate to the queue.

Explicit Subscriber Mapping Commands

explicit-sub-map

Syntax **explicit-sub-map**

Context config>subscr-mgmt

Description This command configures an explicit subscriber mapping

entry

Syntax **entry key** *sub-ident-string* [**sub-profile** *sub-profile-name*] [**alias** *sub-alias-strin*g] [**sla-profile** *sla-profile-name*]
no entry key *sub-profile-string*

Context config>subscr-mgmt>explicit-sub-map

Description This command configures a subscriber identification string.

Parameters *sub-ident-string* — Specifies the profile string.

Values 16 characters maximum

sub-profile-name — Specifies an existing subscriber profile name.

Values 32 characters maximum

alias *sub-alias-string* **—** Specifies an alias for the subscriber identification string.

sla-profile *sla-profile-name* **—** Specifies an existing SLA profile.

Subscriber Management Service Commands

SAP Subscriber Management Commands

sub-sla-mgmt

Syntax [**no**] **sub-sla-mgmt**

Context config>service>vpls>sap
config>service>ies>if>sap
config>service>ies>sub-if>grp-if>sap
config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command enables the context to configure subscriber management parameters for this SAP.

Default no sub-sla-mgmt

def-sla-profile

Syntax **def-sla-profile** *default-sla-profile-name*
no def-sla-profile

Context config>service>vpls>sap>sub-sla-mgmt
config>service>ies>if>sap>sub-sla-mgmt
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt

Description This command specifies a default SLA profile for this SAP.

An SLA profile is a named group of QoS parameters used to define per service QoS for all subscriber hosts common to the same subscriber within a provider service offering. A single SLA profile may define the QoS parameters for multiple subscriber hosts.

The **no** form of the command removes the default SLA profile from the SAP configuration.

Default no def-sla-profile

Parameters *default-sla-profile-name* — Specifies a default SLA profile for this SAP.

def-sub-profile

Syntax **def-sub-profile** *default-subscriber-profile-name*

Context config>service>vpls>sap>sub-sla-mgmt
config>service>ies>if>sap>sub-sla-mgmt
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt

Description This command specifies a default subscriber profile for this SAP.

A subscriber profile defines the aggregate QoS for all hosts within a subscriber context. This is done through the definition of the egress and ingress scheduler policies that govern the aggregate SLA for subscriber using the subscriber profile.

The **no** form of the command removes the default SLA profile from the SAP configuration.

Parameters *default-sub-profile* — Specifies a default subscriber profile for this SAP.

sub-ident-policy

Syntax **sub-ident-policy** *sub-ident-policy-name*

Context config>service>vpls>sap>sub-sla-mgmt
config>service>ies>if>sap>sub-sla-mgmt
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt

Description This command associates a subscriber identification policy to this SAP.

Subscribers are managed by the system through the use of subscriber identification strings. A subscriber identification string uniquely identifies a subscriber. For static hosts, the subscriber identification string is explicitly defined with each static subscriber host.

For dynamic hosts, the subscriber identification string must be derived from the DHCP ACK message sent to the subscriber host. The default value for the string is the content of Option 82 CIRCUIT-ID and REMOTE-ID fields interpreted as an octet sting. As an option, the DHCP ACK message may be processed by a subscriber identification policy which has the capability to parse the message into an alternative ASCII or octet string value.

When multiple hosts on the same port are associated with the same subscriber identification string they are considered to be host members of the same subscriber.

The **no** form of the command removes the default subscriber identification policy from the SAP configuration.

Default no sub-ident-policy

Parameters *sub-ident-policy-name* — Specifies a subscriber identification policy for this SAP.

multi-sub-sap

Syntax **multi-sub-sap** *number-of-sub*
no multi-sub-sap

Context config>service>vpls>sap>sub-sla-mgmt
config>service>ies>if>sap>sub-sla-mgmt
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt

Description This command defines the maximum number of subscribers (dynamic + static) that can be simultaneously active on this SAP.

If the limit is reached, a new host will be denied access and the corresponding DHCP ACK will be dropped.

Default 1

The **no** form of the command reverts back to the default setting.

Default no multi-sub-sap

Parameters *multi-sub-sap* — Specifies the maximum allowed.

single-sub-parameters

Syntax **single-sub-parameters**

Context config>service>vpls>sap>sub-sla-mgmt
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt
config>service>ies>if>sap>sub-sla-mgmt

Description This command configure single subscriber SAP parameters.

non-sub-traffic

Syntax **non-sub-traffic sub-profile** *sub-profile-name* **sla-profile** *sla-profile-name* [**subscriber** *sub-ident-string*]
no non-sub-traffic

Context config>service>vpls>sap>sub-sla-mgmt>single-sub
config>service>ies>if>sap>sub-sla-mgmt>single-sub
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt>single-sub

Description This command configures traffic profiles for non-IP traffic such as PPPoE.It is used in conjunction with the profiled-traffic-only on single subscriber SAPs and creates a subscriber host which is used to forward non-IP traffic through the single subscriber SAP without the need for SAP queues.

The **no** form of the command removes any configured profile.

Default no non-sub-traffic

Parameters *sub-profile-name* — Identifies the subscriber profile name.

Values 32 characters maximum

sla-profile-name — Identifies the SLA profile name.

Values 32 characters maximum

profiled-traffic-only

Syntax [**no**] **profiled-traffic-only**

Context config>service>vpls>sap>sub-sla-mgmt>single-sub-parameters
config>service>ies>if>sap>sub-sla-mgmt>single-sub
config>service>ies>sub-if>grp-if>sap>sub-sla-mgmt>single-sub

Description This command specifies whether only profiled traffic is applicable for this SAP. The profiled traffic refers to single subscriber traffic on a dedicated SAP (in the VLAN-per-subscriber model). When enabled, subscriber queues are instantiated through the QOS policy defined in the sla-profile and the associated SAP queues are deleted. This can increase subscriber scaling by reducing the number of queues instantiated per subscriber (in the VLAN-per-subscriber model). In order for this to be achieved, any configured multi-sub-sap limit must be removed (leaving the default of 1).

The **no** form of the command reverts to the default setting.

Default no profiled-traffic-only

srrp

Syntax [**no**] **srrp** *srrp-id*

Context config>service>vprn>sub-if>grp-if

Description This command creates an SRRP instance on a group IP interface. An SRRP instance manages all subscriber subnets within the group interfaces subscriber IP interface or other subscriber IP interfaces that are associated through a wholesale/retail relationship. Only one unique SRRP instance can be configured per group interface.

The **no** form of the command removes an SRRP instance from a group IP interface. Once removed, the group interface ignores ARP requests for the SRRP gateway IP addresses that may exist on subscriber subnets associated with the group IP interface. Then the group interface stops routing using the redundant IP interface associated with the group IP interface and will stop routing with the SRRP gateway MAC address. Ingress packets destined to the SRRP gateway MAC will also be silently discarded. This is the same behavior as a group IP interface that is disabled (shutdown).

Default no srrp

Parameters *srrp-id* — Specifies a 32 bit instance ID that must be unique to the system. The instance ID must also match the instance ID used by the remote router that is participating in the same SRRP context. SRRP is intended to perform a function similar to VRRP where adjacent IP hosts within local subnets use a default gateway to access IP hosts on other subnets.

Values 1 — 4294967295

gw-mac

Syntax **gw-mac** *mac-address*
no gw-mac

Context config>service>vprn>sub-if>grp-if>srrp

Description This command overrides the default SRRP gateway MAC address used by the SRRP instance. Unless specified, the system uses the same base MAC address for all SRRP instances with the last octet overridden by the lower 8 bits of the SRRP instance ID. The same SRRP gateway MAC address should be in-use by both the local and remote routers participating in the same SRRP context.

One reason to change the default SRRP gateway MAC address is if two SRRP instances sharing the same broadcast domain are using the same SRRP gateway MAC. The system will use the SRRP

instance ID to separate the SRRP messages (by ignoring the messages that does not match the local instance ID), but a unique SRRP gateway MAC is essential to separate the routed packets for each gateway IP address.

The **no** form of the command removes the explicit SRRP gateway MAC address from the SRRP instance. The SRRP gateway MAC address can only be changed or removed when the SRRP instance is shutdown.

Parameters *mac-address* — Specifies a MAC address that is used to override the default SRRP base MAC address

Values Any MAC address except all zeros, broadcast or multicast addresses. The offset is expressed in normal Ethernet MAC address notation. The defined gw-mac cannot be 00:00:00:00:00:00, ff:ff:ff:ff:ff:ff or any multicast address.

If not specified, the system uses the default SRRP gateway MAC address with the last octet set to the 8 least significant bits of the SRRP instance ID.

keep-alive-interval

Syntax **keep-alive-interval** *interval*
no keep-alive-interval

Context config>service>vprn>sub-if>grp-if>srrp

Description This command defines the interval between SRRP advertisement messages sent when operating in the master state. The interval is also the basis for setting the master-down timer used to determine when the master is no longer sending. The system uses three times the keep-alive interval to set the timer. Every time an SRRP advertisement is seen that is better then the local priority, the timer is reset. If the timer expires, the SRRP instance assumes that a master does not exist and initiates the attempt to become master.

When in backup state, the SRRP instance takes the keep-alive interval of the master as represented in the masters SRRP advertisement message. Once in master state, the SRRP instance uses its own configured keep-alive interval.

The keep-alive-interval may be changed at anytime, but will have no effect until the SRRP instance is in the master state.

The **no** form of the command restores the default interval.

Parameters *interval* — Specifies the interval, in milliseconds, between SRRP advertisement messages sent when operating in the master state.

Values 1 — 100

Default 10 milliseconds

message-path

Syntax **message-path** *sap-id*
no message-path

Context config>service>vprn>sub-if>grp-if>srrp

Description This command defines a specific SAP for SRRP in-band messaging. A message-path SAP must be defined prior to activating the SRRP instance. The defined SAP must exist on the SRRP instances group IP interface for the command to succeed and cannot currently be associated with any dynamic or static subscriber hosts. Once a group IP interface SAP has been defined as the transmission path for SRRP Advertisement messages, it cannot be administratively shutdown, will not support static or dynamic subscriber hosts and cannot be removed from the group IP interface.

The SRRP instance message-path command may be executed at anytime on the SRRP instance. Changing the message SAP will fail if a dynamic or static subscriber host is associated with the new SAP. Once successfully changed, the SRRP instance will immediately disable anti-spoof on the SAP and start sending SRRP Advertisement messages if the SRRP instance is activated.

Changing the current SRRP message SAP on an active pair of routers should be done in the following manner:

1. Shutdown the backup SRRP instance.
2. Change the message SAP on the shutdown node.
3. Change the message SAP on the active master node.
4. Re-activate the shutdown SRRP instance.

Shutting down the backup SRRP instance prevents the SRRP instances from becoming master due to temporarily using differing message path SAPs.

If an MCS peering is operational between the redundant nodes and the SRRP instance has been associated with the peering, the designated message path SAP will be sent from each member.

The **no** form of the command can only be executed when the SRRP instance is shutdown. Executing no message-path allows the existing SAP to be used for subscriber management functions. A new message-path SAP must be defined prior to activating the SRRP instance.

Parameters *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

policy

Syntax **[no] policy** *vrrp-policy-id*

Context config>service>vprn>sub-if>grp-if>srrp

Description This command associates one or more VRRP policies with the SRRP instance. A VRRP policy is a collection of connectivity and verification tests used to manipulate the in-use priorities of VRRP and SRRP instances. A VRRP policy can test the link state of ports, ping IP hosts, discover the existence of routes in the routing table or the ability to reach L2 hosts. When one or more of these tests fail, the VRRP policy has the option of decrementing or setting an explicit value for the in-use priority of an SRRP instance.

More than one VRRP policy may be associated with an SRRP instance. When more than one VRRP policy is associated with an SRRP instance the delta decrement of the in-use priority is cumulative unless one or more test fail that have explicit priority values. When one or more explicit tests fail, the lowest priority value event takes effect for the SRRP instance. When the highest delta-in-use-limit is used to manage the lowest delta derived in-use priority for the SRRP instance.

VRRP policy associations may be added and removed at anytime. A maximum of two VRRP policies can be associated with a single SRRP instance.

The **no** form of the command removes the association with vrrp-policy-id from the SRRP instance.

Parameters *vrrp-policy-id* — Specifies one or more VRRP policies with the SRRP instance.

Values 1 — 9999

priority

Syntax **priority** *priority*
no priority

Context config>service>vprn>sub-if>grp-if>srrp

Description This command overrides the default base priority for the SRRP instance. The SRRP instance priority is advertised by the SRRP instance to its neighbor router and is compared to the priority received from the neighbor router. The router with the best (highest) priority enters the master state while the other router enters the backup state. If the priority of each router is the same, the router with the lowest source IP address in the SRRP advertisement message assumes the master state.

The base priority of an SRRP instance can be managed by VRRP policies. A VRRP policy defines a set of connectivity or verification tests which, when they fail, may lower an SRRP instances base priority (creating an in-use priority for the instance). Every time an SRRP instances in-use priority changes when in master state, it sends an SRRP advertisement message with the new priority. If the dynamic priority drops to zero or receives an SRRP Advertisement message with a better priority, the SRRP instance transitions to the *becoming backup* state.

When the priority command is not specified, or the no priority command is executed, the system uses a default base priority of 100. The priority command may be executed at anytime.

The **no** form of the command restores the default base priority to the SRRP instance. If a VRRP policy is associated with the SRRP instance, it will use the default base priority as the basis for any modifications to the SRRP instances in-use priority.

Parameters *priority* — Specifies a base priority for the SRRP instance to override the default.

Values 1 — 254

Default 100

srrp-enabled-routing

Syntax **srrp-enabled-routing** [**hold-time** *hold-time*]
no srrp-enabled-routing

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command configures SRRP-enabled routing.

Parameters **hold-time** *hold-time* — Specifies the hold time in seconds.

Values 1 — 50 deci-seconds

tos-marking-state

Syntax **tos-marking-state** {**trusted** | **untrusted**}
no tos-marking-state

Context config>service>vprn>interface
config>service>vprn>sub-if>grp-if

Description This command is used to alter the default trusted state to a non-trusted state. When unset or reverted to the trusted default, the ToS field will not be remarked by egress network IP interfaces unless the egress network IP interface has the remark-trusted state set, in which case the egress network interface treats all VPRN and network IP interface as untrusted.

When the ingress interface is set to untrusted, all egress network IP interfaces will remark IP packets received on the network interface according to the egress marking definitions on each network interface. The egress network remarking rules also apply to the ToS field of IP packets routed using IGP shortcuts (tunneled to a remote next-hop). However, the tunnel QoS markings are always derived from the egress network QoS definitions.
Egress marking and remarking is based on the internal forwarding class and profile state of the packet once it reaches the egress interface. The forwarding class is derived from ingress classification functions. The profile of a packet is either derived from ingress classification or ingress policing.

The default marking state for network IP interfaces is trusted. This is equivalent to declaring no tos-marking-state on the network IP interface. When undefined or set to tos-marking-state trusted, the trusted state of the interface will not be displayed when using show config or show info unless the detail parameter is given. The **save config** command will not store the default tos-marking-state trusted state for network IP interfaces unless the detail parameter is also specified.

The **no** tos-marking-state command is used to restore the trusted state to a network IP interface. This is equivalent to executing the tos-marking-state trusted command.

Default trusted

Parameters **trusted** — The default prevents the ToS field to not be remarked by egress network IP interfaces unless the egress network IP interface has the remark-trusted state set.

untrusted — Specifies that all egress network IP interfaces will remark IP packets received on the network interface according to the egress marking definitions on each network interface.

mac-da-hashing

Syntax **mac-da-hashing**
no mac-da-hashing

Context config>service>vpls>sap>sub-sla-mgmt

Description This command specifies whether subscriber traffic egressing a LAG SAP has its egress LAG link selected by a function of the MAC destination address instead of the subscriber ID.

The **no** form of the command reverts to the default setting.

Default no mac-da-hashing

diameter-auth-policy

Syntax **diameter-auth-policy** *name*
no diameter-auth-policy

Context config>service>vpls>sap

Description This command is used to configure the Diameter NASREQ application policy to use for authentication.

Parameters *name* — Specifies the name of the Diameter NASREQ application policy to use for authentication.

host

Syntax **host** {[**ip** *ip-address* [**mac** *mac-address*]} [**subscriber-sap-id** | **subscriber** *sub-ident-string* [**sub-profile** *sub-profile-name* [**sla-profile** *sla-profile-name* [**ancp-string** *ancp-string*] [**app-profile** *app-profile-name*] [**inter-dest-id** *intermediate-destination-id*]
no host {[**ip** *ip-address*] [**mac** *ieee-address*]}
no host all

Context config>service>vpls>sap
config>service>ies>sub-if>grp-if>sap
config>service>ies>if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command creates a static subscriber host for the SAP. Static subscriber hosts may be used by the system for various purposes. Applications within the system that make use of static host entries include anti-spoof, ARP reply agent and source MAC population into the VPLS forwarding database.

Multiple static hosts may be defined on the SAP. Each host is identified by either a source IP address, a source MAC address or both a source IP and source MAC address. Every static host definition must have at least one address defined, IP or MAC.

Static hosts can exist on the SAP even with anti-spoof and ARP reply agent features disabled. When enabled, each feature has different requirements for static hosts.

Use the **no** form of the command to remove a static entry from the system. The specified *ip-address* and *mac-address* must match the host's exact IP and MAC addresses as defined when it was created. When a static host is removed from the SAP, the corresponding anti-spoof filter entry and/or FDB entry is also removed.

Default none

Parameters **ip** *ip-address* — Specify this parameter to associate a subscriber with the static subscriber host. Only one static host can be configured on the SAP with a given IP address.

mac *mac-address* — Specify this optional parameter when defining a static host. The MAC address must be specified for **anti-spoof mac anti-spoof ip-mac**. Multiple static hosts may be configured

with the same MAC address given that each definition is distinguished by a unique IP address.

Every static host definition must have at least one address defined, IP or MAC.

subscriber *sub-ident-string* — Specify this parameter to configure an existing subscriber identification profile to be associated with the static subscriber host. The subscriber identification profile is configured in the **config>subscr-mgmt>sub-ident-policy** context. The subscriber information is used by the VPLS SAP arp-reply-agent to determine the proper handling of received ARP requests from subscribers.

- For VPLS SAPs with **arp-reply-agent** enabled with the optional *sub-ident* parameter, the static subscriber hosts sub-ident-string is used to determine whether an ARP request received on the SAP is sourced from a host belonging to the same subscriber as the destination host. When both the destination and source hosts from the ARP request are known on the SAP and the subscriber identifications do not match, the ARP request may be forwarded to the rest of the VPLS destinations.

  If the static subscriber hosts *sub-ident* string is not defined, the host is not considered to belong to the same subscriber as another host on the SAP.

  If source or destination host is unknown, the hosts are not considered to belong to the same subscriber. (ARP messages from unknown hosts are subject to anti-spoof filtering rules applied at the SAP.)

  If *sub-ident* is not enabled on the SAP arp-reply-agent, subscriber identification matching is not performed on ARP requests received on the SAP.

  ARP requests are never forwarded back to the same SAP or within the receiving SAP's Split Horizon Group.

sub-profile *sub-profile-name* **—** Specify this parameter to configure an existing subscriber profile name to be associated with the static subscriber host. The subscriber profile is configured in the **config>subscr-mgmt>sub-profile** context.

sla-profile *sla-profile-name* **—** Specify this parameter to configure an existing SLA profile name to be associated with the static subscriber host. The SLA profile is configured in the **config>subscr-mgmt>sla-profile** context.

Note that if Enhanced Subscriber Management is enabled on a SAP using the **sub-sla-mgmt** command, the **sub-ident**, **sub-profile,** and **sla-profile** must be configured for all static hosts defined on this SAP.

Wireless Portal Protocol (WPP) Commands

wpp

Syntax **wpp**

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command enables the context to configure Wireless Portal Protocol (WPP) parameters.

enable-triggered-hosts

Syntax [**no**] **enable-triggered-hosts**

Context config>service>vprn>sub-if>grp-if>wpp
config>service>ies>sub-if>grp-if>wpp

Description This command enables system to auto creates ESM hosts upon successful WPP authentication. Default host need to be configured under SAP on the subscriber SAP in order to redirection un-authentication client traffic to web portal.

Default none

initial-app-profile

Syntax **initial-app-profile** *app-profile-name*
no initial-app-profile

Context config>subscr-mgmt>loc-user-db>ipoe>host>wpp
config>service>ies>sub-if>grp-if>wpp
config>service>vprn>sub-if>grp-if>wpp

Description This command specifies the initial app-profile for the hosts created on the group-interface. This initial app-profile will be replaced after hosts pass web portal authentication.

Default none

Parameters *app-profile-name* — Specifies the initial application profile, to be used during the WPP authentication phase of the IPoE hosts.

initial-sla-profile

Syntax **initial-sla-profile** *sla-profile-name*
no initial-sla-profile

Context config>subscr-mgmt>loc-user-db>ipoe>host>wpp
config>service>ies>sub-if>grp-if>wpp
config>service>vprn>sub-if>grp-if>wpp

Description This command specifies the initial sla-profile for the hosts created on the group-interface. This initial sla-profile will be replaced after hosts pass web portal authentication.

Default none

Parameters *sla-profile-name* — Specifies the initial SLA profile to be used during the WPP authentication phase of the IPOE host.

initial-sub-profile

Syntax **initial-sub-profile** *sub-profile-name*
no initial-sub-profile

Context config>subscr-mgmt>loc-user-db>ipoe>host>wpp
config>service>ies>sub-if>grp-if>wpp
config>service>vprn>sub-if>grp-if>wpp

Description This command specifies the initial sub-profile for the hosts created on the group-interface. This initial sub-profile will be replaced after hosts pass web portal authentication.

Default none

Parameters *sub-profile-name* — specifies the initial subscriber profile, to be used during the WPP authentication phase of the IPoE host.

portals

Syntax **portals**

Context config>router>wpp
config>service>vprn>wpp

Description This command enables the context to configure WPP portal server parameters.

portal

Syntax **portal router** *router-instance* **name** *wpp-portal-name*
no portal

Context config>subscr-mgmt>loc-user-db>ipoe>host>wpp
config>service>ies>sub-if>grp-if>wpp
config>service>vprn>sub-if>grp-if>wpp

Description This command specifies the web portal server that system talks to for the hosts on the group-interface.

Default none

router *router-instance* — Specifies the virtual router instance.

Values

router-name:	Base, management
service-id:	1 — 2147483647
service-name:	Specifies the service name up to 64 characters in length.

Default Base

name *wpp-portal-name* — Specifies the name of the web portal server.

lease-time

Syntax **lease-time** [**days** *days*] [**hrs** hours] [**min** *minutes*] [**sec** *seconds*]
no lease-time

Context config>service>vprn>sub-if>grp-if>wpp

Description This command specifies the lease time of the trigger created by the ESM host by WPP authentication.

Parameters **days** *days* — Specifies the lease time in days.

Values 0 — 3650

hrs *hours* — Specifies the lease time in hours.

Values 1 — 23

min *minutes* — Specifies the lease time in minutes.

Values 1 — 59

sec *seconds* — Specifies the lease time in seconds.

Values 0 — 50

restore-disconnected

Syntax **restore-disconnected** {**restore**|**no-restore**}
no restore-disconnected

Context config>subscr-mgmt>loc-user-db>ipoe>host>wpp
config>service>ies>sub-if>grp-if>wpp
config>service>vprn>sub-if>grp-if>wpp

Description This command specifies the behavior that system will restore the initial-sla-profile/initial-sub-profile/ initial-aa-prfofile when hosts disconnects instead of removing them.

Default none

Parameters **restore** — Specifies that the initial profiles must be restored after a DHCP host has disconnected.

no-restore — Specifies that the initial profiles will not be restored after a DHCP host has disconnected.

user-db

Syntax **user-db** *local-user-db-name*
no user-db

Context config>subscr-mgmt>loc-user-db>ipoe>host>wpp
config>service>ies>sub-if>grp-if>wpp
config>service>vprn>sub-if>grp-if>wpp

Description This command configures the user database. Note that if configured, the values configured under grp-if will only be used if there is no corresponding value returned from LUDB lookup.

This command specifies the LUDB system use to lookup while creating initial host before WPP authentication. LUDB could return WPP attributes such as portal name, initial-sla-profile, initial-sub-profile, etc. LUDB is configured in **config>subscr-mgmt>local-user-db** context.

Default none

Parameters *local-user-db-name* — Specifies the Local User Database name.

Subscriber Management Service Commands

subscriber-interface

Syntax **subscriber-interface** *ip-int-name* [**create**]
subscriber-interface *ip-int-name* [**create**] **fwd-service** *service-id* **fwd-subscriber-interface** *ip-int-name*]

Context config>service>ies
config>service>vprn

Description This command allows the operator to create special subscriber-based interfaces. It is used to contain multiple group interfaces. Multiple subnets associated with the subscriber interface can be applied to any of the contained group interfaces in any combination. The subscriber interface allows subnet sharing between group interfaces.

Use the **no** form of the command to remove the subscriber interface.

Default no subscriber interfaces configured

Parameters *ip-int-name* — Specifies the interface name of a subscriber interface. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

fwd-service *service-id* — specifies the wholesale service ID.

Values

fwd-subscriber-interface *ip-int-name* — specifies the wholesale subscriber interface.

address

Syntax [**no**] **address** {*ip-address/mask* | *ip-address netmask*} [**gw-ip-address** *ip-address*] [**populate-host-routes**]

Context config>service>ies>subscriber-interface
config>service>vprn>subscriber-interface

Description This command creates or removes an IP address, IP subnet or broadcast address format for the interface. Multiple IP addresses can be associated with a subscriber-interface

The IP address for the interface can be entered in either CIDR (Classless Inter-Domain Routing) or traditional dotted decimal notation. The show commands display CIDR notation and is stored in configuration files.

In the IES subscriber interface context, this command is used to assign one or more 256maximum) host IP addresses and subnets. This differs from a normal IES interfaces where **secondary** command creates and additional subnet after the primary address is assigned. A user can then add or remove addresses without having to keep a primary address.

Use the **no** form of this command to remove the IP address assignment from the IP interface.

Default no IP address or subnet associations configured

Parameters *ip-address* — The IP address of the IP interface. The *ip-address* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address must be unique within the subnet and specified in dotted decimal notation. Allowed values are IP addresses in the range 1.0.0.0 – 223.255.255.255 (with support of /31 subnets).

/ — The forward slash is a parameter delimiter and separates the *ip-address* portion of the IP address from the mask that defines the scope of the local subnet. No spaces are allowed between the *ip-address*, the "/" and the *mask-length* parameter. If a forward slash is not immediately following the *ip-address*, a dotted decimal mask must follow the prefix.

mask — The subnet mask in dotted decimal notation. When the IP prefix is not specified in CIDR notation, a space separates the *ip-address* from a traditional dotted decimal mask. The *mask* parameter indicates the complete mask that will be used in a logical AND function to derive the local subnet of the IP address. Allowed values are dotted decimal addresses in the range 128.0.0.0 – 255.255.255.252. Note that a mask of 255.255.255.255 is reserved for system IP addresses.

netmask — The subnet mask in dotted decimal notation.

Values 0.0.0.0 - 255.255.255.255

gw-ip-address *ip-address* **—** Specifies a separate IP address within the subnet for SRRP routing purposes. This parameter must be followed by a valid IP interface that exists within the subscriber subnet created by the address command. The defined gateway IP address cannot currently exist as a subscriber host (static or dynamic). If the defined ip-address already exists as a subscriber host address, the address command will fail. The specified ip-address must be unique within the system.

The gw-address parameter may be specified at anytime. If the subscriber subnet was created previously, executing the address command with a gw-address parameter will simply add the SRRP gateway IP address to the existing subnet.

If the address command is executed without the gw-address parameter when the subscriber subnet is associated with an active SRRP instance, the address will fail. If the SRRP instance is inactive or removed, executing the address command without the gw-address parameter will remove the SRRP gateway IP address from the specified subscriber subnet.

If the address command is executed with a new gw-address, all SRRP instances currently associated with the specified subscriber subnet will be updated with the new SRRP gateway IP address.

populate-host-routes — Specifies to populate subscriber-host routes in local FIB. Storing them in FIB benefits topologies only where the external router advertises more specific routes than the one corresponding to locally configured subscriber-interface subnets.

allow-unmatching-subnets

Syntax **[no] allow-unmatching-subnets**

Context config>service>ies>sub-if
config>service>vprn>sub-if

Description This command allows address assignment for IPoEv4 and PPPoEv4 subscriber hosts in cases where the subscriber assigned IPv4 address falls outside of the subscriber-interface subnet configured under

the same CLI hierarchy. Such subscriber host will be installed in the FIB as /32 hosts because the aggregated subscriber-interface route is not available for them (not configured under the subscriber-interface). Without the **allow-unmatching-subnets** command, such host are instantiated in the system but forwarding for them is disabled.

This command can be only configured in case where the subscriber-interface has an IP address (and therefore subnet) configured. In case where the subscriber interface does not have explicitly configured and IP address, execution of this command will fail.

IPv6 hosts are not affected by this command.

Default no allow-unmatching-subnets

allow-unmatching-subnets

Syntax [**no**] **allow-unmatching-subnets**

Context config>service>ies>sub-if>ipv6
config>service>vprn>sub-if>ipv6

Description This command will allow address assignment for IPoEv6 and PPPoEv6 hosts in cases where the subscriber host assigned IPv6 address or prefix falls outside of the subscriber-prefix range explicitly configured for the subscriber-interface (**configure>service>vprn/ies>sub-if>ipv6**) or the subscriber-prefix is not configured at all.

SLAAC hosts will be installed in the FIB as /64 entries, the length of the installed DHCP-PD prefix will be dictated by the prefix-length and the DHCP-NA host will be installed as /128 entries.

IPv4 subscriber hosts are unaffected by this command.

Default no allow-unmatching-subnets

allow-unmatching-prefixes

Syntax [**no**] **allow-unmatching-prefixes**

Context config>service>ies>sub-if>ipv6
config>service>vprn>sub-if>ipv6

Description This command will allow address assignment for IPoEv6 and PPPoEv6 hosts in cases where the subscriber host assigned IPv6 address or prefix falls outside of the subscriber-prefix range explicitly configured for the subscriber-interface (**configure>service>vprn/ies>sub-if>ipv6**) or the subscriber-prefix is not configured at all.

SLAAC hosts will be installed in the FIB as /64 entries, the length of the installed DHCP-PD prefix will be dictated by the prefix-length and the DHCP-NA host will be installed as /128 entries.

IPv4 subscriber hosts are unaffected by this command.

Default no allow-unmatching-subnets

authentication-policy

Syntax **authentication-policy *name***
no authentication-policy

Context config>service>vprn>if
config>service>vprn>sub-if>grp-if

Description This command assigns an authentication policy to the interface.

The **no** form of this command removes the policy name from the group interface configuration.

Default no authentication-policy

Parameters *name* — Specifies the authentication policy name. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

arp-populate

Syntax [**no**] **arp-populate**

Context config>service>vprn>if
config>service>vprn>sub-if>subscriber-interface
config>service>vprn>sub-if>grp-if

Description This command enables populating static and dynamic hosts into the system ARP cache. When enabled, the host's IP address and MAC address are placed in the system ARP cache as a managed entry. Static hosts must be defined on the interface using the **host** command. Dynamic hosts are enabled on the system through enabling lease-populate in the IP interface DHCP context. In the event that both a static host and a dynamic host share the same IP and MAC address, the system's ARP cache retains the host information until both the static and dynamic information are removed. Both static and dynamic hosts override static ARP entries. Static ARP entries are marked as inactive when they conflict with static or dynamic hosts and will be repopulated once all static and dynamic host information for the IP address are removed. Since static ARP entries are not possible when static subscriber hosts are defined or when DHCP lease state table population is enabled, conflict between static ARP entries and the arp-populate function is not an issue.

The **arp-populate** command will fail if an existing static subscriber host on the SAP does not have both MAC and IP addresses specified.

Once **arp-populate** is enabled, creating a static subscriber host on the SAP without both an IP address and MAC address will fail.

arp-populate can only be enabled on VPRN interfaces supporting Ethernet encapsulation.

Use the **no** form of the command to disable ARP cache population functions for static and dynamic hosts on the interface. All static and dynamic host information in the systems ARP cache will be removed. Any existing static ARP entries previously inactive due to static or dynamic hosts will be populated in the system ARP cache.

When **arp-populate** is enabled, the system will not send out ARP Requests for hosts that are not in the ARP cache. Only statically configured and DHCP learned hosts are reachable through an IP interface with arp-populate enabled.

Default not enabled

arp-timeout

Syntax **arp-timeout** *seconds*
no arp-timeout

Context config>service>vprn>interface
config>service>vprn>sub-if>grp-if

Description This command configures the minimum time in seconds an ARP entry learned on the IP interface will be stored in the ARP table. ARP entries are automatically refreshed when an ARP request or gratuitous ARP is seen from an IP host, otherwise, the ARP entry is aged from the ARP table. If **arp-timeout** is set to a value of zero seconds, ARP aging is disabled.

The **no** form of this command restores **arp-timeout** to the default value.

Default 14400 seconds

Parameters *seconds* — The minimum number of seconds a learned ARP entry will be stored in the ARP table, expressed as a decimal integer. A value of zero specifies that the timer is inoperative and learned ARP entries will not be aged.

Values 0 — 65535

lease-populate

Syntax **lease-populate** [*nbt-of-entries*]
no lease-populate

Context config>service>ies>sub-if>grp-if>dhcp

Description This command enables dynamic host lease state management for SAPs.

For VPLS, DHCP snooping must be explicitly enabled (using the **snoop** command) at all points where DHCP messages requiring snooping enter the VPLS instance (both from the DHCP server and from the subscribers). Lease state information is extracted from snooped DHCP ACK messages to populate lease state table entries for the MSAP.

The optional number-of-entries parameter is used to define the number lease state table entries allowed for an MSAP or IP interface. If number-of-entries is omitted, only a single entry is allowed. Once the maximum number of entries has been reached, subsequent lease state entries are not allowed and subsequent DHCP ACK messages are discarded.

The retained lease state information representing dynamic hosts may be used to:

- Populate an MSAP based anti-spoof filter table to provide dynamic anti-spoof filtering. If the system is unable to populate the dynamic host information in the anti-spoof filter table on the SAP, the DHCP ACK message must be discarded without adding new lease state entry or updating an existing lease state entry.
- Generate dynamic ARP replies if **arp-reply-agent** is enabled.

The **no** form of the command disables dynamic host lease state management for the MSAP.

Default no lease-populate

delayed-enable

Syntax **delayed-enable** *seconds* [**init-only**]
no delayed-enable

Context config>service>ies>subscriber-interface

Description This command delays making interface operational by the specified number of seconds.

In environments with many subscribers, it can take time to synchronize the subscriber state between peers when the subscriber-interface is enabled (perhaps, after a reboot). To ensure that the state has time to be synchronized, the **delayed-enable** timer can be specified. The optional parameter **init-only** can be added to use this timer only after a reboot.

Default no delayed-enable

Parameters *seconds* — Specifies the number of seconds to delay before the interface is operational.

Values 1 — 1200

init-only — Delays the initialization of the subscriber-interface to give the rest of the system time to complete necessary tasks such as allowing routing protocols to converge and/or to allow MCS to sync the subscriber information. The delay only occurs immediately after a reboot.

export-host-routes

Syntax [**no**] **export-host-routes**

Context config>service>ies>subscriber-interface
config>service>vprn>subscriber-interface

Description This command controls the export of subscriber management host routes from a retail service to the corresponding forwarding wholesale VPRN service.

By default, subscriber management host routes are not exported.

The presence of retail subscriber management host routes in the wholesale VPRN service is required for downstream traffic forwarding in multi-chassis redundancy scenario's with a redundant interface and when the retail subscriber subnets are not leaked in the wholesale VPRN service (allow-unmatching-subnets or unnumbered retail subscriber interface).

This command will fail if the subscriber interface is not associated with a forwarding wholesale service subscriber interface or if the subscriber interface is not configured to support address allocation outside the provisioned subnets (allow-unmatching-subnets or unnumbered subscriber interface)

Default no export-host-routes

group-interface

Syntax **group-interface** *ip-int-name* [**create**]
group-interface *ip-int-name* [**create**] **lns**
group-interface *ip-int-name* [**create**] **softgre**
no group-interface *ip-int-name* [**create**]

Context config>service>ies>subscriber-interface
config>service>vprn>subscriber-interface

Description This command creates a group interface. This interface is designed for triple-play services where multiple SAPs are part of the same subnet. A group interface may contain one or more SAPs.

Use the **no** form of the command to remove the group interface from the subscriber interface.

Default no group interfaces configured

Parameters *ip-int-name* — Specifies the interface name of a group interface. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

lns — Specifies to use LNS.

softgre — Specifies to use dynamic GRE encapsulation.

ingress

Syntax **ingress**

Context config>service>vprn>sub-if>grp-if

Description This command configures ingress network filter policies for the interface.

policy-accounting

Syntax **policy-accounting** *template-name*
no policy-accounting

Context config>service>vprn>sub-if>grp-if>ingress

Description This command enables/disables the specified policy accounting template.

ip-mtu

Syntax **ip-mtu** *octets*
no ip-mtu

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command specifies the maximum size of ip packets on this group-interface. Packets larger than this will get fragmented.

The ip-mtu applies to all IPoE host types (dhcp, arp, static). For PPP/L2TP sessions, the ip-mtu is not taken into account for the mtu negotiation; the ppp-mtu in the ppp-policy should be used instead.

Default none

Parameters *octets* — Specifies the largest frame size (in octets) that this interface can handle.

Values 512 — 9000

enable-ingress-stats

Syntax [**no**] **enable-ingress-stats**

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

This command enables the collection of ingress interface IP stats. This command is only appliable to IP statistics, and not to uRPF statistics.

If enabled, then the following statistics are collected:

- IPv4 offered packets
- IPv4 offered octets
- IPv6 offered packets
- IPv6 offered octets

Note that octet statistics for IPv4 and IPv6 bytes at IP interfaces include the layer 2 frame overhead.

Default no enable-ingress-stats

host-connectivity-verify

Syntax **host-connectivity-verify** [**interval** *interval*] [**action** {**remove**|**alarm**}] [**timeout** *retry-timeout*] [**retry-count** *count*] [**family** *family*]

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command enables subscriber host connectivity verification on a given SAP within a service. This tool will periodically scan all known hosts (from dhcp-state) and perform UC ARP requests. The subscriber host connectivity verification will maintain state (connected vs. not-connected) for all hosts.

Default no host-connectivity-verify

Parameters **interval** *interval* **—** The interval, in minutes, which specifies the time interval which all known sources should be verified. The actual rate is then dependent on the number of known hosts and interval.

Values 1— 6000
Note that a zero value can be used by the SNMP agent to disable host-connectivity-verify.

action {**remove** | **alarm**} **—** Defines the action taken on a subscriber host connectivity verification failure for a given host. The **remove** keyword raises an alarm and removes dhcp-state and releases all allocated resources (queues, table entries and etc.). DHCP-RELEASE will be

signaled to corresponding DHCP server. Static hosts will be never removed. The **alarm** keyword raises an alarm indicating that the host is disconnected.

timeout *retry-timeout* **—** Specifies the retry timeout.

Values 10 — 60 seconds

retry-count *count* **—** specifies the number of retry requests.

Values 2 — 29

family *family* **—** The family configuration allows the host connectivity checks to be performed for IPv4 endpoint, IPv6 endpoint or both. With family IPv6 configured, host connectivity checks will be performed on the global unicast address (assigned via SLAAC or DHCPv6 IA_NA) and link-local address of a Layer 3 RG or bridged hosts. In case of SLAAC assignment, host connectivity can only be performed if the /128 is known (via downstream ND). DHCPv6 PD assigned prefixes will be removed if link-local address is determined to be unreachable via "host connectivity check". Reachability checks for GUA and link-local address will be done simultaneously.

Values ipv4, ipv6, both

ipoe-linking

Syntax [**no**] **ipoe-linking**

Context config>service>ies>sub-if
config>service>vprn>sub-if
config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command enables the context to configure IPoE host linking.

gratuitous-rtr-adv

Syntax [**no**] **gratuitous-rtr-adv**

Context config>service>ies>sub-if>ipoe-linking
config>service>vprn>sub-if>ipoe-linking
config>service>ies>sub-if>grp-if>ipoe-linking
config>service>vprn>sub-if>grp-if>ipoe-linking

Description If enabled, this command controls generation of unsolicited Router-advertisement on creation of v4 host.

The **no** form of the command disables **gratuitous-rtr-adv.**

Default gratuitous-rtr-adv

ipoe-session

Syntax [**no**] **ipoe-session**

Context config>service>ies>sub-if
config>service>vprn>sub-if

Description This command enables the context to configure IPoE session parameters.

session-limit

Syntax **session-limit** *session-limit*
no session-limit

Context config>service>ies>sub-if
config>service>vprn>sub-if

Description This command configures the session limit per subscriber interface.

shared-circuit-id

Syntax [**no**] **shared-circuit-id**

Context config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description If configured, circuit-id in DHCPv4 option-82 is used to authenticate DHCPv6. If DHCPv6 is received before DHCPv4, it is dropped. Also, a SLAAC host is created based on DHCPv4 authentication if RADIUS returns IPv6 framed-prefix. IPv6oE host is deleted if the linked IPv4oE host is deleted due to DHCP release or lease time-out. The linkage between IPv4 and IPv6 is based on SAP and MAC address. The sharing of circuit-id from DHCPv4 for authentication of DHCPv6 (or SLAAC) allows 7750 to work around lack of support for LDRA on Access-nodes.

The **no** form of the command disables the feature.

Default no shared-circuit-id

ipv6

Syntax [**no**] **ipv6**

Context config>service>ies>if
config>service>vprn>if

Description This command enables the context to configure IPv6 for an IES interface.

urpf-check

Syntax [**no**] **urpf-check**

Context config>service>ies>if
config>service>ies>if>ipv6

config>service>ies>sub-if>group-if>ipv6
config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command enables unicast RPF (uRPF) Check on this interface.

The **no** form of the command disables unicast RPF (uRPF) Check on this interface.

Default disabled

mode

Syntax **mode** {**strict** | **loose** | **strict-no-ecmp**}
no mode

Context config>service>ies>if>urfp-check
config>service>ies>sub-if>group-if>ipv6>urfp-check

Description This command specifies the mode of unicast RPF check.

The **no** form of the command reverts to the default (strict) mode.

Default strict

Parameters **strict —** When specified, uRPF checks whether incoming packet has a source address that matches a prefix in the routing table, and whether the interface expects to receive a packet with this source address prefix.

loose — In **loose** mode, uRPF checks whether incoming packet has source address with a corresponding prefix in the routing table. However, the loose mode does not check whether the interface expects to receive a packet with a specific source address prefix. This object is valid only when **urpf-check** is enabled.

strict-no-ecmp — When a packet is received on an interface in this mode and the SA matches an ECMP route the packet is dropped by uRPF.

match-circuit-id

Syntax [**no**] **match-circuit-id**

Context config>service>vprn>sub-if>grp-if>dhcp

Description This command enables Option 82 circuit ID on relayed DHCP packet matching. For routed CO, the group interface DHCP relay process is stateful. When packets are relayed to the server the virtual router ID, transaction ID, SAP ID, and client hardware MAC address of the relayed packet are tracked.

When a response is received from the server the virtual router ID, transaction ID, and client hardware MAC address must be matched to determine the SAP on which to send the packet out. In some cases, the virtual router ID, transaction ID, and client hardware MAC address are not guaranteed to be unique.

When the **match-circuit-id** command is enabled this as part of the key is used to guarantee correctness in our lookup. This is really only needed when dealing with an IP aware DSLAM that proxies the client hardware MAC address.

Default no match-circuit-id

mac

Syntax **mac** *ieee-address*
no mac

Context config>service>ies>subscriber-interface>group-interface

Description This command assigns a specific MAC address to a subscriber group interface.

The **no** form of the command returns the MAC address of the group interface to the default value.

Default The physical MAC address associated with the Ethernet interface that the SAP is configured on (the default MAC address assigned to the interface, assigned by the system).

Parameters *ieee-address* — Specifies the 48-bit MAC address for the static ARP in the form aa:bb:cc:dd:ee:ff or aa-bb-cc-dd-ee-ff where aa, bb, cc, dd, ee, and ff are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

oper-up-while-empty

Syntax [**no**] **oper-up-while-empty**

Context config>service>ies>sub-if>group-interface
config>service>vprn>sub-if>group-interface

Description This command allows the subscriber interface to treat this group interface to be operationally enabled without any active SAPs.

This command is typically used with MSAPs where advertising the subnet prior to having a MSAP dynamically created is needed.

policy-control

Syntax **policy-control** *diameter-policy-name*
no policy-control

Context config>service>ies>sub-if>group-interface
config>service>vprn>sub-if>group-interface

Description This command configures a policy-control policy for the interface.

Parameters *diameter-policy-name* — Specifies the name of an existing diameter policy.

mode

Syntax **mode** *mode*

Context configure>card>mda>atm

Description This command configures the ATM MDA into a mode with the increased VC scale (16k VCs, as opposed to 8K VCs). ESM is supported only in 16K VCs mode. In 16K VCs mode, there is only one queue allocated to each VC in the ATM MDA. In 8K VCs mode, there are two queues allocated per VC.

The 16K VC mode is supported only on the 4 port oc-3/12c/STM-1/4c and the 16 port ATM oc-3/STM-1 ATM MDA.

Changing the ATM MDA mode requires a reset of the MDA. A warning is issued asking for the confirmation before the command is executed.

Default max8k-vc.

Parameters *mode* — Specifies VC scale.

Values max8k-vc | max16k-vc

agg-rate

Syntax **[no] agg-rate**

Context configure>service>ies>sub-if>grp-if>sap>egress
configure>service>vprn>sub-if>grp-if>sap>egress

Description This command is used to control an HQoS aggregate rate limit. It is used in conjunction with the following parameter commands: **rate**, **limit-unused-bandwidth**, **and queue-frame-based-accounting**.

When specified under a VPORT, the agg-rate rate, port-scheduler-policy and scheduler-policy commands are mutually exclusive. Changing between the use of a scheduler policy and the use of an agg-rate/port-scheduler-policy involves removing the existing command and applying the new command.

rate

Syntax **rate** {**max** | **rate**}
no rate

Context configure>service>ies>sub-if>grp-if>sap>egress>agg-rate
configure>service>vprn>sub-if>grp-if>sap>egress>agg-rate

Description This command defines the enforced aggregate rate for all queues associated with the agg-rate context. A rate must be specified for the agg-rate context to be considered to be active on the context's object (SAP, subscriber, VPORT etc.).

Parameters **rate** — Specifies the rate limit for the VPORT.

Values **max**, 1— 800000000, max

limit-unused-bandwidth

Syntax [**no**] **limit-unused-bandwidth**

Context configure>service>ies>sub-if>grp-if>sap>egress>agg-rate
configure>service>vprn>sub-if>grp-if>sap>egress>agg-rate

Description This command is used to enable (or disable) aggregate rate overrun protection on the agg-rate context.

queue-frame-based-accounting

Syntax [**no**] **queue-frame-based-accounting**

Context configure>service>vprn>sub-if>grp-if>sap>egress>agg-rate
configure>service>ies>sub-if>grp-if>sap>egress>agg-rate

Description This command is used to enabled (or disable) frame based accounting on all queues associated with the agg-rate context. Only supported on Ethernet ports. Not supported on HSMDA Ethernet ports.

vpi

Syntax **vpi** *vpi* **egress-traffic-desc** *atm-td-profile-id*
no vpi *vpi*

Context configure>port>sonet-sdh>path>atm

Description This command enables the ATM VP shaper under the ATM port. The type of ATM shaper are CBR or rt/nrt-VBR as defined by the traffic descriptor. It cannot be a UBR service-type.

All VCs within the shaper will degrade into a UBR type service class. For example, when a CBR type VC is associated with the shaper, it will degrade into a UBR type VC. Scheduling traffic amongst VCs within the shaper is based on WRR using the weight parameter.

If the VP shaper is deleted, the VCs that were under it is restored to their original service category.

The VP shaper is statically configured and instantiated upon configuration.

A VP shaper can be seamlessly added to or removed from the active VCs in the system.

Default none

Parameters *atm-td-profile-id* — Specifies ATM traffic description id.

Values [1..1000]

vpi —

Values [0..4095]

egress-traffic-desc — References an atm traffic descriptor profile.

traffic-desc

Syntax **traffic-desc** *atm-td-profile-id*
no traffic-desc

Context configure>service>vprn>sub-if>grp-if>sap>atm>egress
configure>service>vprn>sub-if>grp-if>sap>atm>ingress
configure>service>ies>sub-if>grp-if>sap>atm>egress
configure>service>ies>sub-if>grp-if>sap>atm>ingress
configure>subscr-mgmt>msap-policy>atm>egress
configure>subscr-mgmt>msap-policy>atm>ingress

Description This command references traffic-descriptor id for VPs and VCs.

The VP shaper cannot be of service-type UBR.

Default Default traffic descriptor (id=1) of UBR type.

Parameters *atm-td-profile-id* — Specifies traffic-descriptor id.

Values [1..1000]

weight

Syntax **weight** *weight*
no weight

Context configure>qos>atm-td-profile

Description VCs within the VP tunnel are serviced by a single scheduler assigned to each VP tunnel. VCs within the shaped VP tunnel will be degraded from the originally assigned service category to a common UBR service category (default traffic descriptor). Scheduling between VCs will be based on WRR with a weight parameter that can be explicitly configured in the ATM traffic descriptor profile. If weight is not specifically configured, the defaults are taken.

The explicitly configured weight parameter is honored only on the ATM MDA in the max16k-vc mode. On all other ATM capable MDAs (ASAP or ATM MDA in max8k-vc mode), the weight parameter is ignored.

Default VC degraded from CBR = weight 10

VC degraded from rt-VBR = weight 7

VC degraded from nrt-VBR = weight 5

VC degraded from UBR+ = weight 2

VC degraded from UBR = weight 1

Parameters *weight* —

Values [1-255]

encapsulation

Syntax **encapsulation** [**aal5auto** | **aal5nlpid-ppp** | **aal5mux-ppp** | **aal5snap-bridged** | **aal5mux-bridged-eth-nofcs**]
no encapsulation

Context configure>service>ies>sub-if>grp-if>sap>atm
configure>service>vprn>sub-if>grp-if>sap>atm
configure>service>vpls>sap>atm

Description This command is a SAP level command and it will either statically set or enable dynamic detection of the encapsulation.

Default snap-bridged

Parameters **aal5auto —** This option is available only in max16k-vc mode on dynamic or static SAPs. It will enable automatic detection of one of the four supported encapsulation types.

aal5mux-bridged-eth-nofcs — This option already exist outside of the ESM context on regular interfaces. Within the ESM context (group-interfaces and capture SAPs), this option is available only in max16K-vc mode. The encapsulation is statically set to VC-MUX bridged Ethernet with no FCS. This is a valid encapsulation only for PPPoEoA.

aal5mux-ppp — This option is available only in max16k-vc mode on dynamic or static SAPs. The encapsulation is statically set VC-MUX PPP encapsulation. This is a valid encapsulation only for PPPoA.

aal5nlpid-ppp — dynamic or static SAPs. The encapsulation is statically set to NLPID (LLC) PPP encapsulation. This is a valid encapsulation only for PPPoA.

aal5snap-bridged — This option already exist outside of the ESM context on regular interfaces. Within the ESM context (group-interfaces and capture SAPs), this option is available only in max16k-vc mode. The encapsulation is statically set to bridged Ethernet with or without FCS. Both PIDs (0x 00-01 and 0x 00-07) are accepted on ingress and use this to determine whether to strip four bytes from the end of the encapsulated Ethernet frame. The inner FCS is not checked. This is a valid encapsulation only for PPPoEoA.

Note that on ATM frames with Ethernet FCS or without FCS are accepted but only frames with no Ethernet FCS are sent.

def-inter-dest-id

Syntax **def-inter-dest-id string** *interest-string*
def-inter-dest-id {**use-top-q** | **use-vpi**}
no def-inter-dest-id

Context configure>service>ies>sub-if>grp-if>sap>sub-sla-mgmt
configure>service>vprn>sub-if>grp-if>sap>sub-sla-mgmt
configure>subscr-mgmt>msap-policy>sub-sla-mgmt

Description This command is used to associate the vport with the subscriber. The association method will depend on the configured option.

Default Disabled

Parameters *string* — A RADIUS VSA (Alc-Int-Dest-Id-Str, type 28) obtained during the subscriber authentication phase will contain the destination string name that will be matched against the string defined under the vport. In this fashion the subscriber host will be associated with the corresponding vport.

Alternatively, the destination string can be defined in LUDB.

use-top-q — This is applicable only to Ethernet ports.

use-vpi — VP Identifier (VPI) will be used to make the association between the subscriber and the vport automatically.

Control Plane will be aware of the VPI during the session initiation phase. This VPI will be used to make the association between the host and the vport with the same name (VPI number). Note that in this case the vport name under the **configure>port>sonet-sdh>path>access>egress** context must be the VPI number.

pppoe-user-db

Syntax **pppoe-user-db** *ludb-name*
no pppoe-user-db

Context configure>services>vpls>sap

Description This command will enable LUDB authentication on capture SAPs for PPPoE(oA) clients. In case that this command is configured along with the authentication-policy command (RADIUS authentication), then the authentication-policy command will take precedence.

Optionally, with a separate command (ppp-user-db) PPPoA clients can be authenticated under a separate LUDB.

Default Disabled

Parameters *ludb-name* — Name of local user database.

ppp-user-db

Syntax **pppp-user-db** *ludb-name*
no pppp-user-db

Context configure>services>vpls>sap

Description This command will enable LUDB authentication on capture SAPs for PPPoA clients. In case that this command is configured along with the authentication-policy command (RADIUS authentication), then the authentication-policy command will take precedence.

Optionally, with a separate command (pppoe-user-db) PPPoE(oA) clients can be authenticated under a separate LUDB.

Default Disabled

Parameters *ludb-name* — Name of local user database.

ppp-policy

Syntax **ppp-policy** *ppp-pol-name*
no ppp-policy

Context configure>services>vpls>sap

Description This command will reference a ppp-policy that will define session parameters (ppp-mtu, authentication options, etc.) during the session initiation phase. Normally, ppp-policy is referenced under the group-interface hierarchy. But with capture SAP is it not known at the session initiation phase to which group-interface the session belongs. This is why, with the capture SAP, the ppp-policy must be referenced directly under the capture SAP. The ppp-policy referenced under the group-interface must be the same as the ppp-policy referenced under the capture SAP. Otherwise the session will not come up.

Default Disabled

Parameters *ppp-pol-name* — Name of the ppp-policy.

pppoe-policy

Syntax **pppoe-policy** *ppoep-pol-name*
no pppoe-policy

Context configure>services>vpls>sap

Description This command will reference a pppoe-policy that will define session parameters (ppp-mtu, authentication options, etc.) during the session initiation phase. Normally, pppoe-policy is referenced under the group-interface hierarchy. But with capture SAP is it not known at the session initiation phase to which group-interface the session belongs. This is why, with the capture SAP, the ppp-policy must be referenced directly under the capture SAP. The pppoe-policy referenced under the group-interface must be the same as the pppoe-policy referenced under the capture SAP. Otherwise the session will not come up.

Default Disabled

Parameters *pppoe-pol-name* — Name of the pppoe-policy

vc-range

Syntax **vc-range** *num* **vpi-range** *vpi-range* **vci-range** *vci-range*
no vc-range num

Context configure>services>vpls>sap>atm

Description This command is supported only in max16k-vc ATM MDA mode. An ATM MDA supports a number (see scaling guides for more info) of passive (or listening) VCs, of which a subset can be simultaneously active.

Default Disabled

Parameters *num* — Specifies the VC range.

Values 1 — 5 (Five ranges are supported to accommodate non-contiguous ranges of VPI/VCI pairs.)

vci-range *vci-range* **—** Specifies the VCI range.

Values 1, 2, 5 — 65535 (Contiguous VCI ranges in the form of 'x'-'y'.)

vpi-range *vpi-range.* — Specifies the VPI range.

Values 0 — 255 for UNI
0 — 4095 for NNI
(Contiguous VPI range in the form of 'x'-'y'.)

local-address-assignment

Syntax **local-address-assignment**

Context config>service>ies>sub-if
config>service>vprn>sub-if
config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command enables the context t configure the local address assignment.

ipv6

Syntax [**no**] **ipv6**

Context config>service>ies>sub-if>lcl-addr-assign
config>service>vprn>sub-if>lcl-addr-assign

Description This command configures the IPv6 local address assignment.

client-application

Syntax **client-application [ppp-v4]**
no client-application

Context config>service>ies>sub-if>lcl-addr-assign
config>service>vprn>sub-if>lcl-addr-assign
config>service>ies>sub-if>grp-if>lcl-addr-assign
config>service>ies>sub-if>grp-if>lcl-addr-assign

Description This command enables local 7x50 DHCP server pool management for PPPoXv4 clients. A pool of IP addresses can be shared between IPoE clients that rely on DHCP protocol (lease renewal process) and PPPoX clients wehre address allocation is not dependent on DHCP messaging but instead an IP address allocation within the pool is tied to the PPPoX session.

client-application

Syntax **client-application [ppp-slaac] [ipoe-wan] [ipoe-slaac]**
no client-application

Context config>service>vprn>sub-if>grp-if>lcl-addr-assign>ipv6
config>service>vprn>sub-if>grp-if>lcl-addr-assign>ipv6

Description This defines the client application that will use the local address server to perform address assignment. This feature is relies on RADIUS or local-user-database to return a pool name. The pool name is matched again the pools defined in the local-dhcp6-server. The name of the local-dhcp6-server must also be provisioned.

Parameters **ppp-slaac —** This parameter indicates using the local DHCPv6 prefix pool to assign SLAAC prefixes for hosts. The "pool name" where the prefixes are used for SLAAC prefix assignment are obtained from RADIUS or local-user-database during the authentication process. The RADIUS attribute "Alc-slaac-ipv6-pool" is used to indicate the SLAAC pool name for PPPoE hosts.

ipoe-wan — This parameter indicates using the local DHCPv6 pool for IA_NA address assignment and a static pre-defined prefixes for IA_PD. Both the IA_NA "pool name" and the IA_PD static "framed-prefix" are either obtained from RADIUS or LUDB during authentication. In the case of RADIUS, it must return both IA_NA "Framed-IPv6-Pool" and IA_PD "Delegated-IPv6-Prefix" after a successful authentication. In the case of LUDB, it must have "ipv6-wan-address-pool" and "ipv6-delegated-prefix" populated. This feature is specific to this use case and is not required for other combinations of DHCPv6 assignments such as IA_NA and IA_PD address assignment through RADIUS or LUDB.

ipoe-slaac — This parameter indicates using the local DHCPv6 prefix pool to assign SLAAC prefixes for hosts. The "pool name" where the prefixes are used for SLAAC prefix assignment are obtained from RADIUS or local-user-database during the authentication process. The RADIUS attribute "Alc-slaac-ipv6-pool" is used to indicate the SLAAC pool name for PPPoE hosts.

default-pool

Syntax **default**-pool *pool-name* [**secondary** *pool-name*]
no default-pool

Context config>service>ies>sub-if>lcl-addr-assign
config>service>vprn>sub-if>lcl-addr-assign
config>service>ies>sub-if>grp-if>lcl-addr-assign
config>service>vprn>sub-if>grp-if>lcl-addr-assign

Description This command references a default DHCP address pool for local PPPoX pool management in case that the pool-name is not retuned via RADIUS or LUDB.

Parameters *pool-name* — Name of the local 7x50 DHCP server pool.

server

Syntax **server** *server-name*
no server

Context config>service>ies>sub-if>lcl-addr-assign
config>service>vprn>sub-if>lcl-addr-assign
config>service>ies>sub-if>grp-if>lcl-addr-assign
config>service>vprn>sub-if>grp-if>lcl-addr-assign

Description This command designates a local 7x50 DHCPv4 server for local pools management where IPv4 addresses for PPPoXv4 clients will be allocated without the need for the internal 7x50 DHCP relay-agent. Those addresses will be tied to PPPoX sessions and they will be de-allocated when the PPPoX session is terminated.

Parameters *server-name* — The name of the local 7x50 DHCP server.

server

Syntax **server** *server-name*
no server

Context config>service>ies>sub-if>grp-if>lcl-addr-assign>ipv6
config>service>vprn>sub-if>grp-if>lcl-addr-assign>ipv6

Description This command designates a local 7x50 DHCPv6 server for local pools management where IPv6 prefixes or address for PPPoXv6 clients or IPoEv6 clients will be allocated without the need for the internal 7x50 DHCP relay-agent. Those addresses will be tied to PPPoX or IPoE sessions and they will be de-allocated when the PPPoX or IPoE session is terminated.

Default none

Parameters *server-name* — The name of the local 7x50 DHCPv6 server.

Layer 3 Subscriber Interfaces SAP Commands

accounting-policy

Syntax **accounting-policy** *acct-policy-id*
no accounting-policy

Context config>service>ies>sub-if>grp-if>sap
config>service>vprn>if>sap
config>service>vprn>if>spoke-sdp
config>service>vprn>sub-if>grp-if>sap

Description This command specifies the policy to use to collect accounting statistics on a subscriber profile.

A maximum of one accounting policy can be associated with a profile at one time.

The **no** form of this command removes the accounting policy association.

Default no accounting policy

Parameters *acct-policy-id* — Enter the accounting *policy-id* as configured in the **config>log>accounting-policy** context.

Values 1 — 99

anti-spoof

Syntax **anti-spoof** {**ip** | **ip-mac** | **nh-mac**}
no anti-spoof

Context config>service>ies>sub-if>grp-if>sap
config>service>vprn>sub-if>grp-if>sap
config>subscr-mgmt>msap-policy

Description This command configures the anti-spoof type of the MSAP.

The type of anti-spoof filtering defines what information in the incoming packet is used to generate the criteria to lookup an entry in the anti-spoof filter table. The type parameter (**ip**, **ip-mac**) defines the anti-spoof filter type enforced by the SAP when anti-spoof filtering is enabled.

The **no** form of the command reverts back to the default.

Note that for IES and VPRN subscriber group interfaces, setting no anti-spoof will set the default anti-spoofing type which is **ip-mac**.

Default no anti-spoof

Parameters **ip —** Configures SAP anti-spoof filtering to use only the source IP address in its lookup. If a static host exists on the SAP without an IP address specified, the anti-spoof type **ip** command will fail. Note that this parameter is not applicable in the **config>subscr-mgmt>msap-policy** context.

ip-mac — Configures SAP anti-spoof filtering to use both the source IP address and the source MAC address in its lookup. If a static host exists on the SAP without both the IP address and MAC

address specified, the anti-spoof type **ip-mac** command will fail. This is also true if the default anti-spoof filter type of the SAP is **ip-mac** and the default is not overridden. The anti-spoof type **ip-mac** command will also fail if the SAP does not support Ethernet encapsulation.

nh-mac — Indicates that the ingress anti-spoof is based on the source MAC and egress anti-spoof is based on the nh-ip-address.

app-profile

Syntax **app-profile** *app-profile-name*
no app-profile

Context config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command configures the application profile name.

Parameters *app-profile-name* — Specifies an existing application profile name configured in the **config>app-assure>group>policy** context.

collect-stats

Syntax [**no**] **collect-stats**

Context config>service>ies>sub-if>grp-if>sap
config>service>vprn>sub-if>grp-if>sap

Description When enabled, the agent collects non-RADIUS accounting statistics on a subscriber profile.

When the **no collect-stats** command is issued the statistics are still accumulated by the IOM cards. However, the CPU will not obtain the results and write them to the billing file. If a subsequent **collect-stats** command is issued then the counters written to the billing file include all the traffic while the **no collect-stats** command was in effect.

Default collect-stats

cpu-protection

Syntax **cpu-protection** *policy-id* [**mac-monitoring**] | [**eth-cfm-monitoring** [**aggregate**] [**car**]]
no cpu-protection

Context config>service>ies>sub-if>grp-if>sap

Description This command assigns an existing CPU protection policy to the associated group interface. The CPU protection policies are configured in the **config>sys>security>cpu-protection>policy** *cpu-protection-policy-id* context.

If no CPU-Protection policy is assigned to a group interface SAP, then the default policy is used to limit the overall-rate. The default policy is policy number 254 for access interfaces and 255 for network interfaces.

The **no** form of the command removes the association of the CPU protection policy from the associated interface and reverts to the default policy values.

Default cpu-protection 254 (for access interfaces)

cpu-protection 255 (for network interfaces)

The configuration of no cpu-protection returns the interface/SAP to the default policies as shown above.

Parameters *policy-id* — Specifies an existing CPU protection policy.

Values 1 — 255

mac-monitoring — This keyword enables MAC monitoring.

eth-cfm-monitoring — This keyword enables Ethernet Connectivity Fault Management monitoring.

aggregate — This keyword applies the rate limit to the sum of the per peer packet rates.

car — (Committed Access Rate) This keyword causes Eth-CFM packets to be ignored when enforcing the overall-rate.

egress

Syntax **egress**

Context config>service>ies>sub-if>grp-if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command enables the context to configure egress SAP Quality of Service (QoS) policies and filter policies.

If no sap-egress QoS policy is defined, the system default sap-egress QoS policy is used for egress processing. If no egress filter is defined, no filtering is performed.

filter

Syntax **filter ip** *ip-filter-id*
filter
no filter [**ip** *ip-filter-id*]
no filter

Context config>service>ies>sub-if>grp-if>sap>egress
config>service>ies>sub-if>grp-if>sap>ingress
config>service>vprn>sub-if>grp-if>sap>egress
config>service>vprn>sub-if>grp-if>sap>ingress

Description This command associates an IP filter policy with an ingress or egress Service Access Point (SAP). Filter policies control the forwarding and dropping of packets based on the matching criteria.

MAC filters are only allowed on Epipe and Virtual Private LAN Service (VPLS) SAPs.

The **filter** command is used to associate a filter policy with a specified *ip-filter-id* with an ingress or egress SAP. The filter policy must already be defined before the **filter** command is executed. If the filter policy does not exist, the operation will fail and an error message returned.

In general, filters applied to SAPs (ingress or egress) apply to all packets on the SAP. One exception is non-IP packets are not applied to the match criteria, so the default action in the filter policy applies to these packets.

The **no** form of this command removes any configured filter ID association with the SAP. The filter ID itself is not removed from the system unless the scope of the created filter is set to local. To avoid deletion of the filter ID and only break the association with the service object, use the **scope** command within the filter definition to change the scope to **local** or **global**. The default scope of a filter is **local**.

Special Cases **IES —** Only IP filters are supported on an IES IP interface, and the filters only apply to routed traffic.

Parameters **ip —** Keyword indicating the filter policy is an IP filter.

ip-filter-id — Specifies the ID for the IP filter policy. Allowed values are an integer in the range of 1 and 65535 that corresponds to a previously created IP filter policy in the **configure>filter** context.

qos

Syntax **qos** *policy-id*
no qos

Context config>service>ies>sub-if>grp-if>sap>egress
config>service>vprn>sub-if>grp-if>sap>egress
config>service>vprn>sub-if>grp-if>sap>ingress

Description Associates a Quality of Service (QoS) policy with an egress Service Access Point (SAP) or IP interface.

QoS egress policies are important for the enforcement of SLA agreements. The policy ID must be defined prior to associating the policy with a SAP or IP interface. If the *policy-id* does not exist, an error will be returned.

The **qos** command is used to associate egress QoS policies. The **qos** command only allows egress policies on SAP or IP interface egress. Attempts to associate a QoS policy of the wrong type returns an error.

Only one ingress QoS policy can be associated with a SAP or IP interface at one time. Attempts to associate a second QoS policy of a given type will return an error.

By default, no specific QoS policy is associated with the SAP or IP interface for egress, so the default QoS policy is used.

The normal behavior is for queues to be created per destination.

The **no** form of this command removes the QoS policy association from the SAP or IP interface, and the QoS policy reverts to the default.

policy-id — The egress policy ID to associate with SAP or IP interface on egress. The policy ID must already exist.

Values 1 — 65535

qos

Syntax **qos** *policy-id* [**shared-queuing**]
no qos

Context config>service>ies>sub-if>grp-if>sap>ingress

Description Associates a Quality of Service (QoS) policy with an ingress Service Access Point (SAP) or IP interface.

QoS ingress policies are important for the enforcement of SLA agreements. The policy ID must be defined prior to associating the policy with a SAP or IP interface. If the *policy-id* does not exist, an error will be returned.

This **qos** command is used to associate ingress QoS policies. The **qos** command only allows ingress policies to be associated on SAP or IP interface ingress.

Only one ingress and one egress QoS policy can be associated with a SAP or IP interface at one time. Attempts to associate a second QoS policy of a given type will return an error.

By default, no specific QoS policy is associated with the SAP or IP interface for ingress so the default QoS policy is used.

The normal behavior is for queues to be created per destination. Shared and multipoint shared change this behavior creating either unicast or unicast and mcast shared queues.

The **no** form of this command removes the QoS policy association from the SAP or IP interface, and the QoS policy reverts to the default.

policy-id — The ingress policy ID to associate with SAP or IP interface on ingress. The policy ID must already exist.

Values 1 — 65535

shared-queuing — This keyword can only be specified on SAP ingress. Specify the ingress shared queue policy used by a SAP. When the value of this object is null it means that the SAP will use individual ingress QoS queues, instead of the shared ones.

scheduler-policy

Syntax **scheduler-policy** *scheduler-policy-name*
no scheduler-policy

Context config>service>ies>sub-if>grp-if>sap>egress
config>service>ies>sub-if>grp-if>sap>ingress
config>service>vprn>sub-if>grp-if>sap>egress
config>service>vprn>sub-if>grp-if>sap>ingress

Description This command applies an existing scheduler policy to an ingress or egress scheduler used by SAP queues associated with this multi-service customer site. The schedulers defined in the scheduler pol-

icy can only be created once the customer site has been appropriately assigned to a chassis port, channel or slot. Scheduler policies are defined in the **config>qos>scheduler-policy** *scheduler-policy-name* context.

The **no** form of this command removes the configured ingress or egress scheduler policy from the multi-service customer site. When the policy is removed, the schedulers created due to the policy are removed also making them unavailable for the ingress SAP queues associated with the customer site. Queues that lose their parent scheduler association are deemed to be orphaned and are no longer subject to a virtual scheduler. The SAPs that have ingress queues reliant on the removed schedulers enter into an operational state depicting the orphaned status of one or more queues. When the **no scheduler-policy** command is executed, the customer site ingress or egress node will not contain an applied scheduler policy.

scheduler-policy-name: — The *scheduler-policy-name* parameter applies an existing scheduler policy that was created in the **config>qos>scheduler-policy** *scheduler-policy-name* context to create the hierarchy of ingress or egress virtual schedulers. The scheduler names defined within the policy are created and made available to any ingress or egress queues created on associated SAPs.

Values Any existing valid scheduler policy name.

host

Syntax **host ip** *ip-address* [**mac** *ieee-address*]] [**subscriber** *sub-ident-string*] [**sub-profile** *sub-profile-name*] [**sla-profile** *sla-profile-name*]
no host {[**ip** *ip-address*] [**mac** *ieee-address*]}
no host all

Context config>service>ies>sub-if>grp-if>sap
config>service>ies>if>sap
config>service>ies>sub-if>grp-if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command creates a static subscriber host for the SAP. Static subscriber hosts may be used by the system for various purposes. Applications within the system that make use of static host entries include anti-spoof filters and ARP cache population.

Multiple static hosts may be defined on the SAP. Each host is identified by either a source IP address, a source MAC address or both a source IP and source MAC address. Every static host definition must have at least one address defined, IP or MAC.

Static hosts can exist on the SAP even with anti-spoof and ARP populate features disabled. When enabled, each feature has different requirements for static hosts.

anti-spoof — When enabled, this feature uses static and dynamic host information to populate entries into an anti-spoof filter table. The anti-spoof filter entries generated will be of the same type as specified in the anti-spoof type parameter. If the SAP anti-spoof filter is defined as **ip**, each static host definition must specify an IP address. If the SAP anti-spoof filter is defined as **ip-mac**, each static host definition must specify both an IP address and MAC address. If definition of a static host is attempted without the appropriate addresses specified for the enabled anti-spoof filter, the static host definition will fail.

arp-populate — When enabled, this feature uses static and dynamic host information to populate entries in the system ARP cache.

Attempting to define a static subscriber host that conflicts with an existing DHCP lease state table entry will fail.

Use the **no** form of the command to remove a static entry from the system. The specified *ip-address* and *mac-address* must match the host's exact IP and MAC addresses as defined when it was created. When a static host is removed from the SAP, the corresponding anti-spoof entry and/or ARP cache entry is also removed.

Default none

Parameters **ip** *ip-address* — Specify this optional parameter when defining a static host. The IP address must be specified for **anti-spoof ip**, **anti-spoof ip-mac** and **arp-populate**. Only one static host may be configured on the SAP with a given IP address.

mac *mac-address* — Specify this optional parameter when defining a static host. The MAC address must be specified for **anti-spoof ip-mac** and **arp-populate**. Multiple static hosts may be configured with the same MAC address given that each definition is distinguished by a unique IP address.

subscriber *sub-ident-string* — Specify this optional parameter to specify an existing subscriber identification profile to be associated with the static subscriber host. The subscriber identification profile is configured in the **config>subscr-mgmt>sub-ident-policy** context. The subscriber information is used by the VPRN SAP arp-reply-agent to determine the proper handling of received ARP requests from subscribers.

- For VPRN SAPs with **arp-reply-agent** enabled with the optional *sub-ident* parameter, the static subscriber hosts sub-ident-string is used to determine whether an ARP request received on the SAP is sourced from a host belonging to the same subscriber as the destination host. When both the destination and source hosts from the ARP request are known on the SAP and the subscriber identifications do not match, the ARP request may be forwarded to the rest of the VPRN destinations.

  If the static subscriber hosts *sub-ident* string is not defined, the host is not considered to belong to the same subscriber as another host on the SAP.

  If source or destination host is unknown, the hosts are not considered to belong to the same subscriber. (ARP messages from unknown hosts are subject to anti-spoof filtering rules applied at the SAP.)

  If *sub-ident* is not enabled on the SAP arp-reply-agent, subscriber identification matching is not performed on ARP requests received on the SAP.

  ARP requests are never forwarded back to the same SAP or within the receiving SAP's Split Horizon Group.

sub-profile *sub-profile-name* **—** Specify this optional parameter to specify an existing subscriber profile name to be associated with the static subscriber host. The subscriber profile is configured in the **config>subscr-mgmt>sub-profile** context.

sla-profile *sla-profile-name* **—** Specify this optional parameter to specify an existing SLA profile name to be associated with the static subscriber host. The SLA profile is configured in the **config>subscr-mgmt>sla-profile** context.

ingress

Syntax **ingress**

Context config>service>ies>sub-if>grp-if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command enables the context to configure ingress SAP Quality of Service (QoS) policies and filter policies.

If no SAP ingress QoS policy is defined, the system default sap-ingress QoS policy is used for ingress processing. If no ingress filter is defined, no filtering is performed.

multi-service-site

Syntax [**no**] **multi-service-site** *customer-site-name*

Context config>service>ies>sub-if>grp-if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command creates a new customer site or edits an existing customer site with the *customer-site-name* parameter. A customer site is an anchor point to create an ingress and egress virtual scheduler hierarchy. When a site is created, it must be assigned to a chassis slot or port with the exception of the 7750 SR-1 in which the slot is set to 1. When scheduler policies are defined for ingress and egress, the scheduler names contained in each policy are created according to the parameters defined in the policy. Multi-service customer sites exist for the sole purpose of creating a virtual scheduler hierarchy and making it available to queues on multiple Service Access Points (SAPs).

The scheduler policy association with the customer site normally prevents the scheduler policy from being deleted until after the scheduler policy is removed from the customer site. The multi-service-site object will generate a log message indicating that the association was deleted due to scheduler policy removal.

When the multi-service customer site is created, an ingress and egress scheduler policy association does not exist. This does not prevent the site from being assigned to a chassis slot or prevent service SAP assignment. After the site has been created, the ingress and egress scheduler policy associations can be assigned or removed at anytime.

Default None — Each customer site must be explicitly created.

Parameters *customer-site-name* — Each customer site must have a unique name within the context of the customer. If *customer-site-name* already exists for the customer ID, the CLI context changes to that site name for the purpose of editing the site scheduler policies or assignment. Any modifications made to an existing site will affect all SAPs associated with the site. Changing a scheduler policy association may cause new schedulers to be created and existing queues on the SAPs to no longer be orphaned. Existing schedulers on the site may cease to exist, causing queues relying on that scheduler to be orphaned.

If the *customer-site-name* does not exist, it is assumed that an attempt is being made to create a site of that name in the customer ID context. The success of the command execution depends on the following:

- The maximum number of customer sites defined for the chassis slot has not been met.

- The *customer-site-name* is valid.
- The **create** keyword is included in the command line syntax (if the system requires it).

When the maximum number of customer sites has been exceeded a configuration error occurs, the command will not execute and the CLI context will not change.

If the *customer-site-name* is invalid, a syntax error occurs, the command will not execute and the CLI context will not change.

Values Valid names consist of any string up to 32 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

ATM Commands

atm

Syntax **atm**

Context config>service>ies>sub-if>grp-if>sap
config>service>vprn>if>sap
config>service>vprn>sub-if>grp-if>sap

Description This command enables access to the context to configure ATM-related attributes. This command can only be used when a given context (for example, a channel or SAP) supports ATM functionality such as:

- Configuring ATM port or ATM port-related functionality on MDAs supporting ATM functionality
- Configuring ATM-related configuration for ATM-based SAPs that exist on MDAs supporting ATM functionality.

If ATM functionality is not supported for a given context, the command returns an error.

egress

Syntax **egress**

Context config>service>ies>sub-if>grp-if>sap>atm
config>service>vprn>if>sap>atm
config>service>vprn>sub-if>grp-if>sap>atm

Description This command enables the context to configure egress ATM attributes for the SAP.

encapsulation

Syntax **encapsulation** *atm-encap-type*

Context config>service>ies>sub-if>grp-if>sap>atm
config>service>vprn>if>sap>atm
config>service>vprn>sub-if>grp-if>sap>atm

Description This command configures RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*, encapsulation for an ATM PVCC delimited SAP.

This command specifies the data encapsulation for an ATM PVCC delimited SAP. The definition references RFC 2684 and to the ATM Forum LAN Emulation specification.

Ingress traffic that does not match the configured encapsulation will be dropped.

Default The encapsulation is driven by the services for which the SAP is configured.
For IES service SAPs, the default is **aal5snap-routed**.

Parameters *atm-encap-type* — Specify the encapsulation type.

Values **aal5snap-routed** — Routed encapsulation for LLC encapsulated circuit (LLC/SNAP precedes protocol datagram) as defined in RFC 2684.
aal5mux-ip — Routed IP encapsulation for VC multiplexed circuit as defined in RFC 2684

ingress

Syntax **ingress**

Context config>service>ies>sub-if>grp-if>sap>atm
config>service>vprn>if>sap>atm
config>service>vprn>sub-if>grp-if>sap>atm

Description This command configures ingress ATM attributes for the SAP.

traffic-desc

Syntax **traffic-desc** *traffic-desc-profile-id*
no traffic-desc

Context config>service>ies>sub-if>grp-if>sap>atm>egress
config>service>ies>sub-if>grp-if>sap>atm>ingress
config>service>vprn>if>sap>atm>egress
config>service>vprn>if>sap>atm>ingress
config>service>vprn>sub-if>grp-if>sap>atm>egress
config>service>vprn>sub-if>grp-if>sap>atm>ingress

Description This command assigns an ATM traffic descriptor profile to a given context (for example, a SAP). When configured under the ingress context, the specified traffic descriptor profile defines the traffic contract in the forward direction. When configured under the egress context, the specified traffic descriptor profile defines the traffic contract in the backward direction.

The **no** form of the command reverts the traffic descriptor to the default traffic descriptor profile.

Default The default traffic descriptor (trafficDescProfileId. = 1) is associated with newly created PVCC-delimited SAPs.

Parameters *traffic-desc-profile-id* — Specify a defined traffic descriptor profile (see the QoS atm-td-profile command).

oam

Syntax **oam**

Context config>service>ies>sub-if>grp-if>sap>atm
config>service>vprn>interface >sap>atm
config>service>vprn>sub-if>grp-if>sap>atm

Description This command enables the context to configure OAM functionality for a PVCC delimiting a SAP.

The ATM-capable MDAs support F5 end-to-end OAM functionality (AIS, RDI, Loopback):

- ITU-T Recommendation I.610 - B-ISDN Operation and Maintenance Principles and Functions version 11/95
- GR-1248-CORE - Generic Requirements for Operations of ATM Network Elements (NEs). Issue 3 June 1996
- GR-1113-CORE - Bellcore, Asynchronous Transfer Mode (ATM) and ATM Adaptation Layer (AAL) Protocols Generic Requirements, Issue 1, July 1994

alarm-cells

Syntax [**no**] **alarm-cells**

Context config>service>ies>sub-if>grp-if>sap>atm>oam
config>service>vprn>if>sap>atm>oam
config>service>vprn>sub-if>grp-if>sap>atm>oam

Description This command configures AIS/RDI fault management on a PVCC. Fault management allows PVCC termination to monitor and report the status of their connection by propagating fault information through the network and by driving PVCCs operational status.

When alarm-cells functionality is enabled, PVCCs operational status is affected when a PVCC goes into AIS or RDI state because of an AIS/RDI processing (i.e. assuming nothing else affects PVCCs operational status, PVCC goes DOWN, when it enters a fault state and comes back UP, when it exits that fault state) and RDI cell are generated when PVCC is operationally DOWN. No OAM-specific SNMP trap is raised whenever an endpoint enters/exits an AIS or RDI states, however, if as result of an OAM state change, the PVCC changes operational status, then a trap is expected from an entity the PVCC is associated with (for example a SAP).

The no command disables alarm-cells functionality for a PVCC. When alarm-cells functionality is disabled, PVCCs operational status is no longer affected by PVCCs OAM state changes due to AIS/RDI processing (Note that when alarm-cells is disabled, a PVCC will change operational status to UP, if it was DOWN because of the alarm-cell processing) and RDI cells are not generated as result of PVCC going into AIS or RDI state, however, PVCCs OAM status will record OAM faults as described above.

Default Enabled for PVCCs delimiting IES SAPs

periodic-loopback

Syntax [**no**] **periodic-loopback**

Context config>service>ies>sub-if>grp-if>sap>atm>oam
config>service>vprn>if >sap>atm>oam
config>service>vprn>sub-if>grp-if>sap>atm

Description This command enables periodic OAM loopbacks on this SAP. This command is only configurable on IES and VPRN SAPs. When enabled, an ATM OAM loopback cell is transmitted every period as configured in the `config>system>atm>oam>loopback-period` *`period`* context.

If a response is not received and consecutive retry-down retries also result in failure, the endpoint will transition to an alarm indication signal/loss of clock state. Then, an ATM OAM loopback cell will be transmitted every period as configured in the `loopback-period` *`period`*. If a response is received for the periodic loopback and consecutive retry-up retries also each receive a response, the endpoint will transition back to the up state.

The **no** form of the command sets the value back to the default.

Default no periodic-loopback

Redundant Interface Commands

redundant-interface

Syntax [**no**] **redundant-interface** *ip-int-name*

Context config>service>ies
config>service>vprn
config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command configures a redundant interface.

Parameters *ip-int-name* — Specifies the name of the IP interface. Interface names can be from 1 to 32 alphanumeric characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

address

Syntax **address** {*ip-address/mask* | *ip-address netmask*} [**remote-ip** *ip-address*]
no address

Context config>service>vprn>redundant-interface

Description This command assigns an IP address mask or netmask and a remote IP address to the interface.

Parameters *ip-address/mask* — Assigns an IP address/IP subnet format to the interface.

ip-address netmask — Specifies a string of 0s and 1s that mask or screen out the network part of an IP address so that only the host computer part of the address remains.

Assigns an IP address netmask to the interface.

remote-ip *ip-address* — Assigns a remote IP to the interface.

spoke-sdp

Syntax [**no**] **spoke-sdp** *sdp-id*

Context config>service>vprn

Description This command binds a service to an existing Service Distribution Point (SDP).

A spoke SDP is treated like the equivalent of a traditional bridge “port” where flooded traffic received on the spoke SDP is replicated on all other “ports” (other spoke and mesh SDPs or SAPs) and not transmitted on the port it was received.

The SDP has an operational state which determines the operational state of the SDP within the service. For example, if the SDP is administratively or operationally down, the SDP for the service will be down.

The SDP must already be defined in the **config>service>sdp** context in order to associate an SDP with a VPRN service. If the **sdp** *sdp-id* is not already configured, an error message is generated. If the *sdp-id* does exist, a binding between that *sdp-id* and the service is created.

SDPs must be explicitly associated and bound to a service. If an SDP is not bound to a service, no far-end 7750 SRdevices can participate in the service.

The **no** form of this command removes the SDP binding from the service. The SDP configuration is not affected; only the binding of the SDP to a service. Once removed, no packets are forwarded to the far-end router.

Default No *sdp-id* is bound to a service.

Special Cases **VPRN —** Several SDPs can be bound to a VPRN service. Each SDP must be destined to a different 7750 SR router. If two *sdp-id* bindings terminate on the same 7750 SR, an error occurs and the second SDP binding is rejected.

Parameters *sdp-id* — The SDP identifier. Allowed values are integers in the range of 1 and 17407 for existing SDPs.

vc-id — The virtual circuit identifier.

Values 1 — 4294967295

egress

Syntax **egress**

Context config>service>vprn>red-if>spoke-sdp

Description This command configures egress SDP parameters.

ingress

Syntax **ingress**

Context config>service>vprn>red-if>spoke-sdp

Description This command configures ingress SDP parameters.

vc-label

Syntax **vc-label** *egress-vc-label*
no vc-label [*egress-vc-label*]

Context config>service>vprn>red-if>spoke-sdp>egress

Description This command configures the egress VC label.

Parameters *vc-label* — A VC egress value that indicates a specific connection.

Values 16 — 1048575

vc-label

Syntax **vc-label** *ingress-vc-label*
no vc-label [*ingress-vc-label*]

Context config>service>vprn>red-if>spoke-sdp>ingress

Description This command configures the ingress VC label.

Parameters *vc-label* — A VC ingress value that indicates a specific connection.

Values 2048 — 18431

filter

Syntax **filter** {**ip** *ip-filter-i*d}
no filter

Context config>service>vprn>red-if>spoke-sdp>ingress
config>service>vprn>red-if>spoke-sdp>egress

Description This command associates an IP filter policy with an ingress or egress Service Access Point (SAP) or IP interface. An IP filter policy can be associated with spoke SDPs.

Filter policies control the forwarding and dropping of packets based on IP or MAC matching criteria.

The filter command is used to associate a filter policy with a specified ip-filter-id with an ingress or egress SAP. The ip-filter-id must already be defined before the filter command is executed. If the filter policy does not exist, the operation will fail and an error message returned.

In general, filters applied to SAPs (ingress or egress) apply to all packets on the SAP. One exception is non-IP packets are not applied to IP match criteria, so the default action in the filter policy applies to these packets.

The no form of this command removes any configured filter ID association with the SAP or IP interface. The filter ID itself is not removed from the system unless the scope of the created filter is set to local. To avoid deletion of the filter ID and only break the association with the service object, use scope command within the filter definition to change the scope to local or global. The default scope of a filter is local.

Parameters **ip** *ip-filter-id* — Specifies IP filter policy. The filter ID must already exist within the created IP filters.

Values 1 — 65535

SDP Binding Commands

binding

Syntax **binding**

Context config>service>sdp

Description The command enables the context to configure SDP bindings.

port

Syntax **port** [*port-id* | *lag-id*]
no ort

Context config>service>sdp>binding

Description This command specifies the port or lag identifier, to which the PW ports associated with the underlying SDP are bound. If the underlying SDP is re-routed to a port or lag other than the specified one, the PW ports on the SDP are operationally brought down.

The **no** form of the command removes the value from the configuration.

Default none

Parameters *port-id* — The identifier of the port in the slot/mda/port format.

lag-id — Specifies the LAG identifier.

pw-port

Syntax **pw-port** *pw-port-id* [vc-id *vc-id*] [**create**]
no pw-port

Context config>service>sdp>binding

Description This command creates a PW-port.

The **no** form of the command removes the PW-port ID from the configuration.

Default none

Parameters *pw-port-id* — Specifies a unique identifier of the PW port.

Values 1 — 10239

vc-id *vc-id* **—** Specifies a virtual circuit identifier signaled to the peer.

Values 1 — 4294967295

description

Syntax **description** *description-string*
no description

Context config>service>sdp>binding>pw-port

Description This command creates a text description stored in the configuration file for a configuration context.

The description command associates a text string with a configuration context to help identify the content in the configuration file.

The **no** form of the command removes the string from the configuration.

Default no description

Parameters *description-string* — Specifies the description character string of the configuration context.

Values Any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

egress

Syntax **egress**

Context config>service>sdp>binding>pw-port

Description This command enables the context to configure PW-port egress side parameters.

encap-type

Syntax **encap-type** {**dot1q**|**qinq**}
no encap-type

Context config>service>sdp>binding>pw-port

Description This command sets the encapsulation type for the PW-port as dot1q or qinq.

Default dot1q

Parameters **dot1q —** Specifies **dot1q** encapsulation type.

qinq — Specifies **qinq** encapsulation type.

shaper

Syntax **shaper**
no shaper

Context config>service>sdp>binding>pw-port>egress

Description This command configures an egress shaping option for use by a PW port..

Default no shaper.

int-dest-id

Syntax [**no**] **int-dest-id** *int-dest-id*

Context config>service>sdp>binding>pw-port>egress>shaper

Description This command specifies the intermediate destination string configured for dynamic vport selection.

The **no** form of the command removes the configured intermediate destination string.

This command is only valid for PW ports used for enhanced subscriber management (ESM on PW).

Default no .int-dest-id

Parameters *int-dest-id* — A text string that describes the intermediate destination ID.

pw-sap-secondary-shaper

Syntax [**no**] **pw-sap-secondary-shaper** *secondary-shaper-name*

Context config>service>sdp>binding>pw-port>egress>shaper

Description This command configures the use of secondary shaper name as a reference to a shaper to use for a PW port on the HSMDA.

The **no** form of the command removes the configured shaper.

This command is valid for PW ports used PW SAPs on the HSMDA.

Default no pw-sap-secondary-shaper

Parameters *secondary-shaper-name* — specifies a text string representing the name of the secondary shaper.

vport

Syntax [**no**] **vport** *vport-name*

Context config>service>sdp>binding>pw-port>egress>shaper

Description This command configures the name of the vport to be used for the PW port.

The **no** form of the command removes the configured vport name.

This command is valid for PW ports used for enhanced subscriber management (ESM on pseudowire) and pseudowire SAPs on Ethernet ports. It is not valid for pseudowire ports on the HSMDA.

Default no vport

Parameters *vport-name* — Specifies a text string representing the name of the vport.

vc-type

Syntax **vc-type** {**ether**|**vlan**}
no vc-type

Context config>service>sdp>binding>pw-port

Description This command sets the forwarding mode for PW-port. The vc-type is signaled to the peer, and must be configured consistently on both ends of the PW. vc-type VLAN is only configurable with dot1q encapsulation on the PW-port. The tag with vc-type vlan only has significance for transport, and is not used for service delineation or ESM. The top (provider tag) is stripped while forwarding out of the PW, and a configured vlan-tag (for vc-type vlan) is inserted when forwarding into the PW. With vc-type ether, the tags if present (max 2), are transparently preserved when forwarding in our out of the PW.

The **no** form of the command reverts to the default value.

Default ether

Parameters **ether —** Specifies **ether** as the virtual circuit (VC) associated with the SDP binding.

vlan — Specifies **vlan** as the virtual circuit (VC) associated with the SDP binding.

vlan-vc-tag

Syntax **vlan-vc-tag** *vlan-id*
no vc-type

Context config>service>sdp>binding>pw-port

Description This command sets tag relevant for vc-type vlan mode. This tag is inserted in traffic forwarded into the PW.

The **no** form of the command reverts to the default value.

Default 0

Parameters *vlan-id* — Specifies the VLAN ID value.

Values 0 — 4094

RIP Commands

rip-policy

Syntax **rip-policy** *policy-name* [**create**]
no rip- policy-name

Context config>subscr-mgmt

Description This command creates a RIP policy. This policy is applied to a subscriber IPv4 host to enable the BNG to learn RIP routes from the host. RIP routes are never sent to the hosts.

Default none

Parameters *policy-name* — Specifies the RIP policy name up to 32 characters in length.

neighbor

Syntax [**no**] **neighbor** *ip-int-name*

Context config>router>rip>group
config>service>vprn>rip>group

Description This command creates a context for configuring a RIP neighbor interface. By default, group interfaces are not activated with RIP, unless explicitly configured. The BNG will only learn RIP routes from IPv4 host on the group interface. Hence, RIP neighbor group interface will default send to "none". The send operation is unchangeable for group-interface.

The no form of the command deletes the RIP interface configuration for this group interface. The shutdown command in the **config>router>rip>group group-name>neighbor** context can be used to disable an interface without removing the configuration for the interface.

Default no neighbor — No RIP interfaces are defined.

Parameters *ip-int-name* — The group interface name. Interface names must be unique within the group of defined group interfaces within config service vprn/ies sub-interface grp-interface commands. An interface name cannot be in the form of an IP address. Interface names can be any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes. If the group interface name does not exist, an error message will be returned.

authentication-key

Syntax **authentication-key** [*authentication-key* | *hash-key*] [**hash** | **hash2**]
no authentication-key

Context config>subscr-mgmt>rip-policy

Description This command configures the BGP authentication key.

Authentication is performed between neighboring routers before setting up the BGP session by verifying the password. Authentication is performed using the MD-5 message-based digest. The authentication key can be any combination of letters or numbers from 1 to 16.

The no form of the command removes the authentication password from the configuration and effectively disables authentication.

Default Authentication is disabled and the authentication password is empty.

Parameters *authentication-key* — The authentication key. The key can be any combination of ASCII characters up to 255 characters in length (unencrypted). If spaces are used in the string, enclose the entire string in quotation marks (“ ”).

hash-key — The hash key. The key can be any combination of ASCII characters up to 342 characters in length (encrypted). If spaces are used in the string, enclose the entire string in quotation marks (“ ”).

This is useful when a user must configure the parameter, but, for security purposes, the actual unencrypted key value is not provided.

hash — Specifies the key is entered in an encrypted form. If the **hash** parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form. If the **hash2** parameter is not used, the less encrypted **hash** form is assumed.

authentication-type

Syntax **authentication-type** {**none**|**password**|**message-digest**|**message-digest-20**}
no authentication-type

Context config>sub-mgmg>rip-policy>

Description This command sets the type of authentication to be used between RIP neighbors. The type and password must match exactly for the RIP message to be considered authentic and processed.

The **no** form of the command removes the authentication type from the configuration and effectively disables authentication.

Default no authentication-type — No authentication enabled.

Parameters **none —** The none parameter explicitly disables authentication at a given level (global, group, neighbor). If the command does not exist in the configuration, the parameter is inherited.

password — Specify password to enable simple password (plain text) authentication. If authentication is enabled and no authentication type is specified in the command, simple password authentication is enabled.

message-digest — Configures 16 byte message digest for MD5 authentication. If this option is configured, then at least one message-digest-key must be configured.

message-digest-20 — Configures 20 byte message digest for MD5 authentication in accordance with RFC 2082, RIP-2 MD5 Authentication. If this option is configured, then at least one message-digest-key must be configured.

retail-svc-id

Syntax **retail-svc-id** *service-id*
retail-svc-id

Context config>service>ies|vprn>sub-if>grp-if>sap>static-host

Description This command specifies the service id of the retailer IES/VPRN service to which the static IPv6 host belongs. A corresponding retailer subscriber interface must exist in the specified service.

Default no retail-svc-id

Parameters *service-id* — Specifies the retailer service ID.

Values 1 — 2148007978

rip

Syntax [**no**] **rip**

Context config>service>vprn
config>service>ies

Description This command enables the RIP protocol on the given VPRN IP interface.

The **no** form of the command disables the RIP protocol from the given VPRN IP interface.

Default no rip

group

Syntax [**no**] **group** *group-name*

Context config>service>vprn>rip
config>service>ies>rip

Description This command creates a context for configuring a RIP group of neighbors. RIP groups are a way of logically associating RIP neighbor interfaces to facilitate a common configuration for RIP interfaces.

The **no** form of the command deletes the RIP neighbor interface group. Deleting the group will also remove the RIP configuration of all the neighbor interfaces currently assigned to this group.

Default **no group** — No group of RIP neighbor interfaces defined

Parameters *group-name* — The RIP group name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

Vport Commands

ethernet

Syntax **ethernet**

Context config>port

Description This command enables access to the context to configure Ethernet port attributes.

This context can only be used when configuring Fast Ethernet, gigabit or 10Gig Fast Ethernet or Ethernet LAN ports on an appropriate MDA.

egress-scheduler-override

Syntax [**no**] **egress-scheduler-override**

Context config>port>ethernet

Description This command applies egress scheduler overrides. When a port scheduler is associated with an egress port, it is possible to override the following parameters:

- The **max-rate** allowed for the scheduler.
- The maximum **rate** for each priority level 8 through 1.
- The CIR associated with each priority level 8 through 1.

See the SR OS Quality of Service Guide for command syntax and usage for the **port-scheduler-policy** command.

The **no** form of this command removes all override parameters from the egress port or channel scheduler context. Once removed, the port scheduler reverts all rate parameters back to the parameters defined on the port-scheduler-policy associated with the port.

level

Syntax **level** *priority-level* **rate** *pir-rate* [**cir** *cir-rate*]
no level *priority-level*

Context config>port>ethernet>egress-scheduler-override

Description This command overrides the maximum and CIR rate parameters for a specific priority level on the port or channel's port scheduler instance. When the **level** command is executed for a priority level, the corresponding priority level command in the port-scheduler-policy associated with the port is ignored.
The override level command supports the keyword **max** for the **rate** and **cir** parameter.
When executing the level override command, at least the **rate** or **cir** keywords and associated parameters must be specified for the command to succeed.

The **no** form of this command removes the local port priority level rate overrides. Once removed, the port priority level will use the port scheduler policies level command for that priority level.

Parameters *priority-level* — Identifies which of the eight port priority levels are being overridden.

Values 1 — 8

rate *pir-rate* **—** Overrides the port scheduler policy's maximum level rate and requires either the **max** keyword or a rate defined in kilobits-per-second to follow.

Values 1 — 40000000, max

cir *cir-rate* **—** Overrides the port scheduler policy's within-cir level rate and requires either the max keyword or a rate defined in kilobits-per-second to follow.

Values 0— 40000000, max

max — removes any existing rate limit imposed by the port scheduler policy for the priority level allowing it to use as much total bandwidth as possible.

access

Syntax **access**

Context config>port>ethernet

Description This command configures Ethernet access port parameters.

egress

Syntax **egress**

Context config>port>ethernet>access

Description This command configures Ethernet access egress port parameters.

vport

Syntax **vport** *name* [**create**]
no vport *name*

Context config>port>ethernet>access>egress

Description This command configures a scheduling node, referred to as virtual port, within the context of an egress Ethernet port. The vport scheduler operates either like a port scheduler with the difference that multiple vport objects can be configured on the egress context of an Ethernet port, or it can be an aggregate rate when an egress port-scheduler policy is applied to the port.

The vport is always configured at the port level even when a port is a member of a LAG.

When a port scheduler policy is applied to a vport the following command is used:

configure>port>ethernet>acess>egress>vport>port-scheduler-policy *port-scheduler-policy-name*

The CLI will not allow the user to apply a port scheduler policy to a vport if one has been applied to the port. Conversely, the CLI will not allow the user to apply a port scheduler policy to the egress of an Ethernet port if one has been applied to any vport defined on the access egress context of this port. The agg-rate-limit, along with an egress port-scheduler, can be used to ensure that a given vport does not oversubscribe the port's rate.

SAP and subscriber host queues can be port-parented to a vport scheduler in a similar way they port-parent to a port scheduler or can be port-parented directly to the egress port-scheduler if the agg-rate-limit is used.

When the vport uses an aggregate rate, the following command is used:

configure>port>ethernet>acess>egress>vport>agg-rate-limit

Parameters *name* — Specifies the name of the vport scheduling node and can be up to 32 ASCII characters in length. This does not need to be unique within the system but is unique within the port or a LAG.

agg-rate-limit

Syntax **agg-rate-limit** *agg-rate*
no agg-rate-limit

Context configure>port>ethernet>access>egress>vport

Description This command configures an aggregate rate for the vport. This command is mutually exclusive with the port-scheduler-policy command.

Parameters *agg-rate* — Specifies the rate limit for the vport.

Values **max**, 1— 10000000

egress-rate-modify

Syntax [**no**] **egress-rate-modify**

Context configure>port>ethernet>access>egress>vport

Description This command is used to apply HQoS Adjustment to a vport. HQoS Adjustment refers to the dynamic adjustment of the rate limit at an QoS enforcement point within 7x50 when the multicast traffic stream is disjointed from the unicast traffic stream. This QoS enforcement point within 7x50 represents the physical point further down in the access part of the network where the two streams join each other and potentially can cause congestion.

An example would be a PON port which is shared amongst subscriber's multicast traffic (single copy of each channel) and subscriber's unicast traffic. The bandwidth control point for this PON port resides in the upstream 7x50 BNG node in the form of a vport. In case that the multicast delivery method in the 7x50 BNG utilizes redirection, the multicast traffic in the 7x50 BNG will flow outside of the subscriber or the vport context and thus will bypass any bandwidth enforcement in 7x50. To correct this, a vport bandwidth adjustment is necessary in 7x50 that will account for the multicast bandwidth consumption that is bypassing vport in 7x50 but is present in the PON port whose bandwidth is controlled by vport.

An estimate of the multicast bandwidth consumption on the PON port can be made at the vport level based on the IGMP messages sourced from the subscribers behind the PON port. This process is called HQoS Adjustment.

A multicast channel bandwidth is subtracted from or added to the vport rate limit according to the received IGMP Join/Leave messages and the channel bandwidth definition policy associated with the vport (indirectly through a group-interface). Since the multicast traffic on the PON port is shared amongst subscribers behind this PON port, only the first IGMP Join or the last IGMP Leave per multicast channel is tracked for the purpose of the vport bandwidth modification.

The vport rate that will be affected by this functionality depends on the configuration:

- In case the agg-rate-limit within the vport is configured, its value will be modified based on the IGMP activity associated with the subscriber under this vport.
- In case the port-scheduler-policy within the vport is referenced, the max-rate defined in the corresponding port-scheduler-policy will be modified based on the IGMP activity associated with the subscriber under this vport.

The channel bandwidth definition policy is defined in the mcac policy in the **configure>router>mcac>policy** context. The policy is applied under the group-interface or in case of redirection under the redirected-interface.

The rates in effect can be displayed with the following two commands:

show port 1/1/5 vport *name*

qos scheduler-hierarchy port *port-id* vport *vport-name*

The configuration of a scheduler policy under a Vport, which is only applicable to Ethernet interfaces, is mutually exclusive with the configuration of the egress-rate-modify parameter.

The configuration of a scheduler policy under a Vport, which is only applicable to Ethernet interfaces, is mutually exclusive with the configuration of the **egress-rate-modify** parameter.

Context HQoS Adjustment for vport is disabled.

host-match

Syntax **host-match dest** *destination-string* [**create**]
no host-match dest *destination-string*

Context config>port>ethernet>access>egr>qgrp

Description This command configures host matching for the Ethernet port egress queue-group.

The no form of the command removes

Parameters **dest** *destination-string* **—** Specify a host match destination string up to 32 characters in length.

create — Keyword used to create the host match. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

port-scheduler-policy

Syntax **port-scheduler-policy** *port-scheduler-policy-name*

no port-scheduler-policy

Context config>port>ethernet>access>egress>vport

Description This command specifies the destination and organization strings to be used for matching subscriber hosts with this vport.

The parent vport of a subscriber host queue, which has the port-parent option enabled, is determined by matching the destination string dest string associated with the subscriber and the organization string org string associated with the subscriber host with the strings defined under a vport on the port associated with the subscriber.

If a given subscriber host queue does not have the port-parent option enabled, it will be foster-parented to the vport used by this subscriber and which is based on matching the dest string and org string. If the subscriber could not be matched with a vport on the egress port, the host queue will not be bandwidth controlled and will compete for bandwidth directly based on its own PIR and CIR parameters.

By default, a subscriber host queue with the port-parent option enabled is scheduled within the context of the port's port scheduler policy.

The **agg-rate rate**, **port-scheduler-policy** and **scheduler-policy** commands are mutually exclusive. Changing between the use of a scheduler policy and the use of an agg-rate/port-scheduler-policy involves removing the existing command and applying the new command. Applying a scheduler-policy to a VPORT is only applicable to Ethernet interfaces.

The **no** form of the command removes the port-scheduler-policy-name from the configuration.

The **agg-rate** *rate*, **port-scheduler-policy** and **scheduler-policy** commands are mutually exclusive. Changing between the use of a scheduler policy and the use of an **agg-rate**/**port-scheduler-policy** involves removing the existing command and applying the new command.

Parameters *port-scheduler-policy-name* — Specifies an existing port-scheduler-policy configured in the **config>qos** context.

scheduler-policy

Syntax **scheduler-policy** *scheduler-policy-name*
no scheduler-policy

Context config>port>ethernet>access>egress>vport

Description This command specifies a scheduler policy to associate to the Vport. Scheduler policies are configured in the **configure>qos>scheduler>policy** context. Each scheduler policy is divided up into groups of schedulers based on the tier each scheduler is created under. A tier is used to give structure to the schedulers within a policy and define rules for parent scheduler associations. The policy defines the hierarchy and operating parameters for virtual schedulers.

The **no** form of this command removes the configured egress scheduler policy from the VPORT.

The **agg-rate rate**, **port-scheduler-policy** and **scheduler-policy** commands are mutually exclusive. Changing between the use of a scheduler policy and the use of an agg-rate/port-scheduler-policy involves removing the existing command and applying the new command.

The configuration of a scheduler policy under a Vport is mutually exclusive with the configuration of the egress-rate-modify parameter.

Parameters *scheduler-policy-name* — The *scheduler-policy-name* parameter applies an existing scheduler policy that was created in the **config>qos>scheduler-policy** *scheduler-policy-name* context to create the hierarchy of egress virtual schedulers.

parent-location

Syntax **parent-location {default | sla}**
no parent-location

Context config>qos>sap-egress

Description This command determines the expected location of the parent schedulers for queues configured with a parent command within the SAP egress policy. All parent schedulers must be configured within a scheduler policy applied at the location corresponding to the parent-location parameter.

If a parent scheduler name does not exist at the specified location, the queue will not be parented and will be orphaned.

Default parent-location default

Parameters **default —** When the SAP egress policy is applied to an SLA profile for a subscriber, the parent schedulers of the queues need to be configured in the scheduler policy applied to the subscriber's SUB profile.
When the SAP egress policy is applied to a SAP, the parent schedulers of the queues need to be configured in the scheduler policy applied to the SAP or the multi-service site.

sla — When the SAP egress policy is applied to an SLA profile for a subscriber, the parent schedulers of the queues need to be configured in the scheduler policy applied to the same SLA profile.
If this parameter is configured within a SAP egress policy that is applied to any object except of the egress of an SLAprofile, the configured parent schedulers will not be found and so the queues will not be parented and will be orphaned.

parent-location

Syntax **parent-location {none | sub | vport}**
no parent-location

Context config>qos>scheduler-policy

Description This command determines the expected location of the parent schedulers for the tier 1 schedulers configured with a parent command within the scheduler policy. The parent schedulers must be configured within a scheduler policy applied at the location corresponding to the parent location parameter.

If a parent scheduler name does not exist at the specified location, the schedulers will not be parented and will be orphaned.

The configuration of parent-location and frame-based-accounting in a scheduler policy is mutually exclusive in to ensure consistency between the different scheduling levels.

Default parent-location none

Parameters **none —** This parameter indicates that the tier 1 schedulers do not have a parent scheduler and the configuration of the parent under a tier 1 scheduler is blocked. Conversely, this parameter is blocked when any tier 1 scheduler has a parent configured.

sub — When the scheduler policy is applied to an SLA profile for a subscriber, the parent schedulers of the tier 1 schedulers need to be configured in the scheduler policy applied to the subscriber's SUB profile.
If this parameter is configured within a scheduler policy that is applied to any object except for the egress of an SLA profile, the configured parent schedulers will not be found and so the tier 1 schedulers will not be parented and will be orphaned.

vport — When the scheduler policy is applied to an SLA profile, a SUB profile for a subscriber or to the egress of a PW SAP, the parent schedulers of the tier 1 schedulers need to be configured in the scheduler policy applied to the VPORT to which the subscriber will be assigned.
If this parameter is configured within a scheduler policy that is applied to to any object except for the egress of an SLA profile or SUB profile, or to the egress of a PW SAP, the configured parent schedulers will not be found and so the tier 1 schedulers will not be parented and will be orphaned.

MLD Policy Commands

mld-policy

Syntax **mld-policy** *mld-policy-name* [**create**]
no mld-policy *mld-policy-name*

Context config>subscr-mgmt

Description This command enables the context to create an MLD policy.

egress-rate-modify

Syntax **egress-rate-modify agg-rate-limit**
egress-rate-modify scheduler *scheduler-name*
no egress-rate-modify

Context config>subscr-mgmt>mld-policy

Description This command configures the egress rate modification.

The **no** form of the command removes the values from the configuration.

Parameters **agg-rate-limit** — specifies that the maximum total rate for all subscriber egress queues for each subscriber associated with the policy.

scheduler *scheduler-name* — specifies the scheduler to be applied for egress rate modification.

fast-leave

Syntax [**no**] **fast-leave**

Context config>subscr-mgmt>mld-policy

Description This command enables fast leave. When fast leave processing is enabled, the router will immediately remove a SAP or SDP from the IP multicast group when it detects an MLD 'leave' on that SAP or SDP. Fast leave processing allows the switch to remove a SAP or SDP that sends a 'leave' from the forwarding table without first sending out group-specific queries to the SAP or SDP, and thus speeds up the process of changing channels ('zapping').

Fast leave should only be enabled when there is a single receiver present on the SAP or SDP.

When fast leave is enabled, the configured last-member-query-interval value is ignored.

Default no fast-leave

import

Syntax **import** *policy-name*
no import

Context config>subscr-mgmt>mld-policy

Description This command specifies the import routing policy to be used. Only a single policy can be imported at a time.

The **no** form of the command removes the policy association.

Default **no import** — No import policy is specified.

Parameters *policy-name* — The import policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes. Routing policies are configured in the config>router>policy-options context The router policy must be defined before it can be imported.

max-num-groups

Syntax **max-num-groups** *count*
no max-num-groups

Context config>subscr-mgmt>mld-policy

Description This command defines the maximum number of multicast groups that can be joined. If the router receives a join message that would exceed the configured number of groups, the request is ignored.

Default no max-num-groups

Parameters *count* — Specifies the maximum number of groups that can be joined.

Values 1 — 1000

max-num-grp-sources

Syntax **max-num-grp-sources** [1..32000]
no max-num-grp-sources

Context config>subscr-mgmt>mld-policy

Description This command configures the maximum number of group sources for which MLD can have local receiver information based on received MLD reports on this interface. When this configuration is changed dynamically to a value lower than currently accepted number of group sources, the group sources that are already accepted are not deleted. Only new group sources will not be allowed. When this object has a value of 0, there is no limit to the number of group sources.

The **no** form of the command removes the value from the configuration.

Default no max-num-grp-sources

Parameters **1..32000 —** Specifies the maximum number of multicast sources allowed to be tracked per group

max-num-sources

Syntax **max-num-sources** *max-num-sources*
no max-num-sources

Context config>subscr-mgmt>mld-policy

Description This command configures the maximum number of multicast sources allowed per group.

The **no** form of the command removes the value from the configuration.

Parameters *max-num-sources* — Specifies the maximum number of multicast sources allowed per group.

Values 1 — 1000

per-host-replication

Syntax [**no**] **per-host-replication**

Context config>subscr-mgmt>mld-policy

Description This command enables per-host-replication. In the per-host-replication mode, multicast traffic is replicated per each host within the subscriber irrespective of the fact that some hosts may be subscribed to the same multicast stream. As a result, in case that multiple hosts within the subscriber are registered for the same multicast group, the multicast streams of that group will be generated. The destination MAC address of multicast streams will be changed to unicast so that each host receives its own copy of the stream. Multicast traffic in the per-host-replication mode can be classified via the existing QoS CLI structure. As such the multicast traffic will flow through the subscriber queues. HQoS Adjustment is not needed in this case.

The alternative behavior for multicast replication in IPoE environment is per-SAP- replication. In this model, only a single copy of the multicast stream is sent per SAP, irrespective of the number of hosts that are subscribed to the same multicast group. This behavior applies to 1:1 connectivity model as well as on 1:N connectivity model (SAP centric behavior as opposed to subscriber centric behavior).

In the per-SAP-replication model the destination MAC address is multicast (as opposed to unicast in the per-host-replication model). Multicast traffic is flowing via the SAP queue which is outside of the subscriber context. The consequence is that multicast traffic is not accounted in the subscriber HQoS. In addition, HQoS Adaptation is not supported in the per SAP replication model.

Default disabled

redirection-policy

Syntax **redirection-policy** *policy-name*
no redirection-policy

Context config>subscr-mgmt>mld-policy

Description This command will apply multicast redirection action to the subscriber. The redirection action along with the redirected interface (and possibly service id) is defined in the referenced policy-name. MLD messages will be redirected to an alternate interface if that alternate interface has MLD enabled. The alternate interface does not have to have any multicast groups registered via MLD. Currently all MLD messages are redirected and there is no ability to selectively redirect MLD messages based on match conditions (multicast-group address, source IP address, etc.). Multicast redirection is supported between VPRN services and also between interfaces within the Global Routing Context. Multicast Redirection is not supported between the VRPN services and the Global Routing Table (GRT).

MLD state is maintained per subscriber host and per redirected interface. Traffic is however forwarded only on the redirected interface.

Default none

Parameters *policy-name* — This is a regular policy defined under the **configure>router>policy-option>policy-statement** context.

static

Syntax **static**

Context config>subscr-mgmt>mld-policy

Description This command adds an MLD static group membership.

group

Syntax [**no**] **group** *grp-ipv6-address*

Context config>subscr-mgmt>mld-policy>static

Description This command configures a static multicast group.

Parameters *grp-ipv6-address* — Specifies the IPv6 address.

Values <grp-ipv6-address> : ipv6-address - x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x - [0..FFFF]H
d - [0..255]D
- multicast group IPv6 address

source

Syntax [**no**] **source** *ipv6-address*

Context config>subscr-mgmt>mld-policy>static>group

Description This command adds or removes a static multicast source.

Parameters *grp-ipv6-address* — Specifies the IPv6 address.

Values <grp-ipv6-address> : ipv6-address - x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x - [0..FFFF]H
d - [0..255]D
- multicast group IPv6 address

starg

Syntax [**no**] **starg**

Context config>subscr-mgmt>mld-policy>static>group

Description This command adds a static (*,G) entry. This command can only be enabled if no existing source addresses for this group are specified.

Use the **no** form of the command to remove the starg entry from the configuration.

Default none

version

Syntax **version** *version*
no version

Context config>subscr-mgmt>mld-policy#

Description This command configures the MLD version.

Parameters *version* —

Values 1, 2

IPoE Session Commands

ipoe-session-policy

Syntax **ipoe-session-policy** *policy-name* [**create**]
no ipoe-session-polic*y policy-name*

Context config>subscr-mgmt

Description This command configures an IPoE session policy. The policies are referenced from subscriber interfaces, group interfaces and capture SAPs. Multiple IPoE session policies can be configured.

Default none

Parameters *policy-name* — Specifies the IPoE policy name up to 32 characters in length.

description

Syntax **description** *description-string*
no description

Context config>subscr-mgmt>ipoe-policy

Description This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the context in the configuration file.

The **no** form of this command removes any description string from the context.

Default no description

Parameters *description-string* — A text string describing the entity. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

session-key

Syntax **session-key sap mac** [**cid**] [**rid**]
no session-key

Context config>subscr-mgmt>ipoe-policy

Description This command configures the key to logically group subscriber hosts that belong to the same dual stack end device in an IPoE session.

The SAP and MAC address are always part of the IPoE session key. Optionally the Circuit-Id/Interface-Id or Remote-Id can be added to the session key.

Default session-key sap mac

Parameters **sap —** Includes the SAP as part of the IPoE session key. The **sap** parameter is mandatory and cannot be removed from the key.

mac — Includes the MAC address as part of the IPoE session key. The **mac** parameter is mandatory and cannot be removed from the key.

cid — Optionally adds the DHCPv4 Relay Agent Circuit-Id (option 82, sub option 1) and DHCPv6 Interface-Id (option 18) field to the IPoE session key.

rid — Optionally adds the DHCPv4 Relay Agent Remote-Id (option 82, sub option 2) and DHCPv6 Remote-Id (option 37) field to the IPoE session key. For DHCPv6, the enterprise number is excluded from the key.

NOTE: sap and **mac** are mandatory parameters while **cid** and **rid** are optional and mutually exclusive. Valid IPoE session key parameters are: **sap mac**, **sap mac cid** and **sap mac rid**.

session-timeout

Syntax **session-timeout** *timeout*
no session-timeout

Context config>subscr-mgmt>ipoe-policy

Description This command defines the time in seconds between 1 second and 360 days before the IPoE session will be disconnected. The default value is unlimited session timeout.

Default no session-timeout

Parameters *timeout* — Specifies the session timeout in seconds.

Values 1 — 31104000

ipoe-session

Syntax [**no**] **ipoe-session**

Context config>service>vpls>sap
config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if
config>service>ies>sub-if
config>service>vprn>sub-if

Description This command configures IPoE session parameters.

Default none

force-auth

Syntax **force-auth** [**cid-change**] [**rid-change**]
force-auth disabled
no force-auth

Context config>service>ies>sub-if>grp-if>ipoe-session
config>service>vprn>sub-if>grp-if>ipoe-session

Description By default, if the circuit-id/interface-id or remote-id in the IPoE session re-authentication trigger packet (such as a DHCP renewal) is not empty and different from the circuit-id/interface-id or remote-id stored in the IPoE session data, a forced re-authentication is performed, ignoring the configured min-auth-interval. This default behavior can be changed with the force-auth command.

The **no** form of the command, resets the default behavior.

Default force-auth cid-change rid-change

Parameters **cid-change** — Perform a forced re-authentication upon a circuit-id/interface-id change. An empty circuit-id/interface-id is not considered a change.

rid-change — Perform a forced re-authentication upon a remote-id change. an empty remote-id is not considered a change. For DHCPv6, the enterprise number is excluded from the comparison.

disabled — Does not perform a forced re-authentication upon a circuit-id/interface-id or remote-id change.

ipoe-session-policy

Syntax **ipoe-session-policy** *policy-name*
no ipoe-session-policy

Default config>service>vpls>sap> ipoe-session
config>service>ies>sub-if>grp-if>ipoe-session
config>service>vprn>sub-if>grp-if>ipoe-session

Description This command specifies the IPoE session policy applicable for this group interface or capture SAP.

Default no ipoe-session-policy

Parameters *policy-name* — Specifies the IPoE session policy name up to 32 characters in length

min-auth-interval

Syntax **min-auth-interval** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec seconds**]
min-auth-interval infinite
no min-auth-interval

Context config>service>ies>sub-if>grp-if>ipoe-session
config>service>vprn>sub-if>grp-if>ipoe-session

Description Re-authentication for IPoE sessions enable dynamic policy changes.

This command configures the maximum frequency of re-authentications by specifying a minimum interval between two non-forced authentications for the same IPoE session.

A forced authentication is by default triggered by a Circuit-Id/Interface-Id or Remote-Id change (see the force-auth command).

Re-authentications are by default disabled and can be enabled by configuring a min-auth-interval.

Setting the min-auth-interval to zero seconds will always re-authenticate on each trigger packet.

Default min-auth-interval infinite

Parameters **days —** Specifies the min number of days between two non-forced authentications for IPoE sessions

Values 0 — 365

hrs — Specifies the min number of hours between two non-forced authentications for IPoE sessions

Values 0 — 23

min — Specifies the min number of minutes between two non-forced authentications for IPoE sessions

Values 0 — 59

sec — Specifies the min number of seconds between two non-forced authentications for IPoE sessions

Values 0 — 59

infinite — Does not perform non-forced re-authentications for IPoE sessions (default).

sap-session-limit

Syntax **sap-session-limit** *sap-session-limit*
no sap-session-limit

Context config>service>ies>sub-if>grp-if>ipoe-session
config>service>vprn>sub-if>grp-if>ipoe-session

Description This command specifies the number of IPoE sessions per SAP allowed for this group-interface

Default sap-session-limit 1

Parameters *sap-session-limit* — Specifies the number of allowed IPoE sessions.

Values 1 — 65535

Note that the operational maximum value may be smaller due to equipped hardware dependencies.

session-limit

Syntax **session-limit** *session-limit*
no session-limit

Context config>service>ies>sub-if>grp-if>ipoe-session

config>service>vprn>sub-if>grp-if>ipoe-session
config>service>ies>sub-if>ipoe-session
config>service>vprn>sub-if>ipoe-session

Description This command specifies the number of IPoE sessions allowed for this group interface or retail subscriber interface.

Default session-limit 1

Parameters *session-limit* — Specifies the number of allowed IPoE sessions.

Values 1 – 65535
1 – 262143 (retail subscriber interface)
The operational maximum value may be smaller due to equipped hardware dependencies.

user-db

Syntax **user-db** *local-user-db-name*
no user-db

Context config>service>vpls>sap> ipoe-session
config>service>ies>sub-if>grp-if>ipoe-session
config>service>vprn>sub-if>grp-if>ipoe-session

Description This command configures the local user database to use for IPoE session authentication.

When configured on a capture SAP, the group interface must have the same local user database configured.

Default no user-db

Parameters *local-user-db-name* — Specifies the local user database name up to 32 characters in length.

shutdown

Syntax [**no**] **shutdown**

Context config>service>vpls>sap> ipoe-session
config>service>ies>sub-if>grp-if>ipoe-session
config>service>vprn>sub-if>grp-if>ipoe-session

Description The **shutdown** command enables or disables IPoE session management on a group-interface or capture SAP.

A shutdown of the IPoE session CLI hierarchy on a group-interface will clear all active IPoE sessions on that interface, resulting in a deletion of all corresponding subscriber hosts.

Default shutdown

Show Commands

radius-configuration

Syntax **radius-configuration**

Context show>aaa

Description This command displays RADIUS configuration information.

Sample Output

```
# show aaa radius-configuration
===============================================================================
RADIUS configuration
===============================================================================
CoA Port                    : 3799
===============================================================================
```

ancp-policy

Syntax **ancp-policy [*policy-name*]**
ancp-policy *policy-name* association

Context show>subscr-mgmt

Description This command displays subscriber Access Node Control Protocol (ANCP) policy information.

Parameters *policy-name* — Displays information for the specified ANCP policy.

association — Displays the information configured with the ANCP policy.

Sample Output

```
A:cses-E11>config>subscr-mgmt>ancp# show subscriber-mgmt ancp-policy "test"
===============================================================================
ANCP Policy "test"
===============================================================================
I. Rate Reduction      : 0 kbps
I. Rate Adjustment     : 100 percent
I. Rate Monitor        : 63360 kbps
I. Rate Monitor Alarm  : Yes
I. Rate Modify         : N/A

E. Rate Reduction      : 0 kbps
E. Rate Adjustment     : 100 percent
E. Rate Monitor        : 0 kbps
E. Rate Monitor Alarm  : no
E. Rate Modify         : N/A
```

```
Port Down : N/A

Last Mgmt Change: 02/13/2013 19:15:28
===============================================================================
*A:cses-E11>config>subscr-mgmt>ancp#
```

ancp-string

Syntax **ancp-string**
ancp-string ***ancp-string***
ancp-string customer ***customer-id*** **site** ***customer-site-name***
ancp-string sap ***sap-id***

Context show>subscr-mgmt

Description This command displays subscriber Access Node Control Protocol (ANCP) string information.

Parameters *ancp-string* — Specifies an Access Node Control Protocol (ANCP) string up to 63 characters in length.

customer *customer-id* **—** Specifies an existing customer ID.

Values 1..2147483647

site *customer-site-name* **—** Specifies an existing customer site name up to 32 characters in length.

sap *sap-id* **—** Displays ANCP string information for the specified SAP ID.

Values

<sap-id>	null	<port-id|bundle-id|bpgrp-id|lag-id|aps-id>
	dot1q	<port-id|bundle-id|bpgrp-id|lag-id|aps-id|pw-id>:qtag1
	qinq	<port-id|bundle-id|bpgrp-id|lag-id| pw-id>:qtag1.qtag2
	atm	<port-id|aps-id>[:vpi/vci|vpi|vpi1.vpi2|cp.conn-prof-id]
		cp - keyword
		conn-prof-id - [1..8000]
	frame	<port-id|aps-id>:dlci
	cisco-hdlc	slot/mda/port.channel
	cem	slot/mda/port.channel
	ima-grp	<bundle-id>[:vpi/vci|vpi|vpi1.vpi2|cp.conn-prof-id]
		cp keyword
		conn-prof-id [1..8000]
	port-id	slot/mda/port[.channel]
	bundle-id	bundle-<type>-slot/mda.<bundle-num>
		bundle keyword
		type ima|fr|ppp
		bundle-num [1..336]
	bpgrp-id	bpgrp-<type>-<bpgrp-num>
		bpgrp keyword
		type ima|ppp
		bpgrp-num [1..2000]
	aps-id	aps-<group-id>[.channel]
		aps keyword
		group-id [1..64]
	ccag-id	ccag-<id>.<path-id>[cc-type]:<cc-id>

	ccag keyword
	id [1..8]
	path-id [a|b]
	cc-type [.sap-net|.net-sap]
	cc-id [0..4094]
eth-tunnel	eth-tunnel-<id>[:<eth-tun-sap-id>]
	id [1..1024]
	eth-tun-sap-id [0..4094]
lag-id	lag-<id>
	lag keyword
	id [1..800]
pw-id	pw-<id>
	pw keyword
	id [1..10239]
qtag1	[0..4094]
qtag2	[*|0..4094]
vpi	[0..4095] (NNI)
	[0..255] (UNI)
vci	[1|2|5..65535]
dlci	[16..1022]
tunnel-id	tunnel-<id>.<private|public>:<tag>
	tunnel keyword
id	[1..16]
tag	[0..4094]

Sample Output

```
show subscriber-mgmt ancp-string "ANCP-0000003-0000001"
===============================================================================
ANCP-String "ANCP-0000003-0000001"
===============================================================================
Type       : SUB - "4AACAHCU74"
State      : Up                Ancp Policy: N/A
I. Rate    : 129 kbps          E. Rate    : 130 kbps
Adj I. Rate: N/A               Adj E. Rate: N/A
Act I. Rate: N/A               Act E. Rate: N/A
Service Id : 50 (VPRN)
Group      : linux
Neighbor   : 10.0.0.2:34885
Persist Key: N/A
-------------------------------------------------------------------------------
Actual-Net-Data-Rate-Upstream              : 129 kbits/s
Actual-Net-Data-Rate-Downstream            : 130 kbits/s
Minimum-Net-Data-Rate-Upstream             : 131 kbits/s
Minimum-Net-Data-Rate-Downstream           : 132 kbits/s
Attainable-Net-Data-Rate-Upstream          : 133 kbits/s
Attainable-Net-Data-Rate-Downstream        : 134 kbits/s
Maximum-Net-Data-Rate-Upstream             : 135 kbits/s
Maximum-Net-Data-Rate-Downstream           : 136 kbits/s
Minimum-Net-Low-Power-Data-Rate-Upstream   : 137 kbits/s
Minimum-Net-Low-Power-Data-Rate-Downstream : 138 kbits/s
Maximum-Interleaving-Delay-Upstream        : 139 ms
Actual-Interleaving-Delay-Upstream         : 140 ms
Maximum-Interleaving-Delay-Downstream      : 141 ms
Actual-Interleaving-Delay-Downstream       : 142 ms
```

```
DSL-Line-State                              : 2 (IDLE)
Access-Loop-Encapsulation                   : 16909056 (0x01020300)
===============================================================================
```

authentication

Syntax **authentication *policy-name* association**
authentication [*policy-name*]
authentication [*policy-name*] **statistics**
authentication coa-statistics

Context show>subscr-mgmt

Description This command displays subscriber management RADIUS authentication policy information and statistics.

Parameters *policy-name* — Specifies the subscriber management RADIUS authentication policy name, up to 32 characters, for which information is requested.

association — Displays SAP, interface, local user database host, AA and L2TP associations of this policy.

coa-statistics — Displays the overall statistics for incoming RADIUS Change of Authorization (CoA) messages and Disconnect Messages. For dropped requests, a counter for different drop reasons is available.

statistics — Displays a list of policies with basic statistics (without specifying a policy name) or detailed statistics, including per-server statistics for the specified policy-name. These statistics apply only to the legacy RADIUS server configuration method where the servers are directly configured in the authentication policy.

Sample Output

```
# show subscriber-mgmt authentication
===============================================================================
Authentication Policies
===============================================================================
Name                            Description
-------------------------------------------------------------------------------
auth-policy-1                   Radius auth policy - servers
auth-policy-2                   Radius auth policy - radius-server-policy
-------------------------------------------------------------------------------
Number of Authentication Policies : 2
===============================================================================


# show subscriber-mgmt authentication "auth-policy-2"
===============================================================================
Authentication Policy auth-policy-2
===============================================================================
Description          : Radius auth policy - radius-server-policy
Re-authentication    : Yes                 Username Format      : MAC Address
PPPoE Access Method  : PAP/CHAP            Username Mac-Format  : "aa:"
PPP-Username Oper    : None
```

```
PPP-Domain-Name      : N/A
Username Oper        : None
Domain-Name          : N/A
Acct-Stop-On-Fail    :
RADIUS Server Policy : "aaa-server-policy-1"
Fallback Action      : deny
Last Mgmt Change     : 06/24/2013 21:16:50
-------------------------------------------------------------------------------
Include Radius Attributes
-------------------------------------------------------------------------------
Remote Id            : Yes                 Circuit Id           : Yes
NAS Port Id          : Yes                 NAS Identifier       : Yes
PPPoE Service Name   : Yes                 DHCP Vendor Class Id : Yes
Access Loop Options  : Yes                 MAC Address          : Yes
NAS Port Prefix      : None                NAS Port Suffix      : None
NAS-Port-Type        : Yes (standard)      Acct Session Id      : Host
Calling Station Id   : Yes (sap-string)    Called Station Id    : Yes
Tunnel Server Attr   : Yes                 DHCP Options         : Yes
NAS Port             : Yes
NAS Port Bits Spec   : *3s*1m*4p*12o*12i
-------------------------------------------------------------------------------
Radius Servers
-------------------------------------------------------------------------------
Router               : management + Base   Source Address       : N/A
Access Algorithm     : Direct              Retry                : 3
Timeout (s)          : 5                   Hold down time (s)   : 30
-------------------------------------------------------------------------------
Index IP Address      Port  Pend-Req-Limit Out/Overload time (s) Oper State
-------------------------------------------------------------------------------
No Radius Servers configured.
-------------------------------------------------------------------------------
Accept Radius Attributes
-------------------------------------------------------------------------------
No Matching Entries
-------------------------------------------------------------------------------
Radius Script Policies
-------------------------------------------------------------------------------
Access-Request          : "N/A"
Access-Accept           : "N/A"
Change-of-Authorization : "N/A"
===============================================================================


# show subscriber-mgmt authentication "auth-policy-2" association
===============================================================================
Authentication Policy auth-policy-2
===============================================================================
-------------------------------------------------------------------------------
SAP Associations
-------------------------------------------------------------------------------
No associations found.
-------------------------------------------------------------------------------
Interface Associations
-------------------------------------------------------------------------------
Service-Id : 3000 (VPRN)
 - If Name : group-int-ws-1-1
-------------------------------------------------------------------------------
Local-User-Db PPPoE Host Associations
-------------------------------------------------------------------------------
Local-User-Db : ludb-1
 - Host : host-1
```

```
-------------------------------------------------------------------------------
Local-User-Db DHCP Host Associations
-------------------------------------------------------------------------------
Local-User-Db : ludb-1
 - Host : default
-------------------------------------------------------------------------------
Application Assurance Associations
-------------------------------------------------------------------------------
No associations found.
===============================================================================
No associated L2TP groups found.
No associated L2TP tunnels found.


# show subscriber-mgmt authentication statistics
===============================================================================
Authentication Policy Statistics
===============================================================================
Policy Name                       Subscr. Pkts   Subscr. Pkts   Subscr. Pkts
                                  Authenticated  Rejected       Rejected
                                                                Send Failed
-------------------------------------------------------------------------------
auth-policy-1                     0              0              0
auth-policy-2                     0              0              0
-------------------------------------------------------------------------------
Number of Authentication Policies : 2
===============================================================================


# show subscriber-mgmt authentication "auth-policy-1" statistics
===============================================================================
Authentication Policy Statistics
===============================================================================
-------------------------------------------------------------------------------
Policy name                              : auth-policy-1
subscriber packets authenticated         : 0
subscriber packets rejected              : 0
subscriber packets rejected send failed  : 0
-------------------------------------------------------------------------------
radius server     requests  requests  requests  requests   requests requests
idx IP-address    accepted  rejected  no reply  md5 failed pending  send failed
-------------------------------------------------------------------------------
1 172.16.1.1      0         0         0         0          0        0
-------------------------------------------------------------------------------
===============================================================================


# show subscriber-mgmt authentication coa-statistics
===============================================================================
Radius Notify Statistics    Change-Of-Authorization   Disconnect-Messages
===============================================================================
Requests Received             7                         10
Requests Accepted             5                         6
Requests Rejected             2                         4
Requests Dropped              0                         0
    No Auth Policy found      0                         0
    Invalid message           0                         0
    Out of resources          0                         0
    Authentication failure    0                         0
===============================================================================
```

diameter-application-policy

Syntax **diameter-application-policy** [*name*]

Context show>subscr-mgmt

Description This command displays Diameter application policy information.

Sample Output

```
# show subscriber-mgmt diameter-application-policy

===============================================================================
DIAMETER application policies
===============================================================================
Name                            Description
-------------------------------------------------------------------------------
diameter-gx-policy-1            Diameter Gx policy
diameter-gy-policy-1            Diameter Gy policy
diameter-nasreq-policy-1        Diameter NASREQ policy
-------------------------------------------------------------------------------
No. of policies: 3
===============================================================================

# show subscriber-mgmt diameter-application-policy "diameter-nasreq-policy-1"

===============================================================================
DIAMETER application policy "diameter-nasreq-policy-1"
===============================================================================
Description                 : Diameter NASREQ policy
Session failover            : enabled
Failover handling           : continue
Peer policy                 : diameter-peer-policy-1
Application                 : nasreq
Tx timer (s)                : 10
Last management change      : 02/28/2015 14:53:49
-------------------------------------------------------------------------------
NASREQ
-------------------------------------------------------------------------------
Include AVP                 : nas-port-id
                              nas-port-type
NAS-Port-Id prefix type     : none
NAS-Port-Id suffix type     : user-string
NAS-Port-Id suffix          : @bng1
NAS-Port-Type type          : standard

User name format            : mac
User name operation         : no-operation
MAC address format          : aa:
Last management change      : 02/28/2015 14:53:49
===============================================================================
Interfaces using diameter-auth-policy "diameter-nasreq-policy-1"
-------------------------------------------------------------------------------
Interface-name                  Service-id Type
-------------------------------------------------------------------------------
group-int-1-1                   1000       IES
-------------------------------------------------------------------------------
No. of interfaces: 1
-------------------------------------------------------------------------------
```

```
VPLS SAP's with diameter-auth-policy "diameter-nasreq-policy-1"
------------------------------------------------------------------------------
Service    SAP
------------------------------------------------------------------------------
10         1/1/4:*.*
------------------------------------------------------------------------------
No. of SAP's: 1
------------------------------------------------------------------------------
```

explicit-subscriber-map

Syntax **explicit-subscriber-map**

Context show>subscriber-mgmt

Description This command displays explicit subscriber mappings.

Sample Output

```
B:Dut-A>show>subscr-mgmt# explicit-subscriber-map
===============================================================================
Explicit Subscriber Map
===============================================================================
Key                              Sub profile
                                 SLA profile
-------------------------------------------------------------------------------
sub_ident_A_1                    sub_prof80
                                 sla_prof80
-------------------------------------------------------------------------------
Number of Explicit Subscriber Mappings : 1
===============================================================================
B:Dut-A>show>subscr-mgmt#
```

host-lockout-policy

Syntax **host-lockout-policy**
host-lockout-policy *policy-name* **association**
host-lockout-policy *policy-name*
host-lockout-policy *policy-name* **all**
host-lockout-policy *policy-name* **sap** *sap-id* [**circuit-id** | **mac** | **remote-id**]

Context show>subscriber-mgmt

Description This command displays host lockout policy information.

Parameters *policy-name* — Specifies a specific subscriber Host Lockout policy name up to 32 characters.

association — Specifies

all — Specifies to display all information fo rthe specified policy ID.

sap *sap-id* **—** Specifies to display SAP ID information.

circuit-id — Specifies to display circuit IDinformation.

mac — Specifies to display MAC address information.

remote-id — Specifies to display remote ID information.

Sample Output

```
*A:cses-E11# show subscriber-mgmt host-lockout-policy
===============================================================================
Host Lockout Policies
===============================================================================
Lockout Policy                   Last Mgmt Change
  Lockout Time Min                 Lockout Time Max
Description
  Lockout Reset Time               Max Lockout Hosts
-------------------------------------------------------------------------------
test                             04/20/2012 19:51:02
  10                               3600
test
  60                               100
===============================================================================
*A:cses-E11#


*A:cses-E11# show subscriber-mgmt host-lockout-policy "test"
===============================================================================
Host Lockout Policy "test"
===============================================================================
Description                      test
Last Mgmt Change                 04/20/2012 19:51:02
Lockout time min                 10
Lockout time max                 3600
Lockout reset time               60
Max lockout hosts                100
Host key                         all
===============================================================================
*A:cses-E11#
```

igmp-policy

Syntax **igmp-policy**
igmp-policy *policy-name* **association**
igmp-policy *policy-name*

Context show>subscriber-mgmt

Description This command displays IGMP policy information.

Parameters *policy-name* — Specifies an existing IGMP policy.

association — Displays the information configured with the IGMP policy.

Sample Output

```
*B:Dut-C# show subscriber-mgmt igmp-policy
===============================================================================
IGMP Policies
===============================================================================
IGMP Policy
  Import Policy                    Admin Version
Description
  Num Subscribers                  Host Max Groups
  Fast Leave
-------------------------------------------------------------------------------
pol1
                                   3
  2                                0
  fast-leave
pol2
                                   3
  0                                0
  fast-leave
===============================================================================
*B:Dut-C#


*B:Dut-C# show subscriber-mgmt igmp-policy "pol1"
===============================================================================
IGMP Policy pol1
===============================================================================
Import Policy                        :
Admin Version                        : 3
Num Subscribers                      : 2
Host Max Group                       : 0
Fast Leave                           : yes
===============================================================================
*B:Dut-C#
```

```
*B:Dut-C# show subscriber-mgmt igmp-policy "pol1" association
===============================================================================
IGMP Policy pol1 Associations
===============================================================================
sub_1
sub_2
-------------------------------------------------------------------------------
No. of subscriber(s): 2
===============================================================================
*B:Dut-C#
```

ipoe-session-policy

Syntax **ipoe-session-policy** *ipoe-session-policy-name* [**association**]
ipoe-session-policy

Context show>subscr-mgmt

Description This command displays IPoE session policy information.

Parameters *ipoe-session-policy-name* — Specifies the IPoE session policy name up to 32 characters in length.

association — Displays the interface and captures SAPs that reference the IPoE session policy.

Sample Output

```
# show subscriber-mgmt ipoe-session-policy "ipoe-policy-1"

===============================================================================
IPoE Session Policy "ipoe-policy-1"
===============================================================================
Description           : IPoE policy
Last Mgmt Change      : 02/28/2015 11:51:25
Session Key           : sap-mac
Session Timeout       : unlimited
===============================================================================

# show subscriber-mgmt ipoe-session-policy "ipoe-policy-1" association

===============================================================================
IPoE Session Policy "ipoe-policy-1"
===============================================================================
-------------------------------------------------------------------------------
IPoE Interface Associations
-------------------------------------------------------------------------------
Service-Id : 1000 (IES)
 - group-int-1-1
Service-Id : 2000 (VPRN)
 - group-int-1-1

-------------------------------------------------------------------------------
Capture SAP Associations
-------------------------------------------------------------------------------
Service-Id : 10 (VPLS)
- 1/1/4:*.*
===============================================================================
```

local-user-db

Syntax **local-user-db** *local-user-db-name* **association** [**dhcp**] [**ppp]** [**12tp**] [**radius**] [**pppoe**] [**dhcp6**] [**capture-sap**] [**rtr-solicit**] [**wpp**] [**ipoe**]
local-user-db *local-user-db-name* **ipoe-all-hosts**
local-user-db *local-user-db-name* **ipoe-host** *ipoe-host-name*
local-user-db *local-user-db-name* **ipoe-unmatched-hosts**
local-user-db [*local-user-db-name*]
local-user-db *local-user-db-name* **pppoe-all-hosts**
local-user-db *local-user-db-name* **pppoe-host** *pppoe-host-name*
local-user-db *local-user-db-name* **pppoe-unmatched-hosts**

Context show>subscriber-mgmt

Description This command displays local user database information.

Sample Output

```
*A:ALA-48>show>subscr-mgmt# local-user-db
===============================================================================
Local User Databases
===============================================================================
Name                            Admin Host  Description
                                State Count
-------------------------------------------------------------------------------
database01                      Down  1
database02 Provider001/Class0002 Down  0     This is a long testdescription wi*
test                            Down  2
-------------------------------------------------------------------------------
Number of Local User Databases : 3     Number of Hosts : 3
===============================================================================
* indicates that the corresponding row element may have been truncated.


*A:ALA-48>show>subscr-mgmt# local-user-db database01
===============================================================================
Local User Database "database01"
===============================================================================
Admin State          : Down
Last Mgmt Change     : 11/08/2007 12:27:36
Host Count           : 1
DHCP Match Types     : circ-id
DHCP CircId Mask Pfx : test
DHCP CircId Mask Sfx : N/A
PPPoE Match Types    : N/A
PPPoE CircId Mask Pfx: N/A
PPPoE CircId Mask Sfx: N/A
===============================================================================
*A:ALA-48>show>subscr-mgmt#


*A:ALA-48>show>subscr-mgmt# local-user-db database01 dhcp-all-hosts
===============================================================================
Local User Database "database01" DHCP hosts
===============================================================================
Name                            Admin     Matched objects
                                State
```

```
-------------------------------------------------------------------------------
host001                           Down      -
-------------------------------------------------------------------------------
Number of DHCP Hosts : 1
===============================================================================

*A:ALA-48>show>subscr-mgmt# local-user-db "database01" dhcp-host host001
===============================================================================
DHCP Host "host001"
===============================================================================
Admin State          : Down
Last Mgmt Change     : 11/08/2007 12:13:42

Host Indentification
 Circuit Id          : N/A
 Mac Address         : N/A
 Remote Id           : N/A
 Sap Id              : N/A
 Service Id          : N/A
 String              : N/A
 Option 60           : N/A
 System Id           : N/A

Matched Objects      : N/A

Address              : N/A

Identification Strings
 Subscriber Id       : N/A
 SLA Profile String  : N/A
 Sub Profile String  : N/A
 App Profile String  : N/A
 ANCP String         : N/A
 Inter Destination Id: N/A
===============================================================================
```

```
*A:ALA-48>show>subscr-mgmt# local-user-db "database01" dhcp-unmatched-hosts
===============================================================================
Local User Database "database01" DHCP unmatched hosts
===============================================================================
Name                              Reason      Duplicate Host
-------------------------------------------------------------------------------
host002                           No match    N/A
host003                           Duplicate   host001
host004                           No match    N/A
host005                           Duplicate   host001
-------------------------------------------------------------------------------
Number of DHCP Unmatched Hosts : 4
===============================================================================
*A:ALA-48>show>subscr-mgmt#


*A:ALA-48>show>subscr-mgmt# local-user-db "database01" association
===============================================================================
DHCP Servers where database01 is used
===============================================================================
Server-Name                       Router-Name
-------------------------------------------------------------------------------
dhcpS1                            vprn1000
-------------------------------------------------------------------------------
No. of Server(s): 1
===============================================================================
Interfaces where database01 is used for authentication
===============================================================================
Interface-Name                    Service-Id Type
-------------------------------------------------------------------------------
No. of Interface(s): 0
===============================================================================
*A:ALA-48>show>subscr-mgmt#


*A:ALA-48>show>subscr-mgmt# local-user-db "database01" association dhcp
===============================================================================
DHCP Servers where database01 is used
===============================================================================
Server-Name                       Router-Name
-------------------------------------------------------------------------------
dhcpS1                            vprn1000
-------------------------------------------------------------------------------
No. of Server(s): 1
===============================================================================
*A:ALA-48>show>subscr-mgmt#
===============================================================================

# show subscriber-mgmt local-user-db "ludb-1" association ipoe

===============================================================================
IPoE client interface associations for ludb-1
===============================================================================
Interface-Name                            Svc-Id     Type
-------------------------------------------------------------------------------
group-int-1-1                             1000       IES
group-int-1-1                             2000       VPRN
-------------------------------------------------------------------------------
No. of Interface(s): 2
===============================================================================
```

```
===============================================================================
Capture SAP associations for ludb-1
===============================================================================
SAP                              Svc-Id     Type   PPPoE PPP IPoE DHCP DHCP6 RS
-------------------------------------------------------------------------------
1/1/4:1202.*                     10         VPLS   y         y    y    y     y
1/1/4:*.*                        10         VPLS   y         y    y    y     y
-------------------------------------------------------------------------------
No. of SAP(s): 2
===============================================================================
```

msap-policy

Syntax **msap-policy** [*msap-policy-name* [**association**]]

Context show>subscr-mgmt

Description This command displays Managed SAP policy information.

Sample Output

```
*A:ALA-48>show>subscr-mgmt# msap-policy
===============================================================================
Managed SAP Policies
===============================================================================
Name                             Num    Description
                                 MSAPs
-------------------------------------------------------------------------------
test                             0      (Not Specified)
test 1                           0      (Not Specified)
-------------------------------------------------------------------------------
Number of MSAP Policies : 2
Number of MSAPs         : 0
===============================================================================
*A:ALA-48>show>subscr-mgmt#
```

sla-profile

Syntax **sla-profile** [*sla-profile-name* [**association**]]

Context show>subscriber-mgmt

Description This command displays SLA profile information.

Parameters *sla-profile-name* — Specifies an existing SLA profile name.

association — Displays the information configured with the specified *sla-profile-name*.

Sample Output

```
A:Dut-A# show subscriber-mgmt sla-profile
===============================================================================
```

```
SLA Profiles
===============================================================================
Name                             Description
-------------------------------------------------------------------------------
sla_default
sla_prof100_VOIP
sla_prof110_VOIP
sla_prof120_VOIP
sla_prof130_VOIP
sla_prof140_VOIP
sla_prof230_VOIP
sla_prof80
sla_prof80_VOIP
sla_prof81_VOIP
sla_prof90_VOIP
sla_profPC1
sla_profPC2
sla_profPC3
-------------------------------------------------------------------------------
Number of SLA Profiles : 14
===============================================================================
A:Dut-A#


A:Dut-A# show subscriber-mgmt sla-profile sla_prof100_VOIP
===============================================================================
SLA Profile sla_prof100_VOIP
===============================================================================
Host Limit           : 3 (Remove Oldest)
Ingress Qos-Policy   : 100                    Egress Qos-Policy : 100
Ingress Queuing Type : Service-queuing
Ingress Filter-Id    : N/A                    Egress Filter-Id  : N/A
Last Mgmt Change     : 07/10/2006 12:55:33
-------------------------------------------------------------------------------
Ingress Queue Overrides
-------------------------------------------------------------------------------
Queue Rate      CIR       HiPrio  CBS     MBS
-------------------------------------------------------------------------------
2     4000      -         -       -       -
3     2500      -         -       -       -

-------------------------------------------------------------------------------
Egress Queue Overrides
-------------------------------------------------------------------------------
Queue Rate      CIR       HiPrio  CBS     MBS
-------------------------------------------------------------------------------
2     4000      -         -       -       -
3     2500      -         -       -       -
===============================================================================
A:Dut-A#


A:Dut-A# show subscriber-mgmt sla-profile sla_prof100_VOIP association
===============================================================================
SLA Profile sla_prof100_VOIP
-------------------------------------------------------------------------------
SAP Default-Profile Associations
-------------------------------------------------------------------------------
No associations found.
-------------------------------------------------------------------------------
SAP Static Host Associations
```

```
-------------------------------------------------------------------------------
No associations found.
-------------------------------------------------------------------------------
SAP Non-Sub-Traffic-Profile Associations
-------------------------------------------------------------------------------
No associations found.
-------------------------------------------------------------------------------
Sub-Ident-Policy Profile Map Associations
-------------------------------------------------------------------------------
Policy-name : sub_ident_all
 - Key : sla_prof100_VOIP
-------------------------------------------------------------------------------
Sub-Profile Map Associations
-------------------------------------------------------------------------------
No associations found.
-------------------------------------------------------------------------------
Explicit Subscriber Map Associations
-------------------------------------------------------------------------------
No associations found.
===============================================================================
A:Dut-A#
```

sla-profile

Syntax **subscriber** *sub-ident-string* **sla-profile** *sla-profile-name* **sap** *sap-id* [**scheduler** *scheduler-name*]

Context show>qos>scheduler-stats

Description This command displays the subscriber's SLA profile scheduler stats.

Parameters **subscriber** *sub-ident-string* — Displays information for the specified subscriber profile name.

sla-profile *sla-profile-name* — Displays information for the specified *sla-profile-name*.

sap *sap-id* — Displays information for the specified SAP.

scheduler *scheduler-name* — Displays information for the specified *scheduler-name.*

Sample Output

```
*A:BNG# show qos scheduler-stats subscriber "sub1" sla-profile "sla-profile.1" sap 1/
1/1:1 scheduler

"session-sched"

===============================================================================
Scheduler Stats
===============================================================================
Scheduler                          Forwarded Packets      Forwarded Octets
-------------------------------------------------------------------------------

Egress Schedulers

session-sched                      0                      0
===============================================================================
*A:BNG#
```

port

Syntax **port** *port-id* **vport** *name* [**scheduler** *scheduler-name*] [**detail**]

Context show>qos>scheduler-hierarchy

Description This command displays the subscriber's SLA profile scheduler stats.

Parameters **port** *port-id* — Displays information for the specified port.

vport *name* — Displays information for the specified vport.

scheduler *scheduler-name* — Displays information for the specified *scheduler-name.*

detail — Displays detailed information.

Sample Output

```
*A:BNG# show qos scheduler-hierarchy port 1/1/1 vport "dslam1" scheduler "dslam-
sched"

===============================================================================
Scheduler Hierarchy - Port 1/1/1
===============================================================================
Scheduler-policy dslam-sched-pol
| slot(1)
|--(S) : subscriber-sched (VPort dslam1 1/1/1)
|   |
|   |--(S) : session-sched
|   |   |
|   |   |--(Q) : Sub=sub2:sla-profile.2 200->1/1/1:2->3
|   |   |
|   |   |--(Q) : Sub=sub2:sla-profile.2 200->1/1/1:2->2
|   |   |
|   |   |--(Q) : Sub=sub2:sla-profile.2 200->1/1/1:2->1
|   |   |
|   |
|   |--(S) : session-sched
|   |   |
|   |   |--(Q) : Sub=sub2:sla-profile.1 200->1/1/1:2->3
|   |   |
|   |   |--(Q) : Sub=sub2:sla-profile.1 200->1/1/1:2->2
|   |   |
|   |   |--(Q) : Sub=sub2:sla-profile.1 200->1/1/1:2->1
|   |   |
|
|--(S) : subscriber-sched (VPort dslam1 1/1/1)
|   |
|   |--(S) : session-sched
|   |   |
|   |   |--(Q) : Sub=sub1:sla-profile.2 200->1/1/1:1->3
|   |   |
|   |   |--(Q) : Sub=sub1:sla-profile.2 200->1/1/1:1->2
|   |   |
|   |   |--(Q) : Sub=sub1:sla-profile.2 200->1/1/1:1->1
|   |   |
|   |
|   |--(S) : session-sched
|   |   |
```

```
|   |   |--(Q) : Sub=sub1:sla-profile.1 200->1/1/1:1->3
|   |   |
|   |   |--(Q) : Sub=sub1:sla-profile.1 200->1/1/1:1->2
|   |   |
|   |   |--(Q) : Sub=sub1:sla-profile.1 200->1/1/1:1->1
|   |   |
===============================================================================
*A:BNG#
```

vport

Syntax **port** *port-id* **vport** *name* [**scheduler** *scheduler-name*]

Context show>qos>scheduler-stats

Description This command displays the vport scheduler stats.

Parameters **port** *port-id* — Displays information for the specified port.

vport *name* — Displays information for the specified vport.

scheduler *scheduler-name* — Displays information for the specified *scheduler-name.*

Sample Output

```
*A:BNG# show qos scheduler-stats port 1/1/1 vport "dslam1" scheduler "dslam-sched"
===============================================================================
Scheduler Stats
===============================================================================
Scheduler                          Forwarded Packets      Forwarded Octets
-------------------------------------------------------------------------------
Egress Schedulers

dslam-sched                        0                      0
===============================================================================
*A:BNG#
```

statistics

Syntax **statistics iom** (*slot* | **all**) [**host**|**session**|**subscriber**|**summary**] [**non-zero-value-only**]
statistics mda (*mda* | **all**) [**host**|**session**|**subscriber**|**summary**] [**non-zero-value-**only]
statistics port (*port-id* | **all**) [**host**|**session**|**subscriber**|**summary**] [**non-zero-value-only**]
statistics pw-port (*pw-port* | **all**) [**host**|**session**|**subscriber**|**summary**] [**non-zero-value-only**]
statistics system [**host**|**session**|**subscriber**|**summary**] [**non-zero-value-only**]

Context show>subscr-mgmt

Description This command displays enhanced subscriber management statistics per port/pw-port/MDA/IOM/system.

For each statistic, there is current value and peak value, peak value is the highest value since last reset via system boot or command **clear subscriber-mgmt peakvalue-stats**.

Note that the peak values can be reset via the **clear subscriber-mgmt peakvalue-stats** command.

Parameters. **iom** *slot* **—** Displays specified IOM slot information.

mda *mda* **—** Displays specified slot/mda information.

port *port-id* **—** Specifies to display information for both the physical port ID and LAG.

pw-port *pw-port* **—** Specifies to display information for a pseudowire port ID.

Values 1 — 10239

all — displays statistics of all IOM or MDA or port or pseudowire port in the system.

host — Displays v4/v6 host statistics only.

session — Displays PPPoX/LAC/LNS session statistics only.

subscriber — Displays subscriber statistics only.

summary — Displays summary statistics only.

non-zero-value-only — Displays only non-zero value counters.

The following tables describe the counters available in the **show subscriber management statistics** command output.

The following terminology is used to indicate applicability of the stats:

- ESM — Enhanced Subscriber Management. Subscriber traffic forwarded via subscriber queues. Enabled with SAP sub-sla-mgmt in no shutdown state.
- BSM — Basic Subscriber Management. Subscriber traffic forwarded via SAP queues. SAP sub-sla-mgmt must be in shutdown state. For DHCP, dhcp lease-populate or dhcp6-relay lease-populate must be enabled to count the leases. For IPv4, if anti-spoof is enabled on the SAP, a subscriber host is instantiated.
- Routed CO — IES or VPRN service with subscriber-interface and group-interface constructs.
- Bridged CO — VPLS service with DHCPv4 lease management enabled (lease-populate)
- regular interface — IES or VPRN interface (none subscriber-interface or group-interface)
- Host (also subscriber host) — A resource in the system that is used for traffic forwarding and security related actions. The creation of a subscriber host entry is linked to anti-spoof being enabled on a SAP. For ESM, anti-spoof is mandatory and hence every connected {IP/MAC} consumes by default a subscriber host entry. A DHCP6 IA-PD can also be modeled as a managed route. In this case, no subscriber host is instantiated. For BSM, anti-spoof is optional on regular interfaces. An IPv4 static-host and DHCPv4 lease do not result in a subscriber host instantiation when anti-spoof is disabled on the SAP.

Host and Protocol Statistics			
Section	**Counter**	**Counts**	**Applies to**
IPv4	1. PPP Hosts - IPCP	IPv4 local terminated PPP hosts (PTA, LNS)	ESM, Routed CO
	2. IPOE Hosts - DHCP	DHCPv4 hosts (lease states)	ESM, Routed CO, Bridged CO
	3. IPOE Hosts - ARP	ARP hosts	ESM, Routed CO, Bridged CO

Host and Protocol Statistics (Continued)			
Section	**Counter**	**Counts**	**Applies to**
	4. IPOE Hosts – Static	IPv4 static hosts	ESM, Routed CO, Bridged CO
	5. IPOE Hosts BSM - DHCP	DHCPv4 hosts (lease states: anti-spoof and lease-populate enabled)	BSM, Routed CO, Bridged CO, regular interface
	6. IPOE Hosts BSM – Static	IPv4 static hosts (with anti-spoof enabled)	BSM, Routed CO, Bridged CO, regular interface
	7. IPOE BSM - DHCP	DHCPv4 lease states (with lease-populate enabled, no anti-spoof)	BSM, Routed CO, Bridged CO, regular interface
	8. IPOE BSM – Static	IPv4 static hosts (no anti-spoof)	BSM, Routed CO, Bridged CO, regular interface

Host and Protocol Statistics (Continued)			
Section	**Counter**	**Counts**	**Applies to**
IPv6	9. PPP Hosts – SLAAC	Local terminated IPv6 wan-host – SLAAC (PTA, LNS)	ESM, Routed CO
	10. PPP Hosts - DHCP6 (PD)	Local terminated IPv6 pd-host (PTA, LNS) – DHCP6 IA-PD leases over PPP (excluding PD as managed route)	ESM, Routed CO
	11. PPP Hosts - DHCP6 (NA)	Local terminated IPv6 wan-host (PTA, LNS) – DHCP6 IA-NA leases over PPP	ESM, Routed CO
	12. PPP Mngd Rt - DHCP6 (PD)	IPv6 (PTA, LNS) – DHCP6 IA-PD leases over PPP (PD as managed route only)	ESM, Routed CO
	13. IPOE Hosts – SLAAC	IPv6 wan-host – SLAAC	ESM, Routed CO
	14. IPOE Hosts - DHCP6 (PD)	IPv6 pd-host – DHCP6 IA-PD leases (excluding PD as managed route)	ESM, Routed CO
	15. IPOE Hosts - DHCP6 (NA)	IPv6 wan-host – DHCP6 IA-NA leases	ESM, Routed CO
	16. IPOE Mngd Rt - DHCP6 (PD)	IPv6 – DHCP6 IA-PD leases (PD as managed route only)	ESM, Routed CO
	17. IPOE Hosts – Static (PD)	IPv6 static hosts with prefix-length shorter than /128	ESM, Routed CO
	18. IPOE Hosts – Static (WAN)	IPv6 static hosts with prefix-length equal to /128	ESM, Routed CO
	19. IPOE BSM - DHCP6 (PD)	IPv6 – DHCP6 IA-PD leases (lease-populate)	BSM, regular interface
	20. IPOE BSM - DHCP6 (NA)	IPv6 – DHCP6 IA-NA leases (lease-populate)	BSM, regular interface
Total	21. PPP Hosts	Local terminated PPP hosts (PTA, LNS) Sum of counters 1, 9, 10 and 11	ESM
	22. IPOE Hosts	Total IPv4 and IPv6 IPOE hosts. Sum of counters 2, 3, 4, 5, 6, 13, 14, 15, 17 and 18	ESM
	23. IPv4 Hosts	Total IPv4 hosts. PPP (PTA, LNS) and IPOE. Sum of counters 1, 2, 3, 4, 5 and 6	ESM

Host and Protocol Statistics (Continued)			
Section	**Counter**	**Counts**	**Applies to**
Total (Cont)	24. IPv6 Hosts	Total IPv6 hosts. PPP (PTA, LNS) and IPOE. Sum of counters 9, 10, 11, 13, 14, 15, 17 and 18	ESM
	25. IPv6 PD Mngd Routes	Total DHCP6 IA-PD leases modeled as a managed route. PPP (PTA, LNS) and IPOE. Sum of counters 12 and 16	ESM
	26. L2TP LAC Hosts	L2TP LAC hosts – single host per single or dual stack PPP session. Counter also increases for outgoing LTS sessions.	ESM, Routed CO
	27. Internal Hosts	Subscriber hosts for internal use. For example: LNS redirect hosts (for LTS, an LNS redirect host is also instantiated).	ESM
	28. Non-Sub-Traffic L2-Hosts	Host on a single subscriber SAP in a VPLS service that enables non-IP traffic to be forwarded using the specified SLA profile instance queues. Host on a single subscriber SAP attached to an IES/VPRN group-interface that enables traffic normally forwarded via the SAP queues to flow via the specified SLA profile instance queues. configure service vpls <service-id> sap <sap-id> sub-sla-mgmt single-sub-parameters non-sub-traffic sub-profile <sub-profile-name> sla-profile <sla-profile-name> [subscriber <sub-ident-string>] [app-profile <app-profile-name>]	ESM, Routed CO, Bridged CO
	29. DHCP leases	Total number of DHCPv4 lease states. Sum of counters 2, 5 and 7	ESM, BSM
	30. DHCPv6 leases	Total number of DHCPv6 lease states. Sum of counters 10, 11, 12, 14, 15, 16, 19 and 20	ESM, BSM

Host and Protocol Statistics (Continued)			
Section	**Counter**	**Counts**	**Applies to**
Total (Cont)	31. Subscriber Hosts	Counter displayed in the output of "show subscriber-mgmt statistics iom | mda | port | pw-port" This counter matches the number of hosts accounted for in the per line card limit Sum of counters 1, 2, 3, 4, 5, 6, 9, 10, 11, 13, 14, 15, 17, 18 and 26	ESM
	32. System Hosts Scale	Counter displayed in the output of "show subscriber-mgmt statistics system" This counter matches the number of hosts accounted for in the system wide limit Sum of counters 1, 2, 3, 4, 5, 6, 9, 10, 11, 13, 14, 15, 17, 18, 26 and 27	ESM

PPP Session Statistics			
Section	**Counter**	**Counts**	**Applies to**
Local	33. PPP Sessions - PPPoE	Local terminated PPPoE sessions (PTA)	ESM, Routed CO
	34. PPP Sessions - PPPoEoA	Local terminated PPPoEoA sessions (PTA)	ESM, Routed CO
	35. .PPP Sessions - PPPoA	Local terminated PPPoA sessions (PTA)	ESM, Routed CO
	36. PPP Sessions - L2TP (LNS)	Local terminated PPP sessions (L2TP LNS)	ESM, Routed CO
LAC	37. PPP Sessions - PPPoE	Tunneled PPPoE session (L2TP LAC)	ESM, Routed CO
	38. PPP Sessions - PPPoEoA	Tunneled PPPoEoA session (L2TP LAC)	ESM, Routed CO
	39. PPP Sessions - PPPoA	Tunneled PPPoA session (L2TP LAC)	ESM, Routed CO
	40. PPP Sessions - L2TP (LTS)	Tunneled PPP session (L2TP LTS)	ESM, Routed CO
Total	41. PPP Sessions - established	PPP sessions that are established (at least one active host attached) – PTA/LAC/LTS/LNS	ESM, Routed CO

PPP Session Statistics (Continued)			
Section	**Counter**	**Counts**	**Applies to**
Total (Cont)	42. PPP Sessions - in setup	PPP sessions in setup (session created, host setup in progress) – PTA/LAC/LTS/LNS	ESM, Routed CO
	43. PPP Sessions - local	Local terminated PPPoX sessions (PTA, L2TP LNS) Sum of counters 33, 34, 35 and 36	ESM, Routed CO
	44. PPP Sessions - LAC	Tunneled PPPoX session (L2TP LAC, L2TP LTS) Sum of counters 37, 38, 39 and 40	ESM, Routed CO
L2TP	45. L2TP Tunnels - originator	Number of L2TP Tunnels originated on this node. (LAC/ LTS)	ESM, Routed CO
	46. .L2TP Tunnels - receiver	Number of L2TP Tunnels terminated on this node. (LNS/LTS)	ESM, Routed CO
	47. Total L2TP Tunnels	Number of L2TP Tunnels originated or terminated on this node Sum of counters 45 and 46	ESM, Routed CO

IPoE Session Statistics			
Section	**Counter**	**Counts**	**Applies to**
Total	48. IPOE Sessions - established	IPoE sessions that are established (at least one active host attached).	ESM, Routed CO
	49. IPOE Sessions- in setup	IPoE sessions in setup (session created, host setup in progress).	ESM, Routed CO

Subscriber Statistics			
Section	**Counter**	**Counts**	**Applies to**
Total	50. Subscribers	Total number of active subscribers.	ESM, Routed CO, Bridged CO

SubMgmt Statistics Summary		
Section	**Counter**	**Counts**
Hosts	IPv4	Total IPv4 hosts (counter 23 in tables above)
	IPv6	Total IPv6 hosts (counter 24 in tables above)
Sessions	PPP	Total PPP sessions - established (counter 41 in tables above)
	IPOE	Total IPOE sessions – established (counter 48 in tables above)
Subscribers		Total number of active subscribers (counter 50 in tables above)

Sample Output

```
A:PE-1# show subscriber-mgmt statistics system
===============================================================================
Subscriber Management Statistics for System
===============================================================================
       Type                                Current      Peak      Peak Timestamp
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Host & Protocol Statistics
-------------------------------------------------------------------------------
IPv4   PPP Hosts      - IPCP                   1         1 02/28/2015 16:25:43
       IPOE Hosts     - DHCP                   0         2 02/28/2015 12:38:58
       IPOE Hosts     - ARP                    1         1 02/28/2015 13:46:10
       IPOE Hosts     - Static                 0         0
       IPOE Hosts BSM - DHCP                   0         0
       IPOE Hosts BSM - Static                 0         0
       IPOE BSM       - DHCP                   0         0
       IPOE BSM       - Static                 0         0
-------------------------------------------------------------------------------
IPv6   PPP Hosts      - SLAAC                  0         0
       PPP Hosts      - DHCP6 (PD)             0         0
       PPP Hosts      - DHCP6 (NA)             0         0
       PPP Mngd Rt    - DHCP6 (PD)             0         0
       IPOE Hosts     - SLAAC                  0         0
       IPOE Hosts     - DHCP6 (PD)             0         0
       IPOE Hosts     - DHCP6 (NA)             0         0
       IPOE Mngd Rt   - DHCP6 (PD)             0         0
       IPOE Hosts     - Static (PD)            0         0
       IPOE Hosts     - Static (WAN)           0         0
       IPOE BSM       - DHCP6 (PD)             0         0
       IPOE BSM       - DHCP6 (NA)             0         0
-------------------------------------------------------------------------------
Total  PPP Hosts                                1         1 02/28/2015 16:25:43
       IPOE Hosts                               1         2 02/28/2015 12:38:58
       IPv4 Hosts                               2         2 02/28/2015 16:25:43
       IPv6 Hosts                               0         0
       IPv6 PD Mngd Routes                      0         0
       L2TP LAC Hosts                           0         0
       Internal Hosts                           0         0
       Non-Sub-Traffic L2-Hosts                 0         0
```

```
       DHCP Leases                                0         2 02/28/2015 12:38:58
       DHCPv6 Leases                              0         0
       System Hosts Scale                         2         2 02/28/2015 16:25:43
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
PPP Session Statistics
-------------------------------------------------------------------------------
Local  PPP Sessions  - PPPoE                      1         1 02/28/2015 16:25:43
       PPP Sessions  - PPPoEoA                    0         0
       PPP Sessions  - PPPoA                      0         0
       PPP Sessions  - L2TP (LNS)                 0         0
-------------------------------------------------------------------------------
LAC    PPP Sessions  - PPPoE                      0         0
       PPP Sessions  - PPPoEoA                    0         0
       PPP Sessions  - PPPoA                      0         0
       PPP Sessions  - L2TP (LTS)                 0         0
-------------------------------------------------------------------------------
Total  PPP Sessions  - established                1         1 02/28/2015 16:25:43
       PPP Sessions  - in setup                   0         1 02/28/2015 16:25:43
       PPP Sessions  - local                      1         1 02/28/2015 16:25:43
       PPP Sessions  - LAC                        0         0
-------------------------------------------------------------------------------
L2TP   L2TP Tunnels  - originator                 0         0
       L2TP Tunnels  - receiver                   0         0
       Total L2TP Tunnels                         0         0
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
IPOE Session Statistics
-------------------------------------------------------------------------------
Total  IPOE Sessions - established                0         0
       IPOE Sessions - in setup                   0         0
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Subscriber Statistics
-------------------------------------------------------------------------------
Total  Subscribers                                2         2 02/28/2015 16:25:43
-------------------------------------------------------------------------------
===============================================================================
Peak values last reset at : n/a
```

Sample Output (summary view)

```
A:PE-1# show subscriber-mgmt statistics port 1/1/4 summary
===============================================================================
SubMgmt Statistics
===============================================================================
                  |       Hosts         |      Sessions      |    Subscribers
Port Id           |   IPv4      IPv6    |    PPP      IPOE   |
-------------------------------------------------------------------------------
1/1/4             |        2         2 |        1         1 |        2   (Curr)
                  |        3         3 |        1         2 |        3   (Peak)
===============================================================================
```

sub-ident-policy

Syntax **sub-ident-policy** [*sub-ident-policy-name* [**association**]]
sub-ident-policy *sub-ident-policy-name* **script** {**primary** | **secondary** | **tertiary**}

Context show>subscriber-mgmt

Description This command displays subscriber identification policy information.

Parameters *sub-ident-policy-name* — Specifies an existing subscriber identification policy name.

association — Displays information configured with the specified *sub-ident-policy-name*.

script {**primary** | **secondary** | **tertiary**} **—** Displays information for the specified identification script.

Sample Output

```
B:Dut-A>show>subscr-mgmt# sub-ident-policy
===============================================================================
Subscriber Identification Policies
===============================================================================
Name                            Description
-------------------------------------------------------------------------------
sub_ident_all
sub_ident_pc
-------------------------------------------------------------------------------
Number of Subscriber Identification Policies : 2
===============================================================================
B:Dut-A>show>subscr-mgmt#


B:Dut-A>show>subscr-mgmt# sub-ident-policy sub_ident_all
===============================================================================
Subscriber Identification Policy sub_ident_all
===============================================================================
Sub Profile Map
-------------------------------------------------------------------------------
Key                             Sub profile
-------------------------------------------------------------------------------
sub_prof100                     sub_prof100
sub_prof110                     sub_prof110
sub_prof120                     sub_prof120
sub_prof130                     sub_prof130
sub_prof140                     sub_prof140
sub_prof230                     sub_prof230
sub_prof80                      sub_prof80
sub_prof81                      sub_prof81
sub_prof90                      sub_prof90
-------------------------------------------------------------------------------
SLA Profile Map
-------------------------------------------------------------------------------
Key                             SLA profile
-------------------------------------------------------------------------------
sla_prof100_VOIP                sla_prof100_VOIP
sla_prof110_VOIP                sla_prof110_VOIP
sla_prof120_VOIP                sla_prof120_VOIP
sla_prof130_VOIP                sla_prof130_VOIP
sla_prof140_VOIP                sla_prof140_VOIP
```

```
sla_prof230_VOIP                sla_prof230_VOIP
sla_prof80_VOIP                 sla_prof80_VOIP
sla_prof81_VOIP                 sla_prof81_VOIP
sla_prof90_VOIP                 sla_prof90_VOIP
-------------------------------------------------------------------------------
Python Scripts
-------------------------------------------------------------------------------
#         Admin Oper  Script
          State State Name
-------------------------------------------------------------------------------
Primary   Down  Down  pyTom.py
Secondary Up    Up    pyTomDebug.py
Tertiary  Up    Up    hardcoded.py
===============================================================================
B:Dut-A>show>subscr-mgmt#
B:Dut-A>show>subscr-mgmt# sub-ident-policy sub_ident_all association
===============================================================================
Subscriber Identification Policy sub_ident_all
===============================================================================
SAP Associations
-------------------------------------------------------------------------------
Service-Id : 80 (VPLS)
 - SAP : 1/2/1:80
Service-Id : 90 (VPLS)
 - SAP : 1/2/1:90
Service-Id : 100 (VPLS)
 - SAP : 1/2/1:100
 - SAP : 1/2/1:101
 - SAP : 1/2/1:102
Service-Id : 110 (VPLS)
 - SAP : 1/2/1:110
 - SAP : 1/2/1:111
 - SAP : 1/2/1:112
Service-Id : 120 (VPLS)
 - SAP : 1/2/1:120
 - SAP : 1/2/1:121
 - SAP : 1/2/1:122
Service-Id : 130 (VPLS)
 - SAP : 1/2/1:130
Service-Id : 140 (VPLS)
 - SAP : 1/2/1:140
===============================================================================
B:Dut-A>show>subscr-mgmt#


B:Dut-A>show>subscr-mgmt# sub-ident-policy sub_ident_all script primary
===============================================================================
Subscriber Identification Policy sub_ident_all
===============================================================================
Primary Script
-------------------------------------------------------------------------------
URL         : ftp://xxx:yyy@a.b.c.d/pyTom.py
Admin State : Down                      Oper State : Down
-------------------------------------------------------------------------------
Source (dumped from memory)
-------------------------------------------------------------------------------
Script is not active.
-------------------------------------------------------------------------------
===============================================================================
B:Dut-A>show>subscr-mgmt#
```

```
B:Dut-A>show>subscr-mgmt# sub-ident-policy sub_ident_all script secondary
===============================================================================
Subscriber Identification Policy sub_ident_all
===============================================================================
Secondary Script
-------------------------------------------------------------------------------
URL         : ftp://xxx:yyy@a.b.c.d/pyTomDebug.py
Admin State : Up                        Oper State : Up
-------------------------------------------------------------------------------
Source (dumped from memory)
-------------------------------------------------------------------------------
      1 import alc
      2 yiaddr = alc.dhcp.yiaddr
      3 # Subscriber ID equals full client IP address.
      4 # Note: IP address 10.10.10.10 yields 'sub-168430090'
      5 # and not 'sub-10.10.10.10'
      6 alc.dhcp.sub_ident = 'sub-' + str(yiaddr)
      7 # DHCP server is configured such that the third byte (field) of the IP
      8 # address indicates the session Profile ID.
      9 alc.dhcp.sla_profile = 'sp-' + str((yiaddr & 0x0000FF00) >> 8)
===============================================================================
B:Dut-A>show>subscr-mgmt#


B:Dut-A>show>subscr-mgmt# sub-ident-policy sub_ident_all script tertiary
===============================================================================
Subscriber Identification Policy sub_ident_all
===============================================================================
Tertiary Script
-------------------------------------------------------------------------------
URL         : ftp://xxx:yyy@a.b.c.d/hardcoded.py
Admin State : Up                        Oper State : Up
-------------------------------------------------------------------------------
Source (dumped from memory)
-------------------------------------------------------------------------------
      1 from alc import dhcp
      2
      3 dhcp.sub_ident = 'sub_ident_A_1'
      4 dhcp.sub_profile_string = 'sub_prof_B_2'
      5 dhcp.sla_profile_string = 'sla_prof_C_3'
      6
===============================================================================
B:Dut-A>show>subscr-mgmt#
```

sub-profile

Syntax **sub-profile** [*sub-profile-name* [**association**]]

Context show>subscriber-mgmt

Description This command displays subscriber profile information.

Parameters *sub-profile-name* — Specifies an existing subscriber profile name.

association — Displays the information configured with the specified *sub-profile-name*.

Sample Output

```
A:Dut-A# show subscriber-mgmt sub-profile
===============================================================================
Subscriber Profiles
===============================================================================
Name                            Description
-------------------------------------------------------------------------------
sub_default
sub_prof100
sub_prof110
sub_prof120
sub_prof130
sub_prof140
sub_prof230
sub_prof80
sub_prof81
sub_prof90
sub_profPC1
sub_profPC2
sub_profPC3
-------------------------------------------------------------------------------
Number of Subscriber Profiles : 13
===============================================================================
A:Dut-A#


A:Dut-A# show subscriber-mgmt sub-profile sub_prof100
===============================================================================
Subscriber Profile sub_prof100
===============================================================================
I. Sched. Policy : service100
E. Sched. Policy : service100
Acct. Policy     : 1                                Collect Stats : Enabled
Last Mgmt Change : 07/10/2006 12:55:33
-------------------------------------------------------------------------------
Ingress Scheduler Overrides
-------------------------------------------------------------------------------
Scheduler                       Rate      CIR
-------------------------------------------------------------------------------
serv100                         8000      sum
-------------------------------------------------------------------------------
Egress Scheduler Overrides
-------------------------------------------------------------------------------
Scheduler                       Rate      CIR
-------------------------------------------------------------------------------
serv100                         8000      sum
-------------------------------------------------------------------------------
SLA Profile Map
-------------------------------------------------------------------------------
Key                             SLA Profile
-------------------------------------------------------------------------------
No mappings configured.
===============================================================================
A:Dut-A#


A:Dut-A# show subscriber-mgmt sub-profile sub_prof100 association
===============================================================================
Subscriber Profile sub_prof100
-------------------------------------------------------------------------------
```

```
SAP Default-Profile Associations
-------------------------------------------------------------------------------
No associations found.
-------------------------------------------------------------------------------
SAP Static Host Associations
-------------------------------------------------------------------------------
No associations found.
-------------------------------------------------------------------------------
SAP Non-Sub-Traffic-Profile Associations
-------------------------------------------------------------------------------
No associations found.
-------------------------------------------------------------------------------
Sub-Ident-Policy Profile Map Associations
-------------------------------------------------------------------------------
Policy-name : sub_ident_all
 - Key : sub_prof100
-------------------------------------------------------------------------------
Explicit Subscriber Map Associations
-------------------------------------------------------------------------------
No associations found.
===============================================================================
A:Dut-A#
```

pw-port

Syntax **pw-port** [*pw-port-id*] [**detail**]
pw-port sdp *sdp-id*
pw-port sdp none

Context show>pw-port

Description Displays pseudo-wire port information.

If no optional parameters are specified, the command displays a summary of all defined PW ports. The optional parameters restrict output to only ports matching the specified properties.

Parameters *pw-port-id* — Specifies the pseudo-wire port identifier.

Values 1 — 10239

detail — Displays detailed port information that includes all the **pw-port** output fields.

sdp *sdp-id* **—** The SDP ID for which to display matching PW port information.

Values 1 — 17407

Output **Show PW-Port —** The following table describes **show pw-port** output fields:

Label	Description
PW Port	The PW Port identifier.
Encap	The encapsulation type of the PW Port.
SDP	The SDP identifier.
IfIndex	The interface index used for the PW Port.

Label	Description (Continued)
VC-Id	The Virtual Circuit identifier.
Description	The description string for the PW Port.

Sample Output

```
*A:ALA-48>config>service# show pw-port

===============================================================================
PW Port Information
===============================================================================
PW Port   Encap          SDP        IfIndex             VC-Id
-------------------------------------------------------------------------------
1         dot1q          1          1526726657          1
2         qinq           1          1526726658          2
3         dot1q          1          1526726659          3
4         qinq           1          1526726660          4
===============================================================================

*A:ALA-48>config>service# show pw-port 3
===============================================================================
PW Port Information
===============================================================================
PW Port   Encap          SDP        IfIndex             VC-Id
-------------------------------------------------------------------------------
3         dot1q          1          1526726659          3
===============================================================================
*A:ALA-48>config>service# show pw-port 3 detail

===============================================================================
PW Port Information
===============================================================================
PW Port            : 3
Encap              : dot1q
SDP                : 1
IfIndex            : 1526726659
VC-Id              : 3
Description        : 1-Gig Ethernet dual fiber
===============================================================================
*A:ALA-48>config>pw-port$ show pw-port sdp none

===============================================================================
PW Port Information
===============================================================================
PW Port   Encap          SDP        IfIndex             VC-Id
-------------------------------------------------------------------------------
5         dot1q                     1526726661
===============================================================================


*A:ALA-48>config>pw-port$ show pw-port sdp 1

===============================================================================
PW Port Information
===============================================================================
PW Port   Encap          SDP        IfIndex             VC-Id
-------------------------------------------------------------------------------
```

```
1         dot1q          1          1526726657         1
2         qinq           1          1526726658         2
3         dot1q          1          1526726659         3
4         qinq           1          1526726660         4
===============================================================================
```

port-scheduler-policy

Syntax **port-scheduler-policy** [*port-scheduler-policy-name*] [**association**]
port-scheduler-policy *port-scheduler-policy-name* **network-policy** *network-queue-policy-name*
port-scheduler-policy *port-scheduler-policy-name* **sap-egress** *policy-id*
port-scheduler-policy *port-scheduler-policy-name* **scheduler-policy** *scheduler-policy-name*
port-scheduler-policy *port-scheduler-policy-name* **scheduler-policy** *scheduler-policy-name* **sap-egress** *policy-id*

Context show>qos

Description This command displays scheduler policy information.

Sample Output

```
A:NS072860910>config>qos>port-sched-plcy# info
----------------------------------------------
            max-rate 10000
            group "group1" create
                rate 3000 cir 1000
            exit
            group "group2" create
                rate 2000 cir 500
            exit
            level 7 rate 7000 cir 700 group "group1" weight 3
            level 6 rate 6000 cir 600 group "group1" weight 2
            level 5 rate 5000 cir 500 group "group1" weight 1
            level 2 rate 2000 cir 200 group "group2" weight 2
            level 1 rate 1000 cir 100 group "group2" weight 1
----------------------------------------------

A:NS072860910# show qos scheduler-hierarchy port 5/1/2 vport "fred"
===============================================================================
Scheduler Hierarchy - Port 5/1/2, Vport "fred"
===============================================================================
Port-scheduler-policy psp1
    Port Bandwidth : 1000000    Max Rate : 10000
    Consumed : 0          Offered : 0

[Within CIR Level 8]
    Rate     : max
    Consumed : 0          Offered : 0

    (Q) : 1->5/1/2:1->1
    (Q) : 1->5/1/2:2->1

[Within CIR Group "group1"]
```

```
    Rate     : 1000
    Consumed : 0          Offered : 0

    [Within CIR Level 7]
        Weight   : 3
        Rate     : 700
        Consumed : 0          Offered : 0

        (Q) : 1->5/1/2:1->2
        (Q) : 1->5/1/2:2->2

    [Within CIR Level 6]
        Weight   : 2
        Rate     : 600
        Consumed : 0          Offered : 0

        (Q) : 1->5/1/2:1->3
        (Q) : 1->5/1/2:2->3

    [Within CIR Level 5]
        Weight   : 1
        Rate     : 500
        Consumed : 0          Offered : 0

        (Q) : 1->5/1/2:1->4
        (Q) : 1->5/1/2:2->4

[Within CIR Level 4]
    Rate     : max
    Consumed : 0          Offered : 0

[Within CIR Level 3]
    Rate     : max
    Consumed : 0          Offered : 0

    (Q) : 1->5/1/2:1->5
    (Q) : 1->5/1/2:2->5

[Within CIR Group "group2"]
    Rate : 500
    Consumed : 0          Offered : 0

    [Within CIR Level 2]
        Weight   : 2
        Rate     : 200
        Consumed : 0          Offered : 0

        (Q) : 1->5/1/2:1->6
        (Q) : 1->5/1/2:2->6

    [Within CIR Level 1]
        Weight   : 1
        Rate     : 200
        Consumed : 0          Offered : 0

        (Q) : 1->5/1/2:1->7
        (Q) : 1->5/1/2:2->7

[Within CIR Level 0]
    Rate     : 0
    Consumed : 0          Offered : 0
```

```
    (Q) : 1->5/1/2:1->8
    (Q) : 1->5/1/2:2->8

[Above CIR Level 8]
    Rate     : max
    Consumed : 0          Offered : 0

[Above CIR Group "group1"]
    Rate     : 3000
    Consumed : 0          Offered : 0

    [Above CIR Level 7]
        Weight   : 3
        Rate     : 7000
        Consumed : 0          Offered : 0

    [Above CIR Level 6]
        Weight   : 2
        Rate     : 6000
        Consumed : 0          Offered : 0

    [Above CIR Level 5]
        Weight   : 1
        Rate     : 5000
        Consumed : 0          Offered : 0

[Above CIR Level 4]
    Rate     : max
    Consumed : 0          Offered : 0

[Above CIR Level 3]
    Rate     : max
    Consumed : 0          Offered : 0

[Above CIR Group "group2"]
    Rate     : 2000
    Consumed : 0          Offered : 0

    [Above CIR Level 2]
        Weight   : 2
        Rate     : 2000
        Consumed : 0          Offered : 0

    [Above CIR Level 1]
        Weight   : 1
        Rate     : 1000
        Consumed : 0          Offered : 0

        (Q) : 1->5/1/2:1->1
        (Q) : 1->5/1/2:1->2
        (Q) : 1->5/1/2:1->3
        (Q) : 1->5/1/2:1->4
        (Q) : 1->5/1/2:1->5
        (Q) : 1->5/1/2:1->6
        (Q) : 1->5/1/2:1->7
        (Q) : 1->5/1/2:1->8
        (Q) : 1->5/1/2:2->1
        (Q) : 1->5/1/2:2->2
        (Q) : 1->5/1/2:2->3
        (Q) : 1->5/1/2:2->4
```

```
        (Q) : 1->5/1/2:2->5
        (Q) : 1->5/1/2:2->6
        (Q) : 1->5/1/2:2->7
        (Q) : 1->5/1/2:2->8
===============================================================================
A:NS072860910#


*A:B-Dut-A>config>qos>port-sched-plcy# show qos port-scheduler-policy "psp"
===============================================================================
QoS Port Scheduler Policy
===============================================================================
Policy-Name       : psp
Description       : (Not Specified)
Max Rate          : max                 Last changed      : 04/15/2010 00:37:02
Group             : 1
Group PIR         : 80000               Group CIR         : max

Group             : 2
Group PIR         : 80000               Group CIR         : max

Group             : 3
Group PIR         : 80000               Group CIR         : max

Group             : 4
Group PIR         : 80000               Group CIR         : max

Lvl1 PIR          : max                 Lvl1 CIR          : max
Lvl1 Group        : 1                   Lvl1 Grp Weight   : 10

Lvl2 PIR          : max                 Lvl2 CIR          : max
Lvl2 Group        : 1                   Lvl2 Grp Weight   : 20

Lvl3 PIR          : max                 Lvl3 CIR          : max
Lvl3 Group        : 2                   Lvl3 Grp Weight   : 30

Lvl4 PIR          : max                 Lvl4 CIR          : max
Lvl4 Group        : 2                   Lvl4 Grp Weight   : 40

Lvl5 PIR          : max                 Lvl5 CIR          : max
Lvl5 Group        : 3                   Lvl5 Grp Weight   : 50

Lvl6 PIR          : max                 Lvl6 CIR          : max
Lvl6 Group        : 3                   Lvl6 Grp Weight   : 60

Lvl7 PIR          : max                 Lvl7 CIR          : max
Lvl7 Group        : 4                   Lvl7 Grp Weight   : 70

Lvl8 PIR          : max                 Lvl8 CIR          : max
Lvl8 Group        : 4                   Lvl8 Grp Weight   : 80

Orphan Lvl        : default             Orphan Weight     : default
Orphan CIR-Lvl    : default             Orphan CIR-Weight : default
===============================================================================
*A:Bennet-Dut-A>config>qos>port-sched-plcy#


*A:B-Dut-A# show qos port-scheduler-policy "psp" association
===============================================================================
QoS Port Scheduler Policy
===============================================================================
```

```
Policy-Name       : psp
Description       : (Not Specified)
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
 - Port : 1/1/2 VPort : vp1
===============================================================================
*A:B-Dut-A#


*A:B-Dut-A# show qos port-scheduler-policy "psp" sap-egress 1000
===============================================================================
Compatibility : Port-scheduler Policy psp & Sap Egress Queue 1000
===============================================================================
Orphan Queues :

None Found

Hierarchy     :

Root
|
|---(Q) : 1
|
|---(Q) : 2
|
|---(Q) : 3
|
|---(Q) : 4
|
|---(Q) : 5
|
|---(Q) : 6
|
|---(Q) : 7
|
|---(Q) : 8
===============================================================================
*A:B-Dut-A#
```

sap-egress

Syntax **sap-egress** [*policy-id*] [**association** | **detail**]

Context show>qos

Description This command displays SAP egress policy information.

Parameters *policy-id* — Displays information for the specified SAP egress policy.

association — Displays the information configured with the specified *sap-egress* policy.

detail — Displays detailed information.

Sample Output

```
*A:Dut-A# show qos sap-egress
===============================================================================
Sap Egress Policies
===============================================================================
Policy-Id  Scope     Name                     Description
-------------------------------------------------------------------------------
1          Template  default                  Default SAP egress QoS policy.
30         Template                           1 video channel, 1 BE
31         Template                           1 video EF, 2xvideo AF, 1 BE
80         Template                           Limit outgoing 80
100        Template                           User100
110        Template                           User110
120        Template                           User120
130        Template                           User130
140        Template                           User140
901        Template                           User90_1
902        Template                           User90_2
903        Template                           User90_3
904        Template                           User90_4
905        Template                           User90_5
1000       Template                           Service all
-------------------------------------------------------------------------------
Number of Policies : 15
-------------------------------------------------------------------------------
===============================================================================
*A:Dut-A#


A:Dut-A# show qos sap-egress 31 detail
===============================================================================
QoS Sap Egress
===============================================================================
Sap Scheduler Policy (31)
-------------------------------------------------------------------------------
Policy-id      : 31                           Scope        : Template
Description    : 1 video EF, 2xvideo AF, 1 BE

-------------------------------------------------------------------------------
Queue         CIR Admin PIR Admin CBS     HiPrio  PIR Lvl/Wt    Parent
              CIR Rule  PIR Rule  MBS             CIR Lvl/Wt
-------------------------------------------------------------------------------
1             0         max       def     def     1/1           limit_8000
              closest   closest   def             0/1
2             0         max       def     def     2/1           limit_8000
              closest   closest   def             0/1
3             0         max       def     def     3/1           limit_8000
              closest   closest   def             0/1
-------------------------------------------------------------------------------
FC Name               Queue-id    Explicit/Default
-------------------------------------------------------------------------------
be                    1           Explicit (0)
af                    2           Explicit (0)
ef                    3           Explicit (0)
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Service-Id     : 23 (VPLS)                    Customer-Id  : 1
 - SAP : 1/2/2:4000
Service-Id     : 30 (VPLS)                    Customer-Id  : 2
```

```
 - SAP : lag-1
 - SAP : lag-2:5
Service-Id     : 31 (VPLS)                    Customer-Id  : 2
 - SAP : 1/2/1:31
SLA Profiles :
 - sla_profPC1                        override
-------------------------------------------------------------------------------
Mirror SAPs
-------------------------------------------------------------------------------
No Mirror SAPs Found.
===============================================================================
A:Dut-A#
```

sap-ingress

Syntax **sap-ingress** [*policy-id*] [**association** | **match-criteria** | **detail**]

Context show>qos

Description This command displays SAP ingress policy information.

Parameters *policy-id* — Displays information for the specified SAP ingress policy.

association — Displays the information configured with the specified *sap-ingress* policy.

match-criteria — Displays information about the matching criteria.

detail — Displays detailed information.

Sample Output

```
A:Dut-A# show qos sap-ingress
===============================================================================
Sap Ingress Policies
===============================================================================
Policy-Id  Scope     Name                     Description
-------------------------------------------------------------------------------
1          Template  default                  Default SAP ingress QoS policy.
80         Template                           Dot1p mappings/service for servi*
90         Template                           Dot1p mappings/service for servi*
100        Template                           Dot1p mappings/service for servi*
110        Template                           Dot1p mappings/service for servi*
120        Template                           Dot1p mappings/service for servi*
130        Template                           Dot1p mappings/service for servi*
140        Template                           Dot1p mappings/service for servi*
901        Template                           User90_1
902        Template                           User90_2
903        Template                           User90_3
904        Template                           User90_4
905        Template                           User90_5
1000       Template                           Dot1p mappings/service for all s*
-------------------------------------------------------------------------------
Number of Policies : 14
-------------------------------------------------------------------------------
===============================================================================
* indicates that the corresponding row element may have been truncated.
*A:Dut-A#
```

```
A:Dut-A# show qos sap-ingress 80 detail
===============================================================================
QoS Sap Ingress
===============================================================================
Sap Ingress Policy (80)
-------------------------------------------------------------------------------
Policy-id      : 80                          Scope        : Template
Default FC     : be                          Priority     : Low
Criteria-type  : IP
Description    :  Dot1p mappings/service for service 80
-------------------------------------------------------------------------------
Queue Mode    CIR Admin PIR Admin CBS     HiPrio  PIR Lvl/Wt    Parent
              CIR Rule  PIR Rule  MBS             CIR Lvl/Wt
-------------------------------------------------------------------------------
1     Prio    0         7000      def     def     1/1           serv80
              closest   closest   def             0/1
2     Prio    0         3500      def     def     2/1           serv80
              closest   closest   def             0/1
3     Prio    0         2000      def     def     3/1           serv80
              closest   closest   def             0/1
11    Prio    0         max       def     def     1/1           None
              closest   closest   def             0/1
-------------------------------------------------------------------------------
FC                  UCastQ         MCastQ         BCastQ         UnknownQ
-------------------------------------------------------------------------------
be                  1              def            def            def
af                  2              def            def            def
ef                  3              def            def            def
-------------------------------------------------------------------------------
SubFC                              Profile        In-Remark      Out-Remark
-------------------------------------------------------------------------------
af                                 None           None           None
be                                 None           None           None
ef                                 None           None           None
-------------------------------------------------------------------------------
Dot1p           FC                                Priority
-------------------------------------------------------------------------------
0               be                                Default
2               af                                Default
5               ef                                Default
-------------------------------------------------------------------------------
DSCP            FC                                Priority
-------------------------------------------------------------------------------
No DSCP-Map Entries Found.
-------------------------------------------------------------------------------
Prec Value      FC                                Priority
-------------------------------------------------------------------------------
No Prec-Map Entries Found.
-------------------------------------------------------------------------------
Match Criteria
-------------------------------------------------------------------------------
IP Match Criteria
-------------------------------------------------------------------------------
Entry          : 1
Source IP      : Undefined                       Source Port  : None
Dest. IP       : Undefined                       Dest. Port   : None
Protocol       : None                            DSCP         : None
Fragment       : Off
FC             : Default                         Priority     : Default
-------------------------------------------------------------------------------
```

```
Associations
------------------------------------------------------------------------------
Service-Id     : 80 (VPLS)                    Customer-Id  : 80
 - SAP : 1/2/1:80

SLA Profiles :
 - sla_prof80                       override
 - sla_prof80_VOIP                  override
 - sla_prof81_VOIP                  override
==============================================================================
A:Dut-A#
```

scheduler-hierarchy

Syntax **scheduler-hierarchy**

Context show>qos

Description This command enables the context to display information about policies that use this scheduler.

customer

Syntax **customer** *customer-id* **site** *customer-site-name* [**scheduler** *scheduler-name*] [**ingress**|**egress**] [**detail**]

Context show>qos>scheduler-hierarchy
show>qos>scheduler-stats

Description This command displays the scheduler hierarchy per customer multi-service-site.

Parameters **customer** *customer-id* — Displays information for the specified customer ID.

site ***customer-site-name*** — Displays information for the specified multi-service *customer-site-name.*

scheduler ***scheduler-name*** — Displays information for the specified scheduler-name.

ingress — Displays information for the ingress policy.

egress — Displays information for the egress policy.

detail — Displays detailed information.

sap

Syntax **sap** *sap-id* [**scheduler** *scheduler-name*] [**ingress**|**egress**] [**detail**]

Context show>qos>scheduler-hierarchy
show>qos>scheduler-stats

Description This command displays the scheduler stats per SAP.

Parameters *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

scheduler *scheduler-name* — Displays information for the specified scheduler-name.

ingress — Displays information for the ingress policy.

egress — Displays information for the egress policy.

detail — Displays detailed information.

subscriber

Syntax **subscriber** *sub-ident-string* [**scheduler** *scheduler-name*] [**ingress**|**egress**] [**detail**]
subscriber *sub-ident-string* **sla-profile** *sla-profile-name* **sap** *sap-id* [**scheduler** *scheduler-name*] [**detail**]

Context show>qos>scheduler-hierarchy

Description This command displays the scheduler hierarchy rooted at the SLA profile scheduler.

Parameters **subscriber** *sub-ident-string* — Displays information for the specified subscriber profile name.

sla-profile sla-*profile-name* — Displays information for the specified sla-profile-name.

sap s*ap-id* — Displays information for the specified SAP.

scheduler *scheduler-name* — Displays information for the specified scheduler-name.

detail — Displays detailed information.

Note that if the SLA profile scheduler is orphaned (that is when the scheduler has a parent which does not exist) then the hierarchy is only shown when the show command includes the sla-profile and sap parameters.

Sample Output

```
*A:BNG# show qos scheduler-hierarchy subscriber "sub1" sla-profile "sla-profile.1"
sap 1/1/1:1 scheduler "session-sched"
===============================================================================
Scheduler Hierarchy - Subscriber sub1 SLA-Profile sla-profile.1 SAP 1/1/1:1
===============================================================================
Egress Scheduler Policy : session-sched-pol
-------------------------------------------------------------------------------
session-sched (Egr)
| slot(1)
|--(Q) : Sub=sub1:sla-profile.1 200->1/1/1:1->3
|
|--(Q) : Sub=sub1:sla-profile.1 200->1/1/1:1->2
|
|--(Q) : Sub=sub1:sla-profile.1 200->1/1/1:1->1
|
```

```
B:Dut-A# show qos scheduler-hierarchy subscriber alcatel_100 scheduler serv_all
===============================================================================
Scheduler Hierarchy - Subscriber alcatel_100
===============================================================================
serv_all (Ing)
| slot(1)
```

```
|--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:101->11 MCast
|
|--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:100->11 MCast
|
|--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:102->11 MCast
|
|--(S) : AccessIngress:Sub=6:1 100->1/2/1:100->2
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:100->2 1/1
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:100->2 3/2
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:100->2 1/2
|   |
|
|--(S) : AccessIngress:Sub=6:1 100->1/2/1:100->1
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:100->1 1/1
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:100->1 3/2
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:100->1 1/2
|   |
|
|--(S) : AccessIngress:Sub=6:1 100->1/2/1:100->3
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:100->3 1/1
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:100->3 3/2
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:100->3 1/2
|   |
|
|--(S) : AccessIngress:Sub=6:1 100->1/2/1:102->1
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:102->1 1/1
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:102->1 3/2
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:102->1 1/2
|   |
|
|--(S) : AccessIngress:Sub=6:1 100->1/2/1:102->2
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:102->2 1/1
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:102->2 3/2
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:102->2 1/2
|   |
...
===============================================================================
B:Dut-A#


B:Dut-A# show qos scheduler-hierarchy subscriber alcatel_100 scheduler serv_all
detail
===============================================================================
Scheduler Hierarchy - Subscriber alcatel_100
===============================================================================
Legend :
```

```
(U) - Unrestricted     (P) - Provisioned
(A) - Administrative   (O) - Operational
MIR - Measured Info Rate
-------------------------------------------------------------------------------
serv_all (Ing)
| slot(1)
|--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:101->11 MCast
|   |
|   |    PIR Lvl:4            PIR Wt :1
|   |    CIR Lvl:0            CIR Wt :1
|   |
|   |    MIR    :0
|   |    PIR (P):0            PIR (U):7000
|   |    CIR (P):0            CIR (U):0
|   |
|   |    PIR (A):1000000      PIR (O):7000
|   |    CIR (A):0            CIR (O):0
|   |    CBS    :0            MBS    :1280
|   |    Depth  :0            Hi Prio:256
|
|--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:102->11 MCast
|   |
|   |    PIR Lvl:4            PIR Wt :1
|   |    CIR Lvl:0            CIR Wt :1
|   |
|   |    MIR    :0
|   |    PIR (P):0            PIR (U):7000
|   |    CIR (P):0            CIR (U):0
|   |
|   |    PIR (A):1000000      PIR (O):7000
|   |    CIR (A):0            CIR (O):0
|   |    CBS    :0            MBS    :1280
|   |    Depth  :0            Hi Prio:256
|
|--(S) : AccessIngress:Sub=6:1 100->1/2/1:102->1
|   |
|   |    PIR Lvl:1            PIR Wt :1
|   |    CIR Lvl:0            CIR Wt :1
|   |
|   |    MIR    :1687
|   |    PIR (P):1690         PIR (U):3510
|   |    CIR (P):0            CIR (U):0
|   |
|   |    PIR (A):7000
|   |    CIR (A):0
|   |
|   |--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:102->1 1/1
|   |   |
|   |   |    PIR Lvl:1            PIR Wt :1
|   |   |    CIR Lvl:1            CIR Wt :1
|   |   |
|   |   |    MIR    :0
|   |   |    PIR (P):0            PIR (U):1830
|   |   |    CIR (P):0            CIR (U):0
|   |   |
|   |   |    PIR (A):7000         PIR (O):1850
|   |   |    CIR (A):0            CIR (O):0
|   |   |    CBS    :0            MBS    :64
|   |   |    Depth  :0            Hi Prio:8
|   |
...
```

```
|--(Q) : Sub=alcatel_100:sla_default 100->1/2/1:102->3
|   |
|   |    PIR Lvl:3            PIR Wt :1
|   |    CIR Lvl:0            CIR Wt :1
|   |
|   |    MIR    :0
|   |    PIR (P):0            PIR (U):2000
|   |    CIR (P):0            CIR (U):0
|   |
|   |    PIR (A):2000         PIR (O):2000
|   |    CIR (A):0            CIR (O):0
|   |    CBS    :0            MBS    :64
|   |    Depth  :0            Hi Prio:8
===============================================================================
B:Dut-A#
```

scheduler-name

Syntax **scheduler-name** *scheduler-name*

Context show>qos

Description This command displays information about the specified scheduler name.

Parameters *scheduler-name* — Displays information about the specified scheduler.

scheduler-policy

Syntax **scheduler-policy** [*scheduler-policy-name*] [**association** | **sap-ingress** *policy-id* | **sap-egress** *policy-id*]

Context show>qos

Description This command displays information about the specified scheduler policy.

Parameters *scheduler-policy-name* — Displays information for the specified scheduler policy.

sap-ingress *policy-id* **—** Displays information for the ingress policy.

sap-egress *policy-id* **—** Displays information for the egress policy.

association — Displays the information currently configured with the specified *scheduler-policy-name*.

Sample Output

```
B:Dut-A# show qos scheduler-policy
===============================================================================
Sap Scheduler Policies
===============================================================================
Policy-Id                       Description
-------------------------------------------------------------------------------
maximum_4000_1xEF_1xBE
maximum_8000_1xEF_2xAF_1xBE
```

```
multiservice-site
root
scheduler-7Mbps
service100
service110
service120
service130
service140
service80
service90
service_all
===============================================================================
B:Dut-A#


B:Dut-A# show qos scheduler-policy root association
===============================================================================
QoS Scheduler Policy
===============================================================================
Policy-Name    : root
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
No Association Found.
===============================================================================
B:Dut-A#


B:Dut-A# show qos scheduler-policy association
===============================================================================
QoS Scheduler Policy
===============================================================================
Policy-Name    : maximum_4000_1xEF_1xBE
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
No Association Found.

Policy-Name    : maximum_8000_1xEF_2xAF_1xBE
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Service-Id     : 23 (VPLS)                    Customer-Id  : 1
 - SAP : 1/3/2:4000 (Egr)
Service-Id     : 30 (VPLS)                    Customer-Id  : 2
 - SAP : lag-1 (Egr)
 - SAP : lag-2:5 (Egr)
Policy-Name    : multiservice-site
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Service-Id     : 90 (VPLS)                    Customer-Id  : 90
 - SAP : 1/1/12:95 (Ing) (Egr) MSS : site1
 - SAP : 1/1/20:94 (Ing) (Egr) MSS : site1

 - Customer : 2         MSS : site1  (Ing) (Egr)
 - Customer : 90        MSS : site1  (Ing) (Egr)

Policy-Name    : root
-------------------------------------------------------------------------------
Associations
```

```
-------------------------------------------------------------------------------
No Association Found.

Policy-Name    : scheduler-7Mbps
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
No Association Found.

Policy-Name    : service100
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Service-Id     : 100 (VPLS)                  Customer-Id  : 100
 - SAP : 1/2/1:100 (Ing) (Egr)
 - SAP : 1/2/1:101 (Ing) (Egr)
 - SAP : 1/2/1:102 (Ing) (Egr)

 - Customer : 100       MSS : site100  (Ing) (Egr)

Sub Profiles :
 - sub_prof100 (Ing) (Egr)

Policy-Name    : service110
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Service-Id     : 110 (VPLS)                  Customer-Id  : 110
 - SAP : 1/2/1:110 (Ing) (Egr)
 - SAP : 1/2/1:111 (Ing) (Egr)
 - SAP : 1/2/1:112 (Ing) (Egr)

Sub Profiles :
 - sub_prof110 (Ing) (Egr)

Policy-Name    : service120
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Service-Id     : 120 (VPLS)                  Customer-Id  : 120
 - SAP : 1/2/1:120 (Ing) (Egr)
 - SAP : 1/2/1:121 (Ing) (Egr)
 - SAP : 1/2/1:122 (Ing) (Egr)

Sub Profiles :
 - sub_prof120 (Ing) (Egr)

Policy-Name    : service130
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Service-Id     : 130 (VPLS)                  Customer-Id  : 130
 - SAP : 1/2/1:130 (Ing) (Egr)

Sub Profiles :
 - sub_prof130 (Ing) (Egr)

Policy-Name    : service140
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
```

```
Service-Id     : 140 (VPLS)                    Customer-Id  : 140
 - SAP : 1/2/1:140 (Ing) (Egr)

Sub Profiles :
 - sub_prof140 (Ing) (Egr)

Policy-Name    : service80
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Service-Id     : 80 (VPLS)                     Customer-Id  : 80
 - SAP : 1/2/1:80 (Ing) (Egr)

 - Customer : 80        MSS : site80  (Ing) (Egr)

Sub Profiles :
 - sub_prof80 (Ing) (Egr)
 - sub_prof81 (Ing) (Egr)

Policy-Name    : service90
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Service-Id     : 90 (VPLS)                     Customer-Id  : 90
 - SAP : 1/2/1:90 (Ing) (Egr)

Sub Profiles :
 - sub_prof90 (Ing) (Egr)

Policy-Name    : service_all
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Sub Profiles :
 - sub_default (Ing) (Egr)
===============================================================================
B:Dut-A#
```

scheduler-stats

Syntax **scheduler-stats**

Context show>qos

Description This command enables the context to display scheduler statistics information.

Sample Output

```
A:Dut-A# show qos scheduler-stats subscriber alcatel_100
===============================================================================
Scheduler Stats
===============================================================================
Scheduler                          Forwarded Packets      Forwarded Octets
-------------------------------------------------------------------------------
Ingress Schedulers
root                               112777                 25218126
serv_all                           112777                 25218126
```

```
Egress Schedulers
root                                113781                26008462
serv_all                            113781                26008462
===============================================================================
A:Dut-A#


A:Dut-A# show qos scheduler-stats subscriber alcatel_100 scheduler root
===============================================================================
Scheduler Stats
===============================================================================
Scheduler                           Forwarded Packets     Forwarded Octets
-------------------------------------------------------------------------------
Ingress Schedulers
root                                0                     0
Egress Schedulers
root                                0                     0
===============================================================================
A:Dut-A#
```

shared-queue

Syntax **shared-queue** [*shared-queue-policy-name*] [**detail**]

Context show>qos

Description This command displays shared policy information.

Sample Output

```
A:Dut-A# show qos shared-queue
===============================================================================
Shared Queue Policies
===============================================================================
Policy-Id                       Description
-------------------------------------------------------------------------------
default                         Default Shared Queue Policy
===============================================================================
A:Dut-A#


A:Dut-A# show qos shared-queue detail
===============================================================================
QoS Network Queue Policy
-------------------------------------------------------------------------------
Shared Queue Policy (default)
-------------------------------------------------------------------------------
Policy         : default
Description    : Default Shared Queue Policy
-------------------------------------------------------------------------------
Queue CIR       PIR       CBS     MBS     HiPrio  Multipoint
-------------------------------------------------------------------------------
1     0         100       1       50      10      FALSE
2     25        100       3       50      10      FALSE
3     25        100       10      50      10      FALSE
4     25        100       3       25      10      FALSE
5     100       100       10      50      10      FALSE
```

```
6     100       100       10      50      10      FALSE
7     10        100       3       25      10      FALSE
8     10        100       3       25      10      FALSE
9     0         100       1       50      10      TRUE
10    25        100       3       50      10      TRUE
11    25        100       10      50      10      TRUE
12    25        100       3       25      10      TRUE
13    100       100       10      50      10      TRUE
14    100       100       10      50      10      TRUE
15    10        100       3       25      10      TRUE
16    10        100       3       25      10      TRUE
17    0         100       1       50      10      TRUE
18    25        100       3       50      10      TRUE
19    25        100       10      50      10      TRUE
20    25        100       3       25      10      TRUE
21    100       100       10      50      10      TRUE
22    100       100       10      50      10      TRUE
23    10        100       3       25      10      TRUE
24    10        100       3       25      10      TRUE
25    0         100       1       50      10      TRUE
26    25        100       3       50      10      TRUE
27    25        100       10      50      10      TRUE
28    25        100       3       25      10      TRUE
29    100       100       10      50      10      TRUE
30    100       100       10      50      10      TRUE
31    10        100       3       25      10      TRUE
32    10        100       3       25      10      TRUE
-------------------------------------------------------------------------------
FC    UCastQ    MCastQ    BCastQ  UnknownQ
-------------------------------------------------------------------------------
be    1         9         17      25
l2    2         10        18      26
af    3         11        19      27
l1    4         12        20      28
h2    5         13        21      29
ef    6         14        22      30
h1    7         15        23      31
nc    8         16        24      32
-------------------------------------------------------------------------------
Associations
-------------------------------------------------------------------------------
Service : 10           SAP : 1/1/4:101 (shared Q)
Service : 10           SAP : 1/1/4:102 (shared Q)
Service : 10           SAP : 1/1/4:103 (shared Q)
Service : 10           SAP : 1/1/4:104 (shared Q)
Service : 10           SAP : 1/1/4:105 (shared Q)
Service : 10           SAP : 1/1/4:106 (shared Q)
Service : 10           SAP : 1/1/4:107 (shared Q)
Service : 10           SAP : 1/1/4:108 (shared Q)
Service : 10           SAP : 1/1/4:109 (shared Q)
Service : 10           SAP : 1/1/4:110 (shared Q)
Service : 10           SAP : 1/1/4:111 (shared Q)
Service : 10           SAP : 1/1/4:112 (shared Q)
Service : 10           SAP : 1/1/4:113 (shared Q)
Service : 10           SAP : 1/1/4:114 (shared Q)
Service : 10           SAP : 1/1/4:115 (shared Q)
Service : 10           SAP : 1/1/4:116 (shared Q)
Service : 10           SAP : 1/1/4:117 (shared Q)
Service : 10           SAP : 1/1/4:118 (shared Q)
Service : 10           SAP : 1/1/4:119 (shared Q)
Service : 10           SAP : 1/1/4:120 (shared Q)
```

```
Service : 10            SAP : 1/1/4:121 (shared Q)
Service : 10            SAP : 1/1/4:122 (shared Q)
Service : 10            SAP : 1/1/4:123 (shared Q)
Service : 10            SAP : 1/1/5:279 (shared Q)
===============================================================================
A:Dut-A#
```

ancp-policy

Syntax **ancp-policy** [*policy-name*]

Context show>subscriber-management

Description This command displays subscriber ANCP policy information.

Sample Output

```
A:active# show subscriber-mgmt ancp-policy
===============================================================================
ANCP Policies
===============================================================================
adsl-operator1
vdsl-operator1
-------------------------------------------------------------------------------
Number of ANCP policies : 2
===============================================================================
A:active#

A:active# show subscriber-mgmt ancp-policy adsl-operator1
===============================================================================
ANCP Policy "adsl-operator1"
===============================================================================
I. Rate Reduction      : 0 kbps
I. Rate Adjustment     : 100 percent
I. Rate Monitor        : 0 kbps
I. Rate Monitor Alarm  : no
I. Rate Modify         : scheduler "root"

E. Rate Reduction      : 10 kbps
E. Rate Adjustment     : 100 percent
E. Rate Monitor        : 0 kbps
E. Rate Monitor Alarm  : no
E. Rate Modify         : scheduler "root"
Port Down : N/A
Last Mgmt Change: 01/26/2007 17:10:51
===============================================================================
A:active#

A:active# show subscriber-mgmt ancp-policy adsl-operator1 association
===============================================================================
ANCP Policy "adsl-operator1" associations
===============================================================================
SAP Static Map Associations
-------------------------------------------------------------------------------
- SAP     : 1/1/3                            Svc-id  : 333 (VPLS)
     String : "ANCP-String-1"
     String : "ANCP-String-2"
```

```
-------------------------------------------------------------------------------
MSS Static Map Associations
-------------------------------------------------------------------------------
- Cust-id : 1                                  MSS-name: mss1
     String : "ANCP-String-3"
-------------------------------------------------------------------------------
Subscriber Associations
-------------------------------------------------------------------------------
No associations found.
Number of associations : 3
===============================================================================
A:active#
```

ancp-string

Syntax **ancp-string**
ancp-string *ancp-string*
ancp-string customer *customer-id* **site** *customer-site-name*
ancp-string sap *sap-id*

Context show>subscriber-management

Description This command displays subscriber ANCP string information.

Parameters *ancp-string* — Specify the ASCII representation of the DSLAM circuit-id name.

customer *customer-id* — Specify the associated existing customer name.

site *customer-site-name* — Specify the associated customer's configured MSS name.

sap *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

Sample Output

```
A:active# show subscriber-mgmt ancp-string
===============================================================================
ANCP-Strings
===============================================================================
ANCP-String                                                 Assoc State
-------------------------------------------------------------------------------
"ANCP-String-1"                                             SAP   Up
"ANCP-String-2"                                             SAP   Down
"ANCP-String-3"                                             MSS   Up
"ANCP-String-4"                                             MSS   Unknown
"ANCP-String-5"                                             ANCP  Up
"ANCP-String-6"                                             MSS   Unknown
-------------------------------------------------------------------------------
Number of ANCP-Strings : 6
===============================================================================
A:active#


*A:Dut-C# show subscriber-mgmt ancp-string hpolSub43
===============================================================================
ANCP-String "hpolSub43"
===============================================================================
```

```
Type       : SUB - "hpolSub43"
State      : Up                 Ancp Policy: ancpPol
I. Rate    : 100 kbps           E. Rate    : 200 kbps
Adj I. Rate: N/A                Adj E. Rate: 200 kbps
Act I. Rate: N/A                Act E. Rate: 182 kbps
Service Id : 1 (VPRN)
Group      : Alu
Neighbor   : 100.100.100.1:49063
===============================================================================
*A:Dut-C#
```

Other applicable show command output:

```
A:active# show service id 333 sap 1/1/3 detail
===============================================================================
Service Access Points(SAP)
===============================================================================
Service Id         : 333
SAP                : 1/1/3                    Encap             : null
...
-------------------------------------------------------------------------------
ANCP Override
-------------------------------------------------------------------------------
Ing Sched Name: root
- PIR    : 100 kbps
- String : "ANCP-String-1"
Egr Sched Name: root
- PIR    : 100 kbps
- String : "ANCP-String-1"
-------------------------------------------------------------------------------
...
Dro. InProf           : 0                      0
Dro. OutProf          : 0                      0
===============================================================================
A:active#

A:active# show service customer 1 site mss1
===============================================================================
Customer  1
===============================================================================
Customer-ID        : 1
Description        : Default customer
...
-------------------------------------------------------------------------------
ANCP Override
-------------------------------------------------------------------------------
Egr Sched Name: root
- PIR    : 90 kbps
- String : "ANCP-String-3"

-------------------------------------------------------------------------------
Service Association
-------------------------------------------------------------------------------
No Service Association Found.

===============================================================================
A:active#
```

wpp

Syntax **wpp**
wpp [**portal** *wpp-portal-name*] [**host** *ip-address*] **hosts**
wpp portal *wpp-portal-name*
wpp statistics

Context show>router

Description This command displays WPP port-related information in the specified routing instance.

Parameters **portal** *wpp-portal-name* **—** Specifies the name of this WPP portal.

host *ip-address* **—** Specifies the host IP address.

hosts — Displays the hosts enabled on the portal.

Sample Output

```
show router wpp
===============================================================================
WPP portals
===============================================================================
Portal                          Address         Controlled-Rtr      Num-Itf
-------------------------------------------------------------------------------
svr1                            1.1.1.1         0                   0
svr2                            2.2.2.2         0                   0
-------------------------------------------------------------------------------
No. of portals: 2
===============================================================================


show router wpp portal "svr1"
===============================================================================
WPP Portal "svr1"
===============================================================================
Address                              : 1.1.1.1
Controlled router                    : 0
Number of enabled interfaces         : 0
Triggered hosts                      : disabled
Last management change               : 01/27/2014 00:48:45
===============================================================================
```

ipoe session

Syntax **ipoe session** [**sap** *sap-id*] [**mac** *ieee-address*] [**circuit-id** *circuit-id*] [**remote-id** *remote-id*] [**interface** *ip-int-name*|*ip-address*] [**inter-dest-id** *intermediate-destination-id*] [**no-inter-dest-id**] [**ip-address** *ip-prefix*[/*prefix-length*]] [**port** *port-id*] [**subscriber** *sub-ident-string*] [**sap-session-id** *sap-session-index*] [**wholesaler** *service-id*]
session [**sap** *sap-id*] [**mac** *ieee-address*] [**circuit-id** *circuit-id*] [**remote-id** *remote-id*] [**interface** *ip-int-name*|*ip-address*] [**inter-dest-id** *intermediate-destination-id*] [**no-inter-dest-id**] [**ip-address** *ip-prefix*[/*prefix-length*]] [**port** *port-id*] [**subscriber** *sub-ident-string*] [**sap-ipoe session-id** *sap-session-index*] [**wholesaler** *service-id*] **detail**

Context show>service>id

Description This command displays the identified IPoE session details active on the specified service instance.

Parameters **detail —** Displays all IPoE session details.

Sample Output

```
# show service id 4000 ipoe session
===============================================================================
IPoE sessions for svc-id 4000
===============================================================================
Sap Id                          Mac Address         Up Time         MC-Stdby
    Subscriber-Id
        [CircuitID] | [RemoteID]
-------------------------------------------------------------------------------
1/1/4:1201.27                   00:51:00:00:00:0c   0d 00:00:18
    ipoe-session-001
-------------------------------------------------------------------------------
CID | RID displayed when included in session-key
Number of sessions : 1
===============================================================================


# show service id 4000 ipoe session detail
===============================================================================
IPoE sessions for service 4000
===============================================================================

SAP                     : 1/1/4:1201.27
Mac Address             : 00:51:00:00:00:0c
Circuit-Id              : circuit-id-1
Remote-Id               : remote-id-1
Session Key             : sap-mac

MC-Standby              : No

Subscriber-interface    : sub-int-1
Group-interface         : group-int-1

Up Time                 : 0d 00:01:01
Session Time Left       : N/A
Last Auth Time          : 02/28/2015 01:01:09
Min Auth Intvl (left)   : 0d 00:05:00 (0d 00:03:59)
Persistence Key         : N/A
```

```
Subscriber              : "ipoe-session-001"
Sub-Profile-String      : "sub-profile-1"
SLA-Profile-String      : "sla-profile-1"
ANCP-String             : ""
Int-Dest-Id             : ""
App-Profile-String      : ""
Category-Map-Name       : ""
Acct-Session-Id         : "144DFF0000001354D806D5"
Sap-Session-Index       : 1

IP Address              : 10.10.1.201/24
IP Origin               : Radius
Primary DNS             : N/A
Secondary DNS           : N/A
Primary NBNS            : N/A
Secondary NBNS          : N/A
Address-Pool            : N/A

IPv6 Prefix             : 2001:db8:a:111::/64
IPv6 Prefix Origin      : Radius
IPv6 Prefix Pool        : ""
IPv6 Del.Pfx.           : 2001:db8:a001:a100::/56
IPv6 Del.Pfx. Origin    : Radius
IPv6 Del.Pfx. Pool      : ""
IPv6 Address            : 2001:db8:a:101::aaa:1
IPv6 Address Origin     : Radius
IPv6 Address Pool       : ""
Primary IPv6 DNS        : N/A
Secondary IPv6 DNS      : N/A

Radius Session-TO       : N/A
Radius Class            :
Radius User-Name        : 00:51:00:00:00:0c
-------------------------------------------------------------------------------
Number of sessions : 1
===============================================================================
```

Clear Commands

ancp-sub-string

Syntax **ancp-sub-string *string***

Context clear>subscr-mgmt>ancp>ancp

Description This command clears subscriber ANCP data.

Parameters *string* — Clears the ANCP string corresponding to this subscriber ID.

arp

Syntax **arp** {**all** | *ip-address*}
arp interface [*ip-int-name* | *ip-address*]

Context clear>router

Description This command clears all or specific ARP entries.

The scope of ARP cache entries cleared depends on the command line option(s) specified.

Parameters **all —** Clears all ARP cache entries.

ip-addr — Clears the ARP cache entry for the specified IP address.

interface *ip-int-name* **—** Clears all ARP cache entries for the interface with the specified name.

interface *ip-addr* **—** Clears all ARP cache entries for the specified interface with the specified address.

authentication

Syntax **authentication** [*policy-name*]
authentication coa-statistics

Context clear

Description This command clears subscriber authentication data.

Parameters *policy-name* — Clears the authentication policy name. The policy must be already configured.

coa-statistics — Clears statistics for incoming RADIUS Change of Authorization requests.

msap-policy

Syntax **msap-policy** *msap-policy-name*

Context clear> subscriber-mgmt

Description This command deletes managed SAPs created by the managed SAP policy.

Parameters *msap-policy-name* — Specifies an existing managed SAP policy name. Any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

peakvalue-stats

Syntax **peakvalue-stats iom** (*slot* | **all**) [**recursive**]
peakvalue-stats mda (*mda* | **all**) [**recursive**]
peakvalue-stats port (*port-id* | **all**)
peakvalue-stats pw-port (*pw-port* | **all**)
peakvalue-stats system [**recursive**]

Context clear> subscriber-mgmt

Description This command resets the most recent peak counter.

Note that clearing one counter will not impact other counters. For example, clearing one IOM's most recent peak value will not impact chassis peak value.

Parameters **iom** *slot* — Clears IOM host peak value statistics for the specified IOM.

mda *mda* — Clears MDA host peak value statistics for the specified MDA.

port *port-id* — Clears port host peak value statistics for the specified port ID.

pw-port *pw-port* — Clears pseudowire port host peak value statistics for the specified port.

Values 1 — 10239

system — Clears system host peak value statistics.

all — Clears all host peak value statistics.

recursive — Resets the sub-level counters. For example, clearing IOM counters with the **recursive** keyword will also clear counters of all ports counters on that IOM.

radius-accounting

Syntax **radius-accounting** [*policy-name*]

Context clear> subscriber-mgmt

Description This command clears RADIUS accounting data for the specified policy.

Parameters *policy-name* — The name of the policy. The string is case sensitive and limited to 32 ASCII 7-bit printable characters with no spaces

scheduler-stats

Syntax **scheduler-stats**

Context clear>qos

Description This command clears scheduler statistics.

subscriber

Syntax **subscriber** *sub-ident-string* [**scheduler** *scheduler-name*] [**ingress**|**egress**]

Context clear>qos>scheduler-stats

Description This command clears scheduler stats per subscriber.

Parameters *sub-ident-string* — Clears information for the subscriber profile name.

scheduler *scheduler-name* — Clears information for the specified scheduler-name.

egress — Clears egress information for the subscriber.

ingress — Clears ingress information for the subscriber.

sla-profile

Syntax **subscriber** *sub-ident-string* **sla-profile** *sla-profile-name* **sap** *sap-id* [**scheduler** *scheduler-name*]

Context clear>qos>scheduler-stats

Description This command clears the subscriber's SLA profile scheduler stats.

Parameters **subscriber** *sub-ident-string* — Clears information for the specified subscriber profile name.

sla-profile *sla-profile-name* — Clears information for the specified *sla-profile-name*.

sap *sap-id* — Clears information for the specified SAP.

scheduler *scheduler-name* — Clears information for the specified *scheduler-name.*

srrp

Syntax **srrp**

Context clear>router

Description This command enables the context to clear and reset SRRP virtual router instances.

interface

Syntax **interface** *subscriber-interface* [**id** *srrp-id*]

Context clear>router>srrp

Description This command clears and resets SRRP interface instances.

Parameters *subscriber-interface* — Specifies an existing subscriber interface name.

Values 32 chars max

id *srrp-id* **—** Specifies an existing SRRP ID.

Values 1 — 4294967295

statistics

Syntax **statistics interface** *subscriber-interface* [**id** *srrp-id*]

Context clear>router>srrp

Description This command clears statistics for SRRP instances.

Parameters *subscriber-interface* — Specifies an existing subscriber interface name.

Values 32 chars max

id *srrp-id* **—** Specifies an existing SRRP ID.

Values 1 — 4294967295

route-downloader

Syntax **route-downloader** *name* [**vprn** *vprn*] [**family** *family*]

Context clear>aaa

Description This command clears all the radius-downloaded routes from the internal downloader cache (or protocol RIB/db) (and thus eventually from the RTM itself). The parameters **vprn** and/or **family** allow to restrict the deletion of those routes learned in a particular address family (IPv4 or IPv6) and/or a particular VPRN.

By default, all VPRNs and both IPv4 and IPv6 families are affected.

Note that A clear of the internal protocol DB means the corresponding prefix that were deleted should be removed from the RTM (and from any other exports) as well.

Parameters **vprn —** Specifies to limit the removal of prefixes to only the specific VPRN. The parameter can be either the service-id or service-name that identifies a VPRN.

family *family* **—** Specifies to limit he removal or prefixes only belonging to the address family IPv4 or IPv6. Only these two values will be accepted.

Values ipv4, ipv6

vport

Syntax **port** *port-id* **vport** *name* [**scheduler** *scheduler-name*]

Context clear>qos>scheduler-stats

Description This command clears the vport scheduler stats.

Parameters **port** *port-id* — Clears information for the specified port.

vport *name* — Clears information for the specified vport.

scheduler *scheduler-name* — Clears information for the specified *scheduler-name.*

ipoe session

Syntax **ipoe session** [**sap** *sap-id*] [**interface** *ip-int-name*|*ip-address*] [**mac** *ieee-address*] [**circuit-id** *circuit-id*] [**remote-id** *remote-id*] [**inter-dest-id** *intermediate-destination-id*] [**no-inter-dest-id**] [**ip-address** *ip-prefix*[/*prefix-length*]] [**port** *port-id*] [**subscriber** *sub-ident-string*] [**sap-session-id** *sap-session-index*]
ipoe session all

Context clear>service>id

Description This commands clears all identified IPoE sessions for the specified service instance. All associated subscriber hosts will be deleted from the system.

Parameters **all —** clears all active IPoE sessions for the specified service instance.

Tools Commands

tools

Syntax **tools**

Context <root>

Description The context to enable useful tools for debugging purposes.

Default none

Parameters **dump —** Enables dump tools for the various protocols.

perform — Enables tools to perform specific tasks.

perform

Syntax **perform**

Context tools

Description This command enables the context to enable tools to perform specific tasks.

Default none

persistence

Syntax **persistence**

Context tools>perform

Description This command enables the context to configure downgrade paramters.

downgrade

Syntax **downgrade target-version** *target* [**reboot**]

Context tools>perform>persistence

Description This command downgrades persistence files to a previous version.

Parameters **target-version** *target* — Specifies the downgrade version.

reboot — Specifies to reboot the system after a successful conversion.

subscriber-mgmt

Syntax **subscriber-mgmt**

Context tools>perform

Description This command enables tools to control subscriber management.

edit-lease-state

Syntax **edit-lease-state sap** *sap-id* **ip** *ip-address* [**subscriber** *sub-ident-string*] [**sub-profile-string** *sub-profile-string*] [**sla-profile-string** *sla-profile-string*]
edit-lease-state svc-id *service-id* ip *ip-address* [**subscriber** *sub-ident-string*] [**sub-profile-string** *sub-profile-string*] [**sla-profile-string** *sla-profile-string*]

Context tools>perform>subscr-mgmt

Parameters **sap** *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

ip *ip-address* — Modifies lease state information for the specified IP address.

subscriber *sub-ident-string* — Modifies lease state information for the specified subscriber identification.

sub-profile-string *sub-profile-string* — Modifies lease state information for the specified subscriber profile.

sla-profile-string ***sla-profile-string*** **— Modifies lease state information for the specified SLA profile.**

svc-id *service-id* — Modifies lease state information for the specified service ID.

Values

service-id:	1 — 2147483647
svc-name:	64 characters maximum

credit-reset

Syntax **credit-reset sap** *sap-id* **subscriber** *sub-ident-string* **sla-profile** *sla-profile-name* {**category** *category-name*|**all-categories**}
credit-reset sap *sap-id* **ip** *ip-address* {**category** *category-name*| **all-categories**}
credit-reset svc *service-id* **ip** *ip-address* {**category** *category-name*| **all-categories**}

Context tools>perform>subscr-mgmt

Description This command resets the credit for an SLA-profile instance.

Parameters **sap** *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

ip *ip-address* — Modifies lease state information for the specified IP address.

subscriber *sub-ident-string* **—** Modifies lease state information for the specified subscriber identification.

sub-profile-string *sub-profile-string* **—** Modifies lease state information for the specified subscriber profile.

sla-profile-string *sla-profile-string* **—** Modifies lease state information for the specified SLA profile.

svc-id *service-id* **—** Modifies lease state information for the specified service ID.

Values *service-id*: 1 — 2147483647
svc-name: 64 characters maximum

edit-ipoe-session

Syntax **edit-ipoe-session sap** *sap-id* **mac** *mac-address* [**subscriber** *sub-ident-string*] [**sub-profile-string** *sub-profile-string*] [**sla-profile-string** sla*-profile-string*] [**inter-dest-id** *intermediate-destination-id*] [**ancp-string** *ancp-string*] [**app-profile-string** *app-profile-string*] [**circuit-id** *circuit-id*] [**remote-id** *remote-id*]

Context tools>perform>subscr-mgmt

Description This command updates the data of the IPoE session identified with the given MAC address and SAP identifier. Optionally the remote-id and circuit-id can be specified to identify the IPoE session to update.

Note that the changes take immediate effect.

eval-ipoe-session

Syntax **eval-ipoe-session** [**svc-id** *service-id*] [**sap** *sap-id*] [**mac** *mac-address*] [**circuit-id** *circuit-id*] [**remote-id** *remote-id*] [**subscriber** *sub-ident-string*]

Context tools>perform>subscr-mgmt

Description This command re-evaluates the mapping between authentication strings such as the SLA profile string and the actual profiles for the identified IPoE sessions.

eval-lease-state

Syntax **eval-lease-state** [**svc-id** *service-id*] [**sap** *sap-id*] [**subscriber** *sub-ident-string*] [**ip** *ip-address*]

Context tools>perform>subscr-mgmt

Description This command evaluates lease state information.

Parameters **svc-id** *service-id* **—** Evaluates lease state information for the specified service.

Values *service-id*: 1 — 2147483647
svc-name: 64 characters maximum

sap *sap-id* **—** Evaluates lease state information for the specified SAP.

sap-id — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

subscriber *sub-ident-string* **—** Evaluates lease state information for the specified subscriber identification string.

ip *ip-address* **—** Evaluates lease state information for the specified IP address.

re-ident-sub

Syntax **re-ident-sub** *old-sub-ident-string* **to** *new-sub-ident-string*

Context tools>perform>subscr-mgmt

Description This command renames a subscriber identification string.

Parameters *old-sub-ident-string* — Specifies the existing subscriber identification string to be renamed.

new-sub-ident-string — Specifies the new subscriber identification string name.

redundancy

Syntax **redundancy**

Context tools>dump

Description This command enables the context to dump redundancy parameters.

multi-chassis

Syntax **multi-chassis**

Context tools>dump>redundancy

Description This command enables the context to dump multi-chassis parameters.

mc-ipsec

Syntax **mc-ipsec**

Context tools>perform>redundancy>multi-chassis

Description This command enters the mc-ipsec context.

force-switchover

Syntax **force-switchover tunnel-group** *local-group-id*

Context tools>perform>redundancy>multi-chassis>mc-ipsec

Description This command manually switches over mc-ipsec mastership of the specified tunnel-group.

Parameters *local-group-id* — Specifies the local tunnel-group ID configured under config>redundancy.multi-chassis>peer>mc-ipsec.

mc-ring

Syntax **mc-ring**

Context tools>dump>redundancy>multi-chassis

Description This command dumps multi-chassis ring data.

sync-database

Syntax **sync-database** [**peer** *ip-address*] [**port** *port-id* | *lag-id*] [**sync-tag** *sync-tag*] [**application** *application*] [**detail**] [**type** *type*]

Context tools>dump>redundancy>multi-chassis

Description This command dumps multi-chassis sync database information.

Parameters **peer** *ip-address* **—** Dumps the specified address of the multi-chassis peer.

port *port-id* **—** Dumps the specified port ID of the multi-chassis peer.

port *lag-id* **—** Dumps the specified Link Aggregation Group (LAG) on this system.

sync-tag *sync-tag* **—** Dumps the synchronization tag used while synchronizing this port with the multi-chassis peer.

application — Dumps the specified application information that was synchronized with the multi-chassis peer.

Values dhcps, igmp, igmp-snooping, mc-ring, srrp, sub-mgmt, mld-snooping, all

detail — Displays detailed information.

type *type* **—** Filters by the specified entry type.

Values alarm-deleted, local-deleted

srrp-sync-data

Syntax **srrp-sync-database** [**instance** *instance-id*] [**peer** *ip-address*]

Context tools>dump>redundancy>multi-chassis

Description This command dumps multi-chassis SRRP sync database information.

Parameters *instance-id* — Specifies the instance ID.

Values 1 —4294967295

ip-address — Dumps the specified address (in the form of a.b.c.d).

route-downloader

Syntax **route-downloader start** [**force**]

Context tools>perform>aaa

Description This command causes the download process to start immediately. If an ongoing download is already in progress then no further action is needed, except if the **force** keyword is added. In case the **force** keyword is added, then the current download is aborted and a new one is immediately restarted. If aborting the current download, the internal route table should not be emptied or cleared.

Parameters **start —** Starts the download process immediately.

force — Causes the current download to be aborted and a new one is immediately restarted.

Debug Commands

arp-host

Syntax [**no**] arp-host

Context debug>service>id

Description This command enables and configures ARP host debugging.

The no form of the command disables ARP host debugging.

one-time-http-redirection

Syntax one-time-http-redirection

Context debug>service>id

Description This command produces one-time http redirection debug output.

ppp

Syntax **[no] ppp**

Context debug>service>id>

Description This command enables the PPP debug context.

event

event

Syntax **[no] event**

Context debug>service>id>ppp

Description This command enables the PPP event debug context.

dhcp-client

Syntax **dhcp-client** [**terminate-only**]
no dhcp-client

Context debug>service>id>ppp>event

Description This command enable PPP event debug for DHCP client.

Parameters **terminate-only —** Enables debug for local terminated PPP session

l2tp

Syntax **l2tp** [**terminate-only**]
no l2tp

Context debug>service>id>ppp>event

Description This command enables PPP L2TP event debug.

Parameters **terminate-only —** Enables debug for local terminated PPP session

ppp

Syntax **ppp** [**terminate-only**]
no ppp

Context debug>service>id>ppp>event

Description This command enables PPP event debug.

Parameters **terminate-only —** Enables debug for local terminated PPP session

packet

Syntax [**no**] **packet**

Context debug>service>id>ppp

Description This command enables the PPP packet debug context.

detail-level

Syntax **detail-level** {**low** | **medium** | **high**}
no detail-level

Context debug>service>id>ppp>packet

Description This command specify the detail level of PPP packet debug output.

dhcp-client

Syntax [**no**] **dhcp-client**

Context debug>service>id>ppp>packet

This command enables packet debug output for DHCP client of the PPP session

discovery

Syntax **discovery** [**padi**] [**pado**] [**padr**] [**pads**] [**padt**]
no discovery

Context debug>service>id>ppp>packet

Description This command enables PPP discovery packet debug output.

Parameters **padi/pado/padr/pads/padt —** Enables the corresponding type of PPP discovery packet.

mode

Syntax **mode** {**dropped-only** | **ingr-and-dropped** | **egr-ingr-and-dropped**}
no mode

Context debug>service>id>ppp>packet

Description This command specifies PPP packet debug mode

Parameters **dropped-only —** Only displays dropped packet.

ingr-and-dropped — Only displays ingress packet and dropped packet.

egr-ingr-and-dropped — Displays ingress, egress and dropped packet.

ppp

Syntax **ppp** [**lcp**] [**pap**] [**chap**] [**ipcp**] [**ipv6cp**]
no ppp

Context debug>service>id>ppp>packet

Description This command enables PPP discovery packet debug output for the specified PPP protocol.

Parameters **lcp/pap/chap/ipcp/ipv6cp —** Enables debug for the specified protocol.

sap

Syntax [**no**] **sap** *sap-id*

Context debug>service>id>ppp>packet

Description This command enables PPP debug output for the specified SAP, this command allow multiple instances.

Parameters *sap-id* — Specifies the SAP ID.

username

Syntax [**no**] **username** *username*

Context debug>service>id>ppp

Description This command enable PPP debug for the specified username. since not all PPP packets contain username, so a mac debug filter will be created automatically when system sees a PPP packet contain the specified username.

Multiple username filters can be specified in the same debug command.

Parameters *user-name* — Specifies the ppp username.

circuit-id

Syntax [**no**] **circuit-id** *circuit-id*

Context debug>service>id>ppp

Description This command enable PPP debug for the specified circuit-id.

Multiple circuit-id filters can be specified in the same debug command.

Parameters *circuit-id* — Specifies the circuit-id in PADI.

remote-id

Syntax [**no**]**remote-id** *remote-id*

Context debug>service>id>ppp

Description This command enable PPP debug for the specified remote-id.

Multiple remote-id filters could be specified in the same debug command.

Parameters *remote-id* — Specifies the remote-id in PADI.

msap

Syntax [**no**]**msap** *msap-id*

Context debug>service>id>ppp

Description This command enable PPP debug for the specified managed SAP.

Multiple msap filters could be specified in the same debug command.

Parameters *msap-id* — Specifies the managed SAP ID.

authentication

Syntax **authentication** [**policy** *policy-name*] [**mac-addr** *ieee-address*] [**circuit-id** *circuit-id*]

Context debug>subscr-mgmt

Description This command debugs subscriber authentication.

Parameters **policy** *policy-name* — Specify an existing subscriber management authentication policy name.

mac-addr *ieee-address* — Specifies the 48-bit MAC address xx:xx:xx:xx:xx:xx or xx-xx-xx-xx-xx-xx.

circuit-id *circuit-id* — Specify the circuit-id, up to 256 characters.

sub-ident-policy

Syntax [**no**] **sub-ident-policy** *policy-name*

Context debug>subscr-mgmt

Description This command debugs subscriber identification policies.

Parameters *policy-name* — Specifies the subscriber identification policy to debug.

script-compile-error

Syntax [**no**] **script-compile-error**

Context debug>subscr-mgmt>sub-ident-plcy

Description This command send the traceback of the compile error to the logger. The traceback contains detailed information about where and why the compilation fails. The compilation takes place when the CLI user changes the admin state of the Python URL from shutdown to no-shutdown.

script-export-variables

Syntax [**no**] **script-export-variables**

Context debug>subscr-mgmt>sub-ident-plcy

Description This command sends the result (the three output variables) of the Python script to the logger when the script ran successfully.

script-output

Syntax [**no**] **script-output**

Context debug>subscr-mgmt>sub-ident-plcy

Description This command sends the output (such as from 'print' statements) of the Python script to the logger.

script-output-on-error

Syntax [**no**] **script-output-on-error**

Context debug>subscr-mgmt>sub-ident-plcy

Description This command sends the output (such as from 'print' statements) of the Python script to the logger, but only when the script fails.

script-runtime-error

Syntax [**no**] **script-runtime-error**

Context debug>subscr-mgmt>sub-ident-plcy

Description This command sends the traceback of the Python script failure to the logger.

script-all-info

Syntax **script-all-info**

Context debug>subscr-mgmt>sub-ident-plcy

Description This command enables the script-compile-error, script-export-variables, script-output, script-output-on-error, and script-runtime-error functionalities.

srrp

Syntax [**no**] **srrp**

Context debug>router

Description This command enables debugging for SRRP packets.

The **no** form of the command disables debugging.

events

Syntax [**no**] **events** [**interface** *ip-int-name*]

Context debug>router>srrp

Description This command enables debugging for SRRP packets.

The **no** form of the command disables debugging.

packets

Syntax [**no**] **packets** [**interface** *ip-int-name*]

Context debug>router>srrp

Description This command enables debugging for SRRP packets.

The **no** form of the command disables debugging.

radius

Syntax [**no**] **radius**

Context debug>router

Description This command enables the debug router RADIUS context.

detail-level

Syntax **detail-level** {**low**|**medium**|**high**}
no detail-level

Context debug>router>radius

Description This command specifies the output detail level of command **debug router radius**.

Default medium

Parameters **low —** Output includes packet type, server address, length, radius-server-policy name

medium — All output in low level plus RADIUS attributes in the packet

high — All output in medium level plus hex packet dump

packet-type

Syntax **packet-type** [**authentication**] [**accounting**] [**coa**]
no packet-type

Context debug>router>radius

Description This command specifies the RADIUS packet type filter of command **debug router radius**

Default authentication accounting coa

Parameters **authentication —** RADIUS authentication packet.

accounting — RADIUS accounting packet.

coa — RADIUS change of authorization packet.

radius-attr

Syntax **radius-attr type** *attribute-type* [**transaction**]
radius-attr type *attribute-type* [**transaction**] {**address**|**hex**|**integer**|**string**} **value** *attribute-value*
radius-attr vendor *vendor-id* **type** *attribute-type* [**transaction**] [**encoding** *encoding-type*]
radius-attr vendor *vendor-id* **type** *attribute-type* [**transaction**] [**encoding** *encoding-type*] {**address**|**hex**|**integer**|**string**} **value** *attribute-value*
no radius-attr type *attribute-type*
no radius-attr type *attribute-type* {**address**|**hex**|**integer**|**string**} **value** *attribute-value*
no radius-attr vendor *vendor-id* **type** *attribute-type*
no radius-attr vendor *vendor-id* **type** *attribute-type* {**address**|**hex**|**integer**|**string**} [0..16777215] *attribute-value*

Context debug>router>radius

Description This command specifies the RADIUS attribute filter of command **debug router radius**.

Default none

Parameters **type** *attribute-type* **—** Specifies the RADIUS attribute type.

Values 1 — 255

address — Specifies the value is a IPv4 or IPv6 address/prefix/subnet

string — Specifies the value is a ASCII string

integer — Specifies the value is a integer

hex — Specifies the value is a binary string in hex format, e.g: "\0xAB01FE"

value *attribute-value* **—** Specifies the value of the RADIUS attribute.

Values

address	<ipv4-address>|<ipv6-address>| <ipv6-prefix/prefix-length>
	ipv4-address a.b.c.d
	ipv6-address x:x:x:x:x:x:x:x (eight 16-bit pieces)
	ipv6-prefix x:x:x:x:x:x:x:x (eight 16-bit pieces)
	x:x:x:x:x:d.d.d.d
	x - [0..FFFF]H
	d - [0..255]D
	ipv6-prefix-length [0..128]
	hex - [0x0..0xFFFFFFFF...(max 506 hex nibbles)]
	integer - [0..4294967295]
	string - ascii-string (max 253 chars)

transaction — With this parameter, system will output both request and response packets in the same session even in case response packet doesn't include the filter attribute.

vendor *vendor-id* **—** Specifies the vendor id for the vendor specific attribute.

Values 0 — 16777215

encoding *encoding-type* — Specifies the size of vendor-type and vendor-length in bytes. It is a two digitals string: "xy", x is the size of vendor-type, range from 1-4; y is the size of vendor-length of vendor-length, range from 0-2; it is "11" by default.

Values [type-size:1..4][length-size:0..2]

wpp

Syntax [**no**] **wpp**

Context debug>router

Description This command enables the context to configure WPP debugging parameters.

packet

Syntax [**no**] **packet**

Context debug>router>wpp

Description This command enables WPP packet debugging.

detail-level

Syntax **detail-level** *detail-level*

Context debug>router>wpp
debug>router>wpp>packet

Description This command specifies the detail level of WPP packet debugging.

Parameters *detail-level* — specifies the detail level of WPP packet debugging

Values high — Specifies a high detail level for WPP packet debugging.
low — Specifies a low detail for WPP packet debugging.

portal

Syntax [**no**] **portal** *wpp-portal-name*

Context debug>router>wpp

Description This command enables WPP debugging for the specified WPP portal.

Parameters *wpp-portal-name* — Specifies the WPP portal name.

Monitor Commands

subscriber

Syntax **subscriber** *sub-ident-string* **sap** *sap-id* **sla-profile** *sla-profile-name* [**base** | **ingress-queue-id** *ingress-queue-id* | **egress-queue-id** *egress-queue-id*] [**interval** *seconds*] [**repeat** *repeat*] [**absolute** | **rate**]

Context monitor>service

Description This command monitors statistics for a subscriber.

Parameters **sub-ident-string** — Specifies an existing subscriber identification profile to monitor.

sap *sap-id* — Specifies the physical port identifier portion of the SAP definition. See Common Service Commands on page 2168 for *sap-id* command syntax.

sla-profile ***sla-profile-name*** — Specifies an existing SLA profile.

interval *seconds* — Configures the interval for each display in seconds.

Default 11

Values 11 — 60

repeat *repeat* — Configures how many times the command is repeated.

Default 10

Values 1 — 999

absolute — When the **absolute** keyword is specified, the raw statistics are displayed, without processing. No calculations are performed on the delta or rate statistics.

Default mode delta

rate — When the **rate** keyword is specified, the rate-per-second for each statistic is displayed instead of the delta.

base — Monitor base statistics.

ingress-queue-id *ingress-queue-id* — Monitors statistics for this queue.

Values 1 — 32

egress-queue-id *egress-queue-id* — Monitors statistics for this queue.

Values 1 — 8

Sample Output

```
A:Dut-A# monitor service subscriber alcatel_100 sap 1/2/1:101 sla-profile sla_default
===============================================================================
Monitor statistics for Subscriber alcatel_100
===============================================================================
At time t = 0 sec (Base Statistics)
-------------------------------------------------------------------------------
```

```
SLA Profile Instance statistics
------------------------------------------------------------------------------
                          Packets                  Octets
Off. HiPrio           : 0                        0
Off. LowPrio          : 94531                    30704535
Off. Uncolor          : 0                        0

Queueing Stats (Ingress QoS Policy 1000)
Dro. HiPrio           : 0                        0
Dro. LowPrio          : 7332                     2510859
For. InProf           : 0                        0
For. OutProf          : 87067                    28152288

Queueing Stats (Egress QoS Policy 1000)
Dro. InProf           : 880                      127660
Dro. OutProf          : 0                        0
For. InProf           : 90862                    12995616
For. OutProf          : 0                        0
------------------------------------------------------------------------------
SLA Profile Instance per Queue statistics
------------------------------------------------------------------------------
                          Packets                  Octets
Ingress Queue 1 (Unicast) (Priority)
Off. HiPrio           : 0                        0
Off. LowPrio          : 0                        0
Off. Uncolor          : 0                        0
Dro. HiPrio           : 0                        0
Dro. LowPrio          : 0                        0
For. InProf           : 0                        0
For. OutProf          : 0                        0

Ingress Queue 2 (Unicast) (Priority)
Off. HiPrio           : 0                        0
Off. LowPrio          : 94531                    30704535
Off. Uncolor          : 0                        0
Dro. HiPrio           : 0                        0
Dro. LowPrio          : 7332                     2510859
For. InProf           : 0                        0
For. OutProf          : 87067                    28152288

Ingress Queue 3 (Unicast) (Priority)
Off. HiPrio           : 0                        0
Off. LowPrio          : 0                        0
Off. Uncolor          : 0                        0
Dro. HiPrio           : 0                        0
Dro. LowPrio          : 0                        0
For. InProf           : 0                        0
For. OutProf          : 0                        0

Ingress Queue 11 (Multipoint) (Priority)
Off. HiPrio           : 0                        0
Off. LowPrio          : 0                        0
Off. Uncolor          : 0                        0
Dro. HiPrio           : 0                        0
Dro. LowPrio          : 0                        0
For. InProf           : 0                        0
For. OutProf          : 0                        0

Egress Queue 1
Dro. InProf           : 880                      127660
Dro. OutProf          : 0                        0
```

```
For. InProf           : 90862                  12995616
For. OutProf          : 0                      0

Egress Queue 2
Dro. InProf           : 0                      0
Dro. OutProf          : 0                      0
For. InProf           : 0                      0
For. OutProf          : 0                      0

Egress Queue 3
Dro. InProf           : 0                      0
Dro. OutProf          : 0                      0
For. InProf           : 0                      0
For. OutProf          : 0                      0
===============================================================================
A:Dut-A#


A:Dut-A# monitor service subscriber alcatel_100 sap 1/2/1:101 sla-profile sla_default
base rate
===============================================================================
Monitor statistics for Subscriber alcatel_100
===============================================================================
At time t = 0 sec (Base Statistics)
-------------------------------------------------------------------------------
SLA Profile Instance statistics
-------------------------------------------------------------------------------
                        Packets                  Octets
Off. HiPrio           : 0                      0
Off. LowPrio          : 109099                 35427060
Off. Uncolor          : 0                      0

Queueing Stats (Ingress QoS Policy 1000)
Dro. HiPrio           : 0                      0
Dro. LowPrio          : 8449                   2894798
For. InProf           : 0                      0
For. OutProf          : 100523                 32489663

Queueing Stats (Egress QoS Policy 1000)
Dro. InProf           : 880                    127660
Dro. OutProf          : 0                      0
For. InProf           : 105578                 15104553
For. OutProf          : 0                      0
-------------------------------------------------------------------------------
At time t = 11 sec (Mode: Rate)
-------------------------------------------------------------------------------
SLA Profile Instance statistics
-------------------------------------------------------------------------------
                        Packets                  Octets                   % Port
                                                                          Util.
Off. HiPrio           : 0                      0                        0.00
Off. LowPrio          : 1469                   477795                   0.38
Off. Uncolor          : 0                      0                        0.00

Queueing Stats (Ingress QoS Policy 1000)
Dro. HiPrio           : 0                      0                        0.00
Dro. LowPrio          : 119                    40691                    0.03
For. InProf           : 0                      0                        0.00
For. OutProf          : 1349                   437350                   0.34

Queueing Stats (Egress QoS Policy 1000)
```

```
Dro. InProf           : 0                      0                      0.00
Dro. OutProf          : 0                      0                      0.00
For. InProf           : 1469                   209129                 0.16
For. OutProf          : 0                      0                      0.00
===============================================================================
A:Dut-A#
A:Dut-A# monitor service subscriber alcatel_100 sap 1/2/1:101 sla-profile sla_default
ingress-queue-id 1
===============================================================================
Monitor statistics for Subscriber alcatel_100
===============================================================================
At time t = 0 sec (Base Statistics)
-------------------------------------------------------------------------------
                        Packets                Octets
Ingress Queue 1 (Unicast) (Priority)
Off. HiPrio           : 0                      0
Off. LowPrio          : 0                      0
Off. Uncolor          : 0                      0
Dro. HiPrio           : 0                      0
Dro. LowPrio          : 0                      0
For. InProf           : 0                      0
For. OutProf          : 0                      0
===============================================================================
A:Dut-A#


A:Dut-A# monitor service subscriber alcatel_100 sap 1/2/1:101 sla-profile sla_default
egress-queue-id 1
===============================================================================
Monitor statistics for Subscriber alcatel_100
===============================================================================
At time t = 0 sec (Base Statistics)
-------------------------------------------------------------------------------
                        Packets                Octets
Egress Queue 1
Dro. InProf           : 880                    127660
Dro. OutProf          : 0                      0
For. InProf           : 164366                 23506178
For. OutProf          : 0                      0
===============================================================================
A:Dut-A#
```

host

Syntax **host** [**sap** *sap-id*] [**wholesaler** *service-id*] [**port** *port-id*] [**inter-dest-id** *intermediate-destination-id*] [**detail**]
host [**sap** *sap-id*] [**wholesaler** *service-id*] [**port** *port-id*] **no-inter-dest-id** [**detail**]
host summary
host [**detail**] **wholesaler** *service-id* **(VPRN only)**

Context show>service>id

Description This command displays static host information configured on this service.

Parameters **sap** *sap-id* — Displays SAP information for the specified SAP ID. Refer to Common Service Commands on page 2168 for *sap-id* command syntax.

intermediate-destination-id — Specifies the intermediate destination identifier which is encoded in the identification strings.

Values Up to 32 characters maximum

summary — Displays summary host information.

wholesaler *service-id* **—** The VPRN service ID of the wholesaler. When specified in this context, SAP, SDP, interface, IP address and MAC parameters are ignored.

Values *service-id*: 1 — 2147483647
svc-name: 64 characters maximum

Oversubscribed Multi-Chassis Redundancy (OMCR) in ESM

In This Section

This section describes features and functionality for the Oversubscribed Multi-Chassis Redundancy (OMCR) model.

Topics in this section include:

Overview

Terminology and Abbreviations

- **OMCR** — Oversubscribed Multi-Chassis Redundancy
- **Warm-Standby Node** or **Protecting Node** — Refers to the oversubscribed node that offers the protection of subscriber hosts spread over multiple BNGs. During the normal operation, the protecting node maintains the subscriber host in the form of an MCS record (Multi-Chassis Synchronization Record) in the control plane. Only when the failure occurs and the protecting node becomes active, are the subscriber-hosts fully instantiated in the data and control plane. This node is sometimes referred to as N:1 node.
- **Active/Active (1:1) Model** — This mode of operation refers to the model where subscribers host are fully synchronized between two chassis, regardless of the state of the undelaying SRRP instance (Master/Standby). Each node can have MCS peering sessions with four another nodes where each peering session represent 1 to 1 mapping set of active subscriber hosts.

Restrictions

- The protecting node must use CPM-4 or higher (other protected nodes can continue to use CPM-3).
- The protecting node must use FP2 based cards or higher with chassis mode D.
- The protecting node functionality is not supported in mixed-mode in 7450 ESS chassis.
- All nodes in the OMCR cluster (central standby and the protected nodes) must run at the minimum SR OS R12.0R1.
- Warm-standby mode is a chassis-wide property. In other words, while in warm-standby mode, the chassis cannot operate in 1:1 (active-active) redundancy mode.
- OMCR is supported only for DHCPv4/v6 subscribers. However, non-synchronized PPPoEv4/v6 subscribers are supported in the OMCR cluster. PPPoEv4/v6 PTA (locally terminated) non-synchronized subscribers and the OMCR synchronized IPoE subscriber must be instantiated under separate group-interfaces. On the other hand, non-synchronized PPPov4/v6 LAC sessions are allowed to be under the same group interface as the OMCR synchronized IPoE subscribers. Non-synchronized PPPoEv4/v6 subscriber hosts will rely on ppp-keepalive timeouts to re-establish the connectivity when the failure occurs.
- Pre-emption of already instantiated subscriber hosts in the protecting node by another subscriber hosts is not allowed.

- Redundant interface (shunting) is not supported for subscribers on the protecting node while they are not fully instantiated in the control/data plane (or while the underlying SRRP instance is in a non-Master state on the protecting node).
- Persistency in multi-chassis environment **must** be disabled since redundant nodes are protecting each other and they maintain up-to-date lease states.
- The failover trigger is based on SRRP only (no MC-LAG support).
- Unnumbered subscriber-interface model is not supported in OMCR.
- The protecting node supports 10 MCS peers, while the protected node (in active/active mode of operation) supports 4 MCS peers.
- Synchronization of the following MCS clients is not supported:
  - → Host tracking
  - → MC ring
  - → Layer 2 subscriber hosts
  - → Layer 3 IGMP/MLD
  - → Layer 2 IGMP/MLD
  - → DHCP Server
  - → PPPoE Clients
  - → MC-LAG
  - → MC-IPSEC
  - → MC-ENDPOINT

Deploying Oversubscribed Multi-Chassis Redundancy

In order to optimize the cost, certain operators prefer oversubscribed model in which a single central standby BNG (protecting BNG) supports multiple other BNGs in a semi-stateful fashion.

In Oversubscribed Multi-Chassis Redundancy (OMCR) model, a large number of subscriber-hosts are backed up by a single central standby node. Standby subscriber-hosts within the protecting node are synchronized only within the control plane (CPM) in the form of a Multi-Chassis Synchronization (MCS) record. Such subscriber hosts are not instantiated in the data plane and therefore the data plane resources can be spared and used only on an **as needed** basis. This trait allows the protecting node to back up a large number of subscribers that are scattered over multiple active BNG nodes at the expense of slower convergence.

Only the subset of the subscribers, up to the available resource capacity of the data plane in the protecting node, would be activated on the protecting node at any given time during the failure.

The failover trigger is based on SRRP (no MC-LAG support). The subscriber hosts under the corresponding group-interface will be switched over once the SRRP instance on the protecting node transitions into the Master SRRP state.

There are two possible models for this deployment:

1. Access nodes are directly connected to the BNGs. From the perspective of standby subscribers, in this model the line card is oversubscribed but the physical ports on it are not. For example each of the 10 physical ports on the same line card can be directly connected to respective access nodes. Assume that each physical port can support 64K subscriber hosts. Considering that the subscriber host limit per line card is also 64K (at the time of this writing), the oversubscription ratio in this case would be 10:1.

   The concept of this deployment scenario is shown in Figure 138.

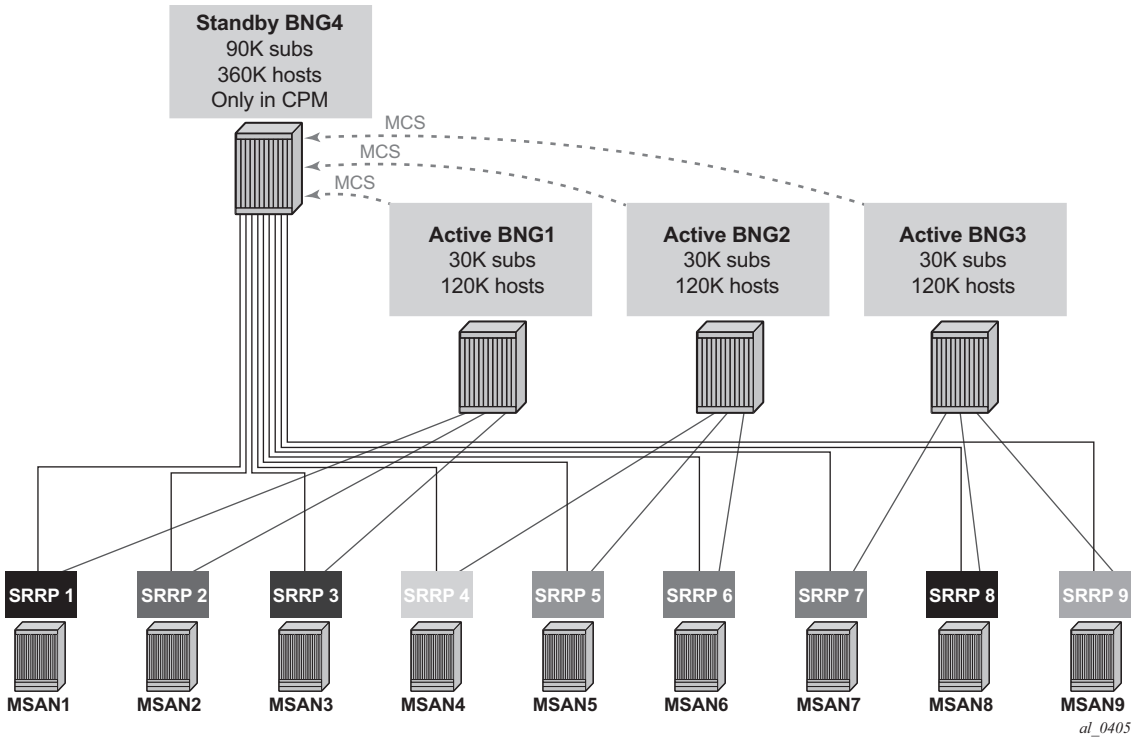


Figure 138: OMCR Scenario Without Aggregation Network

2. Aggregation network in the access (double VLAN tags). In this case a line card and a physical port can be oversubscribed with standby subscribers. For example multiple capture-saps (each capture sap containing 4K c-vlans) can be created on a single physical port on the protecting BNG, for the total of >>64K subscribers per physical port.

Conceptual model for this scenario is shown in Figure 139 (although the number of SRRP instances and capture-saps is in this figure is reduced for simplification).

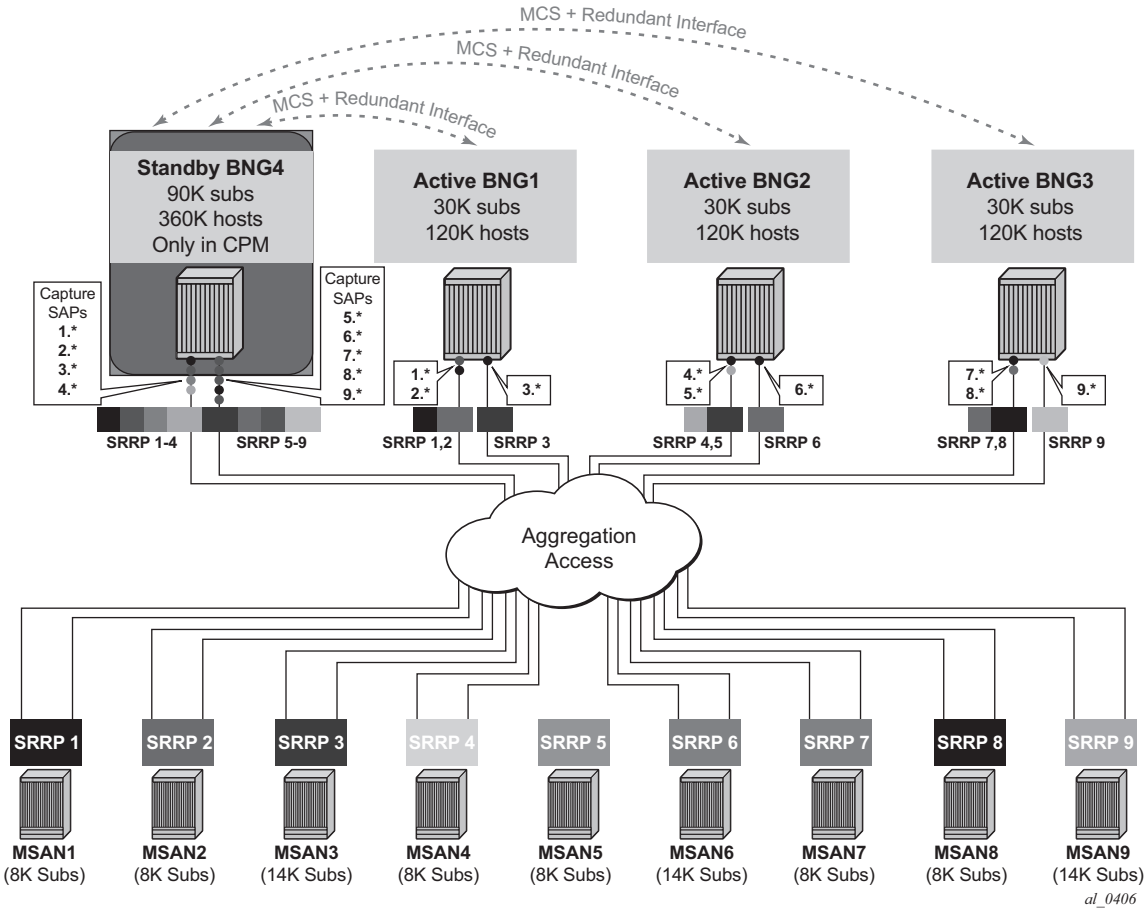


Figure 139: OMCR Scenario with Aggregation Network

In both cases, a maximum of 64K subscribers per line card can be activated on the protecting BNG during the switchover. This is something that the operator should plan around, and consequently group the access nodes in a way so that the eventual number of active subscribers per line card on the protecting node does not exceed the maximum number of supported subscribers per line card.

Note that one could have deployment scenario in which system wide ESM capacity is oversubscribed but the line card capacity is not. For example, on chassis with 10 line cards, each line card can be reserved to protect a total host count of 64k. This would yield a total of 640k

protected hosts distributed across the 10 cards but only up to 256k hosts could be activated simultaneously should it be required due to SRRP transitions to Master.

Resource Exhaustion Notification and Simultaneous Failures

The protection success of the OMCR model relies on grouping protected entities (links and nodes) according to the likelihood of their failure within the timeframe required for their restoration. For example the same resource (IOM card or port) on the protecting node can be used to protect multiple entities in the network as long as their failures do not overlap in time. In other words, if one failure can be repaired before the next one contending for the same resource on the central standby node, the OMCR model will serve the purpose.

But since the oversubscribed model does not offer any guarantees, it is possible that the protecting node in certain cases runs out of resources and fails to offer protection. In this case, the protecting node will generate a SNMP trap identifying the SRRP instance on which subscriber protection has failed. One SNMP trap will be raised per SRRP instance in case that the at least one subscriber under the corresponding group interface was not instantiated. The trap will be cleared either when all subscribers become instantiated or when the SRRP transition into a non-master state.

The number of the subscriber hosts that failed to instantiate, can also be determined via the operational **show redundancy multi-chassis omcr all** command. This command will show the number of subscribers that failed to instantiate along with SRRP instances on which the subscriber host are relaying for successful connectivity.

Pre-emption of already instantiated subscriber hosts in the protecting node by another subscriber hosts is not allowed.

Resource Monitoring

Management and conservation of resources is of utmost importance in OMCR. The resources consumed by the subscriber host depend on the type and the size of subscriber parameters (the number of strings, length of strings, etc.).

For these reasons it is crucial that the operator has a view of the amount of memory in the CPM utilized by subscribers and the amount of free memory that can be used for additional subscribers. The **MCS** line is of particular interest in this output. In addition, the **Subscriber Mgmt** line shows memory utilization for active subscribers in the CPM.

The **Available Memory** gives an indication about how much memory remains.

For example:

```
*A:right-21# show system memory-pools
===============================================================================
Memory Pools
===============================================================================
Name                Max Allowed    Current Size      Max So Far          In Use
```

```
-------------------------------------------------------------------------------
BFD                     No limit       6,291,456       6,291,456       5,509,872
BGP                     No limit       5,242,880       5,242,880       3,635,976
CFLOWD                  No limit       1,048,576       1,048,576          26,576
Cards & Ports           No limit      24,117,248      27,262,976      18,010,424
DHCP Server             No limit       2,097,152       2,097,152         173,680
ETH-CFM                 No limit       6,291,456       9,437,184       4,016,128
ICC                  25,165,824       7,340,032      25,165,824       2,880,008
IGMP/MLD                No limit       1,048,576       1,048,576         166,216
IMSI Db Appl            No limit       1,048,576       1,048,576         793,984
IOM                     No limit       8,388,608       8,388,608       6,894,360
IP Stack                No limit      29,360,128      35,651,584      13,565,120
IS-IS                   No limit       2,097,152       2,097,152       1,095,360
ISA                     No limit       3,145,728       3,145,728       1,217,464
LDP                     No limit       6,291,456       6,291,456       5,607,240
Logging              411,041,792       6,291,456       6,291,456       3,473,024
MBUF               1,073,741,824       2,097,152       2,097,152         299,976
MCS                     No limit     454,033,408     454,033,408     416,753,472
MPLS/RSVP               No limit      49,283,072      69,206,016      42,947,776
MSCP                    No limit       2,097,152       2,097,152       1,022,848
MSDP                    No limit               0               0               0
Management              No limit      19,922,944      26,214,400       5,689,112
OAM                     No limit       1,048,576       1,048,576          86,080
OSPF                    No limit       8,388,608       8,388,608       4,975,824
OpenFlow                No limit       1,048,576       1,048,576         391,880
PIM                     No limit      19,922,944      19,922,944      15,755,792
PTP                     No limit       1,048,576       1,048,576           1,408
RIP                     No limit               0               0               0
RTM/Policies            No limit       9,437,184       9,437,184       7,002,648
Redundancy              No limit       9,437,184     424,673,280         703,160
SIM                     No limit       3,145,728      12,582,912             648
Services                No limit      25,165,824      25,165,824      18,128,056
Stats                   No limit       1,048,576       1,048,576           9,456
Subscriber Mgmt         No limit      24,117,248      41,943,040      14,846,512
System                  No limit     794,820,608     856,686,592     776,394,656
Traffic Eng             No limit       1,048,576       1,048,576         444,744
VRRP                    No limit       2,097,152       3,145,728         393,808
WEB Redirect         16,777,216       1,048,576       1,048,576         128,640
-------------------------------------------------------------------------------
Current Total Size :    1,540,358,144 bytes
Total In Use       :    1,373,041,928 bytes
Available Memory   :    5,778,702,336 bytes
===============================================================================
```

Similar output is given in regards to CLU utilization:

```
*A:right-21#  show system cpu
===============================================================================
CPU Utilization (Sample period: 1 second)
===============================================================================
Name                                  CPU Time       CPU Usage         Capacity
                                        (uSec)                           Usage
-------------------------------------------------------------------------------
BFD                                          0           0.00%           0.00%
BGP                                      2,504           0.03%           0.05%
BGP PE-CE                                    0           0.00%           0.00%
CFLOWD                                      25          ~0.00%          ~0.00%
Cards & Ports                            14,501           0.18%           0.13%
DHCP Server                                 30          ~0.00%          ~0.00%
ETH-CFM                                    614          ~0.00%           0.06%
ICC                                      1,803           0.02%           0.18%
IGMP/MLD                                   538          ~0.00%           0.05%
IMSI Db Appl                                37          ~0.00%          ~0.00%
IOM                                          0           0.00%           0.00%
IP Stack                                 4,578           0.05%           0.24%
IS-IS                                      423          ~0.00%           0.02%
ISA                                      2,690           0.03%           0.10%
LDP                                         78          ~0.00%          ~0.00%
Logging                                     13          ~0.00%          ~0.00%
MBUF                                         0           0.00%           0.00%
MCS                                      2,718           0.03%           0.27%
MPLS/RSVP                                1,137           0.01%           0.08%
MSCP                                         0           0.00%           0.00%
MSDP                                         0           0.00%           0.00%
Management                               6,571           0.08%           0.19%
OAM                                      1,532           0.01%           0.09%
OSPF                                    18,397           0.23%           0.08%
OpenFlow                                    18          ~0.00%          ~0.00%
PIM                                          0           0.00%           0.00%
PTP                                         24          ~0.00%          ~0.00%
RIP                                          0           0.00%           0.00%
RTM/Policies                                 0           0.00%           0.00%
Redundancy                               3,618           0.04%           0.19%
SIM                                     10,959           0.13%           1.08%
SNMP Daemon                                  0           0.00%           0.00%
Services                                 1,037           0.01%           0.03%
Stats                                        0           0.00%           0.00%
Subscriber Mgmt                            835           0.01%           0.03%
System                                  29,863           0.37%           1.32%
Traffic Eng                                  0           0.00%           0.00%
VRRP                                       970           0.01%           0.07%
WEB Redirect                                26          ~0.00%          ~0.00%
-------------------------------------------------------------------------------
Total                                7,975,383         100.00%
   Idle                              7,869,844          98.67%
   Usage                               105,539           1.32%
Busiest Core Utilization                33,264           3.33%
===============================================================================
*A:right-21#
```

Warm-Standby Mode Of Operation

Protecting node operates in a warm-standby mode. Warm-standby mode of operation is the property of the entire node. In other words, while in the central-standby mode of operation (warm-standby command), only subscribers under the SRRP instances that are in the Master state will be fully instantiated in the data plane on the central standby node (protecting node). All other subscribers (under the SRRP instances that are in the standby state) will be synchronized only in the control plane. However, non-central standby node can have a peering connection with a protecting node (OMCR) and at the same time another peering connection with another active BNG node in active/active model. All nodes participating in the OMCR mode of operation must run SROS 12.o or higher. This model is shown in Figure 140.

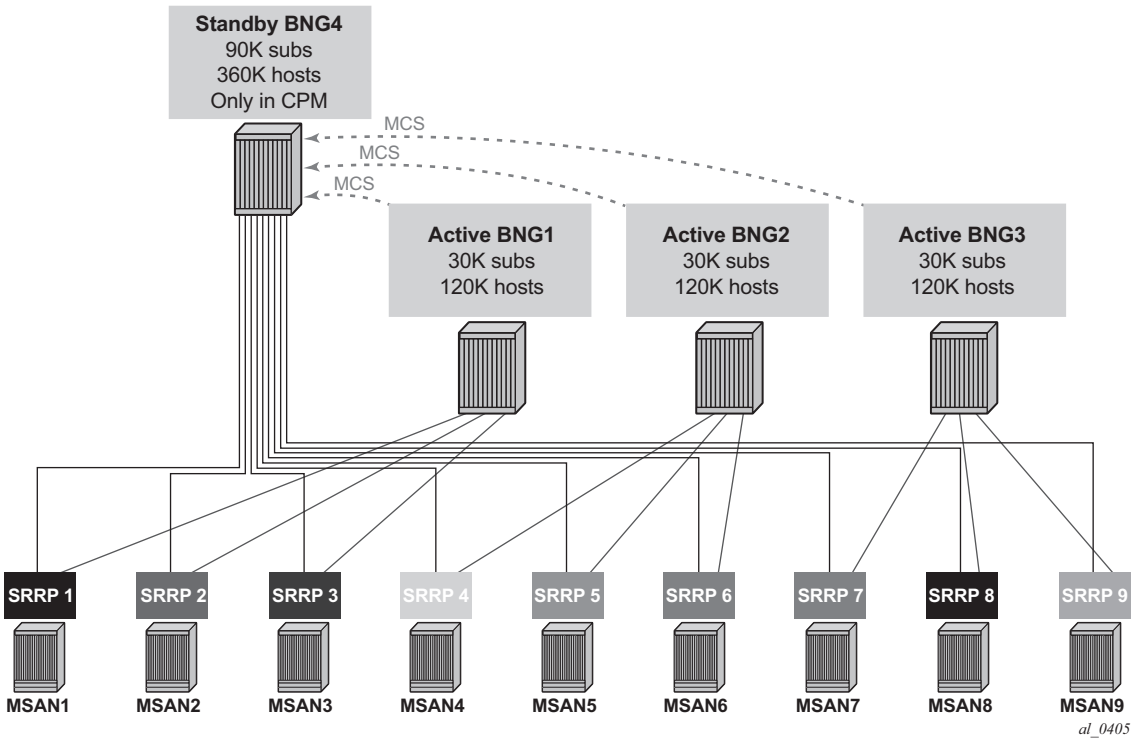


Figure 140: Network Wide Mixing of OMCR and Active/Active (1:1) Model

The central backup property is configured with the following CLI:

```
configure
    redundancy
        multi-chassis
            peer
                warm-standby
```

The **warm-standby** keyword configures the chassis to be in the central standby mode of operation. Although the configuration option is configured per peer, the **warm-standby** functionality is applied per chassis.

Synchronization of IPoE subscribers (**config>redundancy>multi-chassis>peer>sync>sub-mgmt ipoe**) on the protecting node is only possible if all peers are configured for **warm-standby** or none are.

To transition from one mode to another (warm <--> hot), all peers must be administratively shutdown and the warm-standby keyword must be either removed or configured on all peers, depending on the direction of the transition.

Single-homed subscribers are supported in the central standby node, subject to resource limitations.

IPoE vs PPPoE

OMCR is supported only for IPoEv4/v6 subscribers. PPPoEv4/v6 subscriber hosts are not supported. However, non-synchronized PPPoE hosts can be hosted on the protecting node simultaneously with the protected IPoE subscribers. PPPoE PTA (locally terminated) non-synchronized subscribers and OMCR synchronized IPoE subscriber must not be configured under the same group-interfaces. On the other hand, non-synchronized PPPoE LAC sessions are allowed to be under the same group interface as the OMCR synchronized IPoE subscribers.

The recovery of PPPoE subscriber host in non-synchronized environment is based on the timeout of ppp-keepalives.

Persistency

Persistency is multi-chassis environment **must** be disabled since redundant nodes are protecting each other and they maintain up-to-date lease states. Otherwise, race conditions resulting in stale lease states may occur caused by contention between MCS data and persistency data.

Routing and Redundant Interface in OMCR

Support for redundant interface is limited and can be used only in cases where subscribers are activated in the protecting node. In other words, the shunting over the redundant interface cannot be used if subscriber hosts are not fully instantiated (in the data and control plane). For this reason, downstream traffic must not be attracted (via routing) to the protecting node while the subscriber hosts are in the standby mode (SRRP is in a backup state).

During the transient period while the switchover is in progress, subscriber hosts are being instantiated or withdrawn (depending on the direction of the switchover) in the data plane on the protecting node. The duration of this process is dependent on the number of the hosts that needs to be instantiated/withdrawn and it is proportional to the regular host setup/tear-down rates. The redundant interface in this case can be used only for the hosts that are present in the data plane during the switchover transitioning period (from the moment that they are instantiated in the dataplane when protecting node is assuming activity, or up the moment when they are withdrawn from the data plane when the protecting node is relinquishing activity).

The following routing models are supported:

Case 1 — SRRP-Aware routing where subnets can be assigned per group-interfaces (SRRP instances). In a steady state, the redundant interface is not needed since the downstream traffic is attracted to the master node. During switchover periods (routing convergence transitioning periods), redundant interface can be used only for the subscriber hosts that are instantiated in the data plane (from the moment that they are instantiated in the dataplane when protecting node is assuming activity, or up the moment when they are withdrawn from the data plane when the protecting node is relinquishing activity). See Figure 141.

Case 2 — SRRP-Aware routing where subnets spawn (are aggregated) over multiple group-interfaces (SRRP instances). In case of a switchover, /32 IPv4 addresses and /64 IPv6 addresses/prefixes are advertised from the protecting node. In a steady state, the redundant interface is not needed since the downstream traffic is attracted via more specific routes (/32s and /64s) to the master node. During switchover periods (routing convergence transitioning periods), the redundant interface can be used only for the subscriber-hosts that are instantiated in the data plane (from the moment that they are instantiated in the dataplane when protecting node is assuming activity, or up the moment when they are withdrawn from the data plane when the protecting node is relinquishing activity). To reduce the number of routes on the network side, /32s and /64s should only be activated on the protecting node.

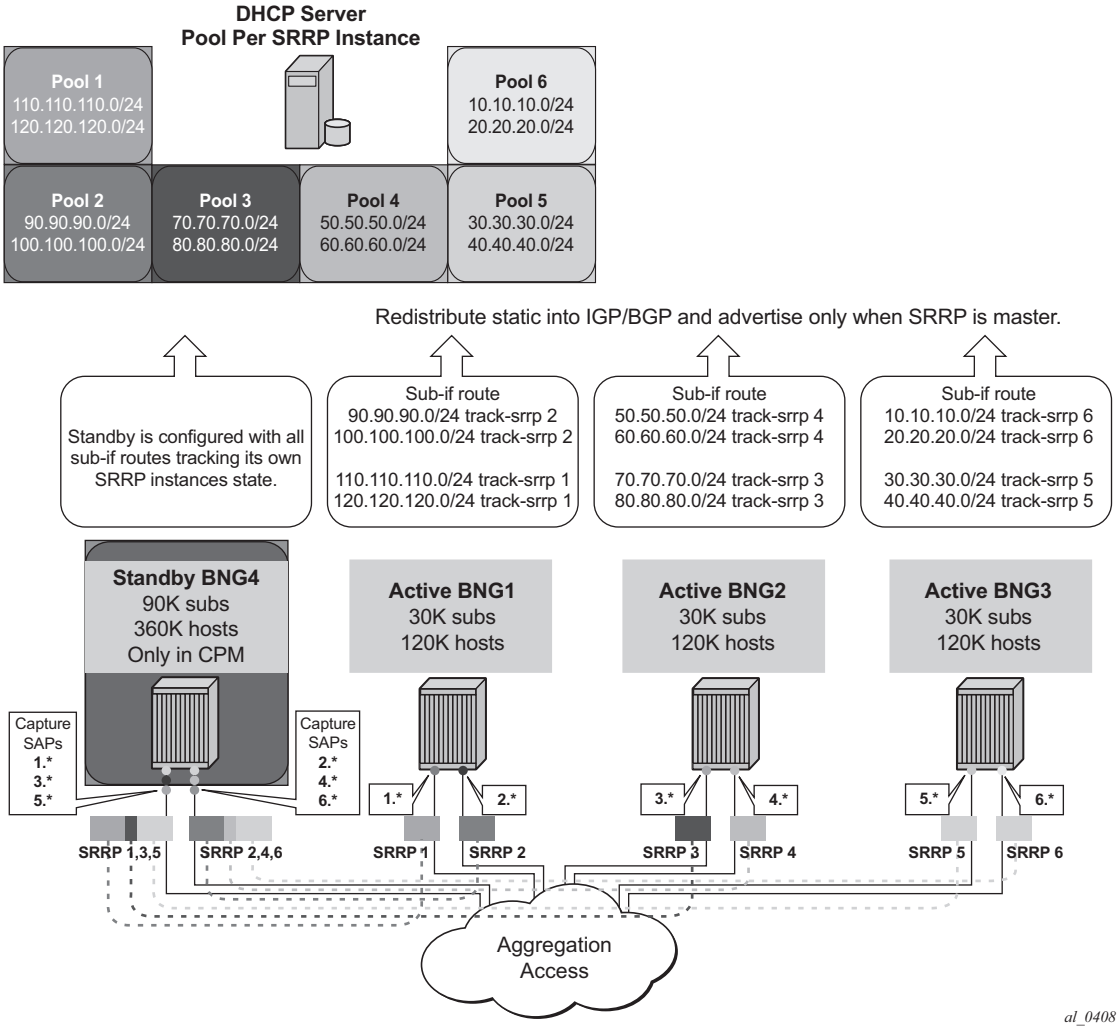


Figure 141: Subnet per Group Interface

A deployment case that is not supported is the one where subnets spawn (are aggregated) over multiple group-interfaces (SRRP instances) and at the same time /32s are not allowed to be advertised from the protecting node. This scenario would require redundant interface support while subscriber-hosts are not necessarily instantiated in the protecting node.

Revertive Behavior

In case that failure is repaired on the original active node (non-central standby node) while SRRP preemption (**preempt**) is configured, the corresponding active subscribers on the protecting node will be withdrawn from the data plane and the activity (mastership) will be switched to the original node.

This behavior will ensure that the resources in the central backup are freed upon failure restoration and are available for protection of other entities in the network (other links/nodes).

In the preemption case, the upstream traffic is steered towards the newly active BNG via gratuitous ARP (GARP). In other words, the virtual MAC is advertised from the newly active node, and consequently the access and aggregation nodes will update their Layer 2 forwarding entries. This action should cause NO interruption in the upstream traffic.

In the downstream direction, the service interruption is equivalent to the time it takes to withdraw the routes from the network side on the standby node. In this case, there are two scenarios:

- A route per group interface (SRRP) is advertised in the network from the central standby node. In this case, downstream traffic interruption is a function of the convergence time of the routing protocol deployed on the network side. Once the routing is converged, all downstream subscriber traffic will be attracted to the newly active node. In the meantime, the redundant interface can be used to shunt traffic from the central standby node to the newly master, but only for the subscriber hosts that have not yet been withdrawn from the data plane on the protecting node. This withdrawal process may take some time and therefore downstream traffic for some subscriber hosts is restored before the others during the routing convergence period.
- /32 subscriber-host routes are advertised from the protecting node. The total recovery time for downstream traffic will depend on the routing convergence. The routing convergence might be slower than in the previous case since more routes (/32s) need to be withdrawn from the network. The redundant interface can be used in the meantime for the subscriber hosts that have not yet been withdrawn from the data plane in protecting node.

Service Restoration Times

Service restoration times depends on the scale of the outage. The factors that affect the restoration times are:

- Failure detection time based on SRRP (could be in a sub second range, also supported based on BFD).
- Time needed to instantiate/withdraw subscriber host in/from the data plane.
- Routing convergence (based on SRRP aware routing).

Processing of the SRRP Flaps

When multiple srrp instances fail at the same time, they will be processed one at the time on first come first serve basis. The subscriber instantiation processing during the switchover is divided into 1seconds intervals. In-between those intervals, the state of the SRRP are checked to ensure that it has not changed while the subscriber instantiation is in progress. This mechanism will break the inertia (snowball effect) that can be caused by SRRP instance flaps. Furthermore, an SRRP flap is handled by not requesting a withdrawal followed by an instantiation request for the same SRRP instance.

Accounting

The OMCR accounting follows the active/active (1:1) redundancy model.

One difference in accounting behavior between the OMCR model and 1:1 redundancy model is in the processing of the accounting session-time attribute which on the protecting node denotes the time when the host was instantiated on the protecting node.

In contrast, the session-time attribute in 1:1 redundancy model is recorded almost simultaneously on both BNG nodes at the time when the host is originally instantiated.

As a result, the session-time attribute is for the most part un-interrupted during the switchover in 1:1 model whereas in OMCR model, the session-time attribute will be reset on the switchover to the protecting node.

Configuration Guidelines

- For all protected SRRP instances, the protected node should be the **preferred Master**. To achieve this, the SRRP priority should be higher in the protected node than in the protecting node. SRRP preemption is recommended in the protecting node to force it to become Master when possible. Note that an SRRP switch from nonMaster to Master in the protected node does not suffer the slow convergence observed when the nonMaster -> Master transition takes place in the protecting node. This is because the protected node always has the hosts instantiated in the data plane.
- ARP hosts configuration is strongly discouraged in protected group interfaces, unless the operator is ready to tolerate an incomplete redundancy mechanism for these hosts.
- SRRP tracking is strongly recommended to expedite the routing convergence upon an SRRP transition from non-Master to Master in the protecting node.
- It is recommended to have a 1:1 relationship between SRRP and subscriber subnets in order to have smooth routing advertisements based on SRRP state tracking.
- The use of M-SAPs should be preferred over the use of static SAPs. Static SAPs are supported in the OMCR mode but they are consuming resources in the protecting node even when the underlying SRRP instance is in a non-Master state.
- It is recommended that the capture-sap configuration include the **track-srrp** statement (at least for the protecting node). With this configuration the CPM will not process trigger packets when the leases cannot be created because the SRRP is not in the Master state. Configuring SRRP tracking at the capture-sap will offload the CPM from performing false authentication and MSAP creation attempts.
- Wholesale/retail VRF is not recommended since SRRP tracking cannot be configured for wholesale/retail VRF, it is cumbersome to make the routing work in such configurations.
- Load balancing between Master and non-Master via export policies for SRRP must not be configured as the hosts are not instantiated in the protecting node when the corresponding SRRP state is non-Master.
- In order to minimize traffic impact in the event of node reboot, it is recommended to use **delayed-enable** *seconds* command under the subscriber-interface and allow enough time for the MCS database to reconcile. This is particularly important in the protected node. If the SRRP becomes master in the protected node before the database has been reconciled, the protecting node will remove the leases (non-Master state) which have not been synchronized. This would create partial outage.
- In order to avoid SRRP collisions, lack of resources and partial subscriber host instantiation, the use of fate-sharing-groups is not recommended. As long as an SRRP instance can be served by the protected node, it is preferred to keep it in the Master state in there, instead of switching it to the protecting node as part of the operation-group.

Troubleshooting Commands

Some of the commands that can assist in troubleshooting are listed below.

Note: To get a summary view of SRRPs and their OMCR status use the following command as shown below (the **domain** concept is reserved for future use):

```
*A:right-21# show redundancy multi-chassis omcr all
===============================================================================
Domain Table
===============================================================================
Domain    Domain SRRP  SRRP    Domain Instan. Failed Failed Reason
name       state ID    State    Color  Failed  Hosts
-------------------------------------------------------------------------------
N/A       N/A    201   Standby N/A    not-act 0
N/A       N/A    202   Standby N/A    not-act 0
N/A       N/A    203   Standby N/A    not-act 0
N/A       N/A    204   Standby N/A    not-act 0
N/A       N/A    301   Standby N/A    not-act 0
N/A       N/A    302   Standby N/A    not-act 0
N/A       N/A    303   Standby N/A    not-act 0
N/A       N/A    304   Standby N/A    not-act 0
N/A       N/A    401   Standby N/A    not-act 0
N/A       N/A    402   Standby N/A    not-act 0
N/A       N/A    403   Standby N/A    not-act 0
N/A       N/A    404   Standby N/A    not-act 0
N/A       N/A    501   Standby N/A    not-act 0
N/A       N/A    601   Standby N/A    not-act 0
N/A       N/A    701   Standby N/A    not-act 0
N/A       N/A    801   Standby N/A    not-act 0
N/A       N/A    901   Standby N/A    not-act 0
N/A       N/A    1001  Standby N/A    not-act 0
N/A       N/A    1101  Standby N/A    not-act 0
-------------------------------------------------------------------------------
No. of Entries: 19
===============================================================================
*A:right-21#
```

Note: To obtain specific SRRP OMCR information, OMCR information has been added to the **show srrp x detail** command:

```
*A:right-21# show srrp 1001 detail
===============================================================================
SRRP Instance 1001
===============================================================================
Description         : (Not Specified)
Admin State         : Up                Oper State       : backupRouting
Oper Flags          : subnetMismatch
Preempt             : yes               One GARP per SAP : no
Monitor Oper Group  : None
System IP           : 10.20.1.1
Service ID          : IES 2
Group If            : grp.Dut-J.1       MAC Address      : 00:00:61:ac:ac:0a
Grp If Description  : N/A
Grp If Admin State  : Up                Grp If Oper State: Up
Subscriber If       : ies-sub-if-svc-2
Sub If Admin State  : Up                Sub If Oper State: Up
```

```
Address             : 102.1.0.1/16       Gateway IP       : 102.1.0.3
Address             : 102.2.0.1/16       Gateway IP       : 102.2.0.3
Msg Path SAP        : 8/2/2:2.4094
Admin Gateway MAC   : 00:00:51:ac:0a:01  Oper Gateway MAC : 00:00:51:ac:0a:01
Config Priority     : 1                  In-use Priority  : 1
Master Priority     : 100
Keep-alive Interval : 10 deci-seconds    Master Since     : 02/11/2014 11:38:52
Master Down Interval: 3.000 sec (Expires in 2.700 sec)
Fib Population Mode : all
VRRP Policy 1       : None               VRRP Policy 2    : None
OMCR Client status  : Sub-mgmt-ipoe
Instantiation failed: not-act            Failed IPOE Hosts: 0
OMCR Reason         :
```

Note: To have a view of the MCS synchronization including OMCR standby records:

```
*A:right-21# show redundancy multi-chassis sync peer 10.20.1.6 detail
===============================================================================
Multi-chassis Peer Table
===============================================================================
Peer
-------------------------------------------------------------------------------
Peer IP Address         : 10.20.1.6
Description             : (Not Specified)
Authentication          : Disabled
Source IP Address       : 10.20.1.1
Admin State             : Enabled
Warm standby            : Yes
Remote warm standby     : No
-------------------------------------------------------------------------------
Sync-status
-------------------------------------------------------------------------------
Client Applications     : SUBMGMT-IPOE SRRP
Sync Admin State        : Up
Sync Oper State         : Up
Sync Oper Flags         :
DB Sync State           : inSync
Num Entries             : 64026
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 64000
OMCR Alarm Entries      : 0
Rem Num Entries         : 64026
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
===============================================================================
MCS Application Stats
===============================================================================
Application             : igmp
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : igmpSnooping
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
```

```
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : subMgmtIpoe
Num Entries             : 64000
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 64000
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 64000
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : srrp
Num Entries             : 26
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 26
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : mcRing
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : mldSnooping
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : dhcpServer
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
```

```
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : subHostTrk
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : subMgmtPppoe
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : mcIpsec
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
Application             : mld
Num Entries             : 0
Lcl Deleted Entries     : 0
Alarm Entries           : 0
OMCR Standby Entries    : 0
OMCR Alarm Entries      : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 0
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
Rem OMCR Standby Entries: 0
```

```
Rem OMCR Alarm Entries  : 0
-------------------------------------------------------------------------------
===============================================================================
===============================================================================
Ports synced on peer 10.20.1.6
===============================================================================
Port/Encap                    Tag
-------------------------------------------------------------------------------
4/2/2
  2.1-2.4094                  Dut-F.1
===============================================================================
===============================================================================
DHCP Server instances synced on peer 10.20.1.6
===============================================================================
Router-Name                       Server-Name
  Tag
-------------------------------------------------------------------------------
No instances found
===============================================================================
===============================================================================
*A:right-21#
```

Note: To have the MCS database view of the sync status including OMCR status use the following command syntax:

```
*A:right-21# tools dump redundancy multi-chassis sync-database application sub-mgmt-ipoe
peer 10.20.1.6
The following totals are for:
 peer ip 10.20.1.6, port/lag ALL, sync-tag ALL, application SUBMGMT-IPOE
Valid Entries:                    64000
Locally Deleted Entries:          0
Locally Deleted Alarmed Entries: 0
Pending Global Delete Entries:    0
Omcr Alarmed Entries:             0
Omcr Standby Entries:             64000
*A:right-21#
```

OMCR Command Reference

Configuration Commands

Refer to the 7x50 SR OS Basic System Configuration Guide for information about redundancy CLI command descriptions and syntax.

```
config
    — redundancy
        — multi-chassis
            — omcr
                — oversubscription-domain domain-name
                — no oversubscription-domain
                — hold-down sec
                — no hold-down
            — [no] peer ip-address
                — warm-standby
```

```
config
    — service
        — vprn service-id/ies service-id
            — subscriber-if
                — group-if
                    — [no] srrp srrp-id
                        — oversubscription-domain domain-name
```

OMCR Configuration Commands

omcr

Syntax **omcr**

oversubscription-domain

Syntax **oversubscription-domain** *domain-name* **color** *1..10*
no oversubscription-domain

Context configure>service>vprn>sub-if>grp-if>srrp
configure>service>ies>sub-if>grp-if>srrp

Description This command associates the instance with a domain that groups multiple SRRP instances together for the coloring purposes in case of resource contention. A SRRP instance can belong only to one domain. This command has only effect when multiple SRRP instances whose subscriber hosts contend for the same resources on the central standby node switch at the same or at approximately the same time. An SRRP domain should group SRRP instances that are tied to an oversubscribed IOM or port. Once the multiple failures occur at the same or at approximately the same time, only the subscriber-hosts from SRRP instance with the highest color will be instantiated in the forwarding plane. Subscriber-host instantiation on a SRRP instances with a lower color will not be attempted. This command is designed to prevent partial subscriber-host instantiation and geographical coloring in case of multiple simultaneous failures tied to the same resource (IOM or port) on the central standby node.

The assumption is that partial subscriber host instantiation would be hard to troubleshoot and for that reason, the operator can chose not to recover any subscriber on an SRRP instance in case of a lack of resources in the central standby node.

Note that preemption is not allowed. In other words, once the subscriber host instantiation commence for one SRRP-instance, the other instances cannot preempt the already started process. In case that multiple SRRP instances have the same color, their subscriber host instantiation will be treated equally.

An SRRP instance must be in a shut-down state before it is placed in a domain. However, moving the SRRP instance out of the domain does not require it to be in shut-down state.

Default No description associated with the configuration context.

Parameters *domain-name* — Specifies the name of the domain that groups SRRP instance contending for the same resources.

oversubscription-domain

Syntax **oversubscription-domain** *domain-name*
no oversubscription-domain

Context configure>redundancy>multi-chassis>omcr

Description This command configures an oversubscription-domain used to group SRRP instances contending for the same resources in central backup node when OMCR model is deployed.

Default no oversubscription-domain

Parameters *domain-name* — Specifies the domain name.

hold-down

Syntax **hold-down** *sec*
no hold-down

Context configure>redundancy>multi-chassis>omcr

Description This command configures wait time before failure events on the central standby node should be processed. The purpose is to catch near simultaneous failures together and consequently prioritize them in order to prevent resource exhaustion on the central-standby-node.

Default none

Parameters *sec* — Specifies the wait time before failure events on the central standby node should be processed.

Values 0 — 10

warm-standby

Syntax **warm-standby**

Context configure>redundancy> multi-chassis>peer

Description This command enables Oversubscribed Multi-Chassis Redundancy (OMCR) model where subscriber hosts are synchronized between the two chassis only in the control plane and are kept there (as part of the Multi-Chassis Synchronization (MCS) state) until the switchover occurs. Link or nodal failure will trigger the switchover at which point the subscriber hosts are being fully instantiated in the control and the forwarding plane. This approach allows oversubscription of the resources in the central standby (or protecting) node that is backing-up a number of other active nodes. The total number of protected subscribers in the OMCR cluster exceeds the forwarding capacity of the protecting node. This is achievable by not fully occupying the resources for the subscriber hosts until the failure occurs.

The restoration times depend on the amount of the subscriber hosts that are affected by the switchover and it is related to the time needed for the full instantiation of the subscribers in the forwarding plane.

Although this command is configured on a peer level, the warm-standby property is a nodal characteristic. In other words, mixing of N:1 and 1:1 (hot standby) mode in the central standby node is not supported. Consequently all peers on the central standby node must be configured for warm-standby (N:1), or all peers must be configured for hot-standby (1:1) by omitting the warm-standby keyword from the configuration.

The peer of the central-backup node is not aware of the redundancy model supported. In in other words, the peer of the central-backup node does not know whether it peers with a warm-standby peer or host-standby-peer. All nodes participating in this protection model must run SR OS R12.0 or higher.

Default no warm-standby

WIFI Aggregation and Offload

In This Section

This section describes features and functionality for 7750 SR to act as a WLAN-GW providing subscriber management (ESM), mobility and 3G/4G interworking functions for WIFI subscribers gaining access from WLANs in hot-spots and home-spots.

Topics in this section include:

WIFI Aggregation and Offload Overview

This solution set adds support for managing subscribers gaining network access over WLAN. The WLAN access enables a service provider to offer a mobile broadband service to its subscribers or to offload traffic on its or a partners macro cellular (3G/4G) network. The WLAN access can be from public hot-spots (indoor or outdoor APs), venues, enterprises, or home-spots (with public SSID).

The 7750 SR serves as a WLAN Gateway (WLAN-GW) providing Layer 3 termination and ESM for these subscribers. The connectivity from WLAN AP or AC can be over any existing access technology (DSL, PON, Fiber, DOCSIS, etc.), with Ethernet based connectivity from the access node (DSLAM, OLT, Eth MTU, Layer 2 CMTS) to the WLAN-GW. WLAN-GW functions could be on a standalone 7750 as shown in Figure 142 or could be an add-on functionality on existing 7750 based BNG as shown in Figure 143. WLAN connectivity to the WLAN-GW could be over a Layer 2 aggregation or an Layer 3 aggregation network (typical when WLAN-GW is upstream of an existing BNG or CMTS). In case of Layer 2 aggregation the connectivity to the WLAN-GW could be tagged or untagged Ethernet. In case of Layer 3 aggregation, supported connectivity option is Ethernet over GRE (or Eth-over-MPLS over GRE) tunnel originating from the AP/AC, and terminating on the WLAN-GW. The WLAN AP acts as a bridge, switching Ethernet frames into a GRE tunnel terminating on an MS-ISA in the WLAN-GW.

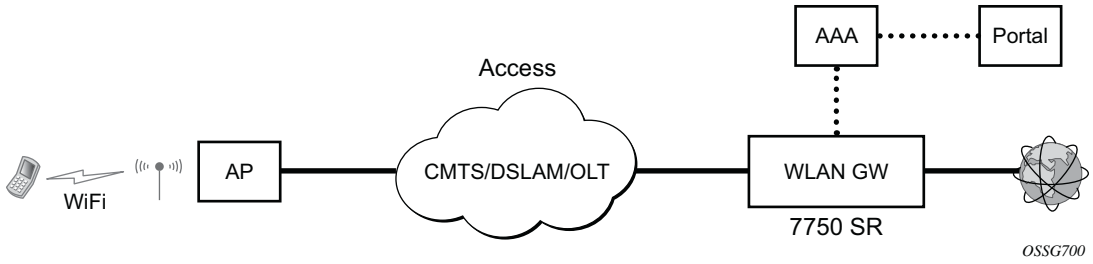


Figure 142: Standalone WLAN-GW

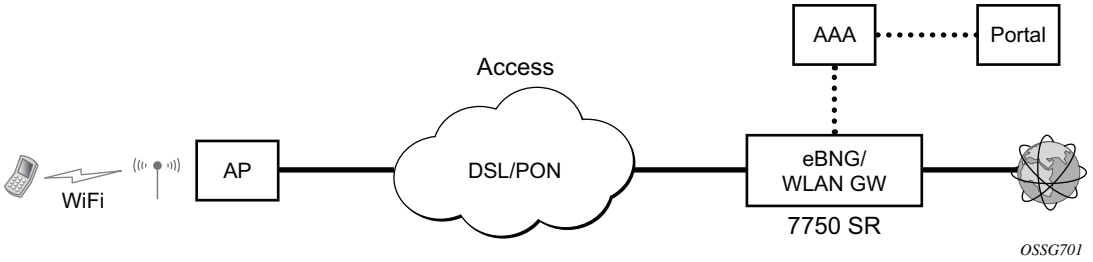


Figure 143: WLAN-GW Functions on Existing BNG

AP Connectivity to the WLAN-GW could be direct Ethernet (tagged or untagged) or could be Ethernet over GRE. In future releases, other tunnels encapsulations will be considered. With the bridged AP using GRE tunnels, the WLAN-GW solution elements are discussed in the following sections.

Layer 2 over Soft-GRE Tunnels

Soft-GRE refers to stateless GRE tunneling, whereby the AP forwards GRE encapsulated traffic to the WLAN-GW, and the GW reflects back the encapsulation in the downstream traffic towards the AP. WLAN-GW does not require any per-AP end-point IP address configuration. The WLAN-GW learns the encapsulation as part of creating the subscriber state on processing the encapsulated control and data traffic. Following are some of the advantages of soft-GRE:

- Resources are only consumed on the WLAN-GW if there is one or more active subscriber on the AP. Merely broadcasting an SSID from an AP does not result in any state on the WLAN-GW.
- No per-AP tunnel end-point configuration on WLAN-GW. This is important as the AP can get renumbered.
- No control protocol to setup and maintain tunnel state on WLAN-GW.

Soft-GRE tunnel termination is performed on dedicated IOMs with MS-ISAs (referred to as WLAN-GW IOM) Each slot requires two MS-ISAs dedicated for soft-GRE tunnel termination. MS-ISA provides tunnel encapsulation/de-capsulation, bandwidth shaping per tunnel (or per-tunnel per SSID), and anchor point for inter-AP mobility. The ESM function such as per-subscriber anti-spoofing (IP and MAC), filters, hierarchical policing, and lawful intercept are provided on the carrier IOM corresponding to the ISA where the subscriber is anchored.

In future releases, other tunnels encapsulations will be considered.

Encapsulation

The GRE encapsulation is based on RFC 1701/2784, *Generic Routing Encapsulation (GRE)*, WLAN-GW will encapsulate according to RFC 1701 with all the flag fields set to 0, and no optional fields present. WLAN-GW is able to receive both encapsulation specified in RFC 1701 and RFC 2784, with all flag fields set to 0, and no optional fields present in the header.

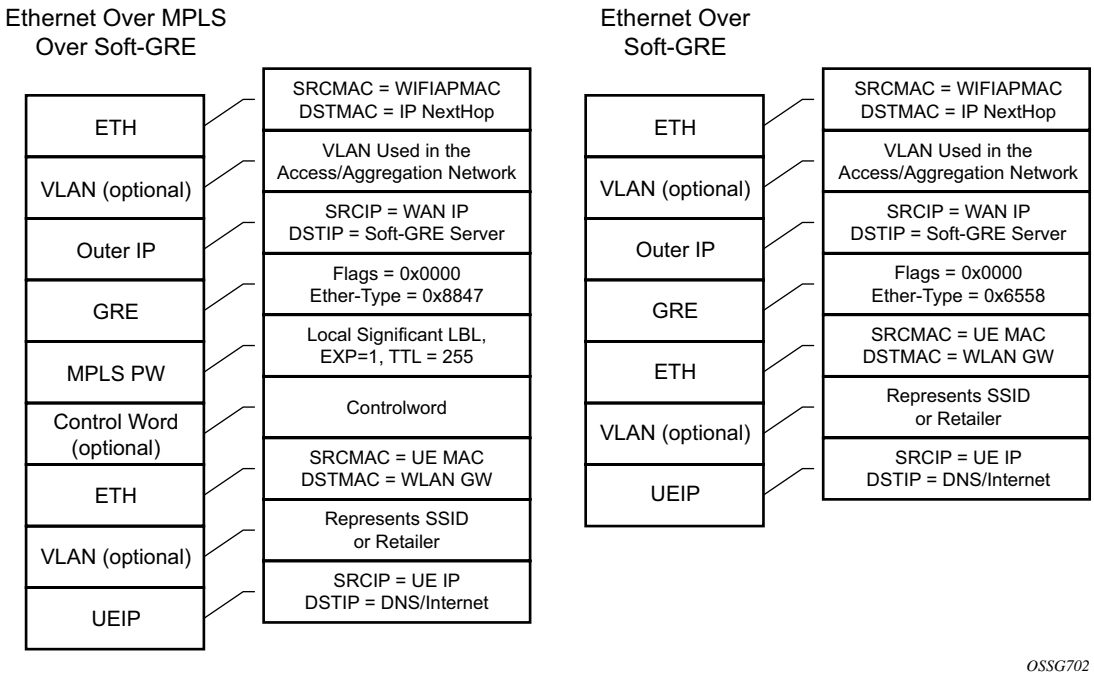


Figure 144: Encapsulation Example

The encapsulation is built as follows:

- Outer Ethernet header: (14 bytes)
  - → Source MAC: MAC address of the WIFI AP/RG/HGW HW address
  - → Destination MAC: MAC address of the first IP NH the WIFI AP/RG/HGW is connected to (for example, CMTS, IP aggregation router, BNG, etc.)
- Outer VLAN: (4 bytes): optional, typically used for service delineation in the access or aggregation network.
- Outer IPv4 Header: (20 bytes)
  - → Source IP — IP address used for WAN addressing which is retrieved by the AP/RG from the ISP through DHCP, PPPoX, etc.
  - → Destination IP — Soft-GRE server address which can be retrieved by a DHCP Option, PPPoX option or configured by TR69 or configured statically in a boot file (in cable environment).
  - → DSCP — Reflects QoS used in the access/aggregation network.
  - → TTL — Should be set to 255 or should reflect the amount of IP hops in the access/aggregation network

- GRE: (4 bytes)
  - → All flags are set to 0, such as checksum, sequence number and keys are not present.
  - → The Ether-Type is set to 0x6558 for native Ethernet is used, and 0x8847 when MPLS encapsulation is used.
- MPLS Pseudowire Label (4 bytes)
  - → Label Value, statically assigned in the WiFi AP/Controller and reflected back from the soft-GRE server to the WIFI AP/Controller. The Label is unique within the context of the source IP address of the tunnel.
  - → EXP: 0 (not used)
  - → TTL: 255 (not used)
- Inner Ethernet header: (14 bytes)
  - → Source MAC: MAC address of the UE
  - → Destination MAC: MAC address of the soft-GRE server/WLAN-GW.
- Inner VLAN: (4 bytes): optional, inserted by AP/RG per unique SSID (typically, when the AP is providing SSID per retailer). WLAN-GW allows mapping the VLAN to a service context per retailer, in the data plane.
- Inner IPv4 Header: (20 bytes)
  - → Source IP: Client's IP address obtained via DHCP (tunneled).
  - → Destination IP: IP address of the destination client trying to reach.
  - → DSCP: set by the client/application
  - → TTL: set by the client/application

Soft-GRE tunnel termination is performed on dedicated IOMs with MS-ISAs (referred to as WLAN-GW IOM). Each WLAN-GW IOM requires both MS-ISAs to be plugged in for soft-GRE tunnel termination. MS-ISA provides tunnel encapsulation/de-capsulation and anchor point for inter-AP mobility. The carrier IOMs of the ISA where the tunnel is terminated performs bandwidth shaping per tunnel (or per-tunnel per SSID). ESM function such as per-subscriber anti-spoofing (IP and MAC), filters, hierarchical policing, and lawful intercept are provided on the carrier IOM corresponding to the ISA where the subscriber is anchored.

N:M warm standby redundancy is supported for WLAN-GW IOM slots. Up to 4 WLAN-GW IOMs can be configured per 7750. A maximum 3 WLAN-GW IOMs can be active. One or more WLAN-GW group can be configured with set of WLAN-GW IOMs, and a limit of active IOMs. Incoming soft-GRE tunnel contexts and corresponding subscribers are load-balanced amongst the MS-ISAs on active IOMs. Tunnel load-balancing is based on outer source IP address of the tunnel. Subscriber load-balancing is based on UE's MAC address in the source MAC of the Ethernet payload in the tunnel. IOM(s) beyond the active limit act as warm standby, and take over the tunnel termination and subscriber management functions from failed WLAN-GW slot.MS-ISAs on WLAN-GW IOMs can also be configured to perform NAT function.

```
config isa wlan-gw-group <group-id>
   [no] active-iom-limit <number>
   [no] description <description-string>
   [no] distributed-sub-mgmt
        [no] isa-aa-group <aa-group-id>
   [no] * iom <slot-number>
      nat
        [no] radius-accounting-policy <nat-accounting-policy>
        [no] session-limits
          [no] reserved <num-sessions>
          [no] watermarks high <percentage> low <percentage>
   [no] shutdown
```

An ESM and soft-gre configuration is required for wlan-gw functions. Subscriber and group interfaces are configured as part of normal ESM configuration. The group interface is enabled for wlan-gw by configuration. L2oGRE is the currently supported soft tunnel types. The wlan-gw related configuration includes the following:

- Tunnel end-point IP address.
- Service context for tunnel termination.
- TCP MSS segment size. This is set in TCP SYN and SYN-ACKs by wlan-gw to adjust to the MTU on access/aggregation network in order to prevent fragmentation of upstream and downstream TCP packets.
- Mobility related configuration, including mobility trigger packet types (normal data or special Ethernet IAPP fame), and hold-down time between successive mobility triggers.
- VLAN to retailer mapping. The AP typically inserts a unique dot1Q tag per retail service provider in the Ethernet payload. The mapping of dot1Q tag to retail service context is configured under wlan-gw tunnel. The subscriber is then created in the configured retail service context. The retail service context can also be provided by AAA server in authentication-accept message based on subscriber credentials or SSID information contained in DHCP Option82.
- Egress QoS configuration for downstream traffic entering the wlan-gw module for tunnel encapsulation. This includes type of aggregate bandwidth shaping (per-tunnel or per-retailer), aggregate-rate-limit, egress QoS policy and scheduler policy. The tunnel shaping can be configured to be applied only when there is more than one subscriber on the tunnel. By default the shaping if configured is applied when first subscriber on the tunnel logs in.

```
*B:Dut-C>config>service>vprn>sub-if>grp-if>wlan-gw# info detail
----------------------------------------------
                        authentication
                            no authentication-policy
                            hold-time sec 5
                        exit
                        no data-triggered-ue-creation
                        dhcp
                            shutdown
                            active-lease-time min 10
                            initial-lease-time min 10
```

```
        no l2-aware-ip-address
        no primary-dns
        no primary-nbns
        no secondary-dns
        no secondary-nbns
    exit
    egress
        no agg-rate-limit
        no hold-time
        qos 1
        no scheduler-policy
        no shape-multi-client-only
        no shaping
    exit
    gw-address 1.1.1.57
    no gw-ipv6-address
    no http-redirect-policy
    no nat-policy
    mobility
        hold-time 5
        no trigger
    exit
    router 70
    no tcp-mss-adjust
    track-mobility
        mac-format "aa:"
        no radius-proxy-cache
    exit
    wlan-gw-group 3
    vlan-tag-ranges
        no default-retail-svc-id
        range start 0 end 100
            authentication
                no authentication-policy
                hold-time sec 5
            exit
            no data-triggered-ue-creation
            dhcp
                shutdown
                active-lease-time min 10
                initial-lease-time min 10
                no l2-aware-ip-address
                no primary-dns
                no primary-nbns
                no secondary-dns
                no secondary-nbns
            exit
            no http-redirect-policy
            no nat-policy
            retail-svc-id 35
            track-mobility
                mac-format "aa:"
                no radius-proxy-cache
            exit
        exit
    exit
    no shutdown
```

Data Path

In the upstream direction, the ingress IOM receiving the GRE tunneled packets from the WIFI AP or AC, load-balances tunnel processing amongst the set of MS-ISAs on the active WLAN-GW IOMs in the WLAN-GW group. The load-balancing is based on a hash of source IP address in the outer IP header. The MS-ISA receiving the GRE encapsulated packets removes the tunnel encapsulation, and internally tunnels (MAC-in-MAC, using BVPLS) the packet to an anchor MS-ISA on the WLAN-GW IOM. All traffic from a given UE is always forwarded to the same anchor MS-ISA based on hashing on UE's MAC address. The MS-ISA provides a mobility anchor point for the UE. The UE MAC's association to the GRE tunnel identifier is created or updated. The corresponding IOM provides ESM functions including ESM lookup, ingress ACLs and QoS. DHCP packets are forwarded to the CPM from the anchor IOM.

In the downstream direction, the IP packets are forwarded as normal from the network IOM (based on route lookup yielding subscriber subnet) to the IOM where the ESM host is anchored. ESM processing including per UE hierarchical policing and LI is performed on the anchor IOM. Configured MTU on the group-interface is enforced on the IOM, and if required packets are fragmented. The packets are then forwarded to the appropriate anchor MS-ISA housed by this IOM. Lookup based on UE's MAC address is performed to get the tunnel identification, and the packets are MAC-in-MAC tunneled to the MS-ISA terminating the GRE tunnel. Aggregate shaping on the tunneled traffic (per tunnel or per retailer) is performed on the carrier IOM housing the tunnel termination MS-ISA. The tunnel termination MS-ISA removes MAC-in-MAC encapsulation, and GRE encapsulates the Layer 2 packet, which exits on the Layer 3 SAP to the carrier IOM. The GRE tunneled packet is forwarded to the right access IOM towards the WIFI AP based on a routing lookup on IP DA in the outer header.

Tunnel Level Egress QoS

Downstream traffic can be subjected to aggregate rate-limit per tunnel or per tunnel and per retailer combination (in case of wholesale). Typically a unique SSID is used per retailer for wholesale on the AP, and is reflected via unique dot1Q tag. In the case of a wlan-gw tunnel per AP, the tunnel encapsulation is performed on the tunnel ISA. The downstream traffic on the tunnel IOM is received over B-VPLS from the anchor IOM, and is MAC-in-MAC (802.1ah) encapsulated. I-SID in the packet represents the GRE tunnel or tunnel and retailer combination. SAP-egress QoS policy defining queues (with rates), and FC to queue mapping, can be specified under the wlan-gw interface. This policy is applicable to all tunnels (or tunnel and SSID combinations) associated with the wlan-gw interface, and is attached to corresponding I-SIDs on the B-VPLS SAP. Traffic is shaped into these queues based on configured queue rates. An aggregate rate-limit applied across queues on an I-SID (representing tunnel or tunnel and retailer combination) can be configured under the wlan-gw interface (represented by the wlan-gw node under the group-interface configuration). The aggregate rate-limit works in conjunction with a port-scheduler. The port-scheduler corresponds to the internal port between tunnel ISA and its carrier IOM, and is specified at the wlan-gw IOM group level. The rate-limit includes the B-VPLS encapsulation overhead. The configuration is shown in Figure 145. Queues per I-SID also work with virtual-scheduler (with or without a port scheduler). Virtual-scheduling and aggregate-rate enforcement are mutually exclusive. Configuration is shown in Figure 146. Egress SAP QoS policy, aggregate rate-limit, port-scheduler, and virtual-schedulers are described in the 7x50 SR OS QoS Guide. The SAP egress QoS policy associated with a wlan-gw interface implicitly creates queues (and scheduler association) on ISIDs as corresponding wlan-gw tunnels are created. General ISID queuing and shaping is defined in the 7x50 SR OS Services Guide.

A configuration node under wlan-gw interface (egress) controls where the egress shaping is applied, and can specify either tunnel or retailer (tunnel and retailer combination in case of wholesale). Per I-SID shaping resources can be held after the last subscriber on the tunnel is deleted, for a configurable amount of time (hold-time) configured under the wlan-gw interface. During ISA or IOM failover the tunnel resources on the IOM kept due to hold-time are reclaimed. ISID shaping can be configured (via knob shape-multi-client) to be applied only when there is more than one UE on the corresponding tunnel (or tunnel and retailer combination). A total of 40,000 shaped tunnels (or shaped tunnel & retailer combinations) are supported per WLAN-GW IOM. Hardware resources for tunnel (ISID) shapers are shared with subscribers. With 3 WLAN-GW IOMs per chassis, a maximum of 98,000 (3 *64K / 2) shaped tunnels and subscribers can be supported per chassis.

The following output depicts per tunnel or per tunnel/SSID egress QoS (with aggregate-rate and port-scheduler).

// Port-scheduler

```
config>qos#
      port-scheduler-policy "lo-gre-port-sched"
           max-rate 5000
           level 1 rate 1000 cir-rate 1000
           level 8 rate 500 cir-rate 500
      exit
exit
```

// Egress queues (per ISID) parented by port-scheduler specified under associated wlan-gw interface

```
config>qos>
   sap-egress 3 create
       queue 1 create
          rate 300
          port-parent level 1 weight 10 cir-level 1 weight 10
       exit
       queue 2 create
          rate 100
          port-parent level 8 weight 10 cir-level 8 weight 10
       fc af create
           dot1p 2
           de-markweight
       exit
       fc be create
          queue 1
          dot1p 0
          de-mark
       exit
       fc ef create
           queue 2
           dot1p 5
           de-mark
       exit
   exit
exit
```

// The wlan-gw interface refers to SAP egress QoS policy and aggregate rate-limit for associated ISIDs

```
config>service>ies>sub-if>grp-if>wlan-gw>egress
      agg-rate-limit 2000
      hold-time 300
      qos 3
      shaping per-tunnel
      shape-multi-client
exit
```

// Port-scheduler parenting queues (per ISID)

```
config>isa>wlan-gw-group#
      active-iom-limit 1
      tunnel-port-policy " lo-gre-port-sched "
      iom 2
      iom 3
      no shutdown
exit
```

Figure 145: Per Tunnel or Per Tunnel/SSID Egress QoS (with aggregate-rate and port-scheduler)

The following output depicts per tunnel or per tunnel/SSID egress QoS (with virtual-scheduler).

```
// hierarchical virtual scheduler
config>qos#
      scheduler-policy "virtual-sched-policy"
           tier1
               scheduler "all-traffic" create
                    rate 10000
               exit
           exit
           tier2
               scheduler "non-voice" create
                   parent all-traffic cir-level 1
                   rate 9000
               exit
               scheduler "voice" create
                  parent all-traffic level 2 cir-level 2
                  rate 3000
               exit
           exit

       exit
```

// egress queues (per ISID) parented by virtual scheduler

```
config>qos>
   sap-egress 3 create
       queue 1 create
          parent "non-voice"
          rate 2000 cir 1000
       exit
       queue 2 create
          parent "voice"
          rate 500 cir-rate 500
       fc be create
          queue 1
          dot1p 0
          de-mark
       exit
       fc ef create
```

```
          queue 2
          dot1p 5
          de-mark
       exit
   exit
exit
```

// A wlan-gw interface refers to SAP egress QoS policy and hierarchical scheduler for associated ISIDs

```
config>service>ies>sub-if>grp-if>wlan-gw>egress
      hold-time 300
      qos 3
      scheduler-policy "virt-sched-policy"
      shaping per-tunnel
      shape-multi-client
exit
```

Figure 146: Per Tunnel or Per Tunnel/SSID Egress QoS (with virtual-scheduler)

Operational Commands

Egress per tunnel (or per tunnel, per SSID) QoS with aggregate rate-limit and port-scheduler.

```
show router 50 wlan-gw soft-gre-tunnels detail
===============================================================================
Soft GRE tunnels
===============================================================================
Remote IP address           : 201.1.1.2
Local IP address            : 50.1.1.1
ISA group ID                : 1
ISA group member ID         : 1
Time established            : 2012/06/19 20:31:36
Number of UE                : 1

Tunnel QoS
----------
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A
Service Access Points(SAP)
===============================================================================
Service Id         : 2147483650
SAP                : 2/1/lo-gre:1             Encap             : q-tag
Description        : Internal SAP
Admin State        : Up                       Oper State        : Up
Flags              : None
Multi Svc Site     : None
Last Status Change : 06/19/2012 07:13:31
Last Mgmt Change   : 06/19/2012 20:30:24
-------------------------------------------------------------------------------
```

```
Encap Group Specifics
-------------------------------------------------------------------------------
Encap Group Name   : _tmnx_SHAPER_GR000       Group Type        : ISID
Qos-per-member     : TRUE
Members            :
1
-------------------------------------------------------------------------------
QOS
-------------------------------------------------------------------------------
E. qos-policy      : 3                       Q Frame-Based Acct: Disabled
E. Sched Policy    :                         E. Agg-limit      : 4000
-------------------------------------------------------------------------------
Encap Group Member 1 Base Statistics
-------------------------------------------------------------------------------
Last Cleared Time     : N/A

Forwarding Engine Stats
                        Packets                 Octets
For. InProf           : 0                       0
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
-------------------------------------------------------------------------------
Encap Group Member 1 Queue Statistics
-------------------------------------------------------------------------------
                        Packets                 Octets
Egress Queue 1
For. InProf           : 0                       0
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
===============================================================================
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================


show qos scheduler-hierarchy sap 2/1/lo-gre:1 encap-group "_tmnx_SHAPER_GR000" member 1
detail
===============================================================================
Scheduler Hierarchy - Sap 2/1/lo-gre:1
===============================================================================
Egress Scheduler Policy :
-------------------------------------------------------------------------------
Legend :
(*) real-time dynamic value
(w) Wire rates
B   Bytes
-------------------------------------------------------------------------------
Root (Egr)
| slot(2)
|--(Q) : -2147483646->2/1/lo-gre:1->EG(_tmnx_SHAPER_GR000):1->1  (Port 2/1/lo-gre Orphan)
|   |    AdminPIR:10000000   AdminCIR:0
|   |    AvgFrmOv:100.00
|   |    AdminPIR:10000000(w) AdminCIR:0(w)
|   |    CBS:0 B             MBS:12582912 B
|   |    Depth:0 B           HiPrio:1376256 B
|   |    MaxAggRate:4000(w)    CurAggRate:0(w)
|   |
```

```
|   |    [Within CIR Level 0 Weight 0]
|   |    Assigned:0(w)       Offered:0(w)
|   |    Consumed:0(w)
|   |
|   |    [Above CIR Level 1 Weight 0]
|   |    Assigned:4000(w)    Offered:0(w)
|   |    Consumed:0(w)
|   |
|   |    TotalConsumed:0
|   |    OperPIR:4000        OperCIR:0
|   |
|   |    PktByteOffset:add 0*
|   |    OnTheWireRates:false
|   |    ATMOnTheWireRates:false
|   |    LastMileOnTheWireRates:false
```

Egress per tunnel (or per tunnel, per SSID) QoS with hierarchical virtual scheduler.

```
show router 50 wlan-gw soft-gre-tunnels detail
===============================================================================
Soft GRE tunnels
===============================================================================
Remote IP address           : 201.1.1.2
Local IP address            : 50.1.1.1
ISA group ID                : 1
ISA group member ID         : 1
Time established            : 2012/06/19 20:43:03
Number of UE                : 1

Tunnel QoS
----------
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A
Service Access Points(SAP)
===============================================================================
Service Id         : 2147483650
SAP                : 2/1/lo-gre:1             Encap             : q-tag
Description        : Internal SAP
Admin State        : Up                       Oper State        : Up
Flags              : None
Multi Svc Site     : None
Last Status Change : 06/19/2012 07:13:31
Last Mgmt Change   : 06/19/2012 20:30:24
-------------------------------------------------------------------------------
Encap Group Specifics
-------------------------------------------------------------------------------
Encap Group Name   : _tmnx_SHAPER_GR000       Group Type        : ISID
Qos-per-member     : TRUE
Members            :
1
-------------------------------------------------------------------------------
QOS
-------------------------------------------------------------------------------
E. qos-policy      : 3                        Q Frame-Based Acct: Disabled
E. Sched Policy    : virtual_scheduler_policy E. Agg-limit      : -1
-------------------------------------------------------------------------------
```

```
Encap Group Member 1 Base Statistics
-------------------------------------------------------------------------------
Last Cleared Time     : N/A

Forwarding Engine Stats
                        Packets                 Octets

For. InProf           : 2                       752
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
-------------------------------------------------------------------------------
Encap Group Member 1 Queue Statistics
-------------------------------------------------------------------------------
                        Packets                 Octets

Egress Queue 1
For. InProf           : 2                       752
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
===============================================================================
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================


show qos scheduler-hierarchy sap 2/1/lo-gre:1 encap-group "_tmnx_SHAPER_GR000" member 1
detail
===============================================================================
Scheduler Hierarchy - Sap 2/1/lo-gre:1
===============================================================================
Egress Scheduler Policy :
-------------------------------------------------------------------------------
Legend :
(*) real-time dynamic value
(w) Wire rates
B   Bytes
-------------------------------------------------------------------------------
Root (Egr)
| slot(2)
|--(S) : virtual_scheduler (Port 2/1/lo-gre)
|   |    AdminPIR:4000       AdminCIR:0(sum)
|   |
|   |    AvgFrmOv:105.31(*)
|   |    AdminPIR:4212(w)    AdminCIR:0(w)
|   |
|   |    [Within CIR Level 0 Weight 0]
|   |    Assigned:0(w)       Offered:0(w)
|   |    Consumed:0(w)
|   |
|   |    [Above CIR Level 1 Weight 1]
|   |    Assigned:4212(w)    Offered:0(w)
|   |    Consumed:0(w)
|   |
|   |
|   |    TotalConsumed:0(w)
|   |    OperPIR:3999
|   |
```

```
|   |    [As Parent]
|   |    Rate:3999
|   |    ConsumedByChildren:0
|   |
|   |
|   |--(Q) : -2147483646->2/1/lo-gre:1->EG(_tmnx_SHAPER_GR000):1->1
|   |   |    AdminPIR:10000000   AdminCIR:0
|   |   |    AvgFrmOv:105.31(*)
|   |   |    CBS:0 B             MBS:12582912 B
|   |   |    Depth:0 B           HiPrio:1376256 B
|   |   |
|   |   |    [Within CIR Level 0 Weight 1]
|   |   |    Assigned:0          Offered:0
|   |   |    Consumed:0
|   |   |
|   |   |    [Above CIR Level 1 Weight 1]
|   |   |    Assigned:3999       Offered:0
|   |   |    Consumed:0
|   |   |
|   |   |    TotalConsumed:0
|   |   |    OperPIR:4000        OperCIR:0
|   |   |
|   |   |    PktByteOffset:add 0*
|   |   |    OnTheWireRates:false
|   |   |    ATMOnTheWireRates:false
|   |   |    LastMileOnTheWireRates:false
```

Authentication

The solution supports multiple authentication mechanisms. Type of authentication support depends on the WIFI AP, UE capabilities and customer preference. In case of 802.1x/EAP capable WIFI APs, supporting secure SSIDs via 802.11i/WPA2, various EAP based authentication such as SIM/uSIM based (SIM/AKA/AKA'), TTLS, PEAP, certs, etc., are supported. The solution also supports web-portal based authentication with or without WISPr client on the UE. EAP and portal authentication works independent of the type of connectivity from the AP (tunneled or native IP).

EAP-Based Authentication

In this model the WIFI AP supports a RADIUS client, and originates RADIUS messages based on 802.1x/EAP exchange with the UE. It sends EAP payload in RADIUS messages towards the RADIUS server or RADIUS proxy. 7750 WLAN-GW can be configured as a RADIUS proxy for the WIFI APs. The WIFI AP should be configured with the IP address of the RADIUS proxy, and should send authentication and accounting messages non-tunneled, natively routed to the RADIUS proxy. See Figure 147.

The RADIUS proxy function allows 7750 SR to look at the RADIUS authentication and accounting messages and create or update corresponding subscriber state. RADIUS proxy transparently forwards RADIUS messages between AP (authenticator) and the AAA server. The access-request message contains standard RADIUS attributes (including user-name), and the EAP payload. Standard authentication algorithms negotiated with EAP involve multiple round-trips (challenge/response) between AP (and UE) and the AAA server.

Once authentication is complete, AAA server passes back subscriber related configuration parameters as well as the computed session keys (aka pair-wise master key) for 802.11i to the AP. These keys are encrypted using shared secret between AP (authenticator) and the AAA server. 7750 WLAN-GW can optionally cache authentication information of the subscriber from access-request and access-accept messages. The cached information allows local authorization of subsequent DHCP messages from the UEs behind the AP against the cached state on the 7750 RADIUS proxy, and avoids another trip to the RADIUS server.

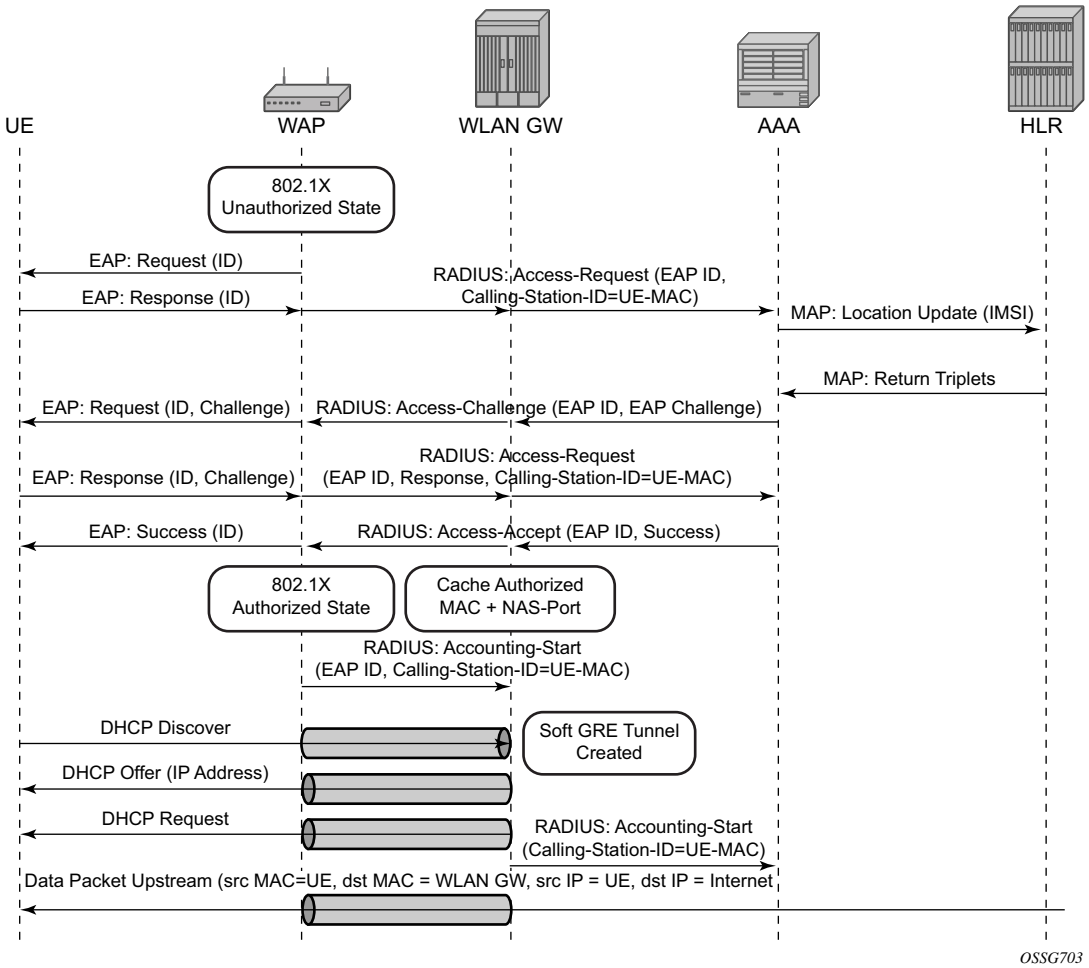


Figure 147: EAP Authentication Call Flow with WLAN-GW RADIUS Proxy

RADIUS Proxy

RADIUS proxy can be configured per service router (base or VPRN). The proxy acts as a server towards the WIFI AP RADIUS clients, and as a client towards RADIUS server(s). Therefore, both client and server parts of the RADIUS proxy need to be configured. The attribute from access-request or response message that serves as the key for the cache is configurable. The key configuration is mandatory for enabling the cache. Commonly the key is the MAC address of the UE, which is available in subsequent DHCP request, and used to locate the cache entry. The UE's MAC address is typically available in the Calling-station-Id attribute (31) in the RADIUS access-request message from the AP. The proxy can be configured for both authentication and accounting. The radius server policies referred by RADIUS proxy are configured under "aaa" context. If caching is enabled in the RADIUS proxy, the subscriber attributes returned in access-accept are cached. These can include 802.1x credentials/keys, IP address or pool, DNS information, default gateway information, retail-service-id, SLA-profile, filter parameters, charging information, session keys (MS-MPPE-RECV-KEY, MS-MPPE-SEND-KEY) etc. If subsequent DHCP DISCOVER is not received within the configured timeout, the cache entry is removed.

The following output displays a RADIUS proxy configuration.

```
config>service>ies>
config>service>vprn>
     description "Default Description For VPRN ID 50"
        interface "listening_radius_server" create
          address 9.9.9.9/32
          loopback
        exit

     radius-proxy
         server "radius_proxy" purpose accounting authentication create
             cache
                 key packet-type request attribute-type 31
                 timeout min 5
                 track-accounting stop interim-update accounting-on accounting-off
                 no shutdown
             exit
             default-accounting-server-policy "radius_acct_server_policy"
             default-authentication-server-policy "radius_Auth_server_policy"
             interface "listening_radius_server"
             load-balance-key attribute-type 102 vendor 5
             secret "AQepKzndDzjRI5g38L3LbbN3E8qualtn" hash2
             send-accounting-response
             no shutdown
         exit
```

RADIUS Proxy — Server Load-Balancing

RADIUS proxy can be configured for load-balancing to multiple authentication and accounting servers. Load-balancing can be “round-robin” or “hash” based, and is configured via access-algorithm under RADIUS policy. With round-robin the first RADIUS request is sent to the first server, the second request to the second server and so on. With hash, it is possible to load-balance subscribers across a set of servers. Based on the configured hash key, configured in the RADIUS proxy, it can be ensured that all RADIUS messages for a single subscriber are sent to the same server. The hash key can include any specified standard or vendor-specific RADIUS attribute. An example is calling-station-id which contains subscriber’s MAC address).

If the hash lookup causes the request to be sent to a server that is currently known to be unresponsive, a second hash lookup is performed that only takes the servers into account that are not known to be unresponsive. This is done to maximize the likelihood that all requests will end on the same server. If all configured servers are known to be unresponsive, the RADIUS proxy will fall back to the round-robin algorithm with the starting point determined by the first hash lookup to maximize the chance of getting any response to the request.

The following output displays a RADIUS server and policy configuration for servers referred from the RADIUS proxy.

```
config>service>vprn
   radius-server
      server "radius_server" address 100.100.100.2 secret "9OkclHYDDbo9eHrzFmuxiaO/
LAft3Pw"
                             hash2 port 1812 create
      exit
   exit

config>aaa
   radius-server-policy "radius_server_policy" create
      servers
         router 50
         access-algorithm hash-based
         source-address 10.1.1.1
         timeout min 1
         hold-down-time 2
         server 1 name "radius_server"
      exit
```

RADIUS Proxy — Cache Lookup

Local-user-database can be programmed to associate a host match with the RADIUS proxy cache instance. The host-match criterion is configurable, based on a subscriber attribute from the DHCP request.

The following output displays a RADIUS proxy cache lookup configuration.

```
config>subscriber-mgmt
   local-user-db "radius_ludb" create
       dhcp
           match-list service-id
           host "default" create
           auth-policy "auth_policy_1"
           match-radius-proxy-cache
              fail-action continue
              match mac
              server router 50 name "radius_proxy"
           exit
              no shutdown
        exit
        no shutdown
    exit
exit
```

If caching is enabled in the RADIUS proxy, then the actions on receiving DHCP message for the authenticated client includes the following:

- A host lookup is done in the local-user-database to find the RADIUS proxy cache for the subscriber.
- The field used to lookup the cache is configurable. It can include circuit-id or remote-id (present in sub-option in DHCP option-82), MAC@ or one of the other options in the DHCP packet. If a match is not found, the configured fail-action is executed. The default match field is MAC@. If the configured fail-action is “drop”, the DHCP DISCOVER is dropped. If the configured fail-action is “continue”, then the ESM host creation proceeds based on the authentication policy configured under the group-interface on which the DHCP packet is received.
- If a match is found, the parameters from original authentication accept in the cache are used to create the ESM host. If the group-interface is wlan-gw, then the ESM host is associated with the wlan-gw tunnel the (AP’s WAN IP@) and corresponding AP (MAC@ from the called-station-id in the authentication state).

RADIUS Proxy — Accounting

An ESM accounting-start is generated once the ESM host is created on successful authorization of DHCP against cached authentication state, and IP@ allocation is complete. The accounting-start contains information from locally cached 802.1x/EAP authentication such as calling-station-id, called-station-id, NAS-port-id, Subscriber-profile, SLA-profile, NAT port range for subscriber-aware NAT etc.

If RADIUS proxy is configured as an accounting proxy in addition to authentication proxy, then the RADIUS proxy transparently forwards the accounting messages to the authentication server(s) referred from the RADIUS proxy, and can also load-balance. If caching is enabled, then the proxy can be configured to also track and locally act on the accounting messages, while still transparently forwarding these messages. The possible actions if accounting messages are tracked include the following:

- Accounting-start — The WIFI AP RADIUS client generates an accounting-start when a UE has successfully authenticated and associated with the AP. In cases where after mobility, the new AP does not re-authenticate due to key caching. accounting-start can be used as a mobility trigger on the WLAN-GW. Also, in cases where a UE associates with a single AP but pre-authenticates with multiple APs in range, tracking mobility based on authentication can falsely associate a UE with incorrect AP. Mobility tracking based on authentication can be disabled via CLI (no track-authentication under radius-proxy cache), and instead be performed based on accounting-start. On receiving accounting-start, the RADIUS proxy on WLAN-GW finds the corresponding ESM host based on the calling-station-id attribute (typically the MAC@) of the subscriber) in accounting-start and associates the UE with the RADIUS client (for example, WIFI AP).
- Accounting-stop — The WIFI AP RADIUS client generates an accounting stop if it detects the UE has disassociated or is deleted due to inactivity or session timeout. The RADIUS proxy finds the corresponding ESM host based on the calling-station-id (typically the MAC@) of the subscriber. Note that if the called-station-id is filled out this must also match with what is currently stored as a security measure. When a UE moves the called-station-id should get updated and as such an accounting-stop from a previous AP cannot delete this UE anymore.
- The ESM host is deleted, an ESM accounting-sop message is sent, and the accounting-stop message from the AP is forwarded to the accounting-server.
- Accounting-ON or Accounting-OFF — This would be received from the AP if the AP has restarted. The RADIUS proxy will find all the impacted subscribers for the AP based on the called-station-id attribute (the AP's MAC@) in the accounting message, and delete all the corresponding ESM hosts.
- Interim Accounting Updates — If the client moves and re-associates with a new AP, the RADIUS client in the new AP generates interim-update. The RADIUS-proxy will locate the impacted ESM host, and update its state to point to the new AP's MAC@ (as available in called-station-id in the accounting message). The ESM interim-updates to accounting

servers are sent on scheduled interval configured in accounting-policy, but with the updated information from the interim updates received from the AP.

Portal Authentication

For SSIDs without 802.11i/WPA2-based key exchange and encryption, it is common to authenticate the user by directing user's HTTP traffic to a portal, where the user is prompted for its credentials, which are verified against a subscriber database. The backend can optionally remember the MAC@ and subscriber credentials for a set period of time such that subsequent logins of the user do not require portal redirection. Some UEs support a client application (aka WISPr client), which automatically posts subscriber credentials on redirect, and parse HTTP success or failure response from the portal sever.

7750 WLAN-GW uses existing http-redirect action in IP filter to trigger redirect port-80 traffic. In case of open SSID, on receiving DHCP DISCOVER, MAC based authentication is performed with the RADIUS server as per configured authentication policy. The SLA-profile returned from RADIUS server in authentication-accept (or the default SLA-profile) contains the filter with http-redirect. Redirect via HTTP 302 message to the UE is triggered from the CPM. Once the user posts its credentials, RADIUS server generates a CoA-request message removing the http-redirect by specifying an SLA-profile without redirect action. If the portal authentication fails, the RADIUS server generates a disconnect-request message to remove the ESM host. In case of wlan-gw tunnel from the AP, the DHCP messages and data are both tunneled to the WLAN-GW. See Figure 148.

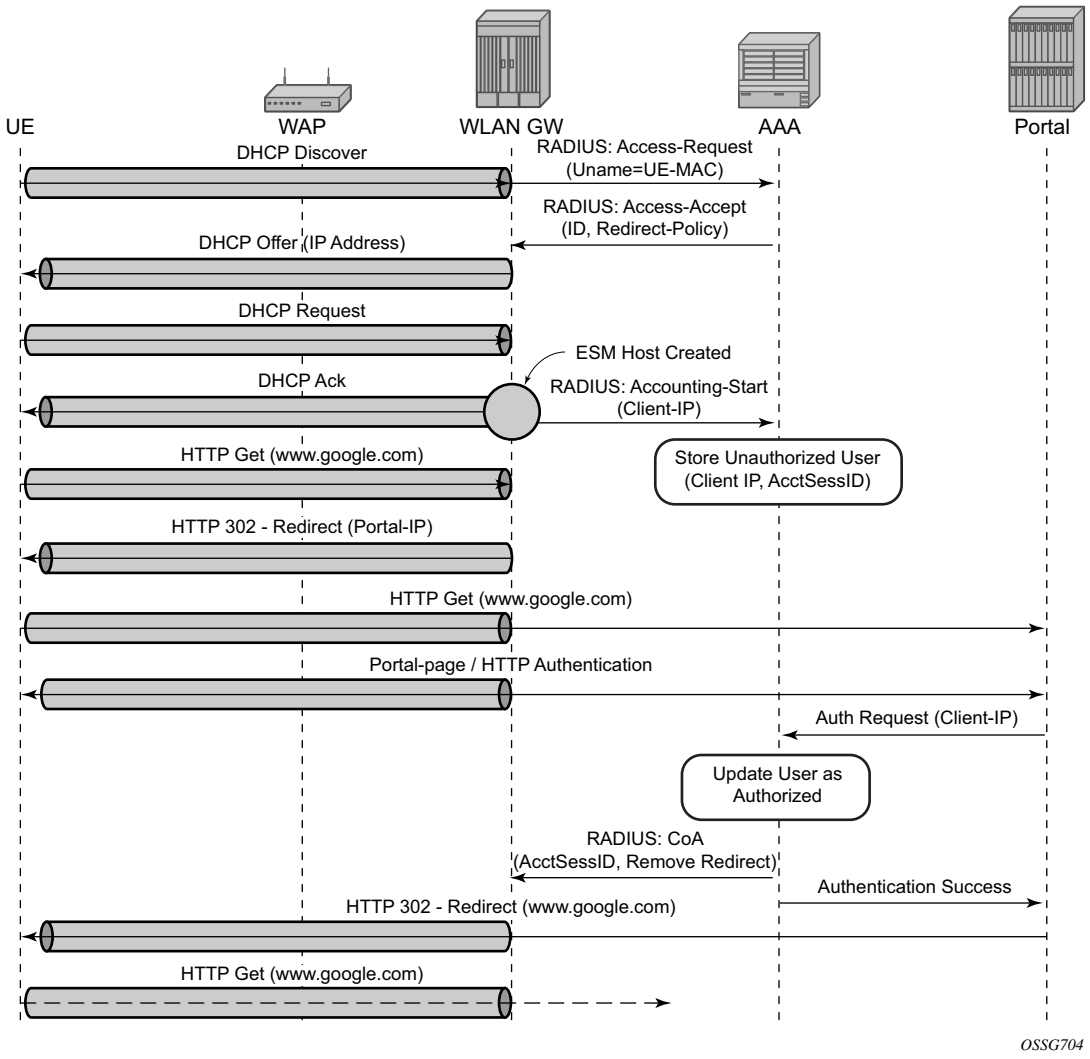


Figure 148: Portal Authentication for Open SSIDs

The following output displays a portal authentication for open SSIDs configuration example.

```
config>subscriber-mgmt
      sla-profile "portal-redirect" create
          ingress
             ip-filter 10
          exit
      exit
   exit

system>config>filter
   ip-filter 10 create
       entry 1 create
```

```
            match protocol udp
                dst-port range 67 68
            exit
            action forward
        exit
        entry 2 create
            match protocol tcp
                dst-port eq 80
            exit
            action http-redirect "http://www.google.ca"
        exit
    exit
exit
```

Address Assignment

The address to the UEs can be assigned via local DHCP server from locally defined pools, or from RADIUS server via local DHCP proxy, or from an external DHCP server. Subscriber-interface and group-interface are configured as part of normal ESM configuration. In case of wlan-gw, the group-interface is wlan-gw enabled. Subnets on the subscriber interface are used for the pools from which the DHCP local server assigns addresses to UEs.

The following output displays an address assignment configuration example.

```
config>service>vprn
    dhcp
       local-dhcp-server "dhcp" create    #### create local DHCP server
           pool "1" create                #### define Pool
               options
                   dns-server 8.8.8.8 8.8.4.4
                   lease-time min 5
               exit
               subnet 128.203.254.180/30 create
                  options
                     subnet-mask 255.255.0.0
                     default-router 128.203.254.181
                  exit
                  address-range 128.203.254.182 128.203.254.183
               exit
             exit
         exit
     exit

    interface "DHCP-lb" create          #### loopback interface with DHCP server
        address 10.1.1.1/32
        local-dhcp-server "dhcp"
        loopback
    exit

    subscriber-interface "sub-int" create          #### subscriber interface
         address 128.203.254.181/30                #### Subnets out of which UE
         address 10.10.0.1/16                      ######  addresses are allocated.
         group-interface "group-int" wlgw create
             sap-parameters
                 sub-sla-mgmt
                   def-sla-profile "sla_def"
                   def-sub-profile "sub_def"
                   sub-ident-policy "sub_ident"
                 exit
              exit
         exit
         dhcp
             proxy-server
                 emulated-server 10.10.0.1   #### proxy to get IP address from AAA
                 lease-time min 5            #### or from DHCP server. Can provide
               no shutdown                 #### split lease (shorter lease towards client,
             exit                         #### and longer lease towards AAA or DHCP server.
              no option
              server 10.1.1.1                #### DHCP local server
```

```
            trusted
            lease-populate 32000
            gi-address 128.203.254.181
            user-db "radius_ludb"      #### LUDB for proxy cache co-relation
            no shutdown
        exit
exit
```

WIFI Mobility Anchor

7750 WLAN-GW supports seamless handling for UE mobility, when a UE moves from one AP to another, where the new AP is broadcasting the same SSID, and is anchored on the same WLAN-GW. In case of open SSID, when the UE re-associates with the same SSID on the new AP and already has an IP@ from association with previous AP, the UE can continue to send and receive data. The WLAN-GW learns the association of the UE's MAC address to the GRE tunnel corresponding to the new AP, and updates its state on the MS-ISA as well as on the CPM. The UE continues to be anchored on the same anchor MS-ISA, thereby avoiding any disruption in ESM functions (SLA enforcement and accounting). State update based on data learning results in fast convergence after mobility and minimal packet loss. The data-triggered mobility can be turned on via configuration. Mobility trigger can be configured to be restricted to special Ethernet IAPP frame (originated by the AP with the source MAC of UE).

For 802.1x/EAP based SSIDs, by default the AP requires re-authentication to learn the new session keys (PMK). 7750-SR as WLAN-GW RADIUS proxy infers mobility from the re-authentication, and updates the ESM host to point to the new AP. The new AP's IP address is derived from the RADIUS attribute NAS-IP-address.The re-authentication also provides the new session keys to the AP in access-accept RADIUS response. In case the WIFI AP or ACs are capable of PMK key caching or standard 802.11r (or OKC, the opportunistic key caching pre-802.11r), the re-authentication on re-association can be avoided. In this case the UE can continue to send data, and the WLAN-GW can provide fast data-triggered mobility as defined in context of open SSIDs.

The following output provides a mobility anchor configuration example.

```
config>service>ies>
config>service>vprn>
     subscriber-interface <if-name>
          group-interface <if-name> wlangw
               wlan-gw
                    [no] router (base | <vprn-id>) # tunnel service context
                    [no] wlan-gw-group <group-id>
      ....snip
               mobility
                    [no] trigger {data | iapp}
                    [no] hold-time <seconds> // [0..255 secs]
                    exit
               exit
          exit
```

Wholesale

With EAP the AAA server can look at the realm from the user credential (IMSI) in authentication request and appropriately provide the service context in retail-service-id, for the ESM host corresponding to the UE.

For open SSID, the decision can be made by the AAA server based on the SSID. The SSID is encapsulated in circuit-id sub-option of option-82. The recommended format for the circuit-id is a string composed of multiple parts (separated by a delimiter) as shown below.

AP-MAC;SSID-STRING;SSID-TYPE

Delimiter is the character ';', and MUST not be allowed in configured SSIDs. AP-MAC sub-string MUST contain the MAC address of the AP in the format "xx:xx:xx:xx:xx:xx"

SSID-TYPE is "o" for open, and "s" for secure.

For example, if AP-MAC is "00:10:A4:23:19:C0", SSID is "SP1-wifi", and SSID-type is secure, then the value of circuit-id would be the string "00:10:A4:23:19:C0;SP1-wifi;s".

The circuit-id is passed to the AAA server in initial MAC based authentication on DHCP DISCOVER. The retail-service-id can be returned in access-accept. This assumes the AP broadcasts unique SSID per retail provider, and inserts it in Option82 as a DHCP relay-agent. As an alternative to SSID in option-82, the AP can insert a unique dot1Q tag per retail provider, before tunneling the Ethernet frame, using single GRE tunnel per AP to the WLAN-GW. 7750 supports configuring a map of .dot1Q tags to retail-service-id. Therefore, the determination of the retail provider for the subscriber can be made in the data plane when DHCP is received, and the subscriber state can be created and processed in the right service context.

The following output displays a wholesale configuration example.

```
config>service>ies>
config>service>vprn>
     subscriber-interface <if-name>
          group-interface <if-name> wlangw
               wlan-gw
                    [no] router (base | <vprn-id>) # tunnel service context
                    [no] wlan-gw-group <group-id>
     ....snip
               vlan-tag-ranges # Precedence for retail-service-id:
               # RADIUS, vlan-retail-service-map, default-retail-svc
                    [no] vlan start <start-tag> end <end-tag> retail-svc-id <svc-id>
                    [no] default-retail-svc-id
                    exit
               exit
          exit
```

CGN on WLAN-GW

Both LSN and L2-aware NAT for WIFI subscribers over wlan-gw tunnels is supported. NAT on WLAN-GW is only supported for locally terminated subscribers and not for GTP tunneled subscribers. NAT can be performed on the same set of ISAs that are used for WLAN-GW functions, by referring to the WLAN-GW ISA group from NAT configuration. Alternatively, dedicated set of ISAs can be used for NAT function by creating and referencing a separate NAT-group. Configuration related to LSN and L2-aware NAT is provided in SROS MS-ISA guide.

Lawful Intercept on WLAN-GW

Mirroring traffic for WIFI subscribers to a mediation device, when the subscriber is under legal intercept is supported. The mirroring function is performed on the anchor IOM where the subscriber is anchored. Both Ether and IP-only mirror is supported. With Ether mirror, VLAN tags which are part of internal SAP between ISA and IOM, are included in the mirrored Ethernet frame of the subscriber. IP-only mirror includes the IP header and the payload. Conventional IP-only mirror service can be used with direct p2p or MPLS (for remote mirroring) connection to the mediation device. In addition, routable-encapsulation added in 10R1 is also supported. Both IP/UDP encapsulation with optional shim-header for subscriber correlation on the mediation device, and IP/GRE encapsulation is supported with routable-encapsulation of mirrored data. LI can be triggered via CLI, SNMPv3 or RADIUS, as supported with ESM. RADIUS triggered LI can be via LI related VSAs in access-accept or in CoA. The CoA is keyed on accounting-session-id. LI is supported for both local and GTP tunnelled subscribers.

Existing LI support with ESM is described in the SROS OAM and diagnostics guide.

WLAN Location Enhancements

This feature adds configurable support for learning and reporting AP's MAC address (which represents WLAN location of the UE), to the AAA server. Support is also added for triggered interim accounting-updates to report the AP's MAC@ to the AAA server.

Triggered Interim Accounting-Updates

Using location based policy for WIFI subscribers is important. The business logic in AAA could use the location of the subscriber. Therefore, it is important to notify location change of the subscriber to AAA. Standard way to do this is by generating an interim accounting update when the WLAN-GW learns of the location change for a subscriber. The location for a WIFI subscriber can be inferred from MAC@ (preferred) or WAN IP@ of the AP.

For open-SSID, learning about mobility could be "data-triggered" or "IAPP packet triggered." If triggered, interim accounting-update is configured via CLI, then on detecting a location change for the UE, an interim accounting-update is sent immediately to the AAA server with the new AP's MAC@ (if already known to WLAN-GW). The accounting-update contains NASP-port-id (which contains the AP's IP@), and circuit-id (from DHCP option-82) which contains AP's MAC@ and SSID. In case of data-triggered mobility, if the new AP's MAC@ is not already known to WLAN-GW, a GRE encapsulated ARP packet is generated towards the AP to learn the MAC@ of the AP. The AP is expected to reply with a GRE encapsulated ARP response containing its MAC@. The generation of ARP to learn the AP's MAC@ is controlled via CLI. The GRE encapsulated ARP packet is shown in Figure 149.

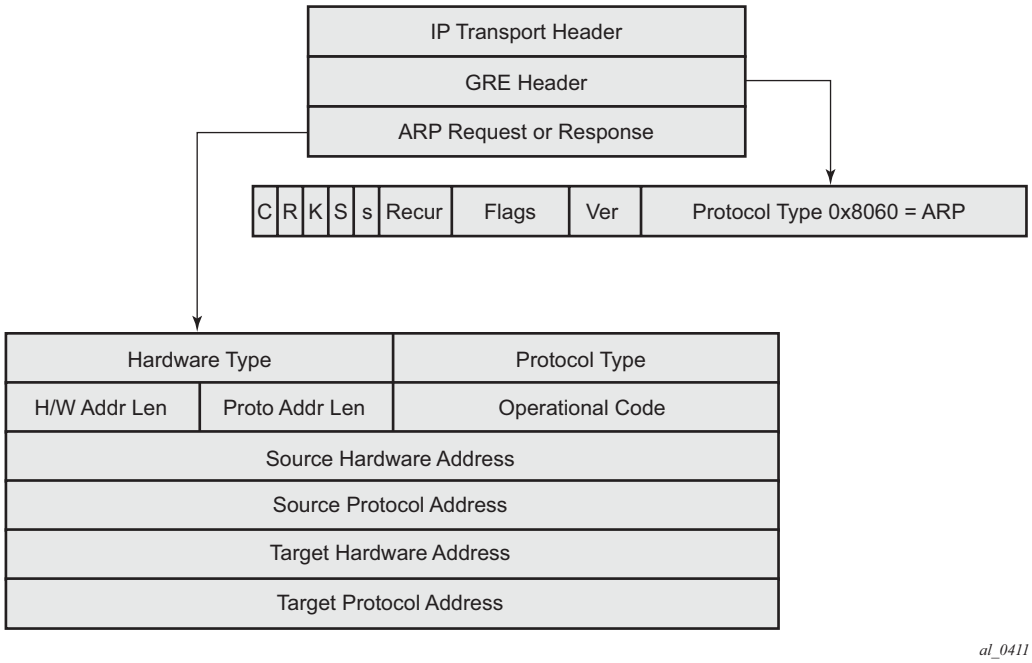


Figure 149: GRE Encapsulated ARP Request

The standard ARP request must be formatted as follows:

- Hardware Type = Ethernet (1)
- Protocol Type = 0x0800 (IPv4)
- H/W Addr Len = 6
- Proto Addr Len = 4
- Operational code (1 = request)
- Source hardware address = WLAN-GW MAC@
- Source protocol address = Tunnel endpoint IP@ on WLAN-GW
- Target hardware address = Unknown
- Target protocol address = WAN IP@ of the AP (source IP in GRE packet)

The AP MUST generate a GRE encapsulated ARP response when it receives the GRE encapsulated ARP request for its WAN IP@ (that is used to source tunneled packets). The standard ARP response should be formatted as follows:

- Hardware Type = Ethernet (1)

- Protocol Type = 0x0800 (IPv4)
- H/W Addr Len = 6
- Proto Addr Len = 4
- Operational code (2 = response)
- Source hardware address = AP MAC@
- Source protocol address = WAN IP@ of AP (used for sourcing tunneled packets)
- Target hardware address = source hardware address from the request
- Target protocol address = source protocol address from ARP request

For 802.1x/EAP SSID, the location change (mobility) is learnt from an interim-accounting update from the AP. The called-station-Id (containing the AP MAC@) is compared against the current stored called-station-Id that the subscriber is associated with. If the called-station-id is different then the received interim accounting update is immediately forwarded to the accounting server, if triggered interim accounting-update is configured via CLI. In previous releases, the interim-update received from the AP is not immediately forwarded by the accounting proxy. Only a regularly scheduled interim-update is sent.

Operational Support

Following command shows if GRE encapsulated ARP request is enabled.

```
*A:Dut-C# show router 4 interface "grp-vprn_ue-2/1/2:50" detail

===============================================================================
Interface Table (Service: 4)
===============================================================================

-------------------------------------------------------------------------------
Interface
-------------------------------------------------------------------------------
If Name          : grp-vprn_ue-2/1/2:50
Sub If Name      : ies-4-20.0.0.1
Red If Name      :
Admin State      : Up                   Oper (v4/v6)      : Up/Up
Protocols        : None

WLAN Gateway details
Administrative state        : in-service
Router                      : 50
IP address                  : 50.1.1.3
IPv6 address                : 2032::1:1:3
ISA group ID                : 1
Egr shaping                 : none
Egr shape multi UE only     : false
Egr qos policy ID           : (Not Specified)
Egr scheduler policy        : (Not Specified)
Egr agg rate limit (kbps)   : (Not Specified)
```

```
Egr qos resrc hold time (s) : 0
Mobility trigger            : data iapp
Mobility ARP AP             : enabled
Mobility hold time (s)      : 0
Default retailer service    : (Not Specified)
TCP MSS adjust              : (Not Specified)
Number of tunnels           : 0
Last management change      : 02/19/2014 17:48:52
```

WIFI Offload – 3G/4G Interworking

This feature adds support for WIFI to 3G/4G interworking on WLAN-GW based on setting up per-UE GTP tunnel from WLAN-GW to the mobile packet core. The feature involves setting up per-UE GTP tunnel from the WLAN-GW to the GGSN or PGW based on authenticating the UE. Access to only a single APN (default WLAN APN) per UE is supported. This default WLAN APN for the UE is obtained in authentication response from the AAA server. A single primary PDP context per UE is supported on the Gn interface (3GPP TS 29.060 Release 8) from WLAN-GW to the GGSN. Single default-bearer per UE is supported on S2b interface (3GPP TS 29.274 Release 10), and S2a interface (work-in-progress for SAMOG Release 11) from WLAN-GW to the PGW. The GTP tunnel setup is triggered via DHCP from the UE after it is successfully authenticated. The IP@ for the UE is obtained via GTP from the GGSN or PGW and returned to the UE in DHCP. The bridged WIFI AP connectivity with the WLAN-GW can be wlan-gw based (L2oGRE or L2VPNoGRE) or can be a native L2 (VLAN). A maximum of 128,000 PDP-contexts or bearers are supported per WLAN-GW. GTP-U encapsulation requires IOM3.

Signaling Call Flow

The decision to setup a GTP tunnel for a subscriber or locally breakout subscriber's traffic is AAA based, and received in authentication response. If the traffic is to be tunneled to the PGW or GGSN, the signaling interface or PGW/GGSN interface would be provided via AAA. Absence of these attributes in the authentication response implicitly signifies local-breakout.

GTP Setup with EAP Authentication

Once the EAP authentication completes as described in the section on authentication, the RADIUS proxy caches the authentication response, including any attributes related to GTP signaling. Subsequently DHCP is initiated from the UE. On receiving DHCP DISCOVER, the RADIUS proxy cache is matched to get the AAA parameters related to the UE from the original authentication response. If PGW/GGSN (mobile gateway) IP address is not present in cached authentication, DNS resolution as described in section 1.2 is initiated for the WLAN APN obtained from AAA (in the cache) or for locally configured APN in the service associated with the UE. The DNS resolution provides a set of IP addresses for the mobile gateways. The GTP tunnel setup is attempted to the selected mobile gateway. The IP address provided by PGW/GGSN in the GTP response is returned in DHCP offer to the UE. The WLAN-GW acts as a DHCP to GTP proxy. The WLAN-GW is the default-GW for the UE. Any packets from the UE are then GTP tunneled to the mobile gateway. If the UE requests an IP address (for which it may have an existing lease on one of its interface) via DHCP option 50 in the DHCP request, then WLAN-GW sets the "handover bit" in the GTP session create message, and indicates the requested address in the PDN Address Allocation (PAA) field. This allows the PGW to look for existing session corresponding to the signaled IMSI and APN (with potentially different RAT-Type) and return its

existing IP address in session create response. The old session and bearer is deleted by the PGW. The signaling of "handover bit" is supported with S2a and S2b (release 10 and beyond). The IP address cannot be preserved over the Gn interface. The call flow in Figure 156 shows basic GTP setup (with S2a), the output provided on page 1838 show IP address preservation across inter-access (WIFI <-> 4G) moves.

DHCP release or lease timeout on WLAN-GW will result in deletion of the GTP tunnel corresponding to the UE. The session or PDP context deactivation from PGW/GGSN will also result in removal of the GTP state for the UE and the corresponding ESM host on WLAN-GW. In this SR-OS release, only default bearer (or primary PDP context) for single default APN is handled over WIFI. GTP path-management messages (echo request and reply) are supported. Mandatory IEs are supported in GTP signaling. Hard coded default values are signaled for QoS and charging related IEs. For GTPv2, the bearer is signaled as non-GBR bearer with QCI value of 8, and MBR/GBR values of 0. APN-AMBR default values signaled are 20Mbps/10Mbps downstream/upstream. For GTPv1, reliability and priority classes default to "best-effort", allocation/retention priority defaults to 1, and the default peak-rate corresponds to class 9 (bit-wise 1001) which is slightly over 2Mbps. Charging characteristics IE which contains a 16 bit flag defaults to 0. In the future, RADIUS returned values or locally configurable values will be signaled in QoS and charging IEs.

The IP address is returned in the create PDP context response or Create session response. The DNS server addresses for the UE are retuned in IP control protocol (IPCP) option in a PCO IE in the response. The default gateway address provided to the UE in DHCP is auto-generated algorithmically on the WLAN-GW from the IP address returned by the PGW/GGSN for the UE. The WIFI AP is required to provide a split-horizon function, where there is no local switching on the AP, and all communication to/from any AP is via WLAN-GW. The WLAN-GW implements proxy-ARP and forwards all received traffic from the UE into the GTP tunnel. In the future, the default-GW address to be returned to the UE could be obtained in a PCO from the PGW/GGSN. The GTP-U processing of data packets is done in the IOM.

APN Resolution

The default WLAN APN is either configured via CLI or obtained from RADIUS in authentication response. The APN FQDN is constructed and resolved in DNS to obtain a set of GGSN/PGW IP addresses. The GTP sessions for UEs are load-balanced across the set of these gateways in a round-robin fashion. The APN FQDN generated for DNS resolution is composed of the Network-ID (NI) portion and the Operator-ID (OI) portion (MCC and MNC) as per 3GPP TS 29.303 and is formatted as APN-NI.apn.epc.mnc<MNC>.mcc<MCC>.3gppnetwork.org. Only basic DNS procedure and A-records from DNS server are supported in this release. S-NAPTR procedure is not yet supported and will be added in a follow-on release. The NI portion or both NI and OI portions of the APN can be locally configured or supplied via RADIUS in a VSA (Alc-Wlan-APN-Name). By default the Operator-ID (OI) portion of the APN is learnt from the IMSI. If the RADIUS returns both the NI and OI portions in the APN attribute, then it is used as is for the FQDN construction. A DNS resolution is limited to a maximum of 20 IP addresses in this

Configuration Objects

The Mobile gateway (PGW or GGSN) IP address can be obtained via DNS resolution of the AP or provided by AAA server in authentication response. Profiles with signaling related configuration per mobile gateway can be created locally on the WLAN-GW. A map of these profiles (mgw-profiles) keyed on the IP@ of the mobile gateway is configurable per router. The serving network (<MCC> & <MNC>) that the WLAN-GW belongs to is configurable per system. The configurable signaling information per mobile gateway includes the type of interface between WLAN-GW and the mobile gateway (Gn, S2a, or S2b), path management parameters, and retransmission parameters for signaling messages. The type of signaling interface can also be explicitly overridden via RADIUS in authentication response. DNS servers and source IP address to be used for DNS resolutions can be configured in the service the APN corresponds to.

GTP related configuration on WLAN-GW

```
config>subscriber-mgmt>wlan-gw
   serving-network mcc "123" mnc "45"
   mgw-profile "pgw-west-mno1" [create]
      description "mgw profile for MNO north-east PGW"
      interface-type s2b
      ip-ttl 255
      keep-alive interval 60 retry-count 3 timeout 10
      message-retransmit timeout 30 retry-count 3
    exit


config>router
config>service>vprn
    apn "internet.mno1.apn"
    mgw-map
        address 33.1.1.1/32 "pgw-west-mno1"
        address 34.1.1.1/32 "ggsn-east-mno1"
    exit

config>service>vprn>dns
     primary-dns 130.1.1.1
     secondary-dns 131.1.1.1
     tertiary-dns 132.1.1.1
     ipv4-source-address 170.1.1.1
 exit
```

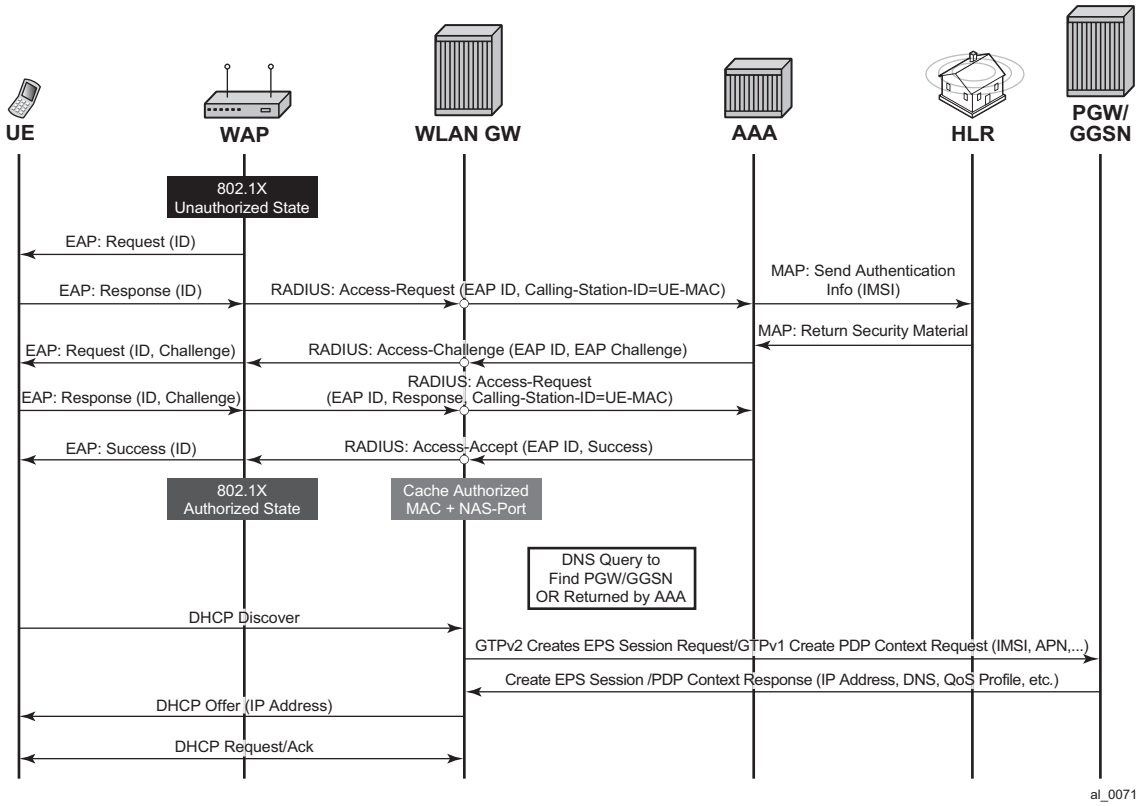


Figure 150: GTP Signaling to PGW or GGSN Based on AAA Decision

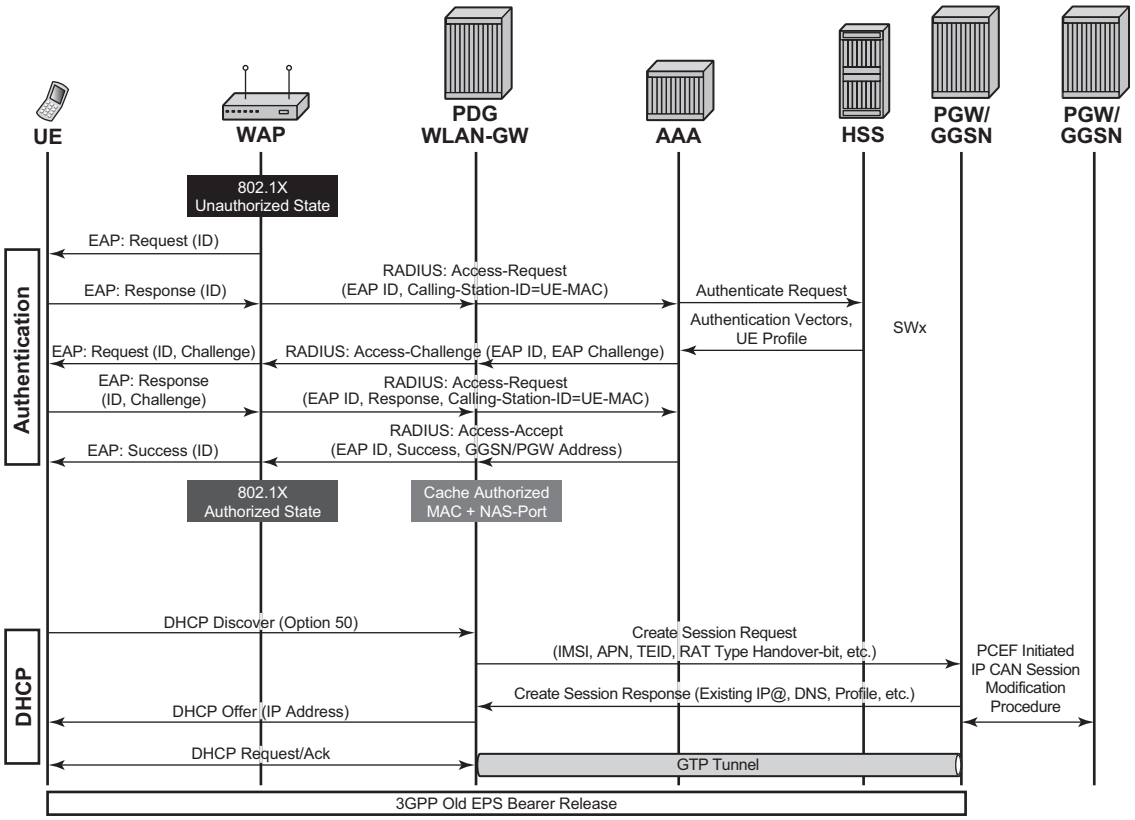


Figure 151: LTE to WIFI Mobility with IP Address Preservation

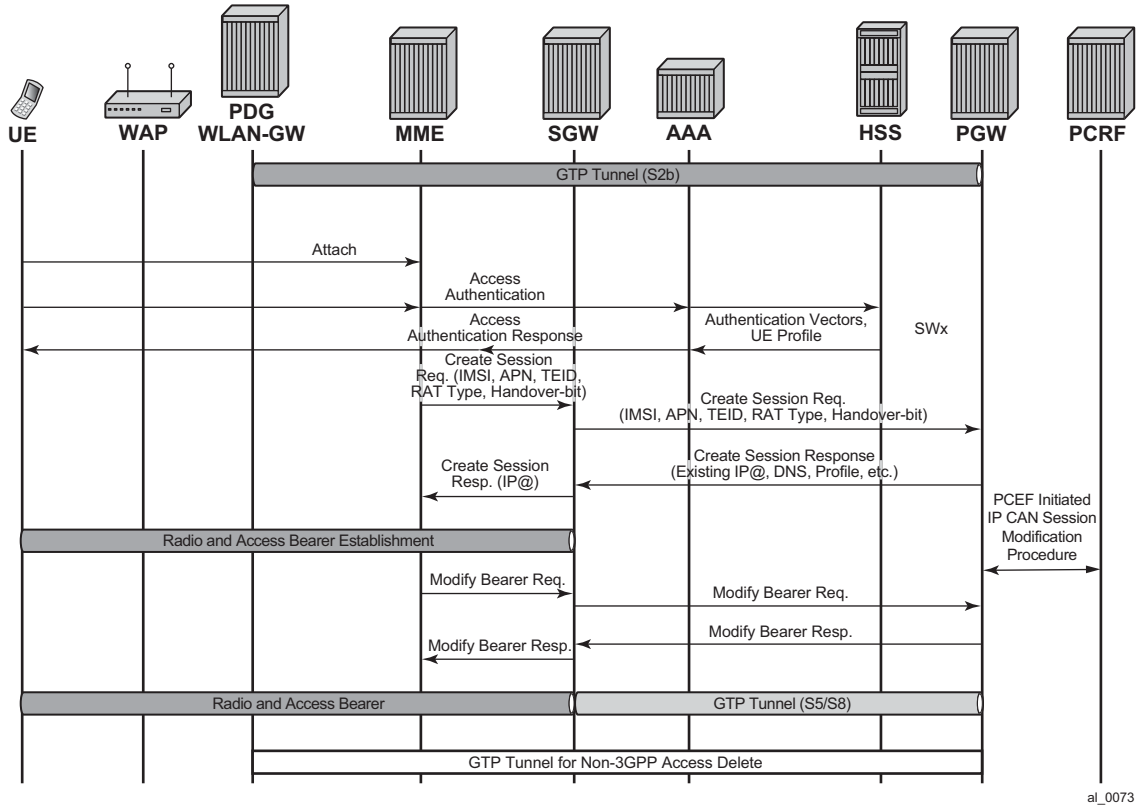


Figure 152: WIFI to LTE Mobility with IP Address Preservation

RADIUS Support

Table 22describes 3GPP attributes and ALU specific attributes related to GTP signaling are supported.

Table 22: 3GPP Attributes and ALU Specific Attributes

Attribute	Number Type	Value
Alc-Wlan-APN-Name	<146> , String	APN-Name
3GPP-GGSN-Address	<3GPP vendor ID = 10415, AVP code = 847>, String.	IPv4addr
Alc-Mgw-Interface-Type	<145 >, Integer	Gn = 1, S2a = 2, S2b = 3
3GPP-IMSI	<3GPP vendor ID = 10415, AVP code = 1>, String	3GPP vendor specific attribute as defined in 3GPP TS 29.061.

Table 22: 3GPP Attributes and ALU Specific Attributes (Continued)

Attribute	Number Type	Value
3GPP-IMEISV	<3GPP vendor ID = 10415, AVP code = 20>, String	3GPP vendor specific attribute as defined in TS 29.061.
Alc-MsIsdn	<147>, String	MSISDN of the UE

QoS Support with GTP

WLAN-GW provides appropriate traffic treatment and (re)marking based on DSCP bits in the outer and/or inner header in GTP packet. In the downstream (PGW/GGSN to WLAN-GW) direction, the DSCP bits from the inner and/or outer header in GTP packet can be mapped to a forwarding class which can be preserved through the chassis as the packet passes to the egress IOM. In case of wlan-gw, as the packet passes through the ISA(s), the FC is carried through (based on static mapping of FC to dot1P bits in internal encapsulation using VLAN tags through the ISAs). The egress IOM (which forwards the GRE tunneled packet towards the AP) can classify on FC to set the DSCP bits in the outer GRE header based on configuration.

In the upstream direction, the DSCP bits from the wlan-gw can be mapped to the DSCP bits in the outer header in GTP encapsulated packet.

Selective Breakout

This feature adds support for selecting subset of traffic from a UE (via IP filter) for local forwarding, while tunneling the remaining traffic to GGSN/PGW. This allows the selected traffic to bypass the mobile packet core. The IP address for the UE comes from the GGSN/PGW during GTP session setup. Therefore, the selected traffic for local breakout from WLAN-GW requires an implicit NAT function in order to draw the return traffic back to the WLAN-GW. To support address overlap with GTP, the implicit NAT function is L2-aware. The selection of traffic for local breakout (local forwarding and NAT) is based on a new action in an IP filter applied to the UE. Selective breakout can be enabled on a per UE basis via RADIUS VSA (ALC-GTP-Local-Breakout) in access-accept. This attribute cannot be changed (enabled/disabled) via COA.

AA function (based on per-UE application profile) is supported for local breakout traffic. Also, LI (after NAT) is supported for local breakout traffic and is enabled via existing secure CLI (as stated in the 7x50 SR OS OAM Diagnostics Guide).

```
system>config>filter
   ip-filter 10 create
      entry 1 create
          match protocol udp
              dst-port eq 4000
          exit
```

```
        action gtp-local-breakout
    exit
```

On traffic ingressing WLAN-GW from the UE, normal ESM host lookup and CAM lookup with ingress host filter is performed. If there is a match in the filter indicating “gtp-local-breakout,” the traffic is forwarded within the chassis to the WLAN-GW anchor IOM for the UE, where it is subjected to L2-aware NAT function and is IP forwarded to the destination based on FIB lookup. The inside IP address is the address returned in GTP, and the outside IP is an address belonging to NAT outside IP address range on the ISA. If there is no match in the filer, the traffic is GTP tunneled using the TEIDs corresponding to the ESM host. The traffic received from the network can be a normal L3 packet or a GTP encapsulated packet. The normal L3 packet is expected to be destined to the NAT outside IP and is normally routed to the NAT ISA.

By default, per UE accounting includes counters that are aggregated across GTP and local-breakout traffic. Separate counters can be obtained by directing the GTP and local-breakout traffic into different queues associated with the corresponding ESM host. NAT information (outside IP and port range) associated with an ESM host subjected to selective breakout is included in accounting-updates.

Location Notification in S2a

This feature adds support on WLAN-GW for reporting UE's WLAN location (TWAN Identifier IE) and cellular location (ULI IE) over S2a interface to PGW and UE's cellular location (ULI IE) to GGSN (over Gn interface). Location information is useful for charging on PGW/GGSN.

WLAN Location over S2a

The WLAN location information consists of the *TWAN Identifier IE* as described in 29 274 V11.6.0 (2013-04) and is sent in GTPv2 "create session request" message. If present, this IE carries BSSID (MAC address of the AP) and the SSID. WLAN-GW learns the AP's MAC@ from calling-station-id attribute in the RADIUS messages from the AP (both authentication and accounting messages) or from circuit-id in DHCP DISCOVE or REQUEST messages. In this release, the IE is only sent at session creation time. Therefore, it reports location on initial attach, on handover from LTE to WIFI, and on AP mobility across WLAN-GWs. Mobility across APs anchored on the same WLAN-GW does not result in location update. 3GPP release 11 does not define location update mechanism for S2a.

By default, location is not reported. It can be enabled via CLI.

```
config>subscriber-mgmt>wlan-gw>
   mgw-profile "pgw-west-mn01"
      [no] report-wlan-location
```

Cellular Location over S2a

The "User Location Info" IE is included in "Create Session Request and is described in 3GPP TS 29.274 version 8.1.1 Release 8. The encoding for individual location identifiers (CGI, SAI, RAI, TAI, and ECGI) is also defined in the same reference (as shown in Figure 153).

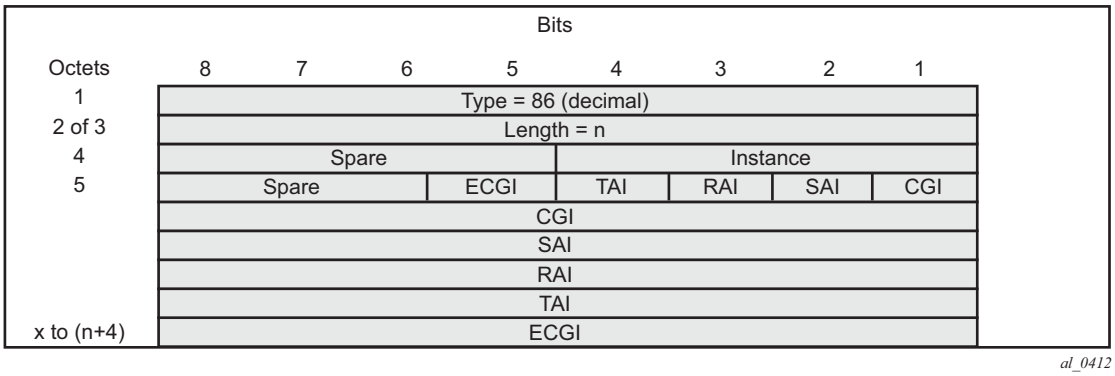


Figure 153: User Location Information

The AP's MAC@ and IP@ are provided to AAA server in RADIUS messages during EAP authentication and accounting. If AAA provides the cellular location (corresponding to this AP) in 3GPP attribute ***3GPP-User-Location-Info*** in access-accept, and location reporting is enabled via CLI. The ULI IE will be included in GTPv2 "create session request". The ***3GPP-User-Location-Info*** attribute is described in 3GPP TS 29.061 v9.3.0.

Cellular Location over Gn Interface

The "User Location Info" IE (as shown in Figure 154) can be included in create-pdp-context message as described in 3GPP TS 29.060 V10.1.0. The geographic location type field describes the type of location included in the "Geographic Location" field that follows. The location can be CGI (cell global identification), SAI (service area identity), or RAI (routing area identity). The formats for these location identifiers are defined in the same reference *3GPP TS 29.060 V10.1.0*.

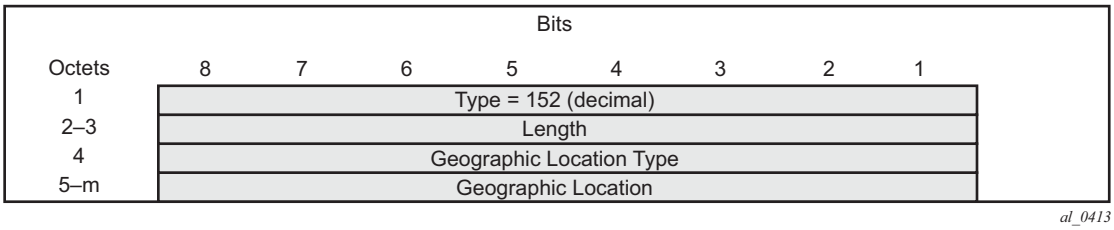


Figure 154: User Location Information IE

AP MAC address and SSID is reported to AAA (including changes on mobility). AAA can then specify the ULI IE contents based on static mapping of AP's MAC address to one of the cellular location types (CGI, SAI or RAI). AAA should provide the cellular location in 3GPP attribute

3GPP-User-Location-Info (below) in access-accept. The attribute is described in 3GPP TS 29.061 v9.3.0.

In case a UE moves to a different WLAN-GW, UE is authenticated based on data-trigger. In this case, the AAA server can provide the WLAN location (AP's MAC@ and SSID) in called-station-ID attribute and cellular location in 3GPP-User-Location-Info attribute. The WLAN location is then encoded in TWAN identifier in "create session request" message, and the cellular location is encoded in the ULI IE.

Operational Support

The following command shows state of location reporting (enabled/disabled).

```
*A:Dut-C>config>subscr-mgmt>wlan-gw>mgw-profile$ /show subscriber-mgmt wlan-gw
mgw-profile "test"

===============================================================================
WLAN Mobile Gateway profile "test"
===============================================================================
Description                 : (Not Specified)
Retransmit timeout (s)      : 5
Retransmit retries          : 3
Keepalive interval (s)      : 60
Keepalive retries           : 4
Keepalive retry timeout (s) : 5
Time to live                : 255
Interface type              : s2a
Charging char home UE       : (None)
Charging char roaming UE    : (None)
Session hold time (s)       : 30
Report WLAN location        : enabled
Last management change      : 02/21/2014 16:31:12
GGSN uplink GBR (Kbps)      : 5000
GGSN uplink MBR (Kbps)      : 5000
GGSN downlink GBR (Kbps)    : 2000
GGSN downlink MBR (Kbps)    : 2000
GGSN Alloc/Retention Prio   : 1
GGSN last management change : 02/19/2014 17:31:55
PGW uplink GBR (Kbps)       : 0
PGW uplink MBR (Kbps)       : 0
PGW downlink GBR (Kbps)     : 0
PGW downlink MBR (Kbps)     : 0
PGW Alloc/Retention Prio    : 1
PGW Qos Class ID            : 8
PGW last management change  : 02/19/2014 17:31:55
===============================================================================
```

Operational Commands

These commands show state related to mobile gateways and GTP sessions.

```
show router wlan-gw
          mobile-gateway – Display mobile gateway information
          mgw-map – Display the mobile gateway map
          mgw-address-cache – Display the mobile gateway's DNS lookup address cache.

show router wlan-gw mgw-address-cache [apn <apn-string>]
                       <apn-string>         : [80 chars max]

show router wlan-gw mobile-gateway
                [mgw-profile <profile-name>] [local-address <ip-address>] [control <proto-
col>]
                remote-address <ip-address> [udp-port <port>]
                remote-address <ip-address> [udp-port <port>] statistics

<profile-name>       : [32 chars max]
     <ip-address>            : ipv4-address   - a.b.c.d
               <ipv6-address   - x:x:x:x:x:x:x:x   (eight 16-bit pieces)
                                          x:x:x:x:x:x:d.d.d.d
                                          x - [0..FFFF]H
                                         d - [0..255]D
               <protocol>          : gtpv1-c|gtpv2-c
               <port>                 : [1..65535]
```

---

show router wlan-gw mobile-gateway

```
===============================================================================
Mobile gateways
===============================================================================
Remote address              : 5.20.1.2
UDP port                          : 2123
-------------------------------------------------------------------------------
State                             : up
Local address               : 5.20.1.3
Profile                           : default
Control protocol         : gtpv1-c
Restart count               : 3
Time                            : 2012/06/28 08:07:11
```

---

show router 300 wlan-gw mgw-address-cache

```
===============================================================================
Mobile Gateway address cache
===============================================================================
APN    : full.dotted.apn.apn.epc.mnc010.mcc206.3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 5.20.1.2
Time left (s)                             : 3587
-------------------------------------------------------------------------------
```

```
No. of cache entries: 1
No. of Mobile gateways: 1
===============================================================================



show subscriber-mgmt wlan-gw
      gtp-session     - Display GTP session information
      gtp-statistics  - Display GTP statistics
      mgw-profile     - Display Mobile Gateway profile information

show subscriber-mgmt wlan-gw gtp-session
              imsi <imsi> apn <apn-string>
              [mgw-address <ip-address>] [mgw-router <router-instance>] [remote-control-
teid <teid>] [local-
        control-teid <teid>] [detail]
              imsi <imsi>
                   <imsi>               : [a string of digits between 9 and 15 long]
                  <apn-string>         : [80 chars max]
                  <ip-address>         : ipv4-address   - a.b.c.d
                   <ipv6-address>      : x:x:x:x:x:x:x:x   (eight 16-bit pieces)
                                                 x:x:x:x:x:x:d.d.d.d
                                                 x - [0..FFFF]H
                                                 d - [0..255]D
                    <router-instance>    : <router-name>|<service-id>
                                                 router-name    - "Base"
                                                 service-id     - [1..2147483647]
                    <teid>               : [1..4294967295]



show subscriber-mgmt wlan-gw gtp-statistics
show subscriber-mgmt wlan-gw mgw-profile
            <profile-name>
            <profile-name> associations
            mgw-profile
                        <profile-name>       : [32 chars max]
```

---

show subscriber-mgmt wlan-gw gtp-session detail

```
===============================================================================
GTP sessions
===============================================================================
IMSI                        : 206100000000041
APN                         : full.dotted.apn.mnc010.mcc206.gprs
-------------------------------------------------------------------------------
Mobile Gateway router       : "Base"
Mobile Gateway address      : 5.20.1.2
Remote control TEID         : 1119232
Local control TEID          : 4293918976
Bearer 5 rem TEID           : 1074861061
Bearer 5 loc TEID           : 4293919013
-------------------------------------------------------------------------------
No. of GTP sessions: 1
```

```
===============================================================================
```

---

show subscriber-mgmt wlan-gw mgw-profile "default"

```
===============================================================================
WLAN Mobile Gateway profile "default"
===============================================================================
Description                          : (Not Specified)
Retransmit timeout (s)         : 5
Retransmit retries                : 3
Keepalive interval (s)          : 60
Keepalive retries                 : 4
Keepalive retry timeout (s) : 5
Time to live                         : 255
Interface type                      : s2a
Last management change   : 06/28/2012 06:05:30
===============================================================================
```

show subscriber-mgmt wlan-gw gtp-statistics

```
===============================================================================
GTP statistics
===============================================================================
tx echo requests                                    : 1
tx echo responses                                   : 0
tx errors                                           : 0
rx echo requests                                    : 0
rx echo responses                                   : 1
rx errors                                           : 0
rx version not supported                            : 0
rx zero TEID responses                              : 0
path faults                                         : 0
path restarts                                       : 0
tx invalid msgs                                     : 0
tx create PDP context requests                      : 0
tx create PDP context responses                     : 0
tx delete PDP context requests                      : 0
tx delete PDP context responses                     : 0
tx create session requests                          : 1
tx create session responses                         : 0
tx delete session requests                          : 0
tx delete session responses                         : 0
tx delete bearer requests                           : 0
tx delete bearer responses                          : 0
tx error indication count                           : 0
rx invalid msgs                                     : 0
rx create PDP context requests                      : 0
rx create PDP context responses                     : 0
rx delete PDP context requests                      : 0
rx delete PDP context responses                     : 0
rx create session requests                          : 0
rx create session responses                         : 1
rx delete session requests                          : 0
rx delete session responses                         : 0
rx delete bearer requests                           : 0
rx delete bearer responses                          : 0
rx error indication count                           : 0
rx invalid pkt length                               : 0
rx unknown pkts                                     : 0
rx missing IE pkts                                  : 0
rx bad IP header pkts                               : 0
rx bad UDP header pkts                              : 0
===============================================================================
```

Migrant User Support

"Migrant users" are UEs that connect to an SSID, but move out of the range of the access-point before initiating or completing authentication. For open-SSIDs, a migrant user may stay in the range of the access-point just enough to get a DHCP lease from the WLAN-GW. In real WIFI deployments with portal authentication, it has been observed that a large percentage of users are migrant, such as get a DHCP lease but do not initiate or complete authentication. Prior to this feature, an ESM host is created when DHCP completes. This results in consumption of resources on both CPM and IOM, limiting the ESM scale and performance for fully authenticated active users. This feature adds support to only create an ESM host after a user has been fully authenticated, either via web portal or with a AAA server based on completing EAP exchange. In addition, with this feature L2-aware NAPT is enabled on the ISA, such that each UE gets the same shared configured inside IP@ from the ISA via DHCP. Until a user is authenticated, forwarding of user traffic is constrained (via policy) to only access DNS and portal servers. Each user is allocated a small number of configured NAT outside ports to minimize public IP address consumption for unauthenticated users. Once the user is successfully authenticated, as indicated via a RADIUS COA on successful portal authentication, an ESM host is created, and the L2-aware NAT is applied via a normal per-subscriber NAT policy. The inside IP address of the user does not change. The outside IP pool used is as per the NAT policy, and the L2-aware NAT could be 1:1 or NAPT with larger number of outside ports than in the un-authenticated phase. If a user is already pre-authenticated (for example, if RADIUS server remembers the MAC@ of the UE from previous successful portal authentication), then the initial access-accept from RADIUS will trigger the creation of the ESM host.

Migrant user support is only applicable to EAP based closed SSIDs when RADIUS-proxy is not enabled on WLAN-GW. This is described in Migrant User Support with EAP Authentication on page 1837.

Migrant User Support with Portal-Authentication

DHCP

Based on DHCP and L2 NAT configuration on the ISA, IP address is assigned to the user via DHCP. A different DHCP lease-time can be configured for an un-authenticated user and an authenticated user for which an ESM host has been created. DHCP return options, for example, DNS and NBNS server addresses can be configured. This configuration can be per wlan-gw group interface or per VLAN range (where a VLAN tag corresponds to an SSID). Once the DHCP ACK is sent back to the UE from the ISA, the UE will be created on the ISA in “migrant (or unauthenticated) state”. ARP requests coming from the UE in migrant state will be responded to from the ISA. The authentication to RADIUS is triggered on receiving first L3 data-packet as opposed to on DHCP DISCOVER.

Authentication and Forwarding

The authentication is initiated from RADIUS client on the ISA anchoring the user, based on an isa-radius-policy (configured under aaa) and specified on the wlan-gw group-interface. The initial access-accept from RADIUS can indicate if a user needs to be portal authenticated or is a pre-authenticated user. The indication is based on inclusion of a “redirect policy” applicable to the user, in a VSA (Alc-Wlan-Portal-Redirect, type = string). The access-accept can also include a redirect URL VSA (Alc-Wlan-Portal-Url, type = string) for the user. An empty Alc-Wlan-Portal_redirect VSA forces the use of locally configured redirect policy. Also, if neither of the above two VSAs are included, then this indicates a “pre-authenticated user”, and an ESM host is created for the subscriber with subscriber-profile and other subscriber configuration from access-accept, and from here normal ESM based forwarding occurs for the subscriber.

However, if a user needs portal authentication (as indicated in access-accept), then while the user is pending authentication, forwarding is restricted to DNS and portal servers via the redirect policy. The redirect policy is an IP ACL that restricts forwarding based on IP destination, destination port, and protocol, and also specifies http-redirect for http traffic that does not match any of the forwarding rules. The URL for re-direct is configured in the redirect policy or can be provided in authentication-accept. A maximum of 16 redirect policies can be created in the system, with a maximum of 64 forward rules across all redirect policies. During this “authentication pending” phase all forwarded traffic is subjected to L2-aware NAT on the ISA. The NAT policy to use for these users can be configured on the wlan-gw interface or per VLAN range under the wlan-gw interface. After an access-accept has been received from RADIUS for such a user, the next http packet triggers a redirect function from the ISA, and an http 302 is sent to the client. The redirect can be configured to append original-URL, subscriber’s MAC address and IP address to the redirect URL sent back in http 302. The client presents its credentials to the portal and once it is successfully authenticated, a COA is generated from the RADIUS server

(triggered by the portal). The COA message triggers creation of an ESM host with the subscriber configuration contained in the COA such as subscriber-profile, SLA-profile, NAT-profile and application-profile. From this point normal ESM based forwarding occurs for the subscriber.

The configuration related to migrant users is shown on page 1839.

Migrant User Support with EAP Authentication

Migrant user support can only be used for closed SSIDs when there is no RADIUS-proxy configured on WLAN-GW. If no RADIUS proxy is configured, then initial RADIUS request carrying EAP from the AP is normally forwarded to a RADIUS server. The RADIUS exchange is between AP and the AAA server, and no information from EAP authentication is cached on the WLAN-GW. The subsequent DHCP DISCOVER after successful EAP authentication is received on the ISA. However, for subscriber that needs to be GTP tunneled to PGW/GGSN, the DHCP is forwarded to the CPM, where it triggers a RADIUS authorization. RADIUS correlates the MAC address with calling-station-id from EAP authentication for the user. GTP tunnel initiation, and ESM host creation then follows after receiving an access-accept. However, for a “local-breakout” subscriber DHCP and L2-aware NAT is handled on the ISA (as in the case for migrant users with portal based authentication). Shared inside IP address can be handed out to each subscriber. The first L3 packet triggers MAC address based RADIUS authorization from the ISA. RADIUS server can correlate the EAP authentication with the MAC address of the user and send an access-accept. This triggers ESM host creation as normal.

For closed SSIDs with EAP authentication, if a RADIUS proxy function is configured on WLAN-GW, then the initial EAP authentication from the AP is processed by the RADIUS-proxy on the CPM, and is forwarded to the RADIUS server based on configured authentication policy. Based on authentication response, ESM host creation with local DHCP address assignment or GTP tunnel initiation proceeds as usual.

Data Triggered Subscriber Creation

With **data-triggered-ue-creation** configured under wlan-gw group interface or per VLAN range (such as, per one or more SSIDs), first Layer 3 packet received on WLAN-GW ISA from an unknown subscriber (with no prior state, such as an unknown MAC address) will trigger RADIUS authentication from the ISA. The authentication is based on configured isa-radius-policy (under aaa context). If RADIUS authentication succeeds, then ESM host is created from the CPM. The ESM host can get deleted based on idle-timeout. Data-triggered authentication and subscriber creation enables stateless inter WLAN-GW redundancy, as shown in Figure 155. If the AP is configured with a backup WLAN-GW address (or FQDN), it can tunnel subscriber traffic to the backup WLAN-GW, when it detects failure of the primary WLAN-GW (based on periodic liveness detection). With “data-triggered-ue-creation” configured, the first data packet results in authentication and ESM host creation on the backup WLAN-GW. If the subscriber had obtained

an IP address via DHCP with L2-aware NAT on the primary WLAN-GW, it can retain it with L2 aware NAT on the backup WLAN-GW. The NAT outside pool for the subscriber changes on the backup WLAN-GW based on local configuration. For a subscriber that needs to be anchored on GGSN/PGW (as indicated via RADIUS access-accept), RADIUS server will return the IP address of PGW/GGSN where the UE was anchored before the switch-over. GTP tunnel is then signaled with "handover indication" set. The PGW/GGSN must return the requested IP address of the UE, which is the address with which the UE originated data packet that triggered authentication.

The same data-triggered authentication and subscriber creation is also used to support inter WLAN-GW mobility, such as when a UE moves form one AP to another AP such that the new AP is anchored on a different WLAN-GW. This is shown in Figure 156.

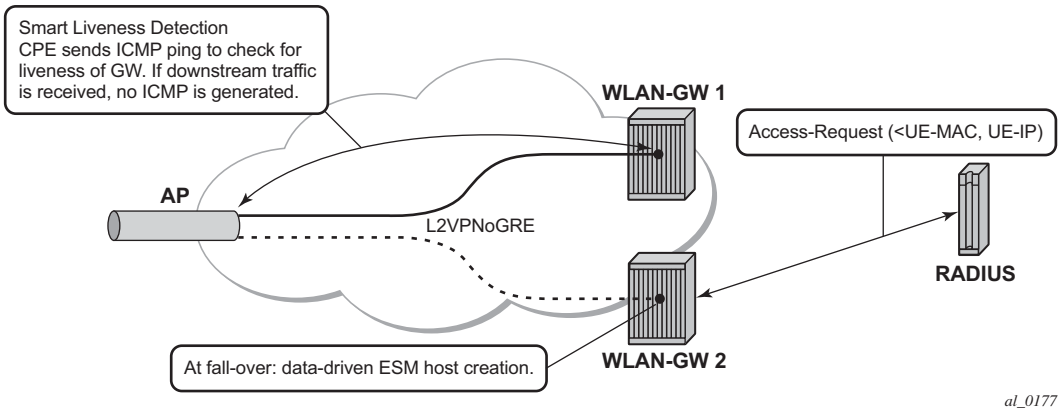


Figure 155: N:1 WLAN-GW Redundancy Based on "Data-Triggered" Authentication and Subscriber Creation

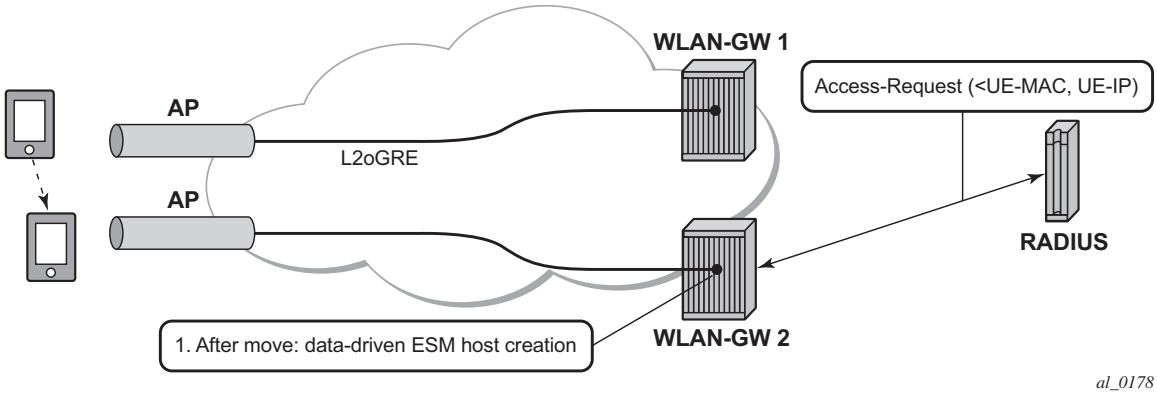


Figure 156: Inter WLAN-GW Mobility Based on "Data-Triggered" Authentication and Subscriber Creation

The following output displays the configuration for migrant user support and “data-triggered” subscriber creation.

```
#--------------------------------------------------
 NAT configuration for migrant and authenticated users
#--------------------------------------------------
service

  vprn 300 customer 1 create

     nat
       inside
          l2-aware
               address 21.1.1.1/16
          exit
       exit
       outside
           pool "migrant_outside_pool" nat-group 1 type wlan-gw-anchor create
                address-range 22.22.0.0 22.22.0.255 create
                exit
                no shutdown
           exit
           pool "wifi_outside_pool" nat-group 1 type l2-aware create
                address-range 22.0.0.0 22.0.0.255 create
                exit
                no shutdown
           exit
       exit
     exit
  exit

  nat
   nat-policy "migrant_nat_300" create
        pool "migrant_outside_pool" router 300
        timeouts
             tcp-established min 1
        exit
   exit

   nat-policy "wifi_nat_300" create
        pool "wifi_outside_pool" router 300
   exit

 exit


#------------------------------------------------------------------------------
echo "AAA Configuration" - ISA-RADIUS-Policy for authentication from WLAN-GW ISA
#------------------------------------------------------------------------------
    aaa
        isa-radius-policy "wifi_isa_radius" create
            description "Default authentication policy for migrant users"
            password "i2KzVe9XPxgy4KN2UEIf6jKeMT3X4mT6JcUmnnPZIrw" hash2
            servers
                router "Base"
                source-address-range 100.100.100.4
                server 1 create
```

```
                    authentication
                    coa
                    ip-address 100.100.100.2
                    secret "ABIQRobhHXzq13ycwqS74FSrj.OdTwh5IdjhRB.yAF." hash2
                    no shutdown
                exit
            exit
        exit
        radius-server-policy "radius_server_policy" create
            servers
                router "Base"
                server 1 name "radius_server"
            exit
        exit
    exit

#--------------------------------------------------
echo "Subscriber-mgmt Configuration" - Redirect Policy
#--------------------------------------------------
    subscriber-mgmt
        http-redirect-policy "migrant_redirect" create
            url "portal.ipdtest.alcatel-lucent.com:8081/start/?mac=$MAC&url=$URL&ip=$IP"
            portal-hold-time 10
            forward-entries
                dst-ip 8.8.8.1 protocol tcp dst-port 8081
                dst-ip 8.8.8.7 protocol tcp dst-port 8007
                dst-ip 8.8.8.8 protocol udp dst-port 53
            exit
        exit
     exit
service

#------------------------------------------------------------------
echo "migrant user configuration under wlan-gw group interface"
#------------------------------------------------------------------

  vprn 300 customer 1 create

    subscriber-interface "ies-4-20.1.1.1" create
        address 20.1.1.1/16

        group-interface "grp-vprn_ue-2/1/2:51" wlangw create
            sap-parameters
                sub-sla-mgmt
                    def-sla-profile "slaprof_1"
                    def-sub-profile "subprof_1"
                    sub-ident-policy "identprof"
                exit
             exit
             dhcp
                 proxy-server
                     emulated-server 20.1.1.1
                     no shutdown
                 exit
                 trusted
                 lease-populate 32767
                 user-db "radius_ludb"
                 no shutdown
              exit
```

```
            host-connectivity-verify interval 1000
            wlan-gw
                gw-address 50.1.1.4
                mobility
                    hold-time 0
                    trigger data iapp
                exit
                router 50
                wlan-gw-group 1
                vlan-tag-ranges
                     range start 100 end 100
                          authentication
                               authentication-policy "wifi_isa_radius"
                          exit
                                                      data-triggered-ue-creation
                          dhcp
                             l2-aware-ip-address 21.1.1.2
 primary-dns 130.1.1.1
              secondary-dns 131.1.1.1
                             no shutdown
                          exit
                          nat-policy "migrant_nat_4"
                exit
    exit
                no shutdown
              exit
         exit
     exit
exit
```

Distributed Subscriber Management (DSM)

With this feature, once the UE is successfully authenticated (portal, auto-signed-in, or EAP), the corresponding subscriber can be created on the anchor ISA, and both control plane and forwarding plane for the subscriber are handled on the ISA. This mode of subscriber management is henceforth referred to as **Distributed Subscriber Management** (DSM).

Prior to this feature, only ESM is supported for WLAN UEs, where the ESM host state is created on the IOM/IMMs from the CPM (triggered by the ISA on successful authentication). With ESM, the initial DHCP process and authentication could be triggered from the ISA (based on a per VLAN-range configuration for DHCP) under the group-interface with of type **wlangw**. However, control plane operations after the ESM host creation (such as accounting and DHCP renews) are handled on the CPM.

With DSM, in addition to initial DHCP and authentication, once the subscriber state exists on the anchor ISA, accounting and DHCP renews are also handled from the anchor ISA for the UE. This allows a higher UE scale and better control plane performance (including DHCP transactions per second, rate of authentications, and web redirects) due to load-balancing amongst set of ISAs in the WLAN-GW group. With DSM, the UE data-plane functions (such as per UE IP filtering, ingress/egress policing, legal intercept, per UE counters, and web-redirect) are performed on the ISA.

The decision to create an authenticated UE as an ESM or DSM UE can be controlled from RADIUS via inclusion of *Alc-Wlan-Ue-Creation-Typ*e VSA. The VSA can be included in access-accept for a UE that is auto-signed-in (for example, it does not need web redirect to portal), or in a COA message triggered to remove web redirect for a UE after successful portal authentication. The VSA is described in the RADIUS guide. If *Alc-Wlan-Ue-Creation-Type* is not present in access-accept (for auto-signed UE) or in the COA message (for UE creation of portal authenticated UE), then the UE is created as an ESM host. In this release DSM is not supported for dual-stack UEs or UEs which require a GTP host. If *Alc-Wlan-Ue-Creation-Type* indicates a DSM UE then any IPv6 or GTP related parameters in access-accept or COA will be ignored, and the UE will be created as a DSM host. *Alc-Wlan-Ue-Creation-Type* cannot be changed mid-session via COA. A COA containing *Alc-Wlan-Ue-Creation-Type* for an existing UE does not result in any change of state, and is NACK’ed.

DHCP

Based on DHCP and L2 NAT configuration on the ISA, the configured IP address (l2-aware-ip-address configured under vlan-range or default vlan-range) is assigned to the user via DHCP. A different DHCP lease-time can be configured for an un-authenticated and an authenticated user for which an ESM or DSM host has been created. DHCP return options, for example, DNS and NBNS server addresses can be configured. This configuration can be per soft-wlan-gw group interface (by explicitly configuring it under vlan-range default), or per VLAN range (where a VLAN tag corresponds to an SSID). By default, for open SSIDs, DHCP DORA is completed, and authentication request is is sent to AAA server only on reception of the first Layer 3 packet. However, with a **authenticate-on-dhcp** command configured under vlan-range (default or specific range), authentication can be triggered on received DHCP DISCOVER or REQUEST when no UE state is present. If UE anchoring on GGSN/PGW is required, then **authenticate-on-dhcp must** be enabled, since the decision to setup GTP tunnel (in which case the IP@ for the UE comes from the GGSN/PGW) is based on RADIUS response.

Authentication and Accounting

The authentication is initiated from RADIUS client on the ISA anchoring the user, based on an isa-radius-policy (configured under **aaa**) and specified on the wlan-gw group-interface. This support exists in prior releases and is described in Authentication and Forwarding on page 1836. The auth-policy can contain up to ten servers, five of which can be for authentication and all ten can be COA servers.

In order to generate accounting updates for DSM UEs, an accounting policy (type isa-radius-policy) must be configured under the **aaa** node and specified under **vlan-range** (**default** or **specific range**) on the wlan-gw interface. Accounting for DSM UEs includes **accounting-start**, **accounting-stop** and **interim-updates**. Interim-update interval is configurable under vlan-range on wlan-gw interface. The user-name format to be included in RADIUS messages is configurable in the auth-policy and accounting-policy via the **user-name-format** command. By default, the user-name contains the UE MAC address, but can be configured to include the UEs MAC address and IP address, or circuit-id or DHCP vendor options. If **authenticate-on-dhcp** is enabled, then the IP address for the UE is not known prior to authentication, and, if the user-name is configured to contain both MAC and IP address, then only the MAC address will be included.

The accounting-policy can be configured with attributes to be included in the accounting messages. The details of the attributes are covered in the *7750 SR-OS RADIUS Attributes Reference Guide*. The attributes are included here for reference.

```
*A:Dut-1>config>aaa# info
----------------------------------------------
  isa-radius-policy "isaRadiusPol1" create
      user-name-format mac mac-format alu
     acct-include-attributes
           acct-delay-time
           acct-trigger-reason
           called-station-id
           calling-station-id
           circuit-id
           dhcp-options
           dhcp-vendor-class-id
           frame-counters
           framed-ip-addr
           framed-ip-netmask
           hardware-timestamp
           inside-service-id
           mac-address
           multi-session-id
           nas-identifier
           nas-port-id
           nas-port-type
           octet-counters
           outside-ip
           outside-service-id
           port-range-block
           release-reason
           remote-id
           session-time
           subscriber-id
           ue-creation-type
           user-name
           wifi-rssi
           wifi-ssid-vlan
        exit
```

The **isa-radius-policy** for auth/COA and accounting specifies the server selection method for the servers specified in the policy with respect to load-balancing and failure of one or more servers. The three methods implemented include:

- Direct — Specifies that the first server will be used as primary for all RADIUS messages, the second server will be used as secondary (that is, used for all RADIUS messages if primary server fails), and so on.
- Round-Robin — RADIUS messages across accounting-sessions are distributed in a round-robin manner amongst the list of configured servers. All accounting messages for a given session are sent to the selected server for that session, until that server fails. If a server fails, then the sessions targeted to that server are distributed in a round-robin manner amongst the remaining servers. If the failed server comes back up, the sessions that were originally assigned to the failed server revert to the original server.
- Hash — Server is picked via hash on UE MAC. The hash list consists of all configured servers that are up. If a server fails, then the UEs hashed to that server are re-hashed over the remaining servers that are up.

If a response is not received for a RADIUS message from a particular server for a configurable timeout value (per server), and the time elapsed since the last packet received from this RADIUS server is longer than this configured timeout value, then the server is deemed to be down. Periodically an accounting-on message is sent to a server that is marked as down, to probe if it has become responsive. If a response is received then the server is marked as up.

```
*A:Dut-1>config>aaa# info
     isa-radius-policy "isaRadiusPol1" create
            nas-ip-address-origin system-ip
            password "6mNsKxvTe.0.nNCTIpGFcu.rr/qtdijazQ3ED8WAFfk" hash2
            user-name-format mac mac-format alu release-reason
            servers
                access-algorithm hash-based
                retry 3
                router "Base"
                source-address-range 81.1.0.1
                timeout sec 5
                server 1 create
                    accounting port 1813
                    authentication port 1812
                    coa port 3799
                    ip-address 10.13.0.2
                    secret "3BmWbBfDO38hPY8DtLFn8bYDBaduy6w.ogeSUsouoHc" hash2
                    no shutdown
                exit
            exit
        exit
----------------------------------------------
*A:Dut-1>config>aaa#
```

DSM Data-Plane

In this release NAT on the anchor ISA is required for forwarding of traffic to/from a DSM UE. There is no UE state in the IOM/IMM for a DSM UE. The downstream forwarding is based on FIB lookup that should match a route corresponding to the NAT outside pool, and get the downstream traffic to the right anchor ISA, where NAT is performed for the UE. The inside IP address assigned to the UE is the configured l2-aware-ip-address on the vlan-range (default or specific range) under wlan-gw interface. Therefore every UE corresponding to the default or specific vlan-range will get the same inside IP@. The NAT is L2-aware, and uses UE MAC to de-multiplex.

IP Filtering

Filtering based on protocol, destination IP, destination port or any combination is supported for traffic to and from the UE. The match entries and corresponding actions can be specified within the **dsm-ip-filter** which can be created in the **subscriber-mgmt>wlan-gw>dsm** context. The filter can be associated with a vlan-range (default or specific vlan-range) on wlan-gw interface, in which case all subscribers associated with the vlan-range will be associated with an instance of this filter.

The supported filter actions include drop and forward. The first match will cause corresponding action to be executed and no further match entries will be executed. In case there is no match or no action configured for a match, configurable default action for the filter will be executed. The filter can be overridden on a per UE basis via RADIUS access-accept or COA. The new VSA *Alc-Wlan-Dsm-Ip-Filter* is defined for specifying the per UE filter from RADIUS. The VSA is defined in the RADIUS guide.

```
*A:vsim>config>subscr-mgmt>wlan-gw>dsm>dsm-ip-filter# info
----------------------------------------------
          dsm-ip-filter "foo" create
                   default-action forward
                    entry 1 create
                        match protocol 17
                            dst-ip 2.2.2.2/32
                            dst-port  eq  53
                        exit
                    exit
              exit

*A:vsim>config>service>vprn# info
----------------------------------------------
 subscriber-interface "s1" create
      group-interface "g1" wlangw create
             wlan-gw
                   vlan-tag-ranges
                          range default
                               distributed-sub-mgmt
                                    dsm-ip-filter "foo"

                               exit
                          exit
                   exit
               exit
----------------------------------------------
```

Policing

Per UE policing for both ingress and egress direction is supported. Policers can be created under **subscriber-mgmt>wlan-gw>dsm**. The policers can be of type single-bucket (PIR) bandwidth limiting or dual-bucket (PIR and CIR) bandwidth limiting. In this release only policer action supported is permit-deny i.e. non-conformant traffic is dropped, as opposed to marked out-of-profile. The administrative peak and committed rates and peak and committed burst sizes are configurable. For single-bucket bandwidth policers, cir and cbs are not applicable, and only pir and mbs are configurable.

```
*A:vsim>config>subscr-mgmt>wlan-gw>distributed-sub-mgmt>dsm-policer# info detail
----------------------------------------------
                    no description
                    action permit-deny
                    cbs 100
                    mbs 200
                    rate 1000 cir 500
```

The policers can be associated with a vlan-range (default or specific vlan-range) on wlan-gw interface, in which case all subscribers associated with the vlan-range will be associated with an instance of these policers. These ingress and egress policers can be overridden on per UE basis via RADIUS access-accept or COA. The new VSAs *Alc-Wlan-Dsm-Ingress-Policer* and *Alc-Wlan-Dsm-Egress-Policer* are defined for specifying the per UE policers from RADIUS. The VSAs are defined in the *7750 SR-OS RADIUS Attributes Reference Guide*. If the policers specified in access-accept are not found the message is dropped. If the policers specified in COA are not found, a NACK is sent back.

```
*A:vsim>config>service>vprn# info
----------------------------------------------
 subscriber-interface "s1" create
      group-interface "g1" wlangw create
             wlan-gw
                   vlan-tag-ranges
                          range default
                                distributed-sub-mgmt
                                     egress-policer "silver-egress"
                                     ingress-policer "silver-ingress"
                                exit
                          exit
                   exit
              exit
----------------------------------------------
```

Lawful Intercept (LI)

LI can be triggered for a DSM UE LI via CLI or RADIUS, and is performed post-NAT. Only routable encaps (IP/UDP/LI-shim) and IP-only mirror-dest are supported. A maximum of 2K DSM UEs per-chassis can be under LI simultaneously. LI mirror dest (service in which mirrored packets are injected) along with other required mirror information (mirror-dest type, encapsulation-type e.g. ip-udp-shim, and encapsulation information e.g. IP and UDP header information) is configurable. A DSM UE identified by its MAC address can be associated with the mirror-dest (service in which mirrored packets for the host are injected) via li-source command. For routable encapsulation (IP/UDP/LI-Shim), the session-id and transaction-id to be inserted in the LI-Shim are configured under **li-source**.

```
A:Dut-1>config>mirror# info
----------------------------------------------
        mirror-dest 60000 type ip-only create
            encap
                layer-3-encap ip-udp-shim create
                    gateway create
                        ip src 1.1.1.1 dest 2.2.2.2
                        udp src 2048 dest 2049
                    exit
                exit
            exit
            no shutdown
        exit

----------------------------------------------
A:Dut-1>config>li# info
----------------------------------------------
        li-source 60000
            wlan-gw
                dsm-subscriber mac 00:00:00:07:02:03
                    intercept-id 10000
                    session-id 20000
                exit
            exit
            no shutdown
        exit
```

LI can be enabled or disabled from RADIUS via inclusion of the *Alc-LI-Action* VSA in access-accept or COA. The *Alc-LI-Destination* VSA is required to indicate the mirror-dest service that the DSM UE under LI is associated with. The Intercept-Id and Session-Id for a DSM UE can be provided from RADIUS access-accept or COA via inclusion of Alc-LI-Intercept-Id and Alc-LI-Session-Id VSAs. These LI related VSAs are described in the RADIUS guide.

Information for a particular li-source, and its associated mirror-dest can be shown via CLI.

Data-Triggered UE Creation

Similar to data-triggered UE creation with ESM, a DSM UE can also be created based on data-triggered authentication discussed in Data Triggered Subscriber Creation on page 1837. The decision to create ESM versus DSM UE is based on the value of RADIUS VSA Alc-Wlan-Ue-Creation-Type present in the access-accept message. The data-triggered authentication and UE creation if configured provides for WLAN-GW IOM redundancy. The DSM UE is created on the standby ISA based on successful data-triggered authentication. Also, inter-chassis redundancy is supported for DSM UE based on data-triggered authentication, and is identical to ESM (as described in Data Triggered Subscriber Creation on page 1837.

Idle-Timeout and Session-Timeout Management

The per UE idle-timeout value can be provided in RADIUS access-accept or COA for a DSM UE in standard Idle-Timeout attribute. The minimum idle-timeout allowed is 150 seconds. The idle-timeout is enforced on the ISA for a DSM UE. If there is no data to/from a UE for up to idle-timeout value, the UE is removed and accounting-stop is sent. Subsequently, if a UE re-associates and connects to an open SSID on an AP, and has an IP address with a valid lease, then the first data packet from the UE triggers authentication. Successful authentication results in creation of DSM UE.

The per UE session timeout value can be provided in RADIUS access-accept or COA in standard Session-Timeout attribute. The value is interpreted as “absolute value”, and the UE is unconditionally deleted regardless of activity. The minimum allowed value for session-timeout is 300 seconds.

Operational Commands

The following shows the command usage to dump information on UE under LI (only allowed to users with LI privilege).

```
A:Dut-1# tools dump li wlan-gw ue
No sessions on Slot #2 MDA #1 match the query
===============================================================================
Matched 2 sessions on Slot #2 MDA #2
===============================================================================
UE-Mac          : 00:00:00:07:02:03     Mirror Service  : 60000
LI Intercept-Id : 10000                 LI Session-Id   : 20000
-------------------------------------------------------------------------------
UE-Mac          : 00:00:00:07:02:08     Mirror Service  : 60000
LI Intercept-Id : 42                    LI Session-Id   : 2013
-------------------------------------------------------------------------------
===============================================================================


A:Dut-1>show>li# li-source 60000
===============================================================================
Mirror Service
===============================================================================
Service Id       : 60000                Type          : ipOnly
-------------------------------------------------------------------------------
L3 encap type    : ip-udp-shim          Router        : Router: Base
                                        Direction bit : No
Primary gateway
Source IP        : 1.1.1.1              Dest IP       : 2.2.2.2
Source UDP port  : 2048                 Dest UDP port : 2049
===============================================================================
Local Sources
-------------------------------------------------------------------------------
Admin State      : Up
-------------------------------------------------------------------------------
WLAN Gateway LI sources
-------------------------------------------------------------------------------
MAC-Address                                          Intercept-Id Session-Id
-------------------------------------------------------------------------------
00:00:00:07:02:03                                    10000        20000
===============================================================================
```

Distributed RADIUS Proxy

The distributed RADIUS proxy acts just like the regular RADIUS proxy but runs on an ISA and is designed for high scale and high performance. It can handle a high number of RADIUS transactions, therefore it is able to keep up with EAP authentications that consists of many RADIUS transactions (EAP-PEAP) and all the accounting messages sent by an Access Point for a particular UE. The distributed RADIUS proxy is designed to handle the scale and performance of Distributed Subscriber Management (DSM) but can also be used as a performance improvement for Enhanced Subscriber Management (ESM). All common server-selection mechanisms are supported (direct, round-robin, hash-based) and both IPv4 and IPv6 RADIUS clients can communicate with the proxy. Important differences with the CPM based proxy are no IPv6 support towards the RADIUS server and no python support on any of the interfaces.

The distributed proxy also supports caching an access-accept to aid authentication of Layer 3 setup (DHCP/SLAAC/DHCPv6). After UE creation the cache supports tracking of both accounting and authentication messages. Contrary to the CPM-based RADIUS proxy the key used in the cache is always the calling-station-id attribute and it is expected to contain the UE MAC address, as specified in RFC 3580, *IEEE 802.1X Remote Authentication Dial In User Service (RADIUS) Usage Guidelines*. Accounting-on and accounting-off messages are not supported. The RADIUS proxy cache works with both ESM and DSM UEs.

For caching to work, the distributed proxy makes sure that all packets are routed via the anchor ISA tied to the UE. An AP will send a RADIUS packet to the radius-proxy IP address shared by all ISAs, the WLAN-GW will forward the packet to a distributor ISA based on the source IP address of the radius packet. That ISA then looks for the calling-station-id and forwards the packet to the correct anchor-isa to handle proxy functionality and caching. If no calling-station-id is found (such as acct-on/acct-off), the packet is always forwarded to a fixed ISA that is chosen at startup. The chosen ISA will forward the packet with a per-ISA IP as source-ip, this source-ip is assigned at startup from the range configured under **configure aaa isa-radius-policy** *policy-name*. From server to client the packet is sent back to that IP address and therefore immediately arrives at the correct anchor ISA, which subsequently forwards the packet straight to the AP without an additional ISA passthrough.

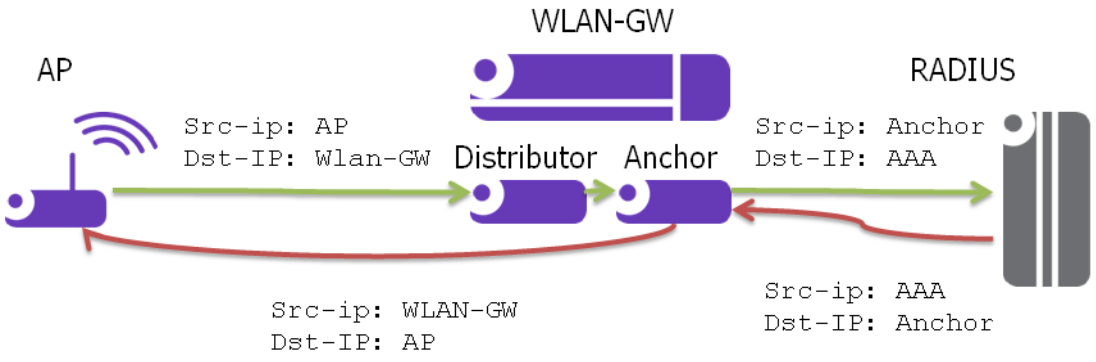


Figure 157: Distributed RADIUS Packet Forwarding

The following is a distributed proxy configuration example.

```
#--------------------------------------------------
/configure service vprn 50 radius-proxy
----------------------------------------------
    server "distributed_radius_proxy" purpose accounting authentication wlan-gw-group 1
create
        cache
            key packet-type request attribute-type 31
            timeout min 5
            no track-accounting
            track-authentication accept
            track-delete-hold-time 0
            no shutdown
        exit
        default-accounting-server-policy "wlangw_isa_radius"
        default-authentication-server-policy "wlangw_isa_radius"
        no description
        no load-balance-key
        no python-policy
        secret "BLoAGDmsLt/Rs9LLU5/lESjjqZa/ssWnEIMJNvgBwmo" hash2
        send-accounting-response
        wlan-gw
            address 50.1.10.1
            ipv6-address 2032::1:a:1
        exit
        no shutdown
    exit
----------------------------------------------

/configure aaa isa-radius-policy "wlangw_isa_radius"
----------------------------------------------
            password "rNPEv/V0j095N0Qy4rnekTVbF89OIlVj" hash2
            servers
                router "Base"
                source-address-range 100.100.100.4
                server 1 create
                    authentication
                    ip-address 100.100.100.2
                    secret "rNPEv/V0j095N0Qy4rnekPU0fmH2TwEl" hash2
                    no shutdown
                exit
            exit
----------------------------------------------
```

Enhanced Subscriber Management

For ESM support authenticate-on-dhcp should always be enabled under **configure>service>vprn|ies** *svc*>**subscriber-interface** *sub-if*>**group-interface** *grp-it*>**wlan-gw vlan-tag-ranges range start** *start* **end** *end*. When receiving DHCPv4 the ISA will send the DHCP message and the cached access-accept to the CPM which will further process the setup sequence. On the CPM a regular radius authentication policy should be picked up for the UE either through configuration on the group-interface or via the LUDB. Typically this policy will reflect the ISA-policy. This policy will be used as a context to store the access-accept on the CPM for 10s.

IPv6 hosts are supported but can only be authenticated after DHCPv4 has triggered the promote from ISA to CPM. When ipoe-linking is enabled a SLAAC host will be created together with the DHCPv4 host as usual. If an additional IPv6 host would arrive after the 10s timeout, a regular radius authentication will be started from the CPM using the previously mentioned radius policy.

When tracking is enabled, the radius messages are handled on the ISA and specific tracking actions (mobility, delete) are sent directly to the CPM

Distributed Subscriber Management

For DSM support the radius-proxy cache is directly tied to the UE record on the anchor ISA and is automatically used during UE creation. Tracking immediately executes the associated actions (mobility, timed host-delete) on the UE record. If a cached accept would time out before DHCP is received, a regular radius authentication will be used using the configuration under **configure>service>vprn|ies** *svc*>**subscriber-interface** *sub-if*>**group-interface** *grp-it*>**wlan-gw vlan-tag-ranges range start** *start* **end** *end*>**authentication**.

Operational Commands

The following commands will display all statistics related to the radius-proxy, both for communication towards the client and for communication towards the server.

show router router-id radius-proxy-server server-name statistics

clear router router-id radius-proxy-server server-name statistics

Example output:

```
*A:Dut-C# show router 50 radius-proxy-server "radius_proxy_isa" statistics
...
Group 1 member 3
-------------------------------------------------------------
Rx packet                                                : 2
Rx Access-Request                                        : 2
Rx Accounting-Request                                    : 0
Rx dropped                                               : 0
  Retransmit                                             : 0
  Wrong purpose                                          : 0
  No UE MAC to cache                                     : 0
  Client context limit reached                           : 0
  No ISA RADIUS policy configured                        : 0
  Invalid attribute encoding                             : 0
  Invalid password                                       : 0
  Accounting-Request with invalid Acct-Status-Type       : 0
  Accounting-Request with no Acct-Status-Type            : 0
  Invalid accounting Authenticator                       : 0
  Invalid Message-Authenticator                          : 0
  Management core overload                               : 0

Tx Access-Accept                                         : 1
Tx Access-Reject                                         : 0
Tx Access-Challenge                                      : 1
Tx Accounting-Response                                   : 0
Tx dropped                                               : 0
  Server timeout                                         : 0
  Invalid response Authenticator                         : 0
  Invalid Message-Authenticator                          : 0
  Invalid attribute encoding                             : 0
  RADIUS server send failure                             : 0
...
```

The following RADIUS proxy messages sent to the server using this policy will also be counted here.

show aaa isa-radius-policy policy-name

clear aaa isa-radius-policy policy-name statistics

Example output:

```
*A:Dut-C# show aaa isa-radius-policy "wifi_isa_radius"
...
Server 1, group 1, member 3
-------------------------------------------------------------------------------
Purposes Up                                     : accounting authentication
Source IP address                               : 100.100.100.6
Acct Tx Requests                                : 0
Acct Tx Retries                                 : 0
Acct Tx Timeouts                                : 0
Acct Rx Replies                                 : 0
Auth Tx Requests                                : 2
Auth Tx Retries                                 : 0
Auth Tx Timeouts                                : 0
Auth Rx Replies                                 : 2
CoA Rx Requests                                 : 0
...
```

WLAN-GW 1:1 Active-Backup Redundancy

This feature provides support for 1:1 inter WLAN-GW active-backup redundancy. The failure detection and switchover mechanism is contained in WLAN-GWs, and there is no dependency on the AP to detect failure of WLAN-GW and switch traffic to tunnel endpoint on a different WLAN-GW. There is also no dependency on NAT or a particular flavor of NAT on WLAN-GW. If local DHCP servers are used for address allocation, then DHCP leases in the server are synchronized to the backup WLAN-GW via MCS. However, ESM state for the UE is created on the backup WLAN-GW based on data-triggered authentication after switchover. The granularity of switchover is subscriber-interface. Both WLAN-GWs are required to be configured with the same tunnel endpoint address. Also, the subscriber-interfaces on both WLAN-GW must be configured with the same subnets. Only the WLAN-GW that is deemed as active announces the tunnel endpoint address in routing towards the APs.

Active-backup decision is based on monitor and export route concept (same as what is used with NAT redundancy). Monitor and export routes are configured on the subscriber-interface on both WLAN-GWs. These should be complementary with respect to the ones on the other WLAN-GW. When WLAN-GW group goes up operationally, check is made in the FIB for presence of monitor route (which is the route exported by the other WLAN-GW). If it is not found, then the WLAN-GW assumes active state with respect to ownership of the tunnel end-point address, and the tunnel end-point address is announced in IGP towards the AP (subject to configured IGP and routing policy). The active WLAN-GW also announces the aggregate subscriber subnets upstream in routing. When WLAN-GW group comes up operationally, and detects the monitor route in the FIB, it assumes standby state with respect to the tunnel endpoint address. It does not announce the tunnel endpoint or the subscriber subnets in routing.

Each WLAN-GW will need to track the monitor route in the FIB. If the monitor route is no longer in the FIB, and the WLAN-GW is in standby state, it will transition to active, and announce the tunnel end-point towards APs, and subscriber subnets upstream. This will draw the traffic from the AP to the backup WLAN-GW. Redundancy will be non-revertive. The monitor and export routes are configured on the subscriber-interface.

```
config>service>ies>sub-if
     wlan-gw
          redundancy
               [no] export <ip-prefix/length>
               [no] monitor <ip-prefix/length>
          exit
     exit
```

If the number of operationally up WLAN-GW IOMs in wlan-gw group drops below the number of active IOMs configured, the WLAN-GW group will be brought down (based on the configuration **oper-down-on-group-degrade** command under wlan-gw interface), and switchover procedures for the subscriber-interface are triggered (export route, tunnel endpoint address and subscriber subnets are withdrawn from routing).

```
config>service>vprn>sub-if>grp-if
config>service>ies>sub-if>grp-if
     wlan-gw
          [no] oper-down-on-group-degrade
```

The switchover can also be triggered administratively on per subscriber-interface basis using the **tools perform** command.

```
*A:vsim-07-cpm# tools perform wlan-gw redundancy force-switchover service <service-id>
interface <ip-int-name>
```

DHCP Server Redundancy

1:1 redundancy provided with this feature only handles complete failure of WLAN-GW (either due to chassis reboot or due to number of operational WLAN-GW IOMs in WLAN-GW group falling below the number of active WLAN-GW IOMs, which will operationally bring down the WLAN-GW group, and trigger switchover). For any partial failures (port, MDA or IOM failure), it is assumed there is network level redundancy, such that the soft-GRE tunnel will be re-routed to the primary WLAN-GW. This ensures there is only one active WLAN-GW owning the subnets defined on the two WLAN-GWs (that is, allows local/local subnets). The DHCP server(s) state will be synchronized between the two WLAN-GWs using MCS.

Supported access includes:

- DHCPv4 Relay to external server.
- DHCPv4 Relay to local server.
  - → Pool name could be returned by AAA (framed-pool) in access-accept.
  - → Pool name could come from LUDB (as relay we would set use-pool-from-client). LUDB could be specified under group-interface or under DHCP server. LUDB or AAA returned pool allows support for per SSID pool selection. SSID is contained in circuit-id.
  - → Local pool selection based on giaddr.
- DHCPv4 proxy (IP@ from AAA or IP@ from PGW/GGSN).

Unnumbered case should work both in relay and proxy scenarios. IPv6 is not supported in this release (as we don’t support data-triggered auth and subscriber creation for IPv6). Therefore, DHCPv6 server synchronization is not applicable. Also, IPv4 address from LUDB is not supported in this release (as data-triggered authentication against LUDB is not supported).

Subscriber Creation after Switchover

When standby WLAN-GW transitions to active state, and receives data on the anchor ISA there will not be any UE state on the anchor ISA. Data-triggered authentication Data Triggered Subscriber Creation on page 1837 will be used to create the subscriber. In order to infer how the UE originally obtained the IP@ (DHCP relay versus proxy, such as AAA or GTP), the following holds:

1. If any GTP related parameters are returned in access-accept, then it is assumed the IP@ comes from GGSN/PGW, and the origin for the IP@ is assumed to be “GTP”.
2. If no GTP parameter is returned, and access-accept contains framed-IP, then proxy case will be assumed (that is, the origin as AAA).
3. If no GTP parameter or framed-IP is returned, then DHCP relay is assumed. The remaining lease time will be set to initial lease-time (if it was originally provided from AAA on primary WLAN-GW, it could be provided in access-accept for data-triggered auth on backup WLAN-GW). If AAA does not provide it, then it will be initialized to default value of 7 days.

If authentication indicates GTP for the subscriber, then create-session-request will be signaled with Handover indication. Data-triggered subscriber creation based on IPv6 packet is not supported in R12. However, for dual-sack subscriber over soft-GRE, if AAA returns the SLAAC prefix in access-accept (in response to IPv4 data-triggered auth), and linking is configured, RA message will be sent (unicast to client’s MAC@), and a SLAAC host is created.

WLAN-GW Triggered Stateless Redundancy (N:1)

Existing stateless redundancy, described in Data Triggered Subscriber Creation on page 1837, is enhanced to support WLAN-GW based failure detection and switchover based on monitor and export route mechanism described above. The AP is not required to be configured with different tunnel endpoint addresses for active and standby WLAN-GWs. Single tunnel endpoint address is configured on the APs. The tunnel endpoint address is only announced in routing by the primary WLAN-GW as described in the section above. This form of redundancy as described in Data Triggered Subscriber Creation on page 1837, required L2-aware NAT. After failure, the subscriber on the standby WLAN-GW that transitions to primary is based on data-triggered authentication. This is supported for both ESM and DSM.

AP Triggered Stateless WLAN-GW Redundancy (N:1)

Existing AP controlled redundancy, described in Data Triggered Subscriber Creation on page 1837, is enhanced to trigger switchover on primary WLAN-GW if the number of WLAN-GW IOMs in the WLAN-GW group fall below number of active WLAN-GW IOMs. Based on a configuration **configure>service>vprn|ies** *svc*>**subscriber-interface** *sub-if*>**group-interface** *grp-it*>**wlan-gw** command, the WLAN-GW group is operationally brought down if a WLAN-GW IOM fails and the number of WLAN-GW IOMs fall below number of active WLAN-GW IOMs configured for the WLAN-GW group. This results in loss of route to the tunnel endpoint from the active WLAN-GW. The AP will detect this as WLAN-GW failure, and start tunneling the data to a configured backup WLAN-GW, where the subscriber will be created based on data-triggered authentication.This is supported for both ESM and DSM.

IPv6-only Access

In order to accommodate IPv6 only AP/CPEs, IPv6 wlan-gw tunnel transport, and IPv6 client-side support for RADIUS-proxy have been added.

IPv6 GRE Tunnels

Support for IPv6 GRE tunnels require configuration of local IPv6 tunnel end-point address under wlan-gw configuration on the group-interface. The transport for L2oGRE (or L2VPNoGRE) packet is IPv6 as shown in Figure 158. The outer IPv6 header contains the value 0x2F (GRE) in its Next Header field. GRE header contains protocol Ethernet (0x6558) or Ethernet-over-MPLS (0x8847) as in the case IPv4 GRE.

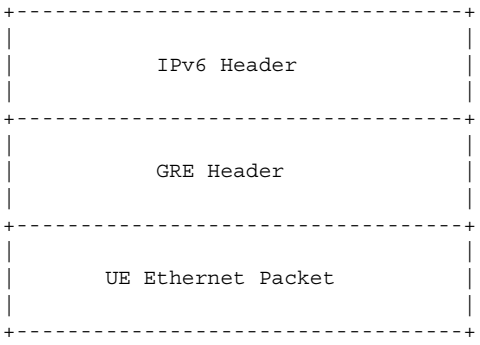


Figure 158: IPv6 Transport for L2oGRE Packet

A single wlan-gw endpoint instance on the group-interface can have both IPv4 and IPv6 address configured as shown in Figure 159, and inter-AP mobility between IPv4 and IPv6 only APs is supported in this scenario.

```
service
    vprn 300 customer 1 create
        group-interface "grp-intf-1" wlangw create
            wlan-gw
                gw-address 50.1.1.4
                gw-ipv6-address 2032::1:1:7
                mobility
                   hold-time 0
                   trigger data iapp
                exit
                egress
                   shaping per-tunnel
                exit
                tcp-mss-adjust 1000
                vlan-tag-ranges
                    range start 100 end 100
                        data-triggered-ue-creation
                        retail-svc-id 402
                    exit
                exit
                router 30
                wlan-gw-group 1
                no shutdown
              exit
           exit
      exit
exit
```

Figure 159: IPv6 Endpoint Configuration for WLAN-GW

The data-path for IPv6 GRE tunneled packets, including load-balancing of tunneled packets amongst set of ISAs in the WLAN-GW group, and anchoring after tunnel de-capsulation remains unchanged. Per tunnel traffic shaping is supported similar to IPv4 tunnels. All existing per tunnel configuration on the group-interface described in previous sections (including mobility, egress shaping, VLAN ranges, etc.) is supported identically for IPv6 tunnels. Tunnel reassembly for upstream tunneled traffic is not supported for IPv6 tunnels in this release. TCP mss-adjust is supported for IPv6 tunnels, and is configurable under wlan-gw mode on group-interface. APs must use globally routable addresses for GRE IPv6 transport. Packets with extension headers are dropped.

IPv6 Client-Side RADIUS Proxy

RADIUS proxy is extended to listen for incoming IPv6 RADIUS messages from IPv6 RADIUS clients on AP/CPEs. The listening interface that the RADIUS proxy binds to must be configured with an IPv6 address as shown in Figure 160. The IPv6 RADIUS proxy is solely for DHCPv4-based UEs behind IPv6 only AP/CPEs (IPv6-capable UEs are not supported in this release). All RADIUS-proxy functions (including caching, correlation with DHCPv4, and mobility tracking) are supported identically to existing IPv4 client-side RADIUS-proxy.

```
service
    vprn 300 customer 1 create
        shutdown
        interface "listening_radius_server" create
             address 9.9.9.9/32
             ipv6
                 address 9::9:9:9/128
             exit
             loopback
         exit
     radius-proxy
         server "radius-proxy" purpose accounting authentication create
             shutdown
             cache
                 key packet-type request attribute-type 31
                 track-accounting stop interim-update accounting-on accounting-off
                 no shutdown
             exit
             default-accounting-server-policy "radius_server_policy"
             default-authentication-server-policy "radius_server_policy"
             interface "listening_radius_server"
             load-balance-key attribute-type 102 vendor 5
             secret "AQepKzndDzjRI5g38L3LbbN3E8qualtn" hash2
             send-accounting-response
             no shutdown
         exit
     exit
```

Figure 160: Configuration for IPv6 Client-Side RADIUS Proxy

Dual-Stack UEs over WLAN-GW

This feature adds support for dual-stack UEs over wlan-gw. Each dual-stack UE appears to WLAN-GW as a bridged client. Dual-stack UE support includes both SLAAC and DHCPv6, with and without linking with DHCPv4. Handling of DHCPv6, RS/RA, and NS/NA messages over wlan-gw has been added. WLAN-GW can assign /128 GUA to the UE via DHCPv6 and/or assign a /64 prefix in SLAAC to each UE. Each UE can be handed via DHCPv6, a /128 IA_NA from a unique /64 prefix, with the "on-link" flag is off in the RA message. This is because the public WIFI users are distinct subscribers, and the communication must always be via WLAN-GW. The CPE MUST prevent local-switching on the WIFI link even if the /64 prefix is signaled as "on-link" or if the UEs are handed out /128 from the same /64 prefix.

Existing ESMv6 support on normal group-interface is applicable to wlan-gw group-interface, and is already documented in general ESMv6 sections in this guide. There are a few exceptions that are mentioned in sections below.

SLAAC Prefix Assignment

SLAAC prefix assignment to the UE can be from local prefix pool, where pool name can come from RADIUS in Alc-SLAAC-IPv6-Pool VSA or from LUDB (see general section on ESMv6 SLAAC pool assignment). Alternatively, the SLAAC prefix can be provided from RADIUS (in standard Framed-IPv6-Prefix attribute) or from LUDB. SLAAC with stateless DHCPv6 (DHCPv6 information-request) is supported. DNS can be sent in RA messages (per RFC 6106). RS authentication (based on MAC address) can be configured (as described in general ESMv6 section on "SLAAC only ESM hosts"). SLAAC host is created on successful RS authentication. For successfully authenticated SLAAC host, an RA is sent in response to every received RS message (subject to a configured min-auth-interval). RA messages are sent to unicast MAC address of the UE.

SLAAC host creation can be linked to DHCPv4 by configuring **ipoe-linking** under group-interface. With **ipoe-linking** enabled, any received RS messages are dropped till DHCPv4 successfully authenticates and ESMv4 host is created. If **gratuitous-rtr-adv** is configured under ipoe-linking context then an RA is sent when ESMv4 host is created. If available, the SLAAC-prefix is included in the RA message. **shared-circuit-id** command under wlan-gw is not supported on wlan-gw interfaces. The O-Bit (other-stateful-configuration) is configurable on the group-interface.

DHCPv6 IA_NA Assignment

If UE requests DHCPv6 IA_NA, a /128 address can be provided from a unique /64 prefix per UE from a local-pool. The pool name can be provided from LUDB or from RADIUS (in Framed-

IPv6-Pool attribute). The address could also be provided via LUDB or RADIUS (in Alc-IPv6-Address VSA). DHCPv6 can also be linked with DHCPv4 by enabling **ipoe-linking** command. The M-bit in RA message is configurable. DHCPv6 IA_NA is allowed if it is received after a SLAAC host exists, if **allow-multiple-wan-addresses** is enabled under group-interface ipv6 configuration. In previous releases, this is precluded. This however consumes two hosts (one each for IA_NA and SLAAC) per UE. Based on a configuration command **override-slaac**, SLAAC host can be deleted if DHCPv6 IA_NA host is successfully created. Prefix-delegation is not supported with DHCPv6 on wlan-gw interfaces.

Migrant User Support

Migrant user support is only applicable to IPv4. However, if linking is configured for SLAAC or DHCPv6 with DHCPv4 then RS and DHCPv6 messages are dropped till IPv4 ESM host exists (that is, the UE is out of migrant state). Once the IPv6 ESM host exists, that is, UE is out of migrant state, RA is sent to the UE (unicast MAC), and subsequent RS or DHCPv6 messages can result in creation of IPv6 ESM host. Therefore, with migrant UEs, linking should be enabled. SLA-profile instance accounting (with interim-updates), and per-host accounting (w/ interim-updates) are supported.

Accounting

Per SLA-profile instance accounting (with interim-updates) and per SLA-profile instance accounting (with interim-updates) with host accounting enabled is supported. The interim-updates are scheduled updates, and carry IPv4 address and IPv6 address or prefix are assigned to the UE.

A sample sequence with per SLA-profile instance accounting (with interim-updates) is shown below:

0. IPv4oE host created based on DHCPv4.

1. Acct-start generated (contains framed-ip-address).

2. SLAAC host comes up.

3. Next scheduled interim-update (contains framed-ip-address and framed-IPv6-Prefix, that is, SLAAC-prefix).

4. DHCPv6 IA_NA gets assigned and corresponding host is created.

5. Next Scheduled interim-update (contains framed-ip-address, framed-IPv6-Prefix and Alc-Ipv6-Address).

6. SLAAC host times out.

7. Next Scheduled interim-update (contains only Alc-IPv6-Address and will NOT contain framed-IPv6-Prefix).

8. DHCPv6 IA_NA lease times out.

9. Next Scheduled interim-update (contains only framed-ip-address).

A sample sequence with per SLA-profile instance accounting (with interim-updates) with host accounting enabled is shown below:

0. IPv4oE host created based on DHCPv4.

1. Acct-start for sla-profile instance generated (contains framed-ip-address).

2. Acct-start for DHCPv4 host will be generated (contains framed-ip-address).

3. SLAAC host comes up.

4. Acct-start for SLAAC host will be generated (this should contain framed-IPv6-Prefix, that is, SLAAC-prefix)

5. Next scheduled interim-update for sla-profile instance accounting (contains framed-ip-address and framed-IPv6-Prefix, that is, SLAAC-prefix).

6. DHCPv6 IA_NA gets assigned and corresponding host is created.

7. Acct-start for DHCPv6 IA_NA host will be generated (contains Alc-Ipv6-Address).

8. Next Scheduled interim-update (contains framed-ip-address, framed-IPv6-Prefix and Alc-Ipv6-Address).

9. SLAAC host times out.

10. Acct-stop (SLACC-host-acct-session-id) will be generated.

11. Next Scheduled interim-update for sla-profile instance accounting (contains only Alc-IPv6-Address).

12. DHCPv6 IA_NA lease times out.

13. Acct-stop (DHCPv6-IA_NA-host-acct-session-id) will be generated.

14. Next Scheduled interim-update for sla-profile instance accounting (contains framed-ip-address).

15. DHCPv4 lease times out.

16. Acct-stop (DHCPv4-host-acct-session-id) will be generated.

17. Acct-stop for sla-profile instance accounting will be generated.

Layer 2 Wholesale

This feature adds support for mapping a UE to a VPLS instance based on configuration. The mapping is explicitly created by assigning a Layer 2 service instance (limited to VPLS only in R. 13) to an SSID that the UE is connected to. The SSID is represented by the .1q tag in the received Layer 2 frames from the UE. A VPLS instance is configured per vlan-range on wlan-gw group-interface (as shown in Figure 142 on page 1784). This feature therefore enables Layer 2 wholesale, where traffic form all UEs on a particular SSID is transparently forwarded into the corresponding VPLS instance associated with the retail ISP. UE authentication, address assignment, Layer 3 classification and QOS are managed by the retail provider terminating the subscriber. There is no local-switching on the WLAN-GW providing the wholesale service. When a VPLS instance is configured under a VLAN-range, an internal SAP is implicitly created in the VPLS instance between each ISA and corresponding carrier IOM in the WLAN-GW group. The internal SAP is associated with an implicitly created SHG to constrain broadcast and multicast traffic received from UEs, such that it is not forwarded back on the SAP. Layer 2 wholesale and Layer 3 termination are possible simultaneously on same wlan-gw interface, since Layer 2 wholesale or Layer 3 termination is a per SSID decision. UE state on the ISA is removed when the UE MAC in the VPLS instance ages out based on local-age configured under VPLS service.

A vpls-sap-template (described in the SR OS Services Guide) can be defined under **service>template** and associated with the VPLS service for Layer 2 wholesale via **config>service>vpls>wlan-gw>sap-template** command. Ingress/egress filter and QoS specified in the vpls-sap-template for the VPLS service is applied to the implicitly created internal SAP (between ISA and carrier IOM) in the VPLS service.

```
*A:vsim>config>service>vprn# info
----------------------------------------------
 subscriber-interface "s1" create
       group-interface "g1" wlangw create
              wlan-gw
                    vlan-tag-ranges
                          range start 100 end 100
                                l2-service 600
                                      no shutdown
                                exit
                          exit
                    exit
               exit
----------------------------------------------

*A:vsim>config>service>vpls# info
----------------------------------------------
 wlan-gw
     shutdown
     sap-template "foo"
 exit
----------------------------------------------
```

VLAN to WLAN-GW IOM/IMM Steering via Internal Epipe

This feature provides the steering of traffic received on an access VLAN or spoke SDP from a WIFI AP/AC to a WLAN-GW IOM/IMM via an internal Epipe. The benefit of this internal steering is that all existing features available with native soft GRE tunnels on WLAN-GW IOM/IMM are now available to pure Layer 2 access via VLANs or spoke SDPs. The access SAP can be null, .1q, or q-in-q. Access SAPs aggregating WIFI APs or ACs can and be configured in the **configure>service>ies>subscriber-interface>group-interface>wlan-gw>l2-access-points>l2-ap** or **configure>service>vprn>subscriber-interface>group-interface>wlan-gw>l2-access-points>l2-ap** context

The aggregation network can insert up to two **AP identifying** VLAN tags, and the AP can insert a .1q tag (typically for identifying the SSID). The number of AP identifying tags sent on the internal epipe depends on the encapsulation on the access SAP. For example, if an aggregation network inserts two AP identifying tags, and an access SAP is configured with null encaps, then the traffic sent on the internal Epipe will carry two AP identifying tags. The number of AP identifying tags in the frame forwarded over the internal Epipe must be configured via the **l2-ap-encap-type** command.

```
configure service (vprn|ies) <svc-id> subscriber-interface <sub-itf> group-interface <grp-
itf> wlan-gw
    l2-access-points
        [no] l2-ap <sap-id> [create]
            [no] encap-type {default|null|dot1q|qinq}
            [no] epipe-sap-template <name>
            [no] shutdown
        exit
    exit
    [no] l2-ap-encap-type {null|dot1q|qinq}
exit
```

The traffic on an internal Epipe is load-balanced among ISAs in the WLAN-GW group. The load balancing uses a hash based on AP identifying tags that remain on the frame after being received on the access SAP (based on the SAP encapsulation). This ensures all traffic from a particular AP is Epiped to the same ISA. Ingress and egress QoS and filters can be defined in an **epipe-sap-template** as displayed in the configuration shown below, and associated with the access sap or spoke SDP. IP filters and DSCP remarking are not supported if more than two tags are present in the frame ingressing the SAP. Also, downstream filters and DSCP remarking is not applied if a retail tag is present. Both Layer 3 ESM and DSM as well as Layer 2 wholesale are supported for steered traffic.

```
configure service template epipe-sap-template <name> [create]
    egress
        [no] filter
            [no] ip <filter-id>
            [no] ipv6 <filter-id>
            [no] mac <filter-id>
        exit
        [no] qos <policy-id>
    exit
    ingress
        [no] filter
            [no] ip <filter-id>
            [no] ipv6 <filter-id>
            [no] mac <filter-id>
        exit
        [no] qos <policy-id> {shared-queuing|multipoint-shared}
    exit
exit
```

Currently, mobility from an AP that is reached over a VLAN or spoke SDP to an AP that is reached over a soft GRE or soft L2TPv3 tunnels are not supported. Each internal Epipe takes away two SAPs on each WLAN-GW IOM (one per ISA) in WLAN-GW group. With 64K SAPs per IOM, the maximum number of internal Epipes supported per chassis is 32K.

Soft-L2TPv3 Tunnels

This feature adds support for Layer 2 over soft-L2TPv3 tunnels. L2TPv3 is over UDP and both IPv4 and IPv6 transport is supported. The encapsulation with UDP allows NAT traversal. Soft-L2TPv3 tunnels are terminated on WLAN-GW IOM/IMM. All features supported with soft-GRE tunnels are supported identically with soft-L2TPv3 tunnels. L2TPv3 tunnels are stateless and there is no support for control channel, dynamic exchange of session-id and cookie, and L2-specific sub-layer for sequencing. Received cookie in L2TPv3 is reflected back. The AP can encode it's MAC address in 8-byte cookie. Based on configuration, the cookie can be ignored and just reflected back, or parsed to interpret AP-MAC from the least significant 6 bytes. Both L2TPv3 over IP and L2TPv3 over UDP encapsulation is supported. L2TPv3 tunnels are load-balanced from ingress IOMs to WLAN-GW IOMs based on source IP address. Figure 161 and Figure 162 shows these encapsulations with IPv6.

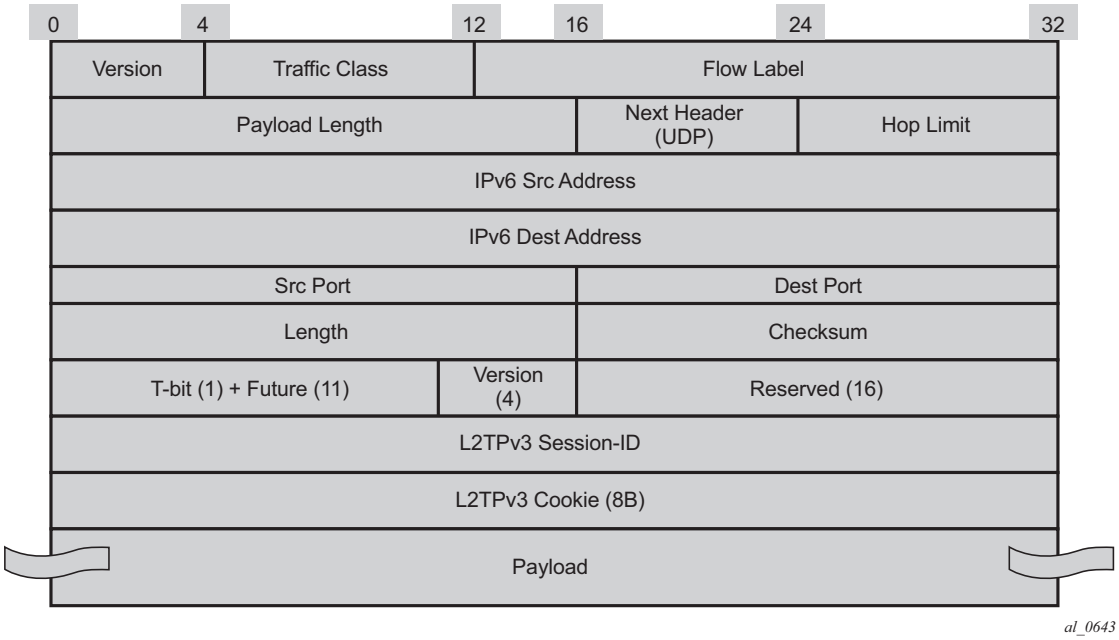


Figure 161: L2TPv3 over UDP (IPv6 Transport)

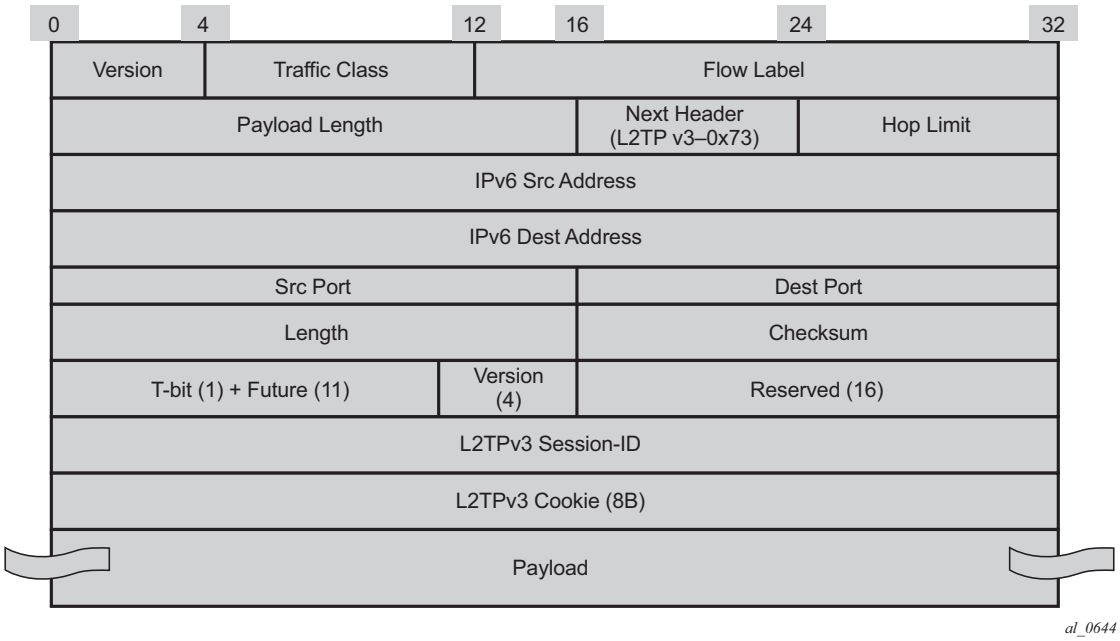


Figure 162: L2TPv3 over IP (IPv6 Transport)

Enabling multi-tunnel-type on a wlan-gw group-interface allows multiple tunnel types (such as soft-GRE and L2TPv3) to the same gateway tunnel endpoint. Mobility between APs reachable via soft-L2TPv3 tunnels and APs reachable via soft-GRE tunnels is supported. There is feature and scale parity between soft-GRE and soft-L2TPv3 tunnels. The local tunnel gateway endpoint and other configurations parameters are shown below.

```
A:Dut-C>config>service>vprn>sub-if>grp-if>wlan-gw# info
----------------------------------------------
                        gw-address 50.1.1.3
                        gw-ipv6-address 2032::1:1:3
                        mobility
                            arp-ap
                            hold-time 0
                            trigger data iapp
                        exit
                        tunnel-encaps
                            learn-l2tp-cookie always
                        exit
                        multi-tunnel-type
                        router 50
                        wlan-gw-group 1
                        no shutdown
----------------------------------------------
```

WiFi Command Reference

Configuration Commands

WLAN-GW Commands

Note that the **wlan-gw** commands apply only to the 7750 SR platform.

config
- — **subscriber-mgmt**
  - — **wlan-gw**
    - — **mgw-profile** *profile-name* [**create**]
    - — **no mgw-profile** *profile-name*
      - — **description** *description-string*
      - — **no description**
      - — **interface-type** {**gn**|**s2a**|**s2b**}
      - — **no interface-type**
      - — **ip-ttl** *hops*
      - — **no ip-ttl**
      - — **keep-alive** [**interval** *seconds*] [**retry-count** *value*] [**timeout** *retry-seconds*]
      - — **no keep-alive**
      - — **message-retransmit** [**timeout** *timeout*] [**retry-count** *value*]
      - — **no message-retransmit**
      - — **report-wlan-location**
      - — **no report-wlan-location**
      - — **signalling-protocol** *protocol*
      - — **no signalling-protocol**
    - — **serving-network mcc** *mcc-value* **mnc** *mnc-value*

— **no serving-network**

configure
— **router**
— **wlan-gw**
— **apn** *apn*
— **no apn**
— **mgw-map**
— **address** *ip-prefix*[/*prefix-length*] [**mgw-profile** *profile-name*]
— **no address** *ip-prefix*[/*prefix-length*]
— **mobility-triggered-acct**
— **interim-update**
— **no interim-update**

configure
— **service**
— **vprn**
— **wlan-gw**
— **apn** *apn*
— **no apn**
— **mgw-map**
— **address** *ip-prefix*[/*prefix-length*] [**mgw-profile** *profile-name*]
— **no address** *ip-prefix*[/*prefix-length*]
— **mobility-triggered-acct**
— **interim-update**
— **no interim-update**

WLAN-GW Service Commands

```
configure
    — service
        — vprn service-id/ies service-id
            — subscriber-interface ip-int-name
                — group-interface ip-int-name [create]
                — group-interface ip-int-name [create] lns
                — group-interface ip-int-name [create] wlangw
                — no group-interface ip-int-name
                    — ip-mtu octets
                    — no ip-mtu
                    — wlan-gw
                        — egress
                            — [no] agg-rate-limit
                                — hold-time infinite
                                — hold-time [1..86400]
                                — no hold-time
                                — qos policy-id
                                — no qos
                                — scheduler-policy scheduler-policy-name
                                — no scheduler-policy
                                — [no] shape-multi-client-only
                                — shaping {per-retailer|per-tunnel}
                                — no shaping
                        — gw-address ip-address
                        — no gw-address
                        — gw-ipv6-address ipv6-address
                        — no gw-ipv6-address
                        — l2-access-points
                            — l2-ap sap-id [create]
                            — no l2-ap sap-id
                                — encap-type {default|null|dot1q|qinq}
                                — no encap-type
                                — epipe-sap-template name
                                — no epipe-sap-template
                                — [no] shutdown
                        — l2-ap-encap-type {null|dot1q|qinq}
                        — no l2-ap-encap-type
                        — mobility
                            — arp-ap
                            — no arp-ap
                            — hold-time time in s
                            — no hold-time
                            — trigger [data] [iapp]
                            — no trigger
                        — [no] multi-tunnel-type
                        — [no] oper-down-on-group-degrade
                        — router router-instance
                        — no router
                        — [no] shutdown
                        — tcp-mss-adjust segment-size
                        — no tcp-mss-adjust
                        — tunnel-encaps
```

- learn-l2tp-cookie {if-match|never|always} [cookie *hex string*]
- no learn-l2tp-cookie

vlan-tag-ranges
- range start [0..4096] end [0..4096]
- range default
- no range start [0..4096] end [0..4096]
  - authenticate-on-dhcp
  - authentication
    - authentication-policy *policy-name*
    - no authentication-policy
    - hold-time [hrs *hours*] [min *minutes*] [sec *seconds*]
  - [no] data-triggered-ue-creation
  - dhcp
    - active-lease-time [hrs *hours*] [min *minutes*] [sec *seconds*]
    - no active-lease-time
    - initial-lease-time [hrs *hours*] [min *minutes*] [sec *seconds*]
    - no initial-lease-time
    - l2-aware-ip-address *ip-address*
    - no l2-aware-ip-address
    - primary-dns *ip-address*
    - no primary-dns
    - primary-nbns *ip-address*
    - no primary-nbns
    - secondary-dns *ip-address*
    - no secondary-dns
    - secondary-nbns *ip-address*
    - no secondary-nbns
    - [no] shutdown
  - distributed-sub-mgmt
    - accounting-policy *policy-name*
    - no accounting-policy
    - accounting-update-interval
    - accounting-update-interval [5..259200]
    - no accounting-update-interval
    - def-app-profile
    - def-app-profile *profile-name*
    - no def-app-profile
    - dsm-ip-filter
    - dsm-ip-filter *dsm-ip-filter-name*
    - no dsm-ip-filter
    - egress-policer
    - egress-policer [256 chars max]
    - no egress-policer
    - ingress-policer
    - ingress-policer *policer-name*
    - no ingress-policer
    - one-time-redirect
    - one-time-redirect url *rdr-url-string* port *port-num*
    - no one-time-redirect

```
                                    — [no] shutdown
                                — http-redirect-policy policy-name
                                — no http-redirect-policy
                                — l2-service service-id
                                — no l2-service
                                    — description description-string
                                    — no description
                                    — [no] shutdown
                                — nat-policy policy-name
                                — no nat-policy
                                — retail-svc-id service-id
                                — [no] track-mobility
                            — vlan start [0..4095] end [0..4095] retail-svc-id
                              service-id
                            — no vlan start [0..4095] end [0..4095]
                        — wlan-gw-group group-id
                        — no wlan-gw-group
                    — [no] shutdown
            — redundancy
                    — export ip-prefix/length
                    — no export
                    — monitor ip-prefix/length
                    — no monitor
                    — [no] shutdown

onfigure
    — service
            — vpls service-id
                    — vwlan-gw
                            — description description-string
                            — no description
                            — sap-template sap template
                            — no sap-template
                            — [no] shutdown
```

RADIUS Server and Proxy Commands

```
configure
    — aaa
        — acct-on-off-group group-name [create]
        — no acct-on-off-group group-name
            — description description-string
            — no description
        — radius-server-policy policy-name [create]
        — no radius-server-policy policy-name
            — accept-script-policy policy-name
            — no accept-script-policy
            — acct-on-off monitor-group group-name
            — acct-on-off oper-state-change [group group-name]
            — no acct-on-off
            — acct-request-script-policy policy-name
            — no acct-request-script-policy
            — auth-request-script-policy policy-name
            — no auth-request-script-policy
            — [no] buffering
                — acct-interim min min-val max max-val lifetime lifetime
                — no acct-interim
                — acct-stop min min-val max max-val lifetime lifetime
                — no acct-stop
            — description description-string
            — no description
            — servers
                — access-algorithm {direct | round-robin | hash-based}
                — no access-algorithm
                — hold-down-time [sec seconds] [min minutes]
                — no hold-down-time
                — ipv6-source-address ipv6-address
                — no ipv6-source-address
                — retry count
                — no retry
                — router router-instance
                — router service-name service-name
                — no router
                — server server-index name server-name
                — no server server-index
                — source-address ip-address
                — no source-address
                — timeout [sec seconds] [min minutes]
                — no timeout
```

```
configure
    — router
        — radius-server
            — server server-name [address ip-address] [secret key ] [hash|hash2]  [port port]
              [create]
            — no server server-name
                — [no] accept-coa
                — acct-port port
```

- [no] acct-port
- auth-port *port*
- [no] auth-port
- coa-script-policy *script-policy-name*
- no coa-script-policy
- description *description-string*
- no description
- pending-requests-limit *limit*
- no pending-requests-limit

configure
- router
  - radius-proxy
    - server *server-name* [create] [purpose {[accounting | authentication]}] [wlan-gw-group *group-id*]
    - no server *server-name*
      - cache
        - key packet-type {accept|request} attribute-type *attribute-type* [vendor *vendor-id*]
        - no key
        - [no] shutdown
        - timeout [hrs *hours*] [min *minutes*] [sec *seconds*]
        - no timeout
        - track-accounting [start] [stop] [interim-update] [accounting-on] [accounting-off]
        - no track-accounting
        - track-authentication [accept]
        - no track-authentication
        - track-delete-hold-time *seconds*
        - no track-delete-hold-time
      - default-accounting-server-policy *policy-name*
      - no default-accounting-server-policy
      - default-authentication-server-policy *policy-name*
      - no default-authentication-server-policy
      - description *description-string*
      - no description
      - [no] interface *interface-name*
      - load-balance-key [vendor *vendor-id* [*vendor-id*...(upto 5 max)]] attribute-type *attribute-type* [*attribute-type*...(upto 5 max)]
      - load-balance-key source-ip-udp
      - no load-balance-key
      - python-policy *name*
      - no python-policy
      - secret *secret* [hash|hash2]
      - no secret
      - [no] send-accounting-response
      - [no] shutdown

configure
- service
  - vprn
    - radius-proxy

- **server** *server-name* [**create**] [**purpose** {[**accounting** | **authentication**]}] [**wlan-gw-group** *group-id*]
- **no server** *server-name*
  - [**no**] **accept-coa**
  - **acct-port** *port*
  - **no acct-port**
  - **auth-port** *port*
  - **no auth-port**
  - **cache**
    - **key packet-type** {**accept**|**request**} **attribute-type** *attribute-type* [**vendor** *vendor-id*]
    - **no key**
    - [**no**] **shutdown**
    - **timeout** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
    - **no timeout**
    - **track-accounting** [**stop**] [**interim-update**] [**accounting-on**] [**accounting-off**]
    - **no track-accounting**
  - **coa-script-policy** *script-policy-name*
  - **no coa-script-policy**
  - **default-accounting-server-policy** *policy-name*
  - **no default-accounting-server-policy**
  - **default-authentication-server-policy** *policy-name*
  - **no default-authentication-server-policy**
  - **description** *description-string*
  - **no description**
  - [**no**] **interface** *interface-name*
  - **load-balance-key** [**vendor** *vendor-id* [*vendor-id*...(upto 5 max)]] **attribute-type** *attribute-type* [*attribute-type*...(upto 5 max)]
  - **load-balance-key source-ip-udp**
  - **no load-balance-key**
  - **pending-requests-limit** *limit*
  - **no pending-requests-limit**
  - **secret** *secret* [**hash**|**hash2**]
  - **no secret**
  - [**no**] **send-accounting-response**
  - [**no**]**shutdown**
  - **username** [1..32] [**prefix-string** *prefix-string*] [**accounting-server-policy** *policy-name*] [**suffix-string** *suffix-string*]
  - **no username** [1..32]

LUDB Matching for RADIUS Proxy Cache

```
config
    — subscriber-mgmt
        — local-user-db local-user-db-name [create]
        — no local-user-db local-user-db-name
            — dhcp
                — host
                    — match-radius-proxy-cache
                        — fail-action {continue | drop}
                        — no fail-action
                        — mac-format mac-format
                        — no mac-format
                        — match {circuit-id|mac|remote-id}
                        — match option [1..254]
                        — no match
                        — server [service service-id] name server-name
                        — no server
```

Data Plane Related Commands

```
config
    — isa
        — wlan-gw-group wlan-gw-group-id [create]
        — no wlan-gw-group wlan-gw-group-id
            — active-iom-limit number
            — no active-iom-limit
            — description description-string
            — no description
            — [no] distributed-sub-mgmt
                — isa-aa-group aa-group-id
                — no isa-aa-group
            — iom slot-number
            — no iom
            — nat
                — radius-accounting-policy nat-accounting-policy
                — no radius-accounting-policy
                — session-limits
                    — reserved num-sessions
                    — no reserved
                    — watermarks high percentage low percentage
                    — no watermarks
            — [no] description
```

Port Policy Commands

config
- **port-policy** *policy-name* [**create**]
- **no port-policy** *policy-name*
  - **description** *description-string*
  - **no description**
  - **egress-scheduler-policy** *port-sched-plcy*
  - **no egress-scheduler-policy**

WIFI Aggregation and Offload – Migrant User Support Commands

```
configure
    — subscriber-mgmt
        — http-redirect-policy policy-name [create]
        — no http-redirect-policy policy-name
            — description description-string
            — no description
            — dst-port tcp-port
            — no dst-port
            — forward-entries
                — [no] dst-ip ip-address protocol ip-protocol dst-port port-number
            — portal-hold-time seconds
            — no portal-hold-time
            — url rdr-url-string
            — no url
```

Distributed Subscriber Management Commands

```
config
    — service
        — vprn service-id/ies service-id
            — subscriber-inteface
                — group-interface ip-int-name [create]
                — group-interface ip-int-name [create] lns
                — group-interface ip-int-name [create] wlangw
                — no group-interface ip-int-name
                    — wlan-gw
                        — vlan-tag-ranges
                            — range start [0..4096] end [0..4096]
                            — range default
                            — no range start [0..4096] end [0..4096]
                            — distributed-sub-mgmt
                                — accounting-policy policy-name
                                — no accounting-policy
                                — accounting-update-interval
                                — accounting-update-interval
                                  [5..259200]
                                — no accounting-update-interval
                                — def-app-profile
                                — def-app-profile profile-name
                                — no def-app-profile
                                — dsm-ip-filter
                                — dsm-ip-filter dsm-ip-filter-name
                                — no dsm-ip-filter
                                — egress-policer
                                — egress-policer [256 chars max]
                                — no egress-policer
                                — ingress-policer
                                — ingress-policer policer-name
                                — no ingress-policer
                                — one-time-redirect
                                — one-time-redirect url rdr-url-string
                                  port port-num
                                — no one-time-redirect
                                — [no] shutdown
```

Show Commands

```
show
    — router
        — radius-proxy-server server-name
        — radius-proxy-server server-name cache
        — radius-proxy-server server-name cache hex-key hex-string
        — radius-proxy-server server-name cache string-key string
        — radius-proxy-server server-name cache summary
        — radius-proxy-server server-name statistics
        — radius-proxy-server
        — wlan-gw
            — mgw-address-cache [arec] [snaptr] [srv]
            — mgw-address-cache apn apn-domain-string
            — mgw-map
            — mobile-gateway [mgw-profile profile-name] [local-address ip-address] [control protocol] [interface-type interface-type]
            — mobile-gateway remote-address ip-address [udp-port port]
            — mobile-gateway remote-address ip-address [udp-port port] statistics
            — soft-gre-tunnel-qos [detail]
            — soft-gre-tunnel-qos remote-ip ip-address [local-ip ip-address] [detail]
            — soft-gre-tunnels local-ip ip-address remote-ip ip-address ue
            — soft-gre-tunnels [local-ip ip-address] [remote-ip ip-address] [isa-group wlan-gw-group-id] [member [1..255]] [summary] [detail]
            — soft-gre-tunnels local-ip ip-address remote-ip ip-address ue
            — tunnels [local-ipip-address] [remote-ip ip-address] [isa-group wlan-gw-group-id] [member [1..255]] [summary] [detail]
            — tunnels local-ip ip-address remote-ip ip-address ue

show
    — aaa
        — acct-on-off-group group-name
        — radius-server-policy policy-name [acct-on-off]
        — radius-server-policy policy-name associations
        — radius-server-policy policy-name msg-buffer-stats
        — radius-server-policy policy-name statistics
        — radius-server-policy [acct-on-off]

show
    — isa
        — wlan-gw-group wlan-gw-group-id
        — wlan-gw-group wlan-gw-group-id associations
        — wlan-gw-group wlan-gw-group-id member [1..255] [statistics]
        — wlan-gw-group

show
    — subscriber-mgmt
        — wlan-gw
            — gtp-session imsi imsi apn apn-string
```

— **gtp-session** [**mgw-address** *ip-address*] [**mgw-router** *router-instance*] [**remote-control-teid** *teid*] [**local-control-teid** *teid*] [**detail**]
— **gtp-session** **imsi** *imsi*
— **gtp-statistics**
— **mgw-profile** *profile-name*
— **mgw-profile** *profile-name* **associations**
— **mgw-profile**
— **ssid**
— **statistics**
— **ue** [**vlan** *qtag*] [**mpls-label** *label*] [**retail-svc-id** *service-id*] [**ssid** *service-set-id*] [**previous-access-point** *ip-address*]
— **ue** **mac** *ieee-address*

Tools Commands

tools
- — **perfrom**
  - — **aaa**
    - — **acct-on** [**radius-server-policy** *policy-name*] [**force**]
    - — **acct-off** **acct-off** [**radius-server-policy** *policy-name*] [**force**] [**acct-terminate-cause** *number*]
  - — **dump**
    - — **aaa**
      - — **radius-server-policy** *policy-name* **msg-buffer** [**session-id** *acct-session-id*]]
    - — **wlan-gw**
      - — **ue**

Clear Commands

clear
- — **aaa**
  - — **radius-server-policy** *policy-name* **msg-buffer** [**acct-session-id** *acct-session-id*]
  - — **radius-server-policy** *policy-name* **statistics** [**msg-buffer-only**]
  - — **radius-server-policy** *policy-name* **server** *server-index* **statistics**

Generic Commands

description

Syntax **description** *description-string*
no description

Context config>aaa>acct-on-off-grp
config>aaa>radius-server-policy
config>isa>wlan-gw-group
config>router>radius-server>server
config>router>radius-proxy>server
config>service>vprn>radius-proxy>server
config>service>vprn>radius-server>server
config>subscr-mgmt>wlan-gw>mgw-profile
config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the context in the configuration file.

The **no** form of this command removes any description string from the context.

Default No description is associated with the configuration context.

Parameters *description-string* — A text string describing the entity. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

shutdown

Syntax [**no**] **shutdown**

Context config>router>radius-proxy>cache
config>router>radius-proxy>server>cache
config>router>radius-proxy>server
config>service>vprn>radius-proxy>server>cache
config>service>vprn>radius-proxy>server
config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface>group-interface>wlan-gw

Description The **shutdown** command administratively disables the entity. When disabled, an entity does not change, reset, or remove any configuration settings or statistics. Many entities must be explicitly enabled using the **no shutdown** command.

The **shutdown** command administratively disables an entity. The operational state of the entity is disabled as well as the operational state of any entities contained within. Many objects must be shut down before they can be deleted.

Unlike other commands and parameters where the default state is not indicated in the configuration file, **shutdown** and **no shutdown** are always indicated in system generated configuration files.

The **no** form of the command puts an entity into the administratively enabled state.

Default no shutdown

subscriber-mgmt

Syntax **subscriber-mgmt**

Context config

Description This command enables the context to configure subscriber management entities. A subscriber is uniquely identified by a subscriber identification string. Each subscriber can have several DHCP sessions active at any time. Each session is referred to as a subscriber host and is identified by its IP address and MAC address.

All subscriber hosts belonging to the same subscriber are subject to the same hierarchical QoS (HQoS) processing. The HQoS processing is defined in the sub-profile (the subscriber profile). A sub-profile refers to an existing scheduler policy (configured in **the configure>qos>scheduler-policy** context) and offers the possibility to overrule the rate of individual schedulers within this policy.

Because all subscriber hosts use the same scheduler policy instance, they must all reside on the same complex.

WLAN-GW Commands

Note that the **wlan-gw** commands apply only to the 7750 SR platform.

wlan-gw

Syntax [**no**] **wlan-gw**

Context config>subscriber-mgmt
config>router
config>service>vprn

Description This command enables the context to configure WLAN Gateway parameters.

mgw-profile

Syntax **mgw-profile** *profile-name* [**create**]
no mgw-profile *profile-name*

Context config>subscr-mgmt>wlan-gw

Description This command creates a new mobile gateway profile or configures an existing mobile gateway profile.

Mobile gateway profile is used to configure signaling interface between WLAN-GW and mobile gateway (PGW or GGSN) and GTP related signaling parameters per mobile gateway.

.The **no** form of the command removes the profile name from the configuration.

Default none

Parameters *profile-name* — Specifies theMobile Gateway profile up to 32 characters in length.

create — Keyword used to create a profile name. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

interface-type

Syntax **interface-type** {**gn**|**s2a**|**s2b**}
no interface-type

Context config>subscriber-mgmt>wlan-gw >mgw-profile

Description This command specifies the signaling interface between WLAN-GW and mobile gateway (PGW or GGSN).

Default s2a

Parameters **gn —** Signaling interface between wlan-gw and mobile gateway is Gn as specified in 3GPP TS 29.060.

S2a — Signaling interface between wlan-gw and mobile gateway is S2a as specified in SAMOG.

S2b — Signaling interface between wlan-gw and mobile gateway is S2b as specified in 3GPP TS 29.274.

ip-ttl

Syntax **ip-ttl** *hops*
no ip-ttl

Context config>subscr-mgmt>wlan-gw>mgw-profile

Description This command configures the value to put in the IP header's TTL field for GTP control messages.

The **no** form of the command reverts to the default value.

Default 255

Parameters *hops* — Specifies the the IP TTL.

Values 1 — 255

keep-alive

Syntax **keep-alive** [**interval** *seconds*] [**retry-count** *value*] [**timeout** *retry-seconds*]
no keep-alive

Context config>subscr-mgmt>wlan-gw>mgw-profile

Description This command configures the context in radius-server-policy.

The **no** form of the command reverts to the default values.

Default keep-alive interval 60 seconds, retry-count 5, timeout 5 seconds

Parameters **interval** *seconds* **—** Specifies, in seconds, the interval between keep-alive Echo-Request messages towards the same peer.

Values 0, 60 — 180

Default 60

retry-count *value* **—** Specifies, in seconds, the interval between keep-alive Echo-Request messages towards the same peer.

Values 1 — 15

Default 4

timeout *retry-seconds* **—** Specifies the retry timeout, in seconds.

Values 1 — 20

Default 5

message-retransmit

Syntax **message-retransmit** [**timeout** *timeout*] [**retry-count** *value*]
no message-retransmit

Context config>subscr-mgmt>wlan-gw>mgw-profile

Description This command configures the retry-count and response-timeout for GTP messages.

The **no** form of the command reverts to the default values.

Default timeout 5 seconds, value 3

Parameters **timeout** *timeout* — specifies, in seconds, the interval between retransmission of signalling request messages towards the same peer Mobile Gateway.

Values 1 — 30

Default 5

retry-count *value* — specifies the number of times a signalling request message is transmitted towards the same peer.

Values 1 — 8

Default 3

report-wlan-location

report-wlan-location
no report-wlan-location

Context config>subscr-mgmt>wlan-gw>mgw-profile

Description This command enables reporting the WLAN location or cellular location of the UE in the signaling interface (S2a or Gn) between wlan-gw and mobile gateway (PGW or GGSN).

The **no** form of the command disables location reporting.

Default not enabled

signalling-protocol

signalling-protocol *protocol*
no signalling-protocol

Context config>subscr-mgmt>wlan-gw>mgw-profile

Description This command specifies the GTP (GPRS Tunneling Protocol) control protocol.

The **no** form of the command reverts to the default value.

Default gtpv1C

Parameters *protocol* — Specifies the the GTP control protocol variant.

Values gtpv1-c, gtpv2-c, gtp-auto

serving-network

Syntax **serving-network mcc** *mcc-value* **mnc** *mnc-value*
no serving-network

Context config>subscr-mgmt>wlan-gw>mgw-profile

Description This command configures the Operator Identifier part (MCC and MNC) of the APN.

The **no** form of the command removes the values from the profile.

Default no serving-network

Parameters **mcc** mcc-value — specifies the Mobile Country Code (MCC) portion of the Serving Network.

Values 2 digits

mnc *mnc-value* — specifies the Mobile Network Code (MNC) portion of the Serving Network.

Values 2 or 3 digits

apn

Syntax **apn** *apn*
no apn

Context config>router>wlan-gw
configure>service>vprn>wlan-gw

Description This command configures the Network Identifier part of the APN.

The **no** form of the command removes the string from the configuration.

Default no apn

Parameters *apn* — Specifies the APN (Access Point Name) used for this IMSI to connect to this Mobile Gateway up to 80 characters in length.

mgw-map

Syntax **mgw-map** *ip-prefix* [*/prefix-length*] **mgw-profile** *profile-name*
no mgw-map

Context config>router>wlan-gw
configure>service>vprn>wlan-gw

Description This command configures the mappings of MGW IP address and GTP profile.

Parameters *ip-prefix*[*/prefix-length*] — Specifies the IP prefix and prefix length.

Values ip-prefix a.b.c.d (host bits must be 0)
length [0..32]

profile-name — specifies the profile associated with this address prefix.

Values 32 characters max

address

Syntax **address** *ip-prefix*[*/prefix-length*] [**mgw-profile** *profile-name*]
no address *ip-prefix*[*/prefix-length*]

Context config>router>wlan-gw>mgw-map
configure>service>vprn>wlan-gw>mgw-map

Description This command specifies the address .

The **no** form of the command removes the parameters form the configuration.

ip-prefix[/prefix-length — Specifies the IP prefix and prefix length of the subnet.

Values ip-prefix[/prefix-length ip-prefix a.b.c.d (host bits must be 0)
length [0..32]

mgw-profile *profile-name* — specifies the Mobile Gateway profile associated with this address prefix up to 32 characters in length.

mobility-triggered-acct

Syntax **mobility-triggered-acct**

Context config>router>wlan-gw
configure>service>vprn>wlan-gw

Description This command enters the configuration context of mobility-triggered-accounting in wlan-gw context under router or VPRN service.

Default none

interim-update

Syntax **interim-update**
no interim-update

Context config>router>wlan-gw>mobility-triggered-acct
configure>service>vprn>wlan-gw>mobility-triggered-acct

Description This command enables generation of a flash interim accounting-update to the accounting service when change in location of the UE is detected.

The **no** form of the command disables generation of flash interim accounting- update to RADIUS when change in location of the UE is detected.

Default Not enabled

RADIUS Server Policy Commands

acct-on-off-group

Syntax **acct-on-off-group** *group-name* [**create**]
no acct-on-off-group *group-name*

Context config>aaa

Description This command creates an acct-on-off-group.

An acct-on-off-group can be referenced by:

- A single radius-server-policy as controller — The acct-on-off oper-state of the acct-on-off-group is set to the acct-on-off oper-state of the radius-server-policy (acts as master).
- Multiple radius-server-policies as monitor — The acct-on-off oper-state of the radius-server-policy is inherited from the acct-on-off oper-state of the acct-on-off group. (acts as a slave).

The **no** form of the command deletes the acct-on-off-group.

Default none

Parameters *group-name* — Specifies the name of an acct-on-off group up to 32 characters in length.

radius-server-policy

Syntax **radius-server-policy** *policy-name* [**create**]
no radius-server-policy *policy-name*

Context config>aaa

Description This command creates a radius-server-policy.

A radius-server-policy can be used in

- radius-proxy, for application like EAP authentication for WIFI access
- authentication policy, for Enhanced Subscriber Management authentication
- radius accounting policy, for Enhanced Subscriber Management accounting
- dynamic data service RADIUS accounting
- AAA route downloader

The **no** form of the command removes the policy name from the configuration.

Default none

Parameters *policy-name* — Specifies the name of the radius-server-policy up to 32 characters in length.

create — Keyword used to create a radius-server-policy name. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

accept-script-policy

Syntax **accept-script-policy** *policy-name*
no accept-script-policy

Context config>aaa>radius-server-policy

Description This command specifies name of the radius-script-policy to be applied for access-accept.

Default none

Parameters *policy-name* — Specifies the name of the accept-script-policy up to 32 characters in length.

acct-on-off

Syntax **acct-on-off**
acct-on-off monitor-group *group-name*
acct-on-off oper-state-change [group *group-name***]**

Context config>aaa>radius-server-policy

Description This command controls the sending of Accounting-On and Accounting-Off messages and the acct-on-off oper-state of the radius-server-policy:

acct-on-off: enables the sending of Accounting-On and Accounting-Off messages for this radius-server-policy. The acct-on-off oper-state is always not blocked.

acct-on-off oper-state-change [group *group-name*]: enables the sending of Accounting-On and Accounting-Off messages for this radius-server-policy. The acct-on-off oper-state is function of the Accounting-response received for the Accounting-On and Accounting-Off. Optionally, sets the acct-on-off oper-state of the acct-on-off-group.

acct-on-off monitor-group *group-name*: no Accounting-On and Accounting-Off messages are sent for this radius-server-policy. The acct-on-off oper-state is inherited from the acct-on-off-group.

The **no** form of the command disables the sending of Accounting-On and Accounting-Off messages.

Default no acct-on-off

Parameters *group-name* — Specifies the name of an acct-on-off group up to 32 characters in length.

acct-on-off-group

Syntax **acct-on-off-group <group-name> [create]**
no acct-on-off-group <group-name>]

Context config>aaa

Description This command creates an acct-on-off-group.

An acct-on-off-group can be referenced by:

-a single **radius-server-policy** as controller: the **acct-on-off oper-state** of the **acct-on-off-group** is set to the **acct-on-off oper-state** of the **radius-server-policy** (acts as master)

-multiple **radius-server-policies** as monitor: the **acct-on-off oper-state** of the **radius-server-policy** is inherited from the **acct-on-off oper-state** of the **acct-on-off group**. (acts as a slave)

The **no** form of the command deletes the acct-on-off-group.

Default none

Parameters *group-name* — Specifies the name of an acct-on-off group up to 32 characters in length.

acct-request-script-policy

Syntax **acct-request-script-policy** *policy-name*
no acct-request-script-policy

Context config>aaa>radius-server-policy

Description This command specifies the name of the acct-request-script-policy pointing to the Python script to be applied for RADIUS accounting request messages.

Default no acct-request-script-policy

Parameters *policy-name* — Specifies the name of the acct-request-script-policy up to 32 characters in length.

auth-request-script-policy

Syntax **uth-request-script-policy** *policy-name*
no auth-request-script-policy

Context config>aaa>radius-server-policy

Description This command specifies the name of the auth-request-script-policy pointing to the Python script to be applied for RADIUS access request messages.

Default no auth-request-script-policy

Parameters *policy-name* — Specifies the name of the auth-request-script-policy up to 32 characters in length.

buffering

Syntax **[no] buffering**

Context config>aaa>radius-server-policy

Description This command enables the context to configure RADIUS message buffering.

The **no** form of the command disables RADIUS message buffering.

Default none

acct-interim

Syntax **acct-interim min** *min-val* **max** *max-val* **lifetime** *lifetime*
no acct-interim

Context config>aaa>radius-srv-plcy>servers>buffering

Description This command enables RADIUS accounting interim update message buffering.

1- The message is stored in the buffer, a lifetime timer is started and the message is sent to the RADIUS server

2- If after retry*timeout seconds no RADIUS accounting response is received for the interim update then a new attempt to send the message is started after minimum[(min-val*2n), max-val] seconds.

3- Repeat step 2 until for one of the following:

a. a RADIUS accounting response is received.

b. the lifetime of the buffered message expires.

c. a new RADIUS accounting interim-update or a RADIUS accounting stop for the same accounting session-id and radius-server-policy is stored in the buffer.

d. the message is manually purged from the message buffer via a clear command.

4- The message is purged from the buffer.

The **no** form of the command disables RADIUS accounting interim update message buffering.

Default no acct-interim

Parameters *min-val* — Specifies the minimum interval in seconds between attempts to resend the RADIUS accounting interim update

Values 1 – 3600

max-val — Specifies the maximum interval in seconds between attempts to resend the RADIUS accounting interim update

Values 1 – 3600

lifetime — Specifies the lifetime in hours

Values 1 – 25

acct-stop

Syntax **acct-stop min** *min-val* **max** *max-val* **lifetime** *lifetime*
no acct-stop

Context config>aaa>radius-srv-plcy>servers>buffering

Description This command enables RADIUS accounting stop message buffering.

1- The message is stored in the buffer, a lifetime timer is started and the message is sent to the RADIUS server

2 - If after retry*timeout seconds no RADIUS accounting response is received for the accounting stop, then a new attempt to send the message is started after minimum[(min-val*2n), max-val] seconds.

3 - Repeat step 2 until

a. a RADIUS accounting response is received, or

b. the lifetime of the buffered message expires, or

c. the message is manually purged from the message buffer via a clear command

4 - The message is purged from the buffer.

The no form of the command disables RADIUS accounting stop message buffering..

Default no acct-interim

Parameters *min-val* — Secifies the minimum interval in seconds between attempts to resend the RADIUS accounting stop

Values 1 – 3600

max-val — Specifies the maximum interval in seconds between attempts to resend the RADIUS accounting stop.

Values 1 – 3600

max-val — Specifies the lifetime in hours.

Values 1 – 25

servers

Syntax **servers**

Context config>aaa>radius-server-policy

Description This command enables the context to configure radius-server-policy parameters.

access-algorithm

Syntax **access-algorithm** {**direct**|**round-robin**|**hash-based**}
no access-algorithm

Context config>aaa>radius-server-policy>servers

Description This command configures the algorithm used to select a RADIUS server from the pool of configured RADIUS servers.

Default direct

Parameters **direct —** Specifies that the first server will be used as primary server for all requests, the second as secondary and so on.

round-robin — Specifies that the first server will be used as primary server for the first request, the second server as primary for the second request, and so on. If the router gets to the end of the list, it starts again with the first server.

hash-based — Select a RADIUS server based on the calculated hash result of the configured load-balance-key under the radius-proxy server hierarchy. This parameter is only applicable for radius-proxy server scenarios and results in an unpredictable RADIUS server selection if used in other scenarios.

retry

Syntax **retry** *count*
no retry

Context config>aaa>radius-srv-plcy>servers

Description This command configures the number of times the router attempts to contact the RADIUS server, if not successful the first time.

Default 3

Parameters *count* — Specifies the number of times a signalling request message is transmitted towards the same peer.

Values 1 — 256

router

Syntax **router** *router-instance*
router service-name *service-name*
no router

Context config>aaa>radius-server-policy>servers

Description This command specifies the virtual router instance applicable for the set of configured RADIUS servers. This value cannot be changed once a RADIUS server is configured for this policy.

Default no router

Parameters *router-instance* — Specifies the router instance.

Values

service-name	Service name up to 64 characters.	
	router-instance:	router-name, service-id
	router-name:	Base, management
	service-id:	1 — 2147483647

service-name — Specifies the router name service-id up to 64 characters.

server

Syntax **server** *server-index* **name** *server-name*
no server *server-index*

Context config>aaa>radius-server-policy>servers

Description This command adds a RADIUS server.

The **no** form of the command removes a RADIUS server.

Default none

Parameters *index* — The index for the RADIUS server. The index determines the sequence in which the servers are queried for authentication requests. Servers are queried in order from lowest to highest index.

Values 1 — 5

server-name — Specifies the server name up to 32 characters in length.

source-address

Syntax **source-address** *ip-address*
no source-address

Context config>aaa>radius-server-policy>servers

Description This command configures the source address of the RADIUS packet. The system IP address must be configured in order for the RADIUS client to work. See Configuring a System Interface in the 7750 SR OS Router Configuration Guide. Note that the system IP address must only be configured if the source-address is not specified. When the no source-address command is executed, the source address is determined at the moment the request is sent. This address is also used in the nas-ip-address attribute: over there it is set to the system IP address if no source-address was given.

The no form of the command reverts to the default value.

Default no source-address

Parameters *ip-address* — Specifies the source address of radius packet.

timeout

Syntax **timeout** [**sec** *seconds*] [**min** *minutes*]
no timeout

Context config>aaa>radius-srv-plcy>servers

Description This command configures the time the router waits for a response from a RADIUS server.

The no form of the command reverts to the default value.

Default 5 seconds

Parameters *seconds* — Specifies the number of seconds for the timeout.

Values 1 — 59

minutes — Specifies the number of minutes for the timeout.

Values 1 — 1

Values Max. value = 5 min 40 sec

hold-down-time

Syntax **hold-down-time** [**sec** *seconds*] [**min** *minutes*]
no hold-down-time

Context config>aaa>radius-server-policy>servers

Description This command configures the hold time before re-using a RADIUS server.

The **no** form of the command reverts to the default value.

Default 30 seconds

Parameters *seconds* — Specifies the number of seconds for the hold down time.

Values 1 — 59

minutes — Specifies the number of minutes for the hold down time.

Values 1 — 15

ipv6-source-address

Syntax **ipv6-source-address** *ipv6-address*
no ipv6-source-address

Context config>aaa>radius-server-policy>servers

Description This command configures the source address of an IPv6 RADIUS packet.

When no ipv6-source-address is configured, the system IPv6 address (inband RADIUS server connection) or Boot Option File (BOF) IPv6 address (outband RADIUS server connection) must be configured in order for the RADIUS client to work with an IPv6 RADIUS server.

This address is also used in the NAS-IPv6-Address attribute.

The **no** form of the command reverts to the default value.

Default no ipv6-source-address

Parameters *ipv6-address* — Specifies the source address of an IPv6 RADIUS packet.

CLI Command Description for RADIUS Server

radius-server

Syntax **radius-server**

Context config>router
config>service>vprn

Description This command enters the radius-server configuration context under router or VPRN service.

Default none

server

Syntax **server** *server-name* [**address** *ip-address*] [**secret** *key*][**hash**|**hash2**][**create**]
no server *server-name*

Context config>router>radius-server
config>service>vprn>radius-server

Description This command either specifies an external RADIUS server in the corresponding routing instance or enters configuration context of an existing server. The configured server could be referenced in the radius-server-policy.

The **no** form of the command removes the parameters from the server configuration.

Default no

Parameters *server-name* — Specifies the name of the external RADIUS server

address *ip-address* **—** Specifies the IPv4 or IPv6 IP address of the external RADIUS server.

secret *key* **—** Specifies the shared secret key of the external RADIUS server

hash — Specifies the hash scheme.

accept-coa

Syntax [**no**] **accept-coa**

Context config>router>radius-server>server
config>service>vprn>radius-server>server

Description This command configures this server for Change of Authorization messages. The system will process the CoA request from the external server if configured with this command; otherwise the CoA request will be dropped.

The **no** form of the command disables the command.

acct-port

Syntax **acct-port** *port*
no acct-port

Context config>router>radius-server>server
config>service>vprn>radius-server>server

Description This command specifies the UDP listening port for RADIUS accounting requests.

The **no** form of the commands resets the UDP port to its default value (1813)

Default acct-port 1813

Parameters *port* — Specifies the UDP listening port for accounting requests of the external RADIUS server.

Values 1 — 65535

auth-port

Syntax **auth-port** *port*
no auth-port

Context config>router>radius-server>server
config>service>vprn>radius-server>server

Description This command specifies the UDP listening port for RADIUS authentication requests.

The **no** form of the commands resets the UDP port to its default value (1812)

Default auth-port 1812

Parameters *port* — Specifies the UDP listening port for accounting requests of the external RADIUS server.

Values 1 — 65535

coa-script-policy

Syntax **coa-script-policy** *policy-name*
no coa-script-policy

Context config>router>radius-server>server
config>service>vprn>radius-server>server

Description This command specifies radius-script-policy for CoA-Request sent from this RADIUS server.

The **no** form of the command removes the policy name from the configuration.

Default none

Parameters *policy-name* — Specifies the name of radius-script-policy up to 80 characters in length.

pending-requests-limit

Syntax **pending-request-limit** *limit*
no pending-request-limit

Context config>router>radius-server>server
config>service>vprn>radius-server>server

Description This command specifies the per-server maximum number of outstanding requests sent to the RADIUS server. If the maximum number is exceeded, the next RADIUS server in the pool is selected.

The **no** form of the command removes the limit value from the configuration.

Default none

Parameters *limit* — Specifies the maximum number of outstanding requests sent to the RADIUS server

Values 1 — 4096

CLI Command Description for RADIUS Proxy Server

radius-proxy

Syntax **radius-proxy**

Context config>router
config>service>vprn

Description This command context to configure RADIUS proxy parameters.

server

Syntax **server** *server-name* [**create**] [**purpose** {[**accounting** | **authentication**]}] [**wlan-gw-group** *group-id*]
no server *server-name*

Context config>router>radius-proxy
config>service>vprn>radius-proxy

Description This command creates a RADIUS-proxy server in the corresponding routing instance. The proxy server can be configured for the purpose of proxying authentication or accounting or both.

If wlan-gw isa group is specified, then the RADIUS proxy server is instantiated on the set of ISAs in the specified wlan-gw group. The RADIUS messages from the AP are load-balanced to these ISAs. The ISA that processes the RADIUS message then hashes this message to the ISA that anchors the UE. The hash is based on UE MAC address (required to be present in the calling-station-id attribute) in the RADIUS message.

If the **create** parameter is not specified, then this command enters configuration context of the specified RADIUS-proxy server.

The no form of the command removes the server-name and parameters from the radius-proxy configuration.

Default purpose authentication

Parameters *server-name* — Specifies the name of the RADIUS-proxy server.

create — The creation parameter. The system will create the specified RADUIS-proxy server.

purpose — Specifies the purpose the RADIUS-proxy server,

Values accounting — proxy accounting packets.
authentication — proxy authentication packets .
both — Specifies both accounting and authentication proxy accounting packets.

wlan-gw-group *group-id* **—** Specifies the WLAN-GW isa group.

interface

Syntax [**no**] **interface** *ip-int-name*

Context config>router>radius-proxy>server
config>service>vprn>radius-proxy>server

Description This command configures the IP interface the RADIUS-proxy server will bind to. One RADIUS-proxy server could bind to multiple interfaces.

Default none

Parameters *ip-int-name* — Specifies the name of IP interface.

load-balance-key

Syntax **load-balance-key** [**vendor** *vendor-id* [*vendor-id*...(up to 5 max)]] **attribute-type** *attribute-type* [*attribute-type*...(up to 5 max)]
load-balance-key source-ip-udp
no load-balance-key

Context config>router>radius-proxy>server
config>service>vprn>radius-proxy>server

Description This command specifies the key(s) used in calculating a hash to select an external RADIUS server from the pool of configured servers.

The key(s) can be the source ip and source udp port tuple, or the specified radius attribute(s) in radius packets.

The **no** form of the command removes the parameters from the configuration.

Default no load-balance-key

Parameters **vendor** *vendor-id* **—** Specifies the vendor-id of vendor-specific attribute.

Values 0 — 16777215

attribute-type attribute-type **—** Specifies that the key is constructed with the attributes in the RADIUS message.

Values 1 — 255

source-ip-udp — Specifies that the key consists of the source IP address and source UDP port of the RADIUS message.

python-policy

Syntax **python-policy** *name*
no python-policy

Context config>router>radius-proxy>server

Description This command specifies the Python policy used to change the RADIUS attributes of the different RADIUS messages.

secret

Syntax **secret** *secret* [**hash**|**hash2**]
no secret

Context config>router>radius-proxy>server
config>service>vprn>radius-proxy>server

Description This command configures the shared secret key. The RADIUS client must have the same key to communicate with the RADIUS-proxy server.

The **no** form of the command removes the parameters from the configuration.

Default none

Parameters **secret** *key* — The secret key to access the RADIUS server. This secret key must match the password on the RADIUS server.

Values secret-key: Up to 20 characters in length.
hash-key: Up to 33 characters in length.
hash2-ke: Up to 55 characters in length.

hash — Specifies the key is entered in an encrypted form. If the **hash** parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form. If the **hash2** parameter is not used, the less encrypted **hash** form is assumed.

default-accounting-server-policy

Syntax **default-accounting-server-policy** *policy-name*
no default-accounting-server-policy

Context config>router>radius-proxy>server
config>service>vprn>radius-proxy>server

Description This command specifies the default radius-server-policy for RADIUS accounting. This policy will be used when there is no specific match based on username.

The **no** form of the command removes the policy name from the configuration.

Default none

Parameters *policy-name* — Specifies the name of the default RADIUS server policy associated with this RADIUS Proxy server for accounting purposes.

default-authentication-server-policy

Syntax **default-authentication-server-policy** *policy-name*
no default-authentication-server-policy

Context config>router>radius-proxy>server
config>service>vprn>radius-proxy>server

Description This command specifies the default radius-server-policy for RADIUS authentication. This policy will be used when there is no specific match based on username.

The **no** form of the command removes the policy name from the configuration.

Default none

Parameters *policy-name* — Specifies the name of the default RADIUS server policy associated with this RADIUS proxy server for authentication purposes.

username

Syntax **username** [1..32] [**prefix-string** *prefix-string*] [**accounting-server-policy** *policy-name*] [**suffix-string** *suffix-string*]
no username [1..32]

Context config>router>radius-proxy>server
config>service>vprn>radius-proxy>server

Description This command configures a mapping of username prefix to a radius-server-policy for authentication or accounting. The username from incoming authentication or accounting messages is matched against the configured mappings to obtain the radius-server-policy to be used. Up to 32 entries could be configured for a RADIUS-proxy server.

Default none

Parameters 1..32 — Assigns an integer to specify this username.

prefix-string — Specifies a prefix string used to match username attribute up to 128 characters.

policy-name — Specifies a radius-server-policy name up to 32 characters in length.

send-accounting-response

Syntax [**no**] **send-accounting-response**

Context config>router>radius-proxy>server
config>service>vprn>radius-proxy>server

Description This command results in the system to always generate RADIUS accounting-response to acknowledge RADIUS accounting-request received from the RADIUS client.

The **no** form of the command disables the command.

Default no send-accounting-response

cache

Syntax **cache**

Context config>router>radius-proxy>server
config>service>vprn>radius-proxy>server

Description This command enters the cache configuration context under radius-proxy server. The cache contains per-subscriber authentication information learnt from RADIUS authentication messages, and is used to authorize subsequent DHCP requests.

Default none

key

Syntax **key packet-type** {**accept**|**request**} **attribute-type** *attribute-type* [**vendor** *vendor-id*]
no key
config>router>radius-proxy>server>cache
config>service>vprn>radius-proxy>server>cache

Description This command specifies the RADIUS cache key that is used to match the information in subsequent DHCP requests for authorization.

Default no key

Parameters **packet-type —** Specifies the packet type of the RADIUS messages to use to generate the key for the cache of this RADIUS proxy server.

Values accept, request

attribute-type *attribute-type* **—** Specifies the RADIUS attribute type to cache for this RADIUS proxy server.

Values 1 — 255

the type value of RADIUS attribute

vendor *vendor-id* **—** Specifies the RADIUS vendor ID.

Values 1 — 16777215, alu

timeout

Syntax **timeout** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no timeout

Context config>router>radius-proxy>server>cache
config>service>vprn>radius-proxy>server>cache

Description This command configures the time for which the cache entry is kept if there is no corresponding DHCP DISCOVER. At the expiry of this time, the cache entry is deleted.

The **no** form of the command reverts to the default value.

Default timeout min 5

Parameters **hrs** *hours* — Specifies, in seconds, the timeout after which an entry in the cache will expire.

min *minutes* — Specifies, in seconds, the timeout after which an entry in the cache will expire.

sec *seconds* — Specifies, in seconds, the timeout after which an entry in the cache will expire.

track-accounting

Syntax **track-accounting** [**start**] [**stop**][**interim-update**][**accounting-on**] [**accounting-off**]
no track-accounting

Context config>router>radius-proxy>server>cache
config>service>vprn>radius-proxy>server>cache

Description This command specifies the type of RADIUS accounting packets from RADIUS client (a WIFI AP) that the router should track.

The **no** form of the command removes the parameters from the configuration.

Default no track-accounting

Parameters **start —** The router will update the associated ESM-host with the RADIUS client (for example, a WIFI AP) that generated the accounting-start. This is required in cases where a UE roams to a new AP that does not re-authenticate due to key caching.

stop — The router will remove the corresponding ESM host and forward the accounting-stop packet to the external RADIUS server.

accounting-on | accounting-off — The router will remove all ESM hosts associated with the RADIUS client (a WIFI AP), and forward the accounting-on packet to the external RADIUS server.

interim-update — The router will update the associated ESM-host with the RADIUS client (e.g. a WIFI AP) that generated the interim-update. The interim-updates with the updated information are sent to the RADIUS server as scheduled.

track-authentication

Syntax **track-authentication [accept]**
no track-authentication

Context config>router>radius-proxy>server>cache
config>service>vprn>radius-proxy>server>cache

Description This command specifies if RADIUS authentication (from the AP) should be tracked in order to update the ESM host with the RADIUS client (for example, WIFI AP) on UE mobility. It also specifies the authentication packet from RADIUS client (for example, a WIFI AP) that the router should track for mobility.

The **no** form of this command stops tracking authentication for UE mobility.

Default Not enabled

Parameters **accept** — Indicates access-accept is tracked for mobility.

track-delete-hold-time

Syntax **track-delete-hold-time** *seconds*
no track-delete-hold-time

Context config>router>radius-proxy>server>cache

Description This command specifies the delete hold-time in case the DHCP host gets a trigger to delete from the matched RADIUS Proxy server.

Default 0

Parameters *seconds* — Spcifies the delete hold time, in seconds.

Values 0 — 600

LUDB Matching of RADIUS Proxy Cache Commands

local-user-db

Syntax **local-user-db** *local-user-db-name* [**create**]
no local-user-db *local-user-db-name*

Context config>subscr-mgmt

Description This command enables the context to configure a local user database.

Default not enabled

Parameters *local-user-db-name* — Specifies the name of a local user database.

dhcp

Syntax **dhcp**

Context config>subscr-mgmt>loc-user-db

Description This command configures DHCP host parameters.

host

Syntax **host**

Context config>subscr-mgmt>loc-user-db

Description This command enables the context to configure DHCP host parameters.

match-radius-proxy-cache

Syntax **match-radius-proxy-cache**

Context config>subscr-mgmt>loc-user-db>dhcp>host

Description This command enables the context to configure match-radius-proxy-cache parameters.

fail-action

Syntax **fail-action** {**continue**|**drop**}
no fail-action

Context config>subscr-mgmt>loc-user-db>dhcp>host>match-radprox-cache

Description This command specifies the router's action when failed to find matched radius-proxy-server cache entry.

The **no** form of the command reverts to the default.

Default drop

Parameters **continue —** Specifies that the will proceed with ESM authentication without dropping the DHCP packet.

drop — Specifies that the router will drop the DHCP packet.

mac-format

Syntax **mac-format** *format*
no mac-format

Context config>subscr-mgmt>loc-user-db>dhcp>host>match-radprox-cache

Description This command specifies the format of MAC address used for matching incoming DHCP DISCOVER against the RADIUS proxy cache.

The **no** form of the command reverts to the default.

Default mac-format "aa:"

Parameters *format* — Specifies the format string that specifies the format of MAC address.

Values mac-format: (only when match is equal to mac)
like ab: for 00:0c:f1:99:85:b8
or XY- for 00-0C-F1-99-85-B8
or mmmm. for 0002.03aa.abff
or xx for 000cf19985b8

match

Syntax **match** {**circuit-id**|**mac**|**remote-id**}
match option [1..254]
no match

Context config>subscr-mgmt>loc-user-db>dhcp>host>match-radprox-cache

Description This command specifies the field/option of DHCP packet that is used to match against the radius-proxy-server cache.

The **no** form of the command reverts to the default.

Default mac

Parameters **circuit-id —** Specifies to match the circuit-id in DHCP option82

remote-id — Specifies to match the remote-id in DHCP option82

mac — Specifies to match the MAC address of DHCP client

option — Specifies to use specified DHCP option , 1 — 254

server

Syntax **server** [**service** *service-id*] **name** *server-name*
no server

Context config>subscr-mgmt>loc-user-db>dhcp>host>match-radprox-cache

Description This command specifies the name of radius-proxy-server and optionally id of the service that the radius-proxy-server resides in.

The **no** form of the command removes the parameters from the configuration.

Default no server

Parameters **service** *service-id* **—** Specifies the ID or name of the service.

Values 1..214748365
svc-name up to 64 char maximum

name *server-name* **—** Specifies the name of radius-proxy-server up to 32 characters in length.

WLAN-GW-Group Commands

wlan-gw-group

Syntax **wlan-gw-group** *group-id* [**create**]
no wlan-gw-group *group-id*

Context config>isa

Description This command creates a WLAN GW group. Note that the wlan-gw-group ID shares the same number space with the nat-group.

The **no** form of the command removes the group

Default none

Parameters *group-id* — Specifies WLAN Gateway Integrated Service Adaptor (ISA) Groups.

Values 1 — 4

active-iom-limit

Syntax **active-iom-limit** *number*
no active-iom-limit

Context config>isa>wlan-gw-group

Description This command specifies the number of WLAN-GW IOMs used as active IOMs from the total number of configured WLAN-GW IOMs. If there are more configured IOM than active-iom-limit, then the remaining number of IOMs will be designated as backup(s).

The **no** form of the command removes the number from the configuration.

Parameters *number* — Specifies the number of IOM's in this WLAN Gateway ISA group that are intended for active use.

Values 1 — 3

distributed-sub-mgmt

Syntax [**no**] **distributed-sub-mgmt**

Context config>isa>wlan-gw-group

Description This command configures the WLAN gateway distributed subscriber management.

isa-aa-group

Syntax **isa-aa-group** *aa-group-id*
no isa-aa-group

Context config>isa>wlan-gw-group>distributed-sub-mgmt

Description This command configures an ISA application assurance group for WLAN gateway DSM subscribers.

iom

Syntax **iom** *slot-number*
no iom

Context config>isa>wlan-gw-group

Description This command designates the specified IOM as a WLAN-GW IOM. Each WLAN-GW IOM MUST be configured with two MS-ISA modules.

The **no** form of the command removes the number from the configuration.

Default none

Parameters *slot-number* — Indicates the IOM slot of the MDA associated with this member.

Values 1 — 10

nat

Syntax **nat**

Context config>isa>wlan-gw-group

Description This command enables the context to configure NAT parameters under wlan-gw-group.

radius-accounting-policy

Syntax **radius-accounting-policy** *nat-accounting-policy*
no radius-accounting-policy

Context config>isa>wlan-gw-group>nat

Description This command configures the RADIUS accounting policy to use for each MDA in this ISA group.

The no form of the command removes the accounting policy from the configuration.

Default none

Parameters *nat-accounting-policy* — Specifies the RADIUS accounting policy up to 32 characters in length.

session-limits

Syntax **session-limits**

Context config>isa>wlan-gw-group>nat

Description This command configures the ISA NAT group session limits.

reserved

Syntax **reserved** *num-sessions*
no reserved

Context config>isa>nat>session-limits

Description This command configures the number of sessions per block that will be reserved for prioritized sessions.

Parameters *num-sessions* — Specifies the number of sessions reserved for prioritized sessions.

Values 0 — 4194303

watermarks

Syntax **watermarks high** *percentage* **low** *percentage*
no watermarks

Context config>isa>nat>session-limits

Description This command configures the ISA NAT group watermarks.

high *percentage* **—** Specifies the high watermark of the number of sessions for each MDA in this NAT ISA group.

Values 2 — 100

low *percentage* — Specifies the low watermark of the number of sessions for each MDA in this NAT ISA group.

Values 1 — 99

Port Policy Commands

port-policy

Syntax **port-policy** *port-policy-name* [**create**]
no port-policy *port-policy-name*

Context config

Description This command either creates a new port-policy with create parameter or enters the configuration context of an existing port-policy.

Default none

Parameters *port-policy-name* — Specifies the name of port-policy.

create — Keyword used to create a port-policy.

egress-scheduler-policy

Syntax **egress-scheduler-policy** *port-sched-plcy*
egress-scheduler-policy

Context config>port-policy

Description This command specifies the port-scheduler-policy to use in the egress direction for the internal port connecting the WLAN-GW IOM to the MS-ISA.

Default none

Parameters *port-sched-plcy* — Specifies the name of the port-scheduler-policy up to 32 characters in length.

WLAN-GW Group Interface Commands

Note that the **wlan-gw** commands apply only to the 7750 SR platform.

group-interface

Syntax **group-interface** *ip-int-name* [**create**]
group-interface *ip-int-name* [**create**] **lns**
group-interface *ip-int-name* [**create**] **wlangw**
no group-interface *ip-int-name* [**create**]

Context config>service>ies>subscriber-interface
config>service>vprn>subscriber-interface

Description This command creates a group interface. This interface is designed for triple-play services where multiple SAPs are part of the same subnet. A group interface may contain one or more SAPs.

Use the **no** form of the command to remove the group interface from the subscriber interface.

Default no group interfaces configured

Parameters *ip-int-name* — Specifies the interface name of a group interface. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

lns — Specifies to use LNS.

wlangw — Specifies the group interface for wlan-gw.

ip-mtu

Syntax **ip-mtu** *octets*
no ip-mtu

Context config>service>ies>subscriber-interface
config>service>vprn>subscriber-interface

Description This command specifies the maximum size of frames on this group-interface. Packets larger than this will get fragmented.

The **no** form of the command removes this functionality.

Default none

Parameters *octets* — Specifies the largest frame size (in octets) that this interface can handle.

Values 512 — 9000

wlan-gw

Syntax **wlan-gw**

Context config>service>ies>subscriber-interface>group-interface
config>service>vprn>subscriber-interface> group-interface

Description This command enables the context to configure wlan-gw parameters.

Default none

egress

Syntax **egress**

Context config>service>ies>subscriber-interface>group-interface>wlan-gw

Description This command enables the context to configure egress QoS parameters for wlan-gw tunnels.

agg-rate-limit

Syntax **agg-rate-limit** *kilobits-per-second*
no agg-rate-limit

Context config>service>ies>subscriber-interface>group-interface>wlan-gw>egress
config>service>vprn>subscriber-interface>group-interface>wlan-gw>egress

Description This command is used to control an HQoS aggregate rate limit. It is used in conjunction with the following parameter commands: **rate**, **limit-unused-bandwidth**, **and queue-frame-based-accounting**.

Parameters *kilobits-per-second* — Specifies the aggregate rate limit.

Values 1..100000000|max

hold-time

Syntax **hold-time infinite**
hold-time [1..86400]
no hold-time

Context config>service>ies>subscriber-interface>group-interface>wlan-gw>egress
config>service>vprn>subscriber-interface> group-interface>wlan-gw>egress

Description This command configures the time for which egress shaping resources associated with a wlan-gw tunnel are held after the last subscriber on a tunnel is deleted.

Parameters 1..86400 — Specifies the time, in seconds, for which shaping resources are held in seconds after last subscriber is deleted.

Values infinite | 1..86400

qos

Syntax **qos** *policy-id*
no qos

Context config>service>ies>subscriber-interface>group-interface>wlan-gw>egress

Description This command configures the identifier of the egress QoS policy associated with each wlan-gw tunnel of this interface.

The **no** form of the command removes the policy ID from the configuration.

Default 1

Parameters *policy-id* — Specifies to apply the specified sap-*egress-policy-id*.

Values 1 — 65535
name: A string up to 64 characters.

scheduler-policy

Syntax **scheduler-policy** *scheduler-policy-name*
no scheduler-policy

Context config>service>ies>subscriber-interface>group-interface>wlan-gw>egress

Description This command configures the identifier of the egress scheduler policy associated with each wlan-gw tunnel of this interface.

The **no** form of the command removes the scheduler policy name from the configuration.

Default none

Parameters *scheduler-policy-name* — Specifies the identifier of the egress scheduler policy associated with each wlan-gw tunnel of this interface

shape-multi-client-only

Syntax [**no**] **shape-multi-client-only**

Context config>service>ies>subscriber-interface>group-interface>wlan-gw>egress

Description This command enables the egress shaping is only enabled for a wlan-gw tunnel while there are multiple UE (User Equipment) using it.

The **no** form of the command disables the egress shaping.

shaping

Syntax **shaping** {**per-retailer**|**per-tunnel**}
no shaping

Context config>service>ies>subscriber-interface>group-interface>wlan-gw>egress

Description This command configures the the granularity of the egress shaping for wlan-gw on this group interface.

The **no** form of the command removes the parameter from the configuration.

Parameters **per-tunnel —** Specifies that a separate shaper is applied to each wlan-gw tunnel.

per-retailer — Specifies that a separate shaper is applied to each retailer Mobile Network Operator's fraction of the wlan-gw tunnel payload.

gw-address

Syntax **gw-address** *ip-address*
no gw-address

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command specifies gateway endpoint address for the wlan-gw tunnel.

The **no** form of the command removes the value from the wlan-gw configuration.

Default none

Parameters *ip-address* — Specifies the IP address of the wlan-gw tunnels on this group interface.

gw-ipv6-address

Syntax **gw-ipv6-address** *ipv6-address*
no gw-ipv6-address

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command specifies a gateway IPv6 endpoint address for the wlan-gw tunnel.

The **no** form of the command removes the IPv6 the gateway IPv6 endpoint address for the wlan-gw tunnel.

Default none

Parameters *ipv6-address* — Specifies the gateway IPv6 endpoint address

Values ipv6-address : x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x - [0..FFFF]H
d - [0..255]D

l2-access-points

Syntax **l2-access-points**

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command enables the context to configure Layer 2 Access Points in WLAN Gateway Group-Interfaces.

l2-ap

Syntax **l2-ap** *sap-id* [**create**]
no l2-ap *sap-id*

Context config>service>vprn>sub-if>grp-if>wlan-gw>l2-access-points
config>service>ies >sub-if>grp-if>wlan-gw>l2-access-points

Description This command adds a specific SAP where Layer 2 WLAN-GW aggregation will be performed. Following SAPs are supported.

- Ethernet
- LAG
- MPLS pseudowire SDPs

This command can be repeated multiple times to create multiple Layer 2 access points. The **no** form of the command removes the L2 wholesale service, this is only allowed if the l2-service node is shutdown.

Default No SAPs are defined

Parameters *sap-id* — Specifies SAP to be created. For the exact syntax, see the common CLI command description of the 7750 Services Guide.

create — Keyword used to create the Layer 2 WLAN-GW aggregation instance. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

encap-type

Syntax **encap-type** {**default**|**null**|**dot1q**|**qinq**}
no encap-type

Context config>service>vprn>sub-if>grp-if>wlan-gw>l2-access-points>l2-ap
config>service>ies >sub-if>grp-if>wlan-gw>l2-access-points>l2-ap

Description If different from default, this command overrides the value specified by **l2-ap-encap-type** on wlan-gw level. See the description of l2-ap-encap-type for more detail. This value can only be changed while the l2-ap is shutdown.

The **no** form of the command sets the default value.

Default default

Parameters **default** — Specifies to use the value specified by l2-ap-encap-type.

null — Specifies to use both the SAP and the AP are not VLAN-tagged.

dot1q — Specifies to use either the AP or the SAP uses one VLAN tag.

qinq — Up to two VLAN tags are used by the AP or SAP.

epipe-sap-template

Syntax **epipe-sap-template** *name*
no epipe-sap-template

Context config>service>vprn>sub-if>grp-if>wlan-gw>l2-access-points>l2-ap
config>service>ies >sub-if>grp-if>wlan-gw>l2-access-points>l2-ap

Description This command specifies which SAP parameter template should be applied to the l2-ap SAP. This can only be changed when the l2-ap is shutdown.

The **no** form of the command removes the template, the SAP will use default parameters.

Default none

Parameters *name* — Specifies the name of the template to use.

shutdown

Syntax **shutdown** *sap-id* [**create**]
no shutdown *sap-id*

Context config>service>vprn>sub-if>grp-if>wlan-gw>l2-access-points>l2-ap
config>service>ies >sub-if>grp-if>wlan-gw>l2-access-points>l2-ap

Description This command administratively enables this SAP to begin accepting Layer 2 packets for WIFI offloading.

The **no** form of the command disables this SAP.

Default shutdown

l2-ap-encap-type

Syntax config>service>vprn>sub-if>grp-if>wlan-gw
config>service>ies >sub-if>grp-if>wlan-gw

Description This parameter specifies the number of AP identifying VLAN tags for an AP. This is the default value that can be overridden per SAP. This value should at least be equal to the number of VLANs configured in the SAP or enabling a SAP will fail.

A SAP VLAN is explicitly configured, for example **l2-ap 1/1/1:25**. Other VLANs on the same port can still be used in other contexts.

The number of VLAN tags Epiped to WLAN-GW IOM equal the **l2-ap-encap-type** minus the encaps of the SAP. Upon receipt of a packet these VLANs will be stored as a Layer 2 tunnel identifier, and are only used in context of WLAN-GW.

The **no** form of the command sets the default value.

Default null

Parameters **null** — Both the SAP and the AP are not VLAN-tagged.

dot1q — Either the AP or the SAP uses one VLAN tag.

qinq — Up to two VLAN tags are used by the AP or SAP.

mobility

Syntax **mobility**

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command enables the context to configure mobility parameters.

arp-ap

Syntax **arp-ap**
no arp-ap

Context config>service>ies>subscriber-interface>group-interface>wlan-gw>mobility
config>service>vprn>subscriber-interface> group-interface>wlan-gw>mobility

Description This command enables the generation of an ARP packet on wlan-gw tunnel to learn the MAC address of the new AP when UE mobility is detected. The IP address in the ARP packet is the wlan-gw tunnel endpoint IP address of the AP.

The **no** form of the command disables sending of special ARP packet on wlan-gw tunnel to learn the MAC address of the AP when UE mobility is detected.

Default not enabled

hold-time

Syntax **hold-time** *time in s*
no hold-time

Context config>service>ies>subscriber-interface>group-interface>wlan-gw>mobility
config>service>vprn>subscriber-interface> group-interface>wlan-gw>mobility

Description This command configures the minimum time that a User Equipment will be held associated with its current Access Point (AP) before being associated with a new AP.

The hold time is used to prevent overwhelming the system with mobility triggers, by limiting the rate at which a UE can move from one AP to another while the system is very busy already.

Default no default

Parameters *time in s* — Specifies a hold-down time, in seconds, for handling of successive mobility triggers for a UE. It is the minimal time a UE stays associated with an AP.

Values 0..255

trigger

Syntax **trigger** [**data**] [**iapp**]
no trigger

Context config>service>ies>subscriber-interface>group-interface>wlan-gw>mobility
config>service>vprn>subscriber-interface> group-interface>wlan-gw>mobility

Description This command specifies the type of packet used as a mobility trigger.

Ths **no** form of the command removes the parameters from the configuration and disables data-plane mobility.

Parameters **data —** Specifies that data traffic be used as a trigger.

iapp — Specifies that Inter Access Point Protocol (IAPP) messages be used as a trigger.

multi-tunnel-type

Syntax [**no**] **multi-tunnel-type**

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command enables terminating multiple types of tunnels.

The **no** form of the command disables terminating multiple types of tunnels.

oper-down-on-group-degrade

Syntax [**no**] **oper-down-on-group-degrade**

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command operationally brings down the WLAN-GW group if the total number of operational WLAN-GW IOMs in the WLAN-GW group fall below the configured number of active WLAN-GW IOMs. This triggers withdrawal of the route to tunnel endpoint and subscriber subnets in routing.

Default none

router

Syntax **router** *router-instance*
no router

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command specifies the routing instance that wlan-gw gateway endpoint resides in.

The **no** form of the command removes the value from the wlan-gw configuration.

Default none

Parameters *router-instance* — Specifies the identifier of the virtual router instance where the tunneled User Equipment traffic is routed.

tcp-mss-adjust

Syntax **tcp-mss-adjust** *segment-size*
no tcp-mss-adjust

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command configures the TCP Maximum Segment Size (MSS) adjustment for the wlan-gw gateway.

The **no** form of the command disables adjusting tcp-mss values.

Default none

Parameters *segment-size* — Specifies the value to put into the TCP Maximum Segment Size (MSS) option if not already present, or if the present value is higher.

Values 160 — 10240

tunnel-encaps

Syntax **tunnel-encaps**

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command enables the context to configure tunnel encapsulation parameters.

learn-l2tp-cookie

Syntax **learn-l2tp-cookie** {**if-match**|**never**|**always**} [**cookie** *hex string*]
no learn-l2tp-cookie

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command specifies when this system will learn the cookie from L2TP tunnels terminating on this interface. Learning the cookie means that the value of the octets 3-8 of the cookie is interpreted as an access point's MAC address, and used as such, for example in the Called-Station-Id attribute of RADIUS Interim-Update messages.

Parameters **if-match** — Specifies that the cookie will be interpreted only if the value of the first two octets of the cookie is equal to the value of the object tmnxWlanGwSoftGreIfL2tpCookie.

cookie *hex string* — Only valid if if-match is used. Specifies the value used to compare the first two bytes of the cookie. Specified in HEX format, possible range [0x0000 .. 0xFFFF]

Values [0x0000..0xFFFF...(4 hex nibbles)]

never — Specifies that the cookie value will always be ignored.

always — Always learn the AP-MAC from the cookie, no matter what the value of the first two bytes is.

vlan-tag-ranges

Syntax **vlan-tag-ranges**

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command enables the context to configure vlan-to-retail-map parameters to map dot1Q tags to retail-service-id. The WIFI AP could insert a dot1Q tag in the Layer 2 frame within the GRE tunnel to indicate the retail service provider for the subscriber.

Default none

retail-svc-id

Syntax **retail-svc-id** *service-id*
no retail-svc-id

Context config>service>vprn>sub-if>grp-if>wlan-gw
config>service>ies>sub-if>grp-if>wlan-gw

Description This command configures the retailer service.

Parameters *service-id* — specifies the identifier of the retail service.

Values 1 — 2147483650
svc-name: up to 64 characters in length.

vlan

Syntax **vlan start** [0..4095] **end** [0..4095] **retail-svc-id** *service-id*
no vlan start [0..4095] **end** [0..4095]

Context config>service>ies>subscriber-interface>group-interface>wlan-gw>retailer
config>service>vprn>subscriber-interface> group-interface>wlan-gw>retailer

Description This command creates a mapping from a range of VLANs (appearing in the wlan-gw encapsulated Layer 2 frame) to a retail service ID.

The **no** form of the command removes the parameters from the configuration.

Default none

Parameters **start** [0..4095] — Specifies the start VLAN tag of this range.

Values

end [0..4095] — Specifies the end VLAN tag of this range.

Values

retail-svc-id *service-id* — Specifies the identifier of the retail service to be used by default of a value in the retail service map of this interface.

Values 1 — 2147483650
svc-name: up to 64 characters in length.

wlan-gw-group

Syntax **wlan-gw-group** *group-id*
no wlan-gw-group

Context config>service>ies>subscriber-interface>group-interface>wlan-gw
config>service>vprn>subscriber-interface> group-interface>wlan-gw

Description This command specifies the id of wlan-gw-group that the wlan-gw gateway binds to.

The **no** form of the command removes the value from the wlan-gw configuration.

Default none

Parameters *group-id* — Specifies the ISA WLAN-GW group.

Values 1 — 4

redundancy

Syntax **redundancy**

Context config>service>ies>subscriber-interface>wlan-gw

Description This command enables the context to configure WLAN-GW redundancy-related paramters.

Default none

export

Syntax **export** *ip-prefix/length*
no export

Context config>service>ies>subscriber-interface>wlan-gw>redundancy

Description This command specifies an IPv4 route (prefix/length) per subscriber-interface to be exported (announced) to indicate liveness of the subscriber-interface on the WLAN-GW. This route is the one that is monitored in routing by the peer WLAN-GW to decide its state with respect.

Default none

Parameters *ip-prefix/length* — Specifies the IP prefix and length.

Values ip-prefix:a.b.c.d
ip-prefix-length: 0 — 32

monitor

Syntax **monitor** *ip-prefix/length*
no monitor

Context config>service>ies>subscriber-interface>wlan-gw>redundancy

Description This command specifies an IPv4 route (prefix/length) per subscriber-interface to be monitored in the FIB to determine liveness of the subscriber-interface (and consequently all associated group-interfaces of type wlangw) on a peer WLAN-GW. This route is the one that is advertised in routing by the peer WLAN-GW when the subscriber-interface and WLAN-GW group are operationally up

Default none

Parameters *ip-prefix/length* — Specifies the IP prefix and length.

Values ip-prefix:a.b.c.d
ip-prefix-length: 0 — 32

Migrant User Support Commands

http-redirect-policy

Syntax **http-redirect-policy** *policy-name*
no http-redirect-policy

Context config>subscr-mgmt

Description This command configures the redirect policy to constrain forwarding of an unauthenticated "migrant" WIFI user.

Default none

Parameters *policy-name* — Specifies the HTTP redirect policy name up to 32 characters in length.

forward-entries

Syntax **forward-entries**

Context config>subscr-mgmt>http-rdr-plcy

Description Enters the context to configure entries that need to be forwarded

Default none

dst-port

Syntax **dst-port** *tcp-port*
no dst-port

Context config>subscr-mgmt>http-rdr-plcy

Description This command specifies the port to match the destination port in the HTTP request.

HTTP traffic that does not match this port, is not redirected.

Default 80

Parameters *tcp-port* — Specifies the TCP port.

Values 1 — 65535]

dst-ip

Syntax **[no] dst-ip** ***ip-address*** **protocol** ***ip-protocol*** **dst-port** ***port-number***

Context config>subscr-mgmt>http-rdr-plcy

Description This command configures traffic flow to be forwarded via match in the redirect policy.

Default none

Parameters *ip-address* — Specifies the IP address to match the destination IP address in the IP header of the traffic received from the subscriber.

protocol *ip-protocol* — Specifies the protocol to match the IP protocol in the IP header of the traffic received from the subscriber.

Values tcp, udp

dst-port *port-number* — specifies the port to match the destination port in the HTTP request.

Values 1 — 65535

portal-hold-time

Syntax **portal-hold-time** *seconds*
no portal-hold-time

Context config>subscr-mgmt>http-rdr-plcy

Description This command configures the time for which the forwarding state applicable during redirect phase is held in the system, after the user has been authenticated on the portal. This allows the http response from the portal to be forwarded back on the existing connection.

none

Parameters *seconds* — Specifies how long the system holds on to re-direct forwarding resources of a subscriber, after it has left the re-direct portal.

Values 1 — 60

url

Syntax **url** *rdr-url-sting*
no url

Context config>subscr-mgmt>http-rdr-plcy

Description This command configures the HTTP URL to re-direct the matching traffic to. It also can specify inclusion of original URL, MAC address and IP address of the subscriber in the redirect URL.

none

Parameters *rdr-url-sting* — Specifies the URL to redirect to.

Values

rdr-url-string	[255 chars max]	
macro substitutions:		
	$URL	Request-URI in the HTTP GET Request received
	$MAC	string that represents the MAC address of the subscriber host
	$IP	a string that represents the IP address of the subscriber host

wlan-gw

Syntax **wlan-gw**

Context config>service>vprn>sub-if>grp-if
config>service>ies>sub-if>grp-if

Description This command enables the context to configure wlan-gw parameters.

vlan-tag-ranges

Syntax **vlan-tag-ranges**

Context config>service>vprn>sub-if>grp-if>wlan-gw
config>service>ies>sub-if>grp-if>wlan-gw

Description This command enters the context for per vlan range configuration.

Default none

default-retail-svc-id

Syntax **default-retail-svc-id** *service-id*

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges
config>service>ies>sub-if>grp-if>wlan-gw>ranges

Description This command configures the default retailer service for WIFI users.

Default none

range

Syntax **range start** [0..4096] **end** [0..4096]
range default
no range start [0..4096] **end** [0..4096]

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges
config>service>ies>sub-if>grp-if>wlan-gw>ranges

Description This command creates or enters the context of specified VLAN range for configuration applicable to that range of VLANs.

Default none

Parameters **start** [0..4096] **—** Specifies the start of the vlan range.

end [0..4096] **—** Specifies the end of vlan the range.

default — Configures defaults for the interface.

distributed-sub-mgmt

Syntax **distributed-sub-mgmt**

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range

Description This command enables the context to configure distributed-sub-mgmt configuration per vlan-range. This also includes vlan-range default, which makes this configuration applicable to the wlan-gw group-interface.

Default none

accounting-policy

Syntax **accounting-policy** *policy-name*
no accounting-policy

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt

Description This command specifies the **isa-radius-policy** used for accounting messages originated from the ISAs in the **wlan-gw** group. The policy can specify up to five accounting servers and configuration-specific to these accounting servers. It also specifies configuration specific to RADIUS client on ISAs and RADIUS attributes to be included in accounting messages.

Default none

Parameters *policy-name* — Specifies the name of the account policy up to 32 characters in length.

accounting-update-interval

Syntax **accounting-update-interval** [5..259200]
no accounting-update-interval

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt

Description This command enables the interim accounting and specifies the interim accounting interval.

Default none

Parameters 5..259200 — Specifies the interim accounting interval in seconds.

def-app-profile

Syntax **def-app-profile** *profile-name*
no def-app-profile

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt

Description This command configures the default application profile.

dsm-ip-filter

Syntax **dsm-ip-filter** *dsm-ip-filter-name*
no dsm-ip-filter

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt

Description This command configures an IP filter that is distributed on ISA cards.

This command specifies the IP filter applied to all UEs corresponding to default vlan-range (such as a group-interface) or the specified vlan-range. The IP filter can be created in the **subscr-mgmt>wlan-gw>distributed-sub-mgmt** context, and can contain up to 1024 match entries. The IP filter can be overridden per UE from RADIUS via access-accept or COA.

Default none

Parameters *dsm-ip-filter-name* — Specifies the identifier of the distributed-sub-mgmt IP filter.

egress-policer

Syntax **egress-policer** [256 chars max]
no egress-policer

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt

Description This command specifies the egress policer applied to all UEs corresponding to default vlan-range (such as, group-interface) or the specified vlan-range. The policer can be created in the **subscr-mgmt>wlan-gw>distributed-sub-mgmt** context. The egress policer can be overridden per UE from RADIUS via access-accept or COA.

Default none

Parameters *256 chars max* — Specifies the identifier of the distributed-sub-mgmt policer for egress traffic.

ingress-policer

Syntax **ingress-policer** *policer-name*
no ingress-policer

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt

Description .This command specifies the ingress policer applied to all UEs corresponding to default vlan-range (such as group-interface) or the specified vlan-range. The policer can be created in the **subscr-mgmt>wlan-gw>distributed-sub-mgmt** context. The ingress policer can be overridden per UE from RADIUS via access-accept or COA.

Default none

Parameters *policer-name* — Specifies the identifier of the distributed-sub-mgmt policer for ingress traffic.

one-time-redirect

Syntax **one-time-redirect url** *rdr-url-string* **port** *port-num*
no one-time-redirect

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>distrib-sub-mgmt

Description This command enables one-time http-redirect to specified redirect URL for traffic matching the specified destination port.

Default none

Parameters **url** *rdr-url-string* **—** Specifies the HTTP web address that will be sent to the user's browser.

port *port-num* **—** Specifies the destination port number as a decimal hex or binary.

Values 1 — 65535

dhcp

Syntax **dhcp**

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges
config>service>ies>sub-if>grp-if>wlan-gw>ranges

Description Enters the context to create DHCP configuration for WLAN-GW ISA subscribers (e.g. migrant subscribers).

Default none

active-lease-time

Syntax **active-lease-time** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no active-lease-time

Context config>service>vprn>sub-if>grp-if>wlan-gw>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>dhcp
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>dhcp

Description This command configures the lease time for an authenticated user.

Default none

Parameters **hrs** *hours* — Specifies the number of initial lease time hours.

Values 1 — 1

min *minutes* — Specifies the number of initial lease time minutes.

Values 5 — 59

sec *seconds* — Specifies the number of initial lease time seconds.

Values 1 — 59

initial-lease-time

Syntax **initial-lease-time** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no initial-lease-time

Context config>service>vprn>sub-if>grp-if>wlan-gw>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>dhcp
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>dhcp

Description This command configures the lease time for a user which is migrant (unauthenticated)

Default none

Parameters **hrs** *hours* — Specifies the number of initial lease time hours.

Values 1 — 1

min *minutes* — Specifies the number of initial lease time minutes.

Values 5 — 59

sec *seconds* — Specifies the number of initial lease time seconds.

Values 1 — 59

l2-aware-ip-address

Syntax **l2-aware-ip-address** *ip-address*
no l2-aware-ip-address

Context config>service>vprn>sub-if>grp-if>wlan-gw>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>dhcp
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>dhcp

Description This command configures the l2-aware NAT inside IP address to be assigned via DHCP on WLAN-GW ISA.

Default none

Parameters *ip-address* — Specifies the l2-aware NAT inside IP address.

primary-dns

Syntax **primary-dns** *ip-address*
no primary-dns

Context config>service>vprn>sub-if>grp-if>wlan-gw>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>dhcp
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>dhcp

Description This command configures the primary DNS address to be returned via DHCP on WLAN-GW ISA.

Default none

Parameters *ip-address* — Specifies the primary DNS address

secondary-dns

Syntax **secondary-dns** *ip-address*
no secondary-dns

Context config>service>vprn>sub-if>grp-if>wlan-gw>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>dhcp
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>dhcp

Description This command configures the secondary DNS address to be returned via DHCP on WLAN-GW ISA.

Default none

Parameters *ip-address* — Specifies the secondary DNS address.

primary-nbns

Syntax **primary-nbns** *ip-address*
no primary-nbns

Context config>service>vprn>sub-if>grp-if>wlan-gw>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>dhcp
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>dhcp

Description This command configures the primary NBNS address to be returned via DHCP on WLAN-GW ISA.

Default none

Parameters *ip-address* — Specifies the primary NBNS address.

secondary-nbns

Syntax **secondary-nbns** *ip-address*
no secondary-nbns

Context config>service>vprn>sub-if>grp-if>wlan-gw>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>dhcp
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>dhcp
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>dhcp

Description This command configures the secondary NBNS address to be returned via DHCP on WLAN-GW ISA.

Default none

Parameters *ip-address* — Specifies the secondary NBNS address.

http-redirect-policy

Syntax **http-redirect-policy** *policy-name*
no http-redirect-policy

Context config>service>vprn>sub-if>grp-if>wlan-gw
config>service>ies>sub-if>grp-if>wlan-gw
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range

Description This command specifies http redirect policy on ISA to redirect http traffic to the URL specified in the policy.

Default none

Parameters *policy-name* — Specifies the name of the http redirect policy under subscriber-management context.

l2-service

Syntax **l2-service** *service-id*
no l2-service

Context config>service>vprn>sub-if>grp-if>wlan-gw>vlan-ranges>range
config>service>ies >sub-if>grp-if>wlan-gw>vlan-ranges>range

Description This command specifies the VPLS service used for L2 wholesale. When such a service is configured no other configuration is allowed under the vlan-range.

The **no** form of the command removes the L2 wholesale service, this is only allowed if the l2-service node is shutdown.

Parameters *service-id* — Specifies the VPLS service ID to use for Layer 2 wholesale.

nat-policy

Syntax **nat-policy** *policy-name*
no nat-policy

Context config>service>vprn>sub-if>grp-if>wlan-gw
config>service>ies>sub-if>grp-if>wlan-gw
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range

Description This command specifies the NAT policy for WLAN-GW ISA subscribers.

Default none

authentication

Syntax **authentication**

Context config>service>vprn>sub-if>grp-if>wlan-gw
config>service>ies>sub-if>grp-if>wlan-gw
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range

Description Enters the context to create configuration for authenticating a user from the WLAN-GW ISA.

Default none

authenticate-on-dhcp

Syntax [**no**] **authenticate-on-dhcp**

Context config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range

Description This command enables initial authentication (when there is no state for the UE on the ISA), to be triggered by DHCP DISCOVER or REQUEST. The default behavior s authentication based on first Layer 3 packet.

Default none

authentication-policy

Syntax **authentication-policy** *policy-name*
no authentication-policy

Context config>service>vprn>sub-if>grp-if>wlan-gw>authentication
config>service>ies>sub-if>grp-if>wlan-gw>authentication
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>authentication
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>authentication

Description This command specifies authentication policy configured under aaa context for authenticating users on WLAN-GW ISA.

Default none

Parameters *policy-name* — Specifies the name of the authentication policy up to 32 characters in length.

hold-time

Syntax **hold-time** [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no hold-time

Context config>service>vprn>sub-if>grp-if>wlan-gw>authentication
config>service>ies>sub-if>grp-if>wlan-gw>authentication
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>authentication
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>authentication

Description This command configures the minimum time that a user is held down after a failed authentication attempt.

Default .none

Parameters **hrs** *hours* — the minimum time that a user is held down in hours.

Values 1 — 1

min *minutes* — the minimum time that a user is held down in minutes

Values 5 — 59

sec *seconds* — the minimum time that a user is held down in seconds.

Values 1. — 59

data-triggered-ue-creation

Syntax [**no**] **data-triggered-ue-creation**

Context config>service>vprn>sub-if>grp-if>wlan-gw
config>service>ies>sub-if>grp-if>wlan-gw
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range

Description This command enables or disables data-triggered subscriber creation for WIFI subscribers.

Default none

track-mobility

Syntax **track-mobility**

Context config>service>vprn>sub-if>grp-if>wlan-gw
config>service>ies>sub-if>grp-if>wlan-gw
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range

Description This command enters the context to configure RADIUS-proxy cache information required for subscribers that are created via "data-triggered" authentication. The RADIUS proxy cache enables efficient handling of UE mobility.

none

mac-format

Syntax **mac-format** *mac-format*
no mac-format

Context config>service>vprn>sub-if>grp-if>wlan-gw>track-mobility
config>service>ies>sub-if>grp-if>wlan-gw>track-mobility
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>track-mobility
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>track-mobility

Description This command configures how the MAC address is represented by the RADIUS proxy server.

Default none

Parameters *mac-format* — Specifies how the MAC address is represented by the RADIUS proxy server

Values

mac-format	like ab: for 00:0c:f1:99:85:b8
	or XY- for 00-0C-F1-99-85-B8
	or mmmm. for 0002.03aa.abff
	or xx for 000cf19985b8

radius-proxy-cache

Syntax **radius-proxy-cache router** *router-instance* **server** *server-name*
no radius-proxy-cache

Context config>service>vprn>sub-if>grp-if>wlan-gw>track-mobility
config>service>ies>sub-if>grp-if>wlan-gw>track-mobility
config>service>vprn>sub-if>grp-if>wlan-gw>ranges>range>track-mobility
config>service>ies>sub-if>grp-if>wlan-gw>ranges>range>track-mobility

Description This command specifies the RADIUS-proxy server to allow subscribers created via data-triggered authentication to create an entry. This RADIUS proxy cache entry allows efficient handling of UE mobility.

Default none

Parameters **router** *router-instance* **—** Specifies the router instance.

Values

router-name	Base
service-id	1 — 2147483647

server *server-name* **—** Specifies the server name up to 32 characters in length.

sap-template

Syntax **sap-template** *sap template*
no sap-template

Context config>service>vpls>wlan-gw

Description This command specifies the vpls-sap-template that will be applied on the internal SAPs created for communication between the VPLS and the ISAs.

The **no** form of the command removes the SAP template.

Parameters *sap-template* — Specifies the SAP template to apply. The template is a vpls-sap-template created in the **service>template** context.

Show Commands

acct-on-off-group

Syntax **acct-on-off-group** [*group-name*]

Context show>aaa

Description This command displays Acct-On-Off group information and the associated RADIUS server policies

Parameters *group-name* — Displays information pertaining to the specified acct-on-off group.

Label	Description
acct on off group name	Displays the name of a RADIUS server policy Accounting-On-Off-Group.
controlling Radius-Server-policy	Specifies the RADIUS policy that controls the Acct-On-Off group.
monitored by Radius-Server-policy	Specifies the RADIUS policy that monitors the Acct-On-Off group.
Nbr of Acct-on-off-groups displayed	Displays the number of acct-on-off-group.

Sample Output

```
# show aaa acct-on-off-group "group-1"
===============================================================================
Acct-On-Off-Group Information
===============================================================================
acct on off group name               : group-1
  - controlling Radius-Server-policy :
        aaa-server-policy-3
  - monitored by Radius-Server-policy :
        aaa-server-policy-4
-------------------------------------------------------------------------------
Nbr of Acct-on-off-groups displayed : 1
-------------------------------------------------------------------------------
===============================================================================
```

radius-proxy-server

Syntax **radius-proxy-server** *server-name*
radius-proxy-server *server-name* **cache**
radius-proxy-server *server-name* **cache hex-key** *hex-string*
radius-proxy-server *server-name* **cache string-key** *string*

radius-proxy-server *server-name* **cache summary**
radius-proxy-server *server-name* **statistics**
radius-proxy-server

Context show>router

Description This command displays summary of RADIUS-proxy cache or specific entries.

Parameters *server-name* — Displays information about the specified server name.

cache — Displays messages used to generate the key for the cache of this RADIUS proxy server.

hex-key *hex-string* **—** Displays information about the specified hex string.

Values 0x0 — 0xFFFFFFFF (maximum of 64 hex nibbles)]

string-key *string* **—** Displays information about the specified string.

summary — Displays a summary of the cache of the RADIUS proxy servers.

statistics — Displays statistics about the RADIUS proxy servers of this system.

Label	Description
Description	Displays the description of this RADIUS proxy server.
Purpose	Displays the purpose of the RADIUS server, either accounting or authentication.
Administrative state	Displays the administrative state of this RADIUS server.
Default acct server policy	Displays the name of the default RADIUS server policy associated with this RADIUS proxy server for accounting purposes.
Default auth server policy	Displays the name of the default RADIUS server policy associated with this RADIUS proxy server for authentication purposes.
Send accounting response	Specifies if this RADIUS Proxy server itself responds with an Accounting-Response message to each received Accounting-Request instead of proxying them to a configured RADIUS server.
Last management change	Displays the sysUpTime at the time of the most recent management-initiated change
Key packet type	Displays the packet type of the RADIUS messages to use to generate the key for the cache of this RADIUS proxy server, access-request, access-accept, access-reject, access-challenge
Key attribute type	Displays the RADIUS attribute type to cache for this RADIUS proxy server. Refer to RFC 2865, *Remote Authentication Dial In User Service (RADIUS)*, Section 5 Attributes.
Key vendor ID	Displays the RADIUS Vendor-Id. Refer to RFC 2865, *Remote Authentication Dial In User Service (RADIUS)*, Section 5.25 Vendor-Specific.

Timeout (s)	Displays, in seconds, the timeout after which an entry in the cache will expire.
Track accounting	Displays the RADIUS accounting packets that have impact on the cache of this RADIUS proxy server.
Load balance key	Displays the key for load-balancing RADIUS messages between RADIUS servers.
Id	Displays the specifies the RADIUS Vendor-Id.
Username	Displays the
RADIUS-server-policy	Displays the RADIUS server name.
Purpose	Displays the purpose of the RADIUS server, either accounting or authentication.

Sample Output

```
system# show router 10 radius-proxy-server "myProxyServer1"
===============================================================================
RADIUS Proxy server "myProxyServer1"
===============================================================================
Description                 : myDesc
Purpose                     : authentication
Administrative state        : in-service
Default acct server policy  : myRadiusServerPolicy1
Default auth server policy  : myRadiusServerPolicy2
Send accounting response    : true
Last management change      : 02/17/2012 14:54:28
-------------------------------------------------------------------------------
Cache settings
-------------------------------------------------------------------------------
Administrative state        : enabled
Key packet type             : access-accept
Key attribute type          : 12
Key vendor ID               : (Not Specified)
Timeout (s)                 : 60
Track accounting            : stop interim-update accounting-on accounting-off
Load balance key            : source-ip-udp
===============================================================================
Interfaces
-------------------------------------------------------------------------------
myInterface1
myInterface2
myInterface3
-------------------------------------------------------------------------------
No. of Interface(s): 3
===============================================================================
Usernames/RADIUS server policies
===============================================================================
Id Username-match                    RADIUS-server-policy             Purpose
-------------------------------------------------------------------------------
1.  aaa                               myRadiusServerPolicy2            auth
===============================================================================
```

```
system#
```

wlan-gw

Syntax **wlan-gw**

Context show>router

Description This command displays Wireless LAN Gateway information.

mgw-address-cache

Syntax **mgw-address-cache** [**arec**] [**snaptr**] [**srv**]
mgw-address-cache apn *apn-domain-string*

Context show>router>wlan-gw

Description This command displays the mobile gateway's DNS lookup address cache.

Parameters **arec —** Displays A-records/

snaptr — Displays Straightforward-NAPTR information.

srv — Displays SRV records.

apn *apn-domain-string* **—** Specifies the APN (Access Point Name) of this DNS cache entry.

Sample Output

```
*A:Dut-C# show router 300 wlan-gw mgw-address-cache
===============================================================================
Mobile Gateway SNAPTR cache
===============================================================================
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.
                              3gppnetwork.org
Order                       : 10
Index                       : 1
-------------------------------------------------------------------------------
Preference                  : 10
Service                     : x-3gpp-pgw:x-gn-gtp
Next lookup                 : dns-srv
Replacement                 : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.
                              3gppnetwork.org
Time left (s)               : 3582
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.
                              3gppnetwork.org
Order                       : 20
Index                       : 2
-------------------------------------------------------------------------------
Preference                  : 20
Service                     : x-3gpp-pgw:x-s2a-gtp
Next lookup                 : dns-srv
Replacement                 : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.
                              3gppnetwork.org
Time left (s)               : 3582
-------------------------------------------------------------------------------
```

```
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.
                              3gppnetwork.org
Order                       : 30
Index                       : 3
-------------------------------------------------------------------------------
Preference                  : 30
Service                     : x-3gpp-pgw:x-s2b-gtp
Next lookup                 : dns-srv
Replacement                 : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.
                              3gppnetwork.org
Time left (s)               : 3581
-------------------------------------------------------------------------------
No. of SNAPTR cache entries: 3
===============================================================================
===============================================================================
Mobile Gateway SRV cache
===============================================================================
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.
                              3gppnetwork.org
Priority                    : 10
Index                       : 1
-------------------------------------------------------------------------------
Weight                      : 10
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.
                              3gppnetwork.org
Priority                    : 20
Index                       : 2
-------------------------------------------------------------------------------
Weight                      : 20
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.
                              3gppnetwork.org
Priority                    : 10
Index                       : 1
-------------------------------------------------------------------------------
Weight                      : 10
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.
                              3gppnetwork.org
Priority                    : 20
Index                       : 2
-------------------------------------------------------------------------------
Weight                      : 20
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
Time left (s)               : 3581
```

```
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.
                              3gppnetwork.org
Priority                    : 10
Index                       : 1
-------------------------------------------------------------------------------
Weight                      : 10
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.
                              3gppnetwork.org
Priority                    : 20
Index                       : 2
-------------------------------------------------------------------------------
Weight                      : 20
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
Time left (s)               : 3581
-------------------------------------------------------------------------------
No. of SRV cache entries: 6
===============================================================================
===============================================================================
Mobile Gateway address cache
===============================================================================
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.23
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.29
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.35
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.24
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.30
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
```

```
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.36
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.25
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.31
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.37
Time left (s)               : 3581
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.26
Time left (s)               : 3580
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.32
Time left (s)               : 3580
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.38
Time left (s)               : 3580
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.27
Time left (s)               : 3580
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.33
Time left (s)               : 3580
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.39
Time left (s)               : 3580
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
```

```
Mobile Gateway address      : 9.0.0.28
Time left (s)               : 3580
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.34
Time left (s)               : 3580
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.40
Time left (s)               : 3580
-------------------------------------------------------------------------------
No. of cache entries: 18


*A:Dut-C# show router 300 wlan-gw mgw-address-cache arec
===============================================================================
Mobile Gateway address cache
===============================================================================
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.23
Time left (s)               : 3573
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.29
Time left (s)               : 3573
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.35
Time left (s)               : 3573
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.24
Time left (s)               : 3573
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.30
Time left (s)               : 3573
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.36
Time left (s)               : 3573
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
```

```
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.25
Time left (s)               : 3573
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.31
Time left (s)               : 3573
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.37
Time left (s)               : 3573
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.26
Time left (s)               : 3573
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.32
Time left (s)               : 3573
-------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.38
Time left (s)               : 3572
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.27
Time left (s)               : 3572
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.33
Time left (s)               : 3572
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.39
Time left (s)               : 3572
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.28
Time left (s)               : 3572
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
```

```
Mobile Gateway address      : 9.0.0.34
Time left (s)               : 3572
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.40
Time left (s)               : 3572
-------------------------------------------------------------------------------
No. of cache entries: 18
===============================================================================


*A:Dut-C# show router 300 wlan-gw mgw-address-cache srv
===============================================================================
Mobile Gateway SRV cache
===============================================================================
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.
                              3gppnetwork.org
Priority                    : 10
Index                       : 1
-------------------------------------------------------------------------------
Weight                      : 10
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
Time left (s)               : 3567

-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.
                              3gppnetwork.org
Priority                    : 20
Index                       : 2
-------------------------------------------------------------------------------
Weight                      : 20
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
Time left (s)               : 3567

-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.
                              3gppnetwork.org
Priority                    : 10
Index                       : 1
-------------------------------------------------------------------------------
Weight                      : 10
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
Time left (s)               : 3566

-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.
                              3gppnetwork.org
Priority                    : 20
Index                       : 2
-------------------------------------------------------------------------------
Weight                      : 20
Port                        : 2123
```

```
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
Time left (s)               : 3566
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.
                              3gppnetwork.org
Priority                    : 10
Index                       : 1
-------------------------------------------------------------------------------
Weight                      : 10
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
Time left (s)               : 3566
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.
                              3gppnetwork.org
Priority                    : 20
Index                       : 2
-------------------------------------------------------------------------------
Weight                      : 20
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
Time left (s)               : 3566
-------------------------------------------------------------------------------
No. of SRV cache entries: 6
===============================================================================


*A:Dut-C# show router 300 wlan-gw mgw-address-cache snaptr
===============================================================================
Mobile Gateway SNAPTR cache
===============================================================================
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.
                              3gppnetwork.org
Order                       : 10
Index                       : 1
-------------------------------------------------------------------------------
Preference                  : 10
Service                     : x-3gpp-pgw:x-gn-gtp
Next lookup                 : dns-srv
Replacement                 : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.
                              3gppnetwork.org
Time left (s)               : 3555
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.
                              3gppnetwork.org
Order                       : 20
Index                       : 2
-------------------------------------------------------------------------------
Preference                  : 20
Service                     : x-3gpp-pgw:x-s2a-gtp
Next lookup                 : dns-srv
Replacement                 : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.
                              3gppnetwork.org
Time left (s)               : 3555
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.
                              3gppnetwork.org
```

```
Order                       : 30
Index                       : 3
-------------------------------------------------------------------------------
Preference                  : 30
Service                     : x-3gpp-pgw:x-s2b-gtp
Next lookup                 : dns-srv
Replacement                 : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.
                              3gppnetwork.org
Time left (s)               : 3554

-------------------------------------------------------------------------------
No. of SNAPTR cache entries: 3


*A:Dut-C# show router 300 wlan-gw mgw-address-cache apn full.dot-
ted.apn.apn.epc.mnc010.mcc206.3gppnetwork.org
===============================================================================
Mobile Gateway APN Cache
===============================================================================
-------------------------------------------------------------------------------
APN > NAPTR
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.
                              3gppnetwork.org
Order                       : 10
Index                       : 1
-------------------------------------------------------------------------------
Preference                  : 10
Service                     : x-3gpp-pgw:x-gn-gtp
Next lookup                 : dns-srv
Replacement                 : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.
                              3gppnetwork.org
Time left (s)               : 3531
-------------------------------------------------------------------------------
APN > NAPTR > SRV
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.
                              3gppnetwork.org
Priority                    : 10
Index                       : 1
-------------------------------------------------------------------------------
Weight                      : 10
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
Time left (s)               : 3531
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.23
Time left (s)               : 3530
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.29
```

```
Time left (s)               : 3530
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.35
Time left (s)               : 3530
-------------------------------------------------------------------------------
APN > NAPTR > SRV
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.
                              3gppnetwork.org
Priority                    : 20
Index                       : 2
-------------------------------------------------------------------------------
Weight                      : 20
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
Time left (s)               : 3530
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.24
Time left (s)               : 3530
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.30
Time left (s)               : 3530
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv1.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.36
Time left (s)               : 3530
-------------------------------------------------------------------------------
APN > NAPTR
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.
                              3gppnetwork.org
Order                       : 20
Index                       : 2
-------------------------------------------------------------------------------
Preference                  : 20
Service                     : x-3gpp-pgw:x-s2a-gtp
Next lookup                 : dns-srv
Replacement                 : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.
                              3gppnetwork.org
Time left (s)               : 3530
-------------------------------------------------------------------------------
```

```
APN > NAPTR > SRV
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.
                              3gppnetwork.org
Priority                    : 10
Index                       : 1
-------------------------------------------------------------------------------
Weight                      : 10
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.25
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.31
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.37
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.
                              3gppnetwork.org
Priority                    : 20
Index                       : 2
-------------------------------------------------------------------------------
Weight                      : 20
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.26
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
```

```
                                3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.32
Time left (s)               : 3529

-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv2.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.38
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.
                              3gppnetwork.org
Order                       : 30
Index                       : 3
-------------------------------------------------------------------------------
Preference                  : 30
Service                     : x-3gpp-pgw:x-s2b-gtp
Next lookup                 : dns-srv
Replacement                 : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.
                              3gppnetwork.org
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.
                              3gppnetwork.org
Priority                    : 10
Index                       : 1
-------------------------------------------------------------------------------
Weight                      : 10
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.27
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.33
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a1.
                              3gppnetwork.org
```

```
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.39
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.
                              3gppnetwork.org
Priority                    : 20
Index                       : 2
-------------------------------------------------------------------------------
Weight                      : 20
Port                        : 2123
Target                      : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.28
Time left (s)               : 3529
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.34
Time left (s)               : 3528
-------------------------------------------------------------------------------
APN > NAPTR > SRV > A
-------------------------------------------------------------------------------
APN                         : full.dotted.apn.apn.epc.mnc010.mcc206.srv3.a2.
                              3gppnetwork.org
-------------------------------------------------------------------------------
Mobile Gateway address      : 9.0.0.40
Time left (s)               : 3528
-------------------------------------------------------------------------------
No. of cache entries: 18
```

mgw-map

Syntax **mgw-map**

Context show>router>wlan-gw

Description This command displays the Mobile Gateway map.

Sample Output

```
*A:Dut-C# show router 300 wlan-gw mgw-map
===============================================================================
Mobile Gateway map
===============================================================================
```

```
Address prefix                                  Profile
-------------------------------------------------------------------------------
9.0.0.29/32                                     Ivo
-------------------------------------------------------------------------------
No. of address prefixes: 1
```

mobile-gateway

Syntax **mobile-gateway** [**mgw-profile** *profile-name*] [**local-address** *ip-address*] [**control** *protocol*] [**interface-type** *interface-type*]
mobile-gateway remote-address *ip-address* [**udp-port** *port*]
mobile-gateway remote-address *ip-address* [**udp-port** *port*] **statistics**

Context show>router>wlan-gw

Description This command displays Mobile Gateway information.

Parameters **mgw-profile** *profile-name* **—** Specifies the name that identifies the profile.

local-address *ip-address* **—**

Values

ip-address:	ipv4-address	- a.b.c.d
ipv6-address :	x:x:x:x:x:x:x:x	(eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d	
	x - [0..FFFF]H	
	d - [0..255]D	

control *protocol* **—** Specifies the control plane protocol used for the connection with this Mobile Gateway.

Values gtpv1-c, gtpv2-c

interface-type *interface-type* **—** Specifies the interface type of the connection between WLAN Gateway and Mobile Gateway.

Values
gn — Gn interface
s2a — S2a interface
s2b —S2b interface

remote-address *ip-address* **—**

Values

ip-address:	ipv4-address	- a.b.c.d
ipv6-address :	x:x:x:x:x:x:x:x	(eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d	
	x - [0..FFFF]H	
	d - [0..255]D	

udp-port *port* **—** Specifies the UDP port.

Values 1 — 65535

statistics — Displays statistics information about the Mobile Gateways connected to this system.

Sample Output

```
*A:Dut-C# show router 300 wlan-gw mobile-gateway mgw-profile "Ivo"
===============================================================================
Mobile gateways
===============================================================================
Remote address              : 9.0.0.29
UDP port                    : 2123
-------------------------------------------------------------------------------
State                       : up
Local address               : 5.1.45.3
Profile                     : Ivo
Control protocol            : gtpv1-c
Interface type              : gn
Restart count               : 1
Time                        : 2014/03/24 15:38:53
-------------------------------------------------------------------------------
No. of Mobile gateways: 1


*A:Dut-C# show router 300 wlan-gw mobile-gateway local-address 5.1.45.3
===============================================================================
Mobile gateways
===============================================================================
Remote address              : 9.0.0.29
UDP port                    : 2123
-------------------------------------------------------------------------------
State                       : up
Local address               : 5.1.45.3
Profile                     : Ivo
Control protocol            : gtpv1-c
Interface type              : gn
Restart count               : 1
Time                        : 2014/03/24 15:38:53

-------------------------------------------------------------------------------
No. of Mobile gateways: 1


*A:Dut-C# show router 300 wlan-gw mobile-gateway control gtpv1-c
===============================================================================
Mobile gateways
===============================================================================
Remote address              : 9.0.0.29
UDP port                    : 2123
-------------------------------------------------------------------------------
State                       : up
Local address               : 5.1.45.3
Profile                     : Ivo
Control protocol            : gtpv1-c
Interface type              : gn
Restart count               : 1
Time                        : 2014/03/24 15:38:53

-------------------------------------------------------------------------------
No. of Mobile gateways: 1
```

```
*A:Dut-C# show router 300 wlan-gw mobile-gateway interface-type gn
===============================================================================
Mobile gateways
===============================================================================
Remote address              : 9.0.0.29
UDP port                    : 2123
-------------------------------------------------------------------------------
State                       : up
Local address               : 5.1.45.3
Profile                     : Ivo
Control protocol            : gtpv1-c
Interface type              : gn
Restart count               : 1
Time                        : 2014/03/24 15:38:53

-------------------------------------------------------------------------------
No. of Mobile gateways: 1


*A:Dut-C# show router 300 wlan-gw mobile-gateway remote-address 9.0.0.29
===============================================================================
Mobile gateway
===============================================================================
Remote address              : 9.0.0.29
UDP port                    : 2123
-------------------------------------------------------------------------------
State                       : up
Local address               : 5.1.45.3
Profile                     : Ivo
Control protocol            : gtpv1-c
Interface type              : gn
Restart count               : 1
Time                        : 2014/03/24 15:38:53


*A:Dut-C# show router 300 wlan-gw mobile-gateway remote-address 9.0.0.29 udp-port
2123
===============================================================================
Mobile gateway
===============================================================================
Remote address              : 9.0.0.29
UDP port                    : 2123
-------------------------------------------------------------------------------
State                       : up
Local address               : 5.1.45.3
Profile                     : Ivo
Control protocol            : gtpv1-c
Interface type              : gn
Restart count               : 1
Time                        : 2014/03/24 15:38:53


*A:Dut-C# show router 300 wlan-gw mobile-gateway remote-address 9.0.0.29 udp-port
2123 statistics
===============================================================================
Mobile gateway statistics
===============================================================================
tx echo requests                                        : 4
tx echo responses                                       : 0
rx echo requests                                        : 0
rx echo responses                                       : 4
```

```
rx version not supported                          : 0
rx malformed pkts                                 : 0
rx unknown pkts                                   : 0
rx missing IE pkts                                : 0
peer restarts                                     : 0
peer restart counter                              : 1
path mgmt failures                                : 0
create PDP requests                               : 1
create PDP responses                              : 1
delete PDP requests                               : 0
delete PDP responses                              : 0
modify PDP requests                               : 0
modify PDP responses                              : 0
```

soft-gre-tunnel-qos

Syntax **soft-gre-tunnel-qos** [**detail**]
soft-gre-tunnel-qos remote-ip *ip-address* [**local-ip** *ip-address*] [**detail**]

Context show>router>wlan-gw

Description This command displays soft-GRE tunnel-QoS resource information.

Parameters **remote-address** *ip-address* — Specifies the IP address of the Mobile Gateway,that is the source IP address in the tunnel header of received packets.

Values

ip-address:	ipv4-address	- a.b.c.d
ipv6-address :	x:x:x:x:x:x:x:x	(eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d	
	x - [0..FFFF]H	
	d - [0..255]D	

local-address *ip-address* — Specifies the IP address of this system,that is the destination IP address in the tunnel header of received packets.

Values

ip-address:	ipv4-address	- a.b.c.d
ipv6-address :	x:x:x:x:x:x:x:x	(eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d	
	x - [0..FFFF]H	
	d - [0..255]D	

detail — Displays detailed information.

Sample Output

```
*A:Dut-C# show router 50 wlan-gw soft-gre-tunnel-qos
===============================================================================
Soft GRE tunnel QoS
===============================================================================
Remote IP address           : 201.0.0.2
Local IP address            : 50.1.1.1
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A
```

```
*A:Dut-C# show router 50 wlan-gw soft-gre-tunnel-qos detail
===============================================================================
Soft GRE tunnel QoS
===============================================================================
Remote IP address           : 201.0.0.2
Local IP address            : 50.1.1.1
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A
Service Access Points(SAP)
===============================================================================
Service Id         : 2147483650
SAP                : 5/1/lo-gre:1             Encap             : q-tag
Description        : Internal SAP
Admin State        : Up                       Oper State        : Up
Flags              : None
Multi Svc Site     : None
Last Status Change : 03/24/2014 15:03:48
Last Mgmt Change   : 03/24/2014 15:14:00

-------------------------------------------------------------------------------
Encap Group Specifics
-------------------------------------------------------------------------------
Encap Group Name   : _tmnx_SHAPER_GR000       Group Type        : ISID
Qos-per-member     : TRUE
Members            :
1

-------------------------------------------------------------------------------
QOS
-------------------------------------------------------------------------------
E. qos-policy      : 1                        Q Frame-Based Acct: Disabled
E. Sched Policy    :                          E. Agg-limit      : -1
                                              Limit Unused BW   : Disabled
-------------------------------------------------------------------------------
Encap Group Member 1 Base Statistics
-------------------------------------------------------------------------------
Last Cleared Time     : N/A

Forwarding Engine Stats
                        Packets                 Octets

For. InProf           : 0                       0
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0

-------------------------------------------------------------------------------
Encap Group Member 1 Queue Statistics
-------------------------------------------------------------------------------

                        Packets                 Octets

Egress Queue 1
For. InProf           : 0                       0
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
```

```
*A:Dut-C# show router 50 wlan-gw soft-gre-tunnel-qos remote-ip 201.0.0.2
===============================================================================
Soft GRE tunnel QoS
===============================================================================
Remote IP address           : 201.0.0.2
Local IP address            : 50.1.1.1
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A


*A:Dut-C# show router 50 wlan-gw soft-gre-tunnel-qos  remote-ip 201.0.0.2  local-ip
50.1.1.1
===============================================================================
Soft GRE tunnel QoS
===============================================================================
Remote IP address           : 201.0.0.2
Local IP address            : 50.1.1.1
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A


*A:Dut-C# show router 50 wlan-gw soft-gre-tunnel-qos  remote-ip 201.0.0.2  local-ip
50.1.1.1 detail
===============================================================================
Soft GRE tunnel QoS
===============================================================================
Remote IP address           : 201.0.0.2
Local IP address            : 50.1.1.1
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A
Service Access Points(SAP)
===============================================================================
Service Id         : 2147483650
SAP                : 5/1/lo-gre:1             Encap             : q-tag
Description        : Internal SAP
Admin State        : Up                       Oper State        : Up
Flags              : None
Multi Svc Site     : None
Last Status Change : 03/24/2014 15:03:48
Last Mgmt Change   : 03/24/2014 15:14:00

-------------------------------------------------------------------------------
Encap Group Specifics
-------------------------------------------------------------------------------
Encap Group Name   : _tmnx_SHAPER_GR000       Group Type        : ISID
Qos-per-member     : TRUE
Members            :
1

-------------------------------------------------------------------------------
QOS
-------------------------------------------------------------------------------
E. qos-policy      : 1                        Q Frame-Based Acct: Disabled
E. Sched Policy    :                          E. Agg-limit      : -1
                                              Limit Unused BW   : Disabled
-------------------------------------------------------------------------------
Encap Group Member 1 Base Statistics
-------------------------------------------------------------------------------
```

```
Last Cleared Time     : N/A

Forwarding Engine Stats
                        Packets                 Octets

For. InProf           : 0                       0
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0

-------------------------------------------------------------------------------
Encap Group Member 1 Queue Statistics
-------------------------------------------------------------------------------

                        Packets                 Octets

Egress Queue 1
For. InProf           : 0                       0
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
```

soft-gre-tunnels

Syntax **soft-gre-tunnels local-ip** *ip-address* **remote-ip** *ip-address* **ue**
soft-gre-tunnels [**local-ip** *ip-address*] [**remote-ip** *ip-address*] [**isa-group** *wlan-gw-group-id*] [**member** [1..255]] [**summary**] [**detail**]

Context show>router>wlan-gw

Description This command displays soft-GRE tunnel-QoS resource information.

Parameters **remote-address** *ip-address* **—** Specifies the IP address of the Mobile Gateway,that is the source IP address in the tunnel header of received packets.

Values

ip-address:	ipv4-address	- a.b.c.d
ipv6-address :	x:x:x:x:x:x:x:x	(eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d	
	x - [0..FFFF]H	
	d - [0..255]D	

local-address *ip-address* **—** Specifies the IP address of this system,that is the destination IP address in the tunnel header of received packets.

Values

ip-address:	ipv4-address	- a.b.c.d
ipv6-address :	x:x:x:x:x:x:x:x	(eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d	
	x - [0..FFFF]H	
	d - [0..255]D	

ue — Displays information for the specified user equipment.

isa-group *wlan-gw-group-id* **—** Specifies the identifier of the WLAN Gateway ISA group that terminates GRE for this group interface.

Values 1 — 4

member [1..255] **—** Specfies the identifier of this WLAN Gateway ISA Group member.

summary — Displays a summary of the specified parameters.

detail — Displays detailed information.

Sample Output

```
*A:Dut-C# show router 50 wlan-gw soft-gre-tunnels
===============================================================================
Soft GRE tunnels
===============================================================================
Remote IP address           : 201.0.0.2
Local IP address            : 50.1.1.1
ISA group ID                : 1
ISA group member ID         : 5
Time established            : 2014/03/24 15:38:52
Number of UE                : 1
Access Point MAC            : 00:00:00:00:00:01
AP MAC learn failed         : false

Tunnel QoS
----------
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A

-------------------------------------------------------------------------------
No. of tunnels: 1


*A:Dut-C# show router 50 wlan-gw soft-gre-tunnels local-ip 50.1.1.1
===============================================================================
Soft GRE tunnels
===============================================================================
Remote IP address           : 201.0.0.2
Local IP address            : 50.1.1.1
ISA group ID                : 1
ISA group member ID         : 5
Time established            : 2014/03/24 15:38:52
Number of UE                : 1
Access Point MAC            : 00:00:00:00:00:01
AP MAC learn failed         : false

Tunnel QoS
----------
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A

-------------------------------------------------------------------------------
No. of tunnels: 1


*A:Dut-C# show router 50 wlan-gw soft-gre-tunnels local-ip 50.1.1.1 remote-ip
201.0.0.2
===============================================================================
Soft GRE tunnels
===============================================================================
Remote IP address           : 201.0.0.2
```

```
Local IP address            : 50.1.1.1
ISA group ID                : 1
ISA group member ID         : 5
Time established            : 2014/03/24 15:38:52
Number of UE                : 1
Access Point MAC            : 00:00:00:00:00:01
AP MAC learn failed         : false

Tunnel QoS
----------
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A

-------------------------------------------------------------------------------
No. of tunnels: 1


*A:Dut-C# show router 50 wlan-gw soft-gre-tunnels local-ip 50.1.1.1 remote-ip
201.0.0.2 ue
===============================================================================
Tunnel User Equipments
===============================================================================
MAC address                 : 00:02:00:00:00:01
-------------------------------------------------------------------------------
VLAN Q-tag                  : 1
MPLS label                  : (Not Specified)
Tunnel router               : 50
Tunnel remote IP address    : 201.0.0.2
Tunnel local IP address     : 50.1.1.1
Retail service              : N/A
SSID                        : "1"
Previous Access Point IP    : (Not Specified)
IMSI                        : 206100000000001
MGW router                  : 300
Mobile Gateway              : 9.0.0.29
APN                         : full.dotted.apn.mnc010.mcc206.gprs
Last move time              : 2014/03/24 15:38:52
-------------------------------------------------------------------------------
No. of UE: 1


*A:Dut-C# show router 50 wlan-gw soft-gre-tunnels local-ip 50.1.1.1 remote-ip
201.0.0.2 isa-group 1
===============================================================================
Soft GRE tunnels
===============================================================================
Remote IP address           : 201.0.0.2
Local IP address            : 50.1.1.1
ISA group ID                : 1
ISA group member ID         : 5
Time established            : 2014/03/24 15:38:52
Number of UE                : 1
Access Point MAC            : 00:00:00:00:00:01
AP MAC learn failed         : false

Tunnel QoS
----------
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A
```

```
-------------------------------------------------------------------------------
No. of tunnels: 1


*A:Dut-C# show router 50 wlan-gw soft-gre-tunnels local-ip 50.1.1.1 remote-ip
201.0.0.2 isa-group 1 member 5
===============================================================================
Soft GRE tunnels
===============================================================================
Remote IP address           : 201.0.0.2
Local IP address            : 50.1.1.1
ISA group ID                : 1
ISA group member ID         : 5
Time established            : 2014/03/24 15:38:52
Number of UE                : 1
Access Point MAC            : 00:00:00:00:00:01
AP MAC learn failed         : false

Tunnel QoS
----------
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A

-------------------------------------------------------------------------------
No. of tunnels: 1


*A:Dut-C# show router 50 wlan-gw soft-gre-tunnels local-ip 50.1.1.1 remote-ip
201.0.0.2 isa-group 1 member 5 summary
===============================================================================
Soft GRE tunnels summary
===============================================================================
Remote IP address - Local IP address
-------------------------------------------------------------------------------
201.0.0.2 - 50.1.1.1
-------------------------------------------------------------------------------
No. of tunnels: 1


*A:Dut-C# show router 50 wlan-gw soft-gre-tunnels local-ip 50.1.1.1 remote-ip
201.0.0.2 isa-group 1 member 5 detail
===============================================================================
Soft GRE tunnels
===============================================================================
Remote IP address           : 201.0.0.2
Local IP address            : 50.1.1.1
ISA group ID                : 1
ISA group member ID         : 5
Time established            : 2014/03/24 15:38:52
Number of UE                : 1
Access Point MAC            : 00:00:00:00:00:01
AP MAC learn failed         : false

Tunnel QoS
----------
Operational state           : active
Number of UE                : 1
Remaining hold time (s)     : N/A
Service Access Points(SAP)
```

```
===============================================================================
Service Id         : 2147483650
SAP                : 5/1/lo-gre:1             Encap             : q-tag
Description        : Internal SAP
Admin State        : Up                       Oper State        : Up
Flags              : None
Multi Svc Site     : None
Last Status Change : 03/24/2014 15:03:48
Last Mgmt Change   : 03/24/2014 15:14:00
-------------------------------------------------------------------------------
Encap Group Specifics
-------------------------------------------------------------------------------
Encap Group Name   : _tmnx_SHAPER_GR000       Group Type        : ISID
Qos-per-member     : TRUE
Members            :
1
-------------------------------------------------------------------------------
QOS
-------------------------------------------------------------------------------
E. qos-policy      : 1                        Q Frame-Based Acct: Disabled
E. Sched Policy    :                          E. Agg-limit      : -1
                                              Limit Unused BW   : Disabled
-------------------------------------------------------------------------------
Encap Group Member 1 Base Statistics
-------------------------------------------------------------------------------
Last Cleared Time     : N/A

Forwarding Engine Stats
                        Packets                 Octets

For. InProf           : 0                       0
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
-------------------------------------------------------------------------------
Encap Group Member 1 Queue Statistics
-------------------------------------------------------------------------------
Packets                 Octets

Egress Queue 1
For. InProf           : 0                       0
For. OutProf          : 0                       0
Dro. InProf           : 0                       0
Dro. OutProf          : 0                       0
===============================================================================
-------------------------------------------------------------------------------
No. of tunnels: 1
```

tunnels

Syntax **tunnels** [**local-ip***ip-address*] [**remote-ip** *ip-address*] [**isa-group** *wlan-gw-group-id*] [**member** [1..255]] [**summary**] [**detail**]
tunnels local-ip *ip-address* **remote-ip** *ip-address* **ue**

Context show>router>wlan-gw

Description This command displays tunnel operation information.

Parameters **local-address** *ip-address* **—** Specifies the IP address of this system,that is the destination IP address in the tunnel header of received packets.

Values

ip-address:	ipv4-address - a.b.c.d
ipv6-address :	x:x:x:x:x:x:x:x (eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d
	x - [0..FFFF]H
	d - [0..255]D

remote-address *ip-address* **—** Specifies the IP address of the Mobile Gateway,that is the source IP address in the tunnel header of received packets.

Values

ip-address:	ipv4-address - a.b.c.d
ipv6-address :	x:x:x:x:x:x:x:x (eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d
	x - [0..FFFF]H
	d - [0..255]D

isa-group *wlan-gw-group-id* **—** Specifies the identifier of the WLAN Gateway ISA group that terminates GRE for this group interface.

Values 1 — 4

member [1..255] **—** Specfies the identifier of this WLAN Gateway ISA Group member.

summary — Displays a summary of the specified parameters.

detail — Displays detailed information.

ue — Displays information for the specified user equipment.

Sample Output

Note that the remote/local IP addresses are locally generated for VLAN tunnels.

```
show router 50 wlan-gw tunnels
===============================================================================
Access Point tunnels
===============================================================================
Remote IP address           : fe80::3e8f:ffff:fe00:1901
Local IP address            : fe80::ff:fe02:202
ISA group ID                : 1
ISA group member ID         : 4
Time established            : 2015/01/07 17:42:01
Number of UE                : 1
Access Point MAC            : 00:00:00:00:00:05
AP MAC learn failed         : false
Encapsulation               : vlan
```

```
VLAN tag 1                  : 1000
VLAN tag 2                  : (None)
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================
```

radius-server-policy

Syntax **radius-server-policy** *policy-name* [**acct-on-off**]
radius-server-policy *policy-name* **associations**
radius-server-policy *policy-name* **msg-buffer-stats**
radius-server-policy *policy-name* **statistics**
radius-server-policy [**acct-on-off**]

Context show>aaa

Description This command displays RADIUS server policy information.

Parameters *policy-name* — Displays information pertaining to the specified policy name.

associations — Displays the association between the RADIUS server policy and the applications referencing the policy (RADIUS proxy, route downloader, authentication policy, accounting policy, dynamic services policy).

statistics — Displays statistics of the RADIUS server policy and RADIUS servers referenced in the policy.

acct-on-off — Displays the acct-on-off operational state for the RADIUS server policy.

msg-buffer-stats — – Displays statistics for the RADIUS message buffering.

Sample Output

```
show aaa radius-server-policy "aaa-server-policy-1"
===============================================================================
RADIUS server policy "aaa-server-policy-1"
===============================================================================
Description                 : Radius AAA server policy
Acct Request script policy  : (Not Specified)
Auth Request script policy  : (Not Specified)
Accept script policy        : script-policy-1
Acct-On-Off                 : Enabled (state Not Blocked)
-------------------------------------------------------------------------------
RADIUS server settings
-------------------------------------------------------------------------------
Router                      : "Base"
Source address              : (Not Specified)
Access algorithm            : direct
Retry                       : 3
Timeout (s)                 : 5
Hold down time (s)          : 30
Last management change      : 02/20/2013 13:32:05
===============================================================================
===============================================================================
Servers for "aaa-server-policy-1"
===============================================================================
Idx Name                              Address         Port        Oper State
                                                      Auth/Acct
-------------------------------------------------------------------------------
1   server-1                          172.16.1.1      1812/1813   in-service
===============================================================================
```

```
# show aaa radius-server-policy acct-on-off
===============================================================================
RADIUS server policies AcctOnOff state
===============================================================================
Name                                    OperState      LastStateChange
-------------------------------------------------------------------------------
aaa-server-policy-1                     on             02/20/2013 21:23:57
aaa-server-policy-2                     NotApplicable  NotApplicable
aaa-server-policy-3                     sendAcctOn     NotApplicable
aaa-server-policy-4                     off            02/20/2013 21:40:57
-------------------------------------------------------------------------------
No. of policies: 4
===============================================================================

# show aaa radius-server-policy "aaa-server-policy-1" acct-on-off
===============================================================================
RADIUS server policy "aaa-server-policy-1" AcctOnOff info
===============================================================================
Oper state                  : on
Session Id                  : 242FFF0000000451253EED
Last state change           : 02/20/2013 21:23:57
Trigger                     : startUp
Server                      : "server-1"
===============================================================================


show aaa radius-server-policy "aaa-server-policy-3" msg-buffer-stats
===============================================================================
RADIUS server policy "aaa-server-policy-3" message buffering stats
===============================================================================
buffering acct-interim      : enabled
  min interval (s)          : 60
  max interval (s)          : 3600
  lifetime (hrs)            : 12
buffering acct-stop         : enabled
  min interval (s)          : 60
  max interval (s)          : 3600
  lifetime (hrs)            : 12

Statistics
-------------------------------------------------------------------------------
Total acct-stop messages in buffer                      : 6
Total acct-interim messages in buffer                   : 10
Total acct-stop messages dropped (lifetime expired)     : 0
Total acct-interim messages dropped (lifetime expired)  : 0
Last buffer clear time                                  : N/A
Last buffer statistics clear time                       : N/A
-------------------------------------------------------------------------------
===============================================================================


show aaa radius-server-policy "aaa-server-policy-1" statistics
===============================================================================
RADIUS server policy "aaa-server-policy-1" statistics
===============================================================================
Tx transaction requests                     : 383
Rx transaction responses                    : 383
Transaction requests timed out              : 0
Transaction requests send failed            : 0
Packet retries                              : 0
Transaction requests send rejected          : 0
```

```
Authentication requests failed                 : 0
Accounting requests failed                     : 0
Ratio of access-reject over auth responses     : 0%
Transaction success ratio                      : 100%
Transaction failure ratio                      : 0%
Statistics last reset at                       : n/a

Server 1 "server-1" address 172.16.1.1 auth-port 1812 acct-port 1813
-------------------------------------------------------------------------------
Tx request packets                             : 383
Rx response packets                            : 383
Request packets timed out                      : 0
Request packets send failed                    : 0
Request packets send failed (overload)         : 0
Request packets waiting for reply              : 0
Response packets with invalid authenticator    : 0
Response packets with invalid msg authenticator : 0
Authentication packets failed                  : 0
Accounting packets failed                      : 0
Avg auth response delay (10 100 1K 10K) in ms  :   27.1   22.8   22.8   22.8
Avg acct response delay (10 100 1K 10K) in ms  :   6.24   12.5   11.5   11.5
Statistics last reset at                       : n/a

===============================================================================


show aaa radius-server-policy "myRadiusServerPolicy1" associations
===============================================================================
RADIUS Proxy Associations
===============================================================================
Router RADIUS Proxy Server Purpose Username
-------------------------------------------------------------------------------
Base myProxyServerBase acc (default)
vprn10 myProxyServer1 acc (default)
-------------------------------------------------------------------------------
No. of associations: 2


show aaa radius-server-policy "aaa-server-policy-1" associations
===============================================================================
RADIUS Proxy Associations
===============================================================================
Router RADIUS Proxy Server Purpose Username
-------------------------------------------------------------------------------
Base   myProxyServerBase   acc     (default)
-------------------------------------------------------------------------------
No. of associations: 1
===============================================================================
No route downloader entries found.
===============================================================================
Authentication Policy Associations
===============================================================================
Authentication Policy
-------------------------------------------------------------------------------
auth-policy-1
-------------------------------------------------------------------------------
No. of associations: 1
===============================================================================
===============================================================================
Accounting Policy Associations
===============================================================================
```

```
Accounting Policy
-------------------------------------------------------------------------------
acct-policy-1
acct-policy-2
-------------------------------------------------------------------------------
No. of associations: 2
===============================================================================
No dynamic-services policy entries found.
```

wlan-gw-group

Syntax **wlan-gw-group** *wlan-gw-group-id*
wlan-gw-group *wlan-gw-group-id* **associations**
wlan-gw-group *wlan-gw-group-id* **member** [1..255] [**statistics**]
wlan-gw-group

Context show>isa

Description This command displays WLAN-GW group information including wlan-gw tunnels.

Parameters *wlan-gw-group-id* — Displays information about the specified wlan-gw-group-id.

associations — Displays information about association for the specified wlan-gw-group-id.

member [1..255] **—** Displays information about the WLAN-GW-specific status and basic statistics information about the specified member.

statistics — Displays statistics information about the members of the specified WLAN-GW group.

Sample Output

```
system# show isa wlan-gw-group 1
===============================================================================
WLAN Gateway group 1
===============================================================================
test
Administrative state        : in-service
Operational state           : in-service
Active IOM limit            : 2
Port policy                 : myPortPol
Last Mgmt Change            : 02/17/2012 14:54:27
-------------------------------------------------------------------------------
NAT specific information for ISA group 1
-------------------------------------------------------------------------------
Reserved sessions           : 10
High Watermark (%)          : 20
Low Watermark (%)           : 10
Accounting policy           : natAccPol
Last Mgmt Change            : 02/17/2012 15:01:31
-------------------------------------------------------------------------------
===============================================================================
===============================================================================
ISA Group 1 members
===============================================================================
Group    Member     State          Mda     Addresses     Blocks     Se-%    Hi     Se-
Prio
-------------------------------------------------------------------------------
```

```
-------------------------------------------
        1               1             active        3/1             0
0          < 1      N         10
1               2             active        3/2             0               0
< 1      N          10
1               3             active        4/1             0               0
< 1      N          10
1               4             active        4/2             0               0
< 1      N          10
-------------------------------------------------------------------------------
-------------------------------------------
No. of members: 4
===============================================================================
System# show isa wlan-gw-group 1 member 2
===============================================================================
ISA WLAN Gateway Group 1 Member 2
===============================================================================
MDA                                                          : 3/2
Number of wlan-gw tunnels                                   : 0
Number of UE                                                 : 0
Number of activated Egress Encapsulation Group members       : 0
Number of pending Egress Encapsulation Group members         : 0
Number of tunnel QoS problems                                : 0
===============================================================================
```

gtp-session

Syntax **gtp-session imsi** *imsi* **apn** *apn-string* | **gtp-session** [**mgw-address** *ip-address*] [**mgw-router** *router-instance*] [**remote-control-teid** *teid*] [**local-control-teid** *teid*] [**detail**]
gtp-session imsi *imsi*
gtp-statistics

Context show>subscr-mgmt>wlan-gw

Description This command displays GTP session information.

Parameters **imsi** *imsi* **—** Specifies the IMSI (International Mobile Subscriber Identity) of this UE.

apn *apn-string* **—** Specifies the APN (Access Point Name).

mgw-address *ip-address* **—** Specifies the IP address of the Mobile Gateway, \that is the source IP address in the tunnel header of received packets.

mgw-router *router-instance* **—** Specifies the identifier of the virtual router instance where the GTP tunnel is terminated.

remote-control-teid *teid* **—** Specifies the remote control plane Tunnel Endpoint Identifier (TEID).

local-control-teid *teid* **—** Specifies the local control plane Tunnel Endpoint Identifier (TEID).

detail — Displays detailed information.

Sample Output

```
*A:Dut-C# show subscriber-mgmt wlan-gw gtp-session
===============================================================================
```

```
GTP sessions
===============================================================================
IMSI                        : 206100000000001
APN                         : full.dotted.apn.mnc010.mcc206.gprs
-------------------------------------------------------------------------------
Mobile Gateway router       : 300
Mobile Gateway address      : 9.0.0.29
Remote control TEID         : 5678
Local control TEID          : 4289724672
Charging characteristics    : (None)
-------------------------------------------------------------------------------
No. of GTP sessions: 1
```

gtp-statistics

Syntax **gtp-statistics**

Context show>subscr-mgmt>wlan-gw

Description This command displays GTP statistics.

mgw-profile

Syntax **mgw-profile** *profile-name*
mgw-profile *profile-name* **associations**
mgw-profile

Context show>subscr-mgmt>wlan-gw

Description This command displays Mobile Gateway profile information.

ssid

Syntax **ssid**

Context show>subscr-mgmt>wlan-gw

Description This command displays SSID information.

statistics

Syntax **statistics**

Context show>subscr-mgmt>wlan-gw

Description This command displays statistics information.

ue

Syntax **ue** [**vlan** *qtag*] [**mpls-label** *label*] [**retail-svc-id** *service-id*] [**ssid** *service-set-id*] [**previous-access-point** *ip-address*]
ue mac *ieee-address*

Context show>subscr-mgmt>wlan-gw

Description This command displays user equipment information.

Parameters **vlan** *qtag* — Displays information about the VLAN Q-tag present in the traffic received from this UE.

Values 1 — 4095

mpls-label *label* — Displays information about the MPLS label present in the traffic received from this UE.

retail-svc-id *service-id* — Displays information about the identifier of the specified retail service.

ssid *service-set-id* — Displays information about the Service Set ID (SSID) of this UE.

previous-access-point *ip-address* — Displays information about the IP address of the previous Access Point (AP) of this UE.

mac *ieee-address* — Displays information about the MAC address of this UE.

Values xx:xx:xx:xx:xx:xx or xx-xx-xx-xx-xx-xx

Sample Output

```
System# show subscriber-mgmt wlan-gw ue
===============================================================================
User Equipments
===============================================================================
MAC address                 : 00:02:00:00:00:39
-------------------------------------------------------------------------------
VLAN Q-tag                  : 1
MPLS label                  : (Not Specified)
Tunnel router               : 50
Tunnel remote IP address    : 20C9::7:1:2
Tunnel local IP address     : 2032::1:1:7
Retail service              : N/A
SSID                        : 1
Previous Access Point IP    : (Not Specified)
IMSI                        : (Not Specified)
Last move time              : 2013/07/02 07:45:31

-------------------------------------------------------------------------------
No. of UE: 1
===============================================================================
System#
```

Tools Commands

acct-on

Syntax **acct-on** [**radius-server-policy** *policy-name*] [**force**]

Context tools>perform>aaa

Description This command triggers a RADIUS Accounting-On message:

- for all radius-server-policies that have acct-on-off configured.
- for the specified radius-server-policy if the acct-on-off is configured

The Accounting-On message is not sent when the last successful event for the radius server policy was an Accounting-On message. In this case, an Accounting-Off should be sent first. By specifying the keyword “force”, this is overruled.

Parameters **radius-server-policy** *policy-name* — Specifies the radius-server-policy for which the Accounting-On should be sent.

force — Sends an Accounting-On also if the last successful event was an Accounting-On.

acct-off

Syntax **acct-off** [**radius-server-policy** *policy-name*] [**force**] [**acct-terminate-cause** *number*]

Context tools>perform>aaa

Description This command triggers a RADIUS Accounting-Off message:

- for all radius-server-policies that have acct-on-off configured.
- for the specified radius-server-policy if the acct-on-off is configured

The Accounting-Off message is not sent when the last successful event for the radius server policy was an Accounting-Off message. In this case, an Accounting-On should be sent first. By specifying the keyword “force”, this is overruled.

Parameters **radius-server-policy** *policy-name* — Specifies the radius-server-policy for which the Accounting-Off should be sent.

force — Sends an Accounting-On also if the last successful event was an Accounting-Off.

acct-terminate-cause *number* — Overrides the default Acct-Terminate-Cause (User-Request) in the Accounting-Off message.

radius-server-policy

Syntax **radius-server-policy** *policy-name* **msg-buffer** [**session-id** *acct-session-id*]

Context tools>perform>aaa

Description This command dumps the RADIUS message buffer content for the specified radius-server-policy:

- message-type (acct-interim or acct-stop)
- Acct-Session-Id
- Remaining lifetime

When specifying the session-id, the message details are displayed.

Parameters *policy-name* — Specifies the radius-server-policy for which the message buffer content should be displayed.

session-id *acct-session-id* — Display the RADIUS message details for the message with specified session-id that is stored in the RADIUS message buffer.

ue

Syntax **ue**

Context tools>dump>wlan-gw

Description This command dumps user equipment (UE) information.

Sample Output

```
tools dump wlan-gw ue
===============================================================================
Matched 1 session on Slot #4 MDA #1
===============================================================================
UE-Mac          : 00:02:00:00:00:11     UE-vlan         : 3600
UE IP Addr      : N/A                   UE timeout      : N/A
UE IP6 Addr     : N/A
Description     : L2-user
Auth/CoA-time   : 01/07/2015 18:56:01
Tunnel MDA      : 5/1                   Tunnel Router   : 50
MPLS label      : N/A                   Shaper          : Default
Tunnel Src IP   : 201.0.0.2             Tunnel Dst IP   : 50.1.1.1
Tunnel Type     : GRE
Anchor SAP      : 4/1/nat-out-ip:2049.6
AP-Mac          : Unknown               AP-RSSI         : Unknown
AP-SSID         : Unknown
Last-forward    : 01/07/2015 18:56:01   Last-move       : None
Session Timeout : None                  Idle Timeout    : 300 sec
Acct Update     : None                  Acct Interval   : N/A
Acct Session-Id : N/A
Acct Policy     : N/A
NAT Policy      : N/A
Redirect Policy : N/A
IP Filter       : N/A
App-profile     : N/A
Rx Oper PIR     : N/A                   Rx Oper CIR     : N/A
Tx Oper PIR     : N/A                   Tx Oper CIR     : N/A
Rx Frames       : 0                     Rx Octets       : 0
Tx Frames       : 0                     Tx Octets       : 0
-------------------------------------------------------------------------------
===============================================================================
No sessions on Slot #4 MDA #2 match the query
```

```
No sessions on Slot #5 MDA #1 match the query
No sessions on Slot #5 MDA #2 match the query
```

Clear Commands

radius-server-policy

Syntax **radius-server-policy** *policy-name* **msg-buffer** [**acct-session-id** *acct-session-id*]
radius-server-policy *policy-name* **statistics** [**msg-buffer-only**]
radius-server-policy *policy-name* **server** *server-index* **statistics**

Context clear>aaa

Description This command dumps the RADIUS message buffer content for the specified radius-server-policy:

- message-type (acct-interim or acct-stop)
- Acct-Session-Id
- Remaining lifetime

When specifying the session-id, the message details are displayed.

Parameters *policy-name* — Specifies the radius-server-policy for which the information should be cleared.

msg-buffer [**acct-session-id** *acct-session-id*] **—** Deletes all RADIUS messages or the RADIUS message with specified session-id from the RADIUS message buffer.

statistics [msg-buffer-only] — Clears all statistics for the specified radius-server-policy: radius-server-policy statistics, RADIUS server statistics and RADIUS message buffer statistics. With the optional keyword “msg-buffer-only”, only the RADIUS message buffer statistics are cleared.

server *server-index* **statistics —** Clears the RADIUS server statistics for the specified server-index in the specified radius-server-policy.

RADIUS Triggered Dynamic Data Services

In This Section

Topics in this section include:

Introduction to RADIUS Triggered Dynamic Data Services

RADIUS triggered Dynamic Data Services enables a zero touch, single ended provisioning model for business services. Triggered by the authentication of a single or dual stack PPPoE session or single stack IPv4 host as business CPE control channel, parameters are passed in a RADIUS Access Accept or CoA message to setup a Layer 2 or Layer 3 data service. Dynamic Data Services supported in this release include local Epipe VLL services, Epipe VLL services with dynamic MS-PWs (FEC 129), vpls services with BGP-AD pseudowire, IES and VPRN services. Dynamic Data Service SAPs have to be located on dot1q or qinq encapsulated Ethernet ports and can be part of a LAG.

A Python script interface adds a flexible abstraction layer reducing the OSS integration cost: only the business user specific service parameters (service type, IP address, QoS, and filter parameters) are required from RADIUS and then used in a CLI template to setup the target service. Both XML and RADIUS accounting to up to two different RADIUS destinations can be activated on a dynamic data service SAP.

RADIUS Triggered Dynamic Data Services Command Reference

Configuration Commands

RADIUS Triggered Dynamic Data Services Commands

```
config
    — service
        — dynamic-services
            — dynamic-services-policy dynsrv-policy-name [create]
            — no dynamic-services-policy dynsrv-policy-name
                — accounting-1
                    — server-policy policy-name
                    — no server-policy
                    — stats-type {time | volume-time}
                    — no stats-type
                    — update-interval [hrs hours] [min minutes] [days days]
                    — no update-interval
                    — update-interval-jitter absolute seconds
                    — no update-interval-jitter
                — accounting-2
                    — server-policy policy-name
                    — no server-policy
                    — stats-type {time|volume-time}
                    — no stats-type
                    — update-interval [hrs hours] [min minutes] [days days]
                    — no update-interval
                    — update-interval-jitter absolute seconds
                    — no update-interval-jitter
                — cli-user name
                — no cli-user
                — description description-string
                — no description
                — sap-limit [0..131072]
                — no sap-limit
                — script-policy name
                — no script-policyy
            — service-range service-id service-id
            — no service-range
            — timers
                — setup-timeout access-accept timeout
                — no setup-timeout
```

```
config
    — system
```

```
            — security
                — password
                    — dynsvc-password password [hash|hash2]
                    — no dynsvc-password

<global>
    — [no] enable-dynamic-services-config
```

Show Commands

```
show
    — service
        — dynamic-services
            — dynamic-services-policy [policy-name]
            — root-objects
            — saps [control-sessionacct-session-id] [port port-id] [dynsvc-policy policy-name]
              [summary] [orphaned] [sap sap-id] [svc-id service-id]
            — script
                — snippets [detail]
                — snippets name snippet-name [instance snippet-instance] [detail]
                — statistics
            — summary
        — sap-using [msap] [dyn-script] [description]
```

Tools Commands

```
tools
    — perfrom
        — service
            — dynamic-services
                — evaluate-script sap sap-id control-session acct-session-id action script-action [dynsvc-policy name] [param-string string]

    — dump
        — service
            — dynamic-services
```

Clear Commands

```
clear
    — services
        — statistics
            — dynamic-services
```

Debug Commands

```
debug
    — [no] dynamic-services
        — scripts
            — [no] event
                — [no] cli
                — [no] errors
                — [no] executed-cmd
                — [no] state-change
                — [no] warnings
            — instance instance
                — [no] event
                    — [no] cli
                    — [no] errors
                    — [no] executed-cmd
                    — [no] state-change
                    — [no] warnings
            — script script
                — [no] event
                    — [no] cli
                    — [no] errors
                    — [no] executed-cmd
                    — [no] state-change
                    — [no] warnings
```

WIFI Aggregation and Offload Command Reference

Command Hierarchies

dynamic-services

Syntax **dynamic-services**

Context config>service

Description This command enables the context to configure dynamic data services. Only available on systems with multi-core CPM (CPM3 or up).

dynamic-services-policy

Syntax **dynamic-services-policy** *dynsrv-policy-name* [**create**]
no dynamic-services-policy *dynsrv-policy-name*

Context config>service>dynsvc

Description This command creates a new dynamic services policy that can be used to create dynamic data services.

The **no** form of the command removes the dynamic services policy from the configuration. This is only allowed when there are no active dynamic data services referencing this policy.

Default none

Parameters *dynsrv-policy-name* — Specifies a unique name of a dynamic services policy up to 32 characters in length.

accounting-1

Syntax **accounting-1**

Context config>service>dynsvc>policy

Description This command enables the context to configure the first RADIUS accounting destination and corresponding RADIUS accounting parameters for dynamic data services.

accounting-2

Syntax **accounting-2**

Context config>service>dynsvc>policy

Description This command enables the context to configure the second RADIUS accounting destination and corresponding RADIUS accounting parameters for dynamic data services.

server-policy

Syntax **server-policy** *policy-name*
no server-policy

Context config>service>dynsvc>acct-1
config>service>dynsvc>acct-2

Description This command configures the radius server policy to be used for dynamic data services RADIUS accounting.

The **no** form of the command removes the radius server policy from the configuration. This is only allowed when there are no active dynamic data services referencing this policy.

Default no server-policy

Parameters *policy-name* — Specifies the nname of the radius server policy.

Values max length = 32 characters.

stats-type

Syntax **stats-type** {*time*|*volume-time*}
no stats-type

Context config>service>dynsvc>acct-1
config>service>dynsvc>acct-2

Description This command configures the type of statistics to be reported in dynamic data services RADIUS accounting. A RADIUS specified Stats Type overrides the CLI configured value.

The no form of the command resets the default value.

Default volume-time

Parameters *time* — Only report Session-Time in the RADIUS Acounting Interim-Update and Stop message.

volume-time — Report both Session-Time and Volume counter attributes in the RADIUS. Acounting Interim-Update and Stop messages.

update-interval

Syntax **update-interval** [**hrs** *hours*] [**min** *minutes*] [**days** *days*]
no update-interval

Context config>service>dynsvc>acct-1
config>service>dynsvc>acct-2

Description This command specifies the interval between each RADIUS Accounting Interim-Update message (minimum 5 minutes; maximum 180 days).

The **no** form of the command disables the sending of Accounting Interim-Update messages.

A RADIUS specified Accounting Interim Interval overrides the CLI configured value.

Default no update-interval (do not send Accounting Interim-Update messages)

Parameters *hrs* — specifies the interval in hours.

Values 1 — 23

min — Specifies the interval in minutes.

Values 1 — 59

days — specifies the interval in days.

Values 1 — 180

update-interval-jitter

Syntax **update-interval-jitter absolute** *seconds*
no update-interval-jitter

Context config>service>dynsvc>acct-1
config>service>dynsvc>acct-2

Description This command specifies the absolute maximum random delay introduced on the update interval between two RADIUS Accounting Interim Update messages. The effective maximum random delay value is the minimum of the configured absolute jitter value and 10% of the configured update-interval.

A value of zero will send the accounting interim update message without introducing an additional random delay.

The **no** form of the command sets the default to 10% of the configured update-interval.

Default no update-interval-jitter (10% of the configured update-interval)

Parameters *seconds* — Specifies the absolute maximum jitter value in seconds.

Values 0 — 3600

cli-user

Syntax **cli-user** *name*
no cli-user

Context config>service>dynsvc>policy

Description This command specifies the CLI user to be used to execute the dynamic data services CLI scripts. Via the specified user's profile, it is possible to further restrict the internal list of allowed commands to be executed via dynamic data service CLI scripts.

The **no** form of the command sets the CLI user to an internal user with all configuration rights.

Default no cli-user

Parameters *name* — Specifies the CLI user name that must exist in the >config>system>security CLI context.

description

Syntax **description** *description-string*
no description

Context config>service>dynsvc>policy

Description The description command associates a text string with a configuration context to help identify the content in the configuration file.

The **no** form of this command removes the string from the configuration.

Default no description

Parameters *description-string* — The description character string. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

sap-limit

Syntax **sap-limit** [0..131072]
no sap-limit

Context config>service>dynsvc>policy

Description This command specifies a limit for the number of dynamic data service instances (SAPs) that can be setup simultaneously using a given dynamic services policy.

A value of zero (0) means the policy will be drained: existing dynamic data services can be modified and torn down but no new dynamic data services can be setup.

Default sap-limit 1

Parameters [0..131072] — Specifies the number of dynamic data service SAPs that can be setup simultaneously using this dynamic services policy.

Values 0 — 131072

script-policy

Syntax **script-policy** *name*
no script-policy

Context config>service>dynsvc>policy

Description This command specifies the radius script policy to be used to setup the dynamic data services. The script-policy configuration cannot be changed when there are active dynamic data services referencing the policy.

The **no** form of this command removes the script-policy from the configuration. This is only allowed when there are no active dynamic data services referencing this policy.

Default no script-policy

Parameters *name* — Specifies the radius script policy name.

service-range

Syntax **service-range** *service-id service-id*
no service-range

Context config>service>dynsvc

Description This command specifies the service id range that is reserved for dynamic data service creation. The range cannot overlap with existing static configured services. Once configured with active dynamic services in the range, the service-range can only be extended at the end.

The **no** form of this command removes the service-range from the configuration. This is only allowed when there are no active dynamic data services.

When **no service-range** is specified, the setup of dynamic data services will fail.

Default no service-range

Parameters *service-id* — Specifies the start and end service-id to define the service-range for dynamic services.

Values 1 — 2147483647

timers

Syntax **timers**

Context config>service>dynsvc

Description This command enables the context to configure dynamic data services related timers.

setup-timeout

Syntax **setup-timeout access-accept** *timeout*
no setup-timeout

Context config>service>dynsvc>timers

Description This command specifies the time that dynamic data services setup requests from a RADIUS Access-Accept are hold in an internal work queue waiting to be processed. If after the timeout, the dynamic data service setup request is still in the queue (meaning it is not setup), then the dynamic service setup request will be removed from the queue and the setup fails.

The **no** form of this command resets the timeout to 2 seconds.

Default no setup-timeout (30 seconds)

Parameters *timeout* — Specifies the setup-timeout in seconds for setup requests of dynamic services received via Access-Accept.

Values 2 — 3600 seconds

dynsvc-password

Syntax **dynsvc-password** *password* [**hash**|**hash2**]
no dynsvc-password

Context config>system>security>password

Description NOTE: See also the description for the **enable-dynamic-services-config** command.

This command allows a user with admin permissions to configure a system wide password which enables a user to enter a special dynamic services configuration mode.

The minimum length of the password is determined by the minimum-length command. The complexity requirements for the password are determined by the complexity command.

The **no** form of the command removes the dynsvc password from the configuration

Default no dynsvc-password

Parameters *password* — Configures the password which enables a user to enter a special dynamic services configuration mode. The maximum length can be up to 20 characters if unhashed, 32 characters if hashed, 54 characters if the hash2 keyword is specified.

hash — Specifies the key is entered in an encrypted form. If the hash parameter is not used, the key is assumed to be in a non-encrypted, clear text form.

hash2 — — Specifies the key is entered in a more complex encrypted form. If the hash2 parameter is not used, the key is assumed to be in a non-encrypted, clear text form.

enable-dynamic-services-config

Syntax [**no**] **enable-dynamic-services-config**

Context <global>

Description NOTE: See also the description for the **dynsvc-password** command.

If the dynsvc-password is configured in the **config>system>security>password** context, then any user can enter a special dynamic services configuration mode by entering the **enable-dynamic-services-config** command.

The **enable-dynamic-services-config** command is not in the default profile. To give access to this command, the user must belong to the administrative profile or a new profile should be created.

Once the **enable-dynamic-services-config** command is entered, the user is prompted for a password. If the password matches, the user is given access to the dynamic services configuration. Access to static configuration is in this case prohibited.

To verify that a user is in the **enable-dynamic-services-config** mode, use the **show users** command. Users in the **enable-dynamic-services-config** mode lists the letter “D” next to the user’s CLI session.

The **no** form of this command disables the dynamic services configuration mode for this user.

Default no enable-dynamic-services-config

Show Commands

dynamic-services

Syntax **dynamic-services**

Context show>service

Description This command enables the context to show dynamic services information.

dynamic-services-policy

Syntax **dynamic-services-policy** [*policy-name*]

Context show>service>dynsvc

Description This command displays the dynamic services policy information.

Parameters *policy-name* — specifies for which dynamic services policy the information is requested.

Sample Output

```
# show service dynamic-services dynamic-services-policy "dynsvc-policy-1"
===============================================================================
Dynamic Service Policies
===============================================================================
Dynamic Service Policy      : dynsvc-policy-1
-------------------------------------------------------------------------------
cli-user                    : (Not Specified)
description                 : Dynamic Services Policy 1
script-policy               : script-policy-5
sap-limit                   : 2000

Accounting instance 1
Stats type                  : volume-time
server policy               : aaa-server-policy-1
Update interval (minutes)   : 30
Update interval jitter      : 180s

Accounting instance 2
Stats type                  : time
server policy               : aaa-server-policy-2
Update interval (minutes)   : 0
Update interval jitter      : 10%
-------------------------------------------------------------------------------
No. of Services-policies: 1
===============================================================================
```

root-objects

Syntax **root-objects**

Context show>service>dynsvc

Description This command displays the root objects created by dynamic data services.

OID prefix and index — The corresponding SNMP OID prefix and index for this root object.

Snippet name — The name of the python function that created this root object. The name is set to N/A when the root-object is orphaned.

Snippet instance — The instance for which the python function with "Snippet name" created this root object. If the snippet is a result from a dynamic reference, then the snippet instance is the reference-id string passed in the dyn.reference(). If the snippet is not the result from a dynamic reference, then the snippet instance is the dynamic data service SAP-ID. The instance is set to N/A when the root object is orphaned.

Orphan time — Shows the timestamp when the root-object became orphaned (root-object not deleted when corresponding teardown function is called) or N/A if the root-object is not orphaned.

Sample Output

```
# show service dynamic-services root-objects
===============================================================================
Dynamic Service Root Objects
===============================================================================
OID prefix                  : svcRowStatus
OID index                   : .100000
Snippet name                : vprn
Snippet instance            : VRF-1
Orphan time                 : N/A
-------------------------------------------------------------------------------
No. of Root Objects: 1
===============================================================================
```

saps

Syntax **saps** [**control-session** *acct-session-id*] [**port** *port-id*] [**dynsvc-policy** *policy-name*] [**summary**] [**orphaned**] [**sap** *sap-id*] [**svc-id** *service-id*]

Context show>service>dynsvc

Description This command displays the dynamic services SAPs (instances) details:

- SAP — The dynamic service SAP id.
- Acct session-ID — The dynamic service accounting session id.
- Acct session-ID control — The control channel accounting session id.
- Service — The dynamic service id.
- Orphaned — Yes/No – orphaned state is when the SAP is not deleted when corresponding dynamic service teardown function was called.
- Dynamic Services policy — The policy referenced to setup the dynamic service.

- Number of scripts executed — The number of times the script was executed for this dynamic service (setup, modify, revert or teardown).
- Number of scripts w success — The number of times the script was executed successfully for this dynamic service.
- Last script action — The setup, modify, revert, teardown.
- Time of last script action — The timestamp.
- Parameters of last action — The content of the Dynamic Services Script Parameters attribute corresponding with the last action.
- For each of the two accounting instances:
  - Status — RADIUS accounting enabled or disabled.
  - Stats type — the type of statistics reported in accounting.
- Update interval (minutes) — the interval between Accounting Interim Update messages.

Parameters **summary —** Displays a summary view only.

orphaned — Displays only SAPs in the orphaned state.

Filtering options, display SAPs that belong to the specified:

control-session *acct-session-id* **—** Specifies control session accounting session id

port *port-id* **—** Specifies Ethernet port.

dynsvc-policy *policy-name* **—** Specifies dynamic services policy.

sap sap-id — Specifies dynamic services SAP id.

svc-id *service-id* **—** - service ID of the dynamic service.

Sample Output

```
# show service dynamic-services saps
===============================================================================
Dynamic Services SAP's
===============================================================================
SAP                          : 1/1/1:1.901
-------------------------------------------------------------------------------
Acct session-ID              : 242FFF000001AE512CE4B6
Acct session-ID control      : 242FFF000001AB512CE4B6
Service                      : [100000]
Orphaned                     : no
Dynamic Services policy      : dynsvc-policy-1
Number of scripts executed   : 1
Number of scripts w success  : 1
Last script action           : setup
Time of last script action   : 2013/02/26 16:37:10
Parameters of last action    : vprn_1={'t':('VRF-1',65000,1000,'cpe-int-1','192.
                             : 168.20.1/24','2001:db8:cafe::1/64',901,901,910,92
                             : 0,'192.168.20.0/24','192.168.20.2')}

Accounting instance 1
Status                       : enabled
Stats type                   : volume-time
Update interval (minutes)    : 30

Accounting instance 2
Status                       : enabled
```

```
Stats type                  : time
Update interval (minutes)   : 0

-------------------------------------------------------------------------------
No. of SAP's: 1
===============================================================================


# show service dynamic-services saps summary
===============================================================================
Dynamic Services SAP's summary
===============================================================================
SAP                           Acct-Session-ID        Acct-Session-ID-Ctrl
-------------------------------------------------------------------------------
1/1/1:1.901                   242FFF000001AE512CE4B6 242FFF000001AB512CE4B6
-------------------------------------------------------------------------------
No. of SAP's: 1
===============================================================================
```

script

Syntax **script**

Context show>service>dynsvc

Description This command enables the context to show dynamic services script information.

snippets

Syntax **snippets** [**detail**]
snippets name *snippet-name* [**instance** *snippet-instance*] [**detail**]

Context show>service>dynsvc>script

Description This command displays the dynamic services snippets information.

The CLI output generated by a single dynamic service python function call is a snippet instance.

The name of the snippet instance is the function key in the dyn.action() dictionary that caused this function to be called. This name is the dictionary name passed via RADIUS for top-level snippets or the first parameter to dyn.reference() for the others.

The snippet instance is either the dynamic data service SAP id or if the function is called via dynamic reference, the reference-id (that is, second parameter) provided in the dyn.reference() call.

Parameters **detail —** display detailed dynamic services snippet information.

Filtering options, display dynamic services snippets information that matches:

name *snippet-name* **—** Specifies the snippet name.

instance *snippet-instance* **—** *S*pecifies the snippet instance.

Sample Output

```
# show service dynamic-services script snippets
```

```
===============================================================================
Dynamic Services Snippets
===============================================================================
Name                        Instance                      Ref-count  Dict-len
-------------------------------------------------------------------------------
vprn                        VRF-1                         1          75
vprn_1                      1/1/1:1.901                   0          190
-------------------------------------------------------------------------------
No. of Snippets: 2
===============================================================================


# show service dynamic-services script snippets detail
===============================================================================
Dynamic Service Snippets
===============================================================================
Snippet            : vprn:VRF-1
-------------------------------------------------------------------------------
reference-count    : 1
dictionary-length  : 75

Root-object
-----------
oid                : svcRowStatus.100000

Reserved-id
-----------
id                 : service-id:100000
-------------------------------------------------------------------------------
Snippet            : vprn_1:1/1/1:1.901
-------------------------------------------------------------------------------
reference-count    : 0
dictionary-length  : 190

Referenced-snippet
------------------
snippet            : vprn:VRF-1
-------------------------------------------------------------------------------
No. of Snippets: 2
===============================================================================
```

statistics

Syntax **statistics**

Context show>service>dynsvc>script

Description This command displays dynamic service script statistics. Only non-zero values are shown.

The script statistics can be cleared with the “clear service statistics dynamic-services” command.

Sample Output

```
# show service dynamic-services script statistics
===============================================================================
Dynamic Services Script Statistics
===============================================================================
Description                                                        Counter
```

```
-------------------------------------------------------------------------------
python scripts with 0 retries due to timeout                          46
setup    - jobs launched                                              16
setup    - jobs handled                                               16
setup    - success                                                    13
setup    - syntax error                                               1
setup    - execution failed                                           2
teardown - jobs launched                                              15
teardown - jobs handled                                               15
teardown - success                                                    14
teardown - syntax error                                               1
-------------------------------------------------------------------------------
No. of Script Statistics: 10
-------------------------------------------------------------------------------
Last Cleared Time: 02/26/2013 09:59:07
===============================================================================
```

summary

Syntax **summary**

Context show>service>dynsvc

Description This command displays the global configuration summary for dynamic services:

- Service range
- Timers

Sample Output

```
# show service dynamic-services summary
===============================================================================
Dynamic Services Summary
===============================================================================
range start                 : 100000
range end                   : 200001
setup timeout Access Accept : 30
===============================================================================
```

sap-using

Syntax **sap-using** [**msap**] [**dyn-script**] [**description**]

Context show>service

Description This command displays SAP information.

Parameters **dyn-script —** Displays dynamic service SAPs information.

Sample Output

```
# show service sap-using dyn-script
```

```
===============================================================================
Service Access Points
===============================================================================
PortId                          SvcId      Ing.  Ing.    Egr.  Egr.   Adm  Opr
                                           QoS   Fltr    QoS   Fltr
-------------------------------------------------------------------------------
[1/1/1:1.901]                   [100000]   901   ip4     901   ip4    Up   Up
-------------------------------------------------------------------------------
Number of SAPs : 1
-------------------------------------------------------------------------------
Number of Dynamic Service SAPs : 1, indicated by [<sap-id>] [<svc-id>]
-------------------------------------------------------------------------------
===============================================================================


# show service sap-using dyn-script description
===============================================================================
Service Access Points
===============================================================================
PortId                            SvcId        Adm  Opr  Description
-------------------------------------------------------------------------------
[1/1/1:1.901]                     [100000]     Up   Up   This is a dynamic
                                                         service SAP
-------------------------------------------------------------------------------
Number of SAPs : 1
-------------------------------------------------------------------------------
Number of Dynamic Service SAPs : 1, indicated by [<sap-id>] [<svc-id>]
-------------------------------------------------------------------------------
===============================================================================
```

Clear Command

dynamic-services

Syntax **dynamic-services**

Context clear>service>stats

Description This command resets the dynamic services script statistics. See also **show service dynamic-services script statistics**.

Debug Commands

dynamic-services

Syntax [**no**] **dynamic-services**

Context debug

Description This command enables the context to configure dynamic services debugging.

scripts

Syntax **scripts**

Context debug>dynsvc

Description This command enables the context to configure dynamic services script debugging.

event

Syntax [**no**] **event**

Context debug>dynsvc>scripts
debug>dynsvc>scripts>inst
debug>dynsvc>scripts>script

Description This command enables/disables the generation of all dynamic data service script debugging events output: cli, errors, executed-cmd, warnings, state-change.

cli

Syntax [**no**] **cli**

Context debug>dynsvc>scripts>event
debug>dynsvc>scripts>inst>event
debug>dynsvc>scripts>script>event

Description This command enables/disables the generation of a specific dynamic data service script debugging event output: cli.

errors

Syntax [**no**] **errors**

Context debug>dynsvc>scripts>event

debug>dynsvc>scripts>inst>event
debug>dynsvc>scripts>script>event

Description This command enables/disables the generation of a specific dynamic data service script debugging event output: errors.

executed-cmd

Syntax [**no**] **executed-cmd**

Context debug>dynsvc>scripts>event
debug>dynsvc>scripts>inst>event
debug>dynsvc>scripts>script>event

Description This command enables/disables the generation of a specific dynamic data service script debugging event output: executed-cmd.

state-change

Syntax [**no**] **state-change**

Context debug>dynsvc>scripts>event
debug>dynsvc>scripts>inst>event
debug>dynsvc>scripts>script>event

Description This command enables/disables the generation of a specific dynamic data service script debugging event output: state-change.

warnings

Syntax [**no**] **warnings**

Context debug>dynsvc>scripts>event
debug>dynsvc>scripts>inst>event
debug>dynsvc>scripts>script>event

Description This command enables/disables the generation of a specific dynamic data service script debugging event output: warnings.

instance

Syntax **instance** *instance*

Context debug>dynsvc>scripts

Description This command enables the context to configure dynamic services script debugging for a specific instance.

Parameters *instance* — Specifies the instance name.

script

Syntax **script** *script*

Context debug>dynsvc>scripts

Description This command enables the context to configure dynamic services script debugging for a specific script.

Parameters *script* — Specifies the script name.

Tools Commands

dynamic-services

Syntax **dynamic-services**

Context tools>perform>service

Description This command enables the context to execute dynamic services tools perform commands.

evaluate-script

Syntax **evaluate-script sap** *sap-id* **control-session** *acct-session-id* **action** *script-action* **[dynsvc-policy** *name*] [**param-string** *string*]

Context tools>perform>service>dynamic-services

Description This tools command performs the execution of a dynamic service script action as if the corresponding RADIUS attributes were received from RADIUS. It is possible to setup, modify or teardown a dynamic service associated with the specified control channel.

Parameters **sap** *sap-id* — specifies the dynamic service SAP id.

control-session *acct-session-id* **—** Specifies the accounting session id of the control channel associated with this dynamic service

action *script-action* **—** Specifies the requested action: setup, modify or teardown.

dynsvc-policy *name* **—** Specifies the dynamic services policy to use for this action. Mandatory parameter for setup and modify actions. In case of a modify action, the dynamic services policy must be the same as the policy used at setup.

param-string *string* **—** Specifies the dynamic service parameter list. Mandatory parameter for setup and modify actions.

dynamic-services

Syntax **dynamic-services command-list**

Context tools>dump>service

Description This command displays the list of supported commands that are allowed to be used in dynamic service CLI scripts.

There are two types of CLI nodes in this list:

- Pass through nodes: navigation is allowed but attributes creation or attribute changes are prohibited in this node.
- Allowed nodes: navigation, attribute creation and attribute changes are allowed in this node (available from 11.0R2 onward).

Diameter and Diameter Applications

In This Section

This section provides information pertaining to the Diameter authentication, authorization, and accounting protocol, and Diameter applications:

In This Section

Restrictions

Diameter-Based Restrictions:

- Accounting (RFC 6733, *Diameter Base Protocol*) via Diameter is not supported in this release.
- Accounting-Request (ACR), Accounting-Answer (ACA), Session-Termination-Requests (STR) and Session-Termination-Answer (STA) messages are not supported.
- SCTP and IPSec as transport protocols are not supported. TCP is supported.

Gx-Based Restrictions:

- Static hosts and LAC/LNS (L2TP) hosts are not supported in Gx.
- Bridged Homes and AA subscribers — Since there is no notion of a subscriber-host in AA, the last AA policy submitted via Gx for any ESM subscriber-host within the home will be applied to the AA subscriber as a whole and overwrite any previously active AA policy.
- <SAP,MAC> combination must be unique for each host (single stack or dual-stack).
- Charging-Rule-Name within the Charging-Rule-Definition cannot contain double colon (::) set of characters in the name string. The use of double colon in the name string itself is reserved for future use.
- Report about **successful** rule activation in 7x50 (3GPP 29.212, §4.5.2) is not supported. The rule report is sent only if the rule instantiation fails.
- Time-based usage monitoring is not supported.
- Gx persistency is not supported. However, upon node reboot with ESM persistency enabled, the 7750 SR will re-initiate Gx sessions (new CCR-I will be generated for each Gx enabled host).
- Gy and usage monitoring cannot be enabled for the same host and the same category-map at the same time. Gy is pre-configured at the time of the host instantiation. If usage-monitoring request is received while Gy is enabled, the 7x50 will ignore the usage monitoring request.
- Each ESM host can have up to three usage-monitoring entities enabled simultaneously. For example, two categories and a session. If three categories are enabled for usage-monitoring, then usage-monitoring cannot be enabled per session (host) since this would exceed the limit of three usage-monitoring entities per host.
- Per-session usage-monitoring is not supported for subscriber hosts (or IP-CAN sessions) that share the same sla-profile instance.

Terminology

Gx Interface (or simply Gx) — Refers to the implementation of Gx reference point in 7x50. The Gx reference point is defined in the 3GPP 29.212 specification.

Enhanced Subscriber Management (ESM) — The subscriber is a host or a collection of hosts instantiated in 7x50 SR Broadband Network Gateway (7x50). The ESM subscriber represents a household or a business entity for which various services with committed Service Level Agreements (SLA) can be delivered.

AA Subscriber — A representation of ESM subscriber in MS-ISA for the purpose of managing its traffic based on applications (Layer 7 awareness). AA subscriber has no concepts of ESM hosts.

Policy Rule — Refers to a set of parameters applied to a subscriber host. Those parameters will determine characteristics of the subscriber-host traffic. Rules can be applied/instantiated or changed dynamically via a Gx interface. This term can be used interchangeably with just the term policy or just the term rule.

7x50 BNG — Refers to the ALU network element on which Gx Interface is implemented and policy rules are enforced (PCEF). This term can be interchangeably used with the 7x50 term.

3GPP-Based Diameter Credit Control Application (DCCA) - Online Charging

The 3GPP-based Diameter Credit Control On-line charging applications allow the control of subscriber access to services based on a pre-paid credit. The volume and time accounting in the 7750 SR supports online charging using the Diameter Credit-Control Application (DCCA). The 7750 SR supports Session Charging with Unit Reservation (SCUR) allowing the 7750SR to reserve volume and time quota for rating-groups. Furthermore, the 7750 SR supports centralized unit determination and centralized rating: it requests quota and reports usage against the quota provided by the Online Charging Server (OCS). Credit control is always on a per rating group basis. A rating group maps to a category inside a category-map of the 7750SR volume and time based accounting function.

The following are the basic configuration steps:

1. Configure a diameter policy

   In the **config>aaa** CLI context, configure a diameter peer policy with one or multiple Diameter peers.

```
configure
    aaa
        diameter-peer-policy "diameter-peer-policy-1" create
            description "Diameter peer policy"
            applications gy
            connection-timer 5
            origin-host "bng.alcatel-lucent.com"
            origin-realm "alcatel-lucent.com"
            source-address 10.0.0.1
            peer "peer-1" create
                address 10.1.0.1
                destination-host "server.alcatel-lucent.com"
                destination-realm "alcatel-lucent.com"
                no shutdown
            exit
        exit
    exit
```

2. Configure a diameter application policy.

   In the **config>subscriber-mgmt** CLI context, configure a diameter application policy:

   – Set the application to Gy (Diameter Credit Control Application),

   – Specify the Diameter peer policy to use and optionally specific additional Gy application specific parameters (for example AVP format).

```
configure
    subscriber-mgmt
        diameter-application-policy "diameter-gy-policy-1" create
            description "Diameter Gy policy"
            application gy
            diameter-peer-policy "diameter-peer-policy-1"
            gy
                avp-subscription-id subscriber-id type e164
                include-avp
                    radius-user-name
                exit
            exit
        exit
    exit
```

3. Create a category-map in which you define:

   – The credit type (time or volume).

   – A category defining the queues to monitor for quota consumption and the rating-group this category maps to in DCCA.

```
configure
    subscriber-mgmt
        category-map "cat-map-1" create
            description "Category Map"
            credit-type time
            category "cat-1" create
                rating-group 1
                queue 1 ingress-egress
                exhausted-credit-service-level
                    pir 256
                exit
            exit
        exit
    exit
```

4. Create a credit control policy.

   Define the credit control servers to use by specifying the diameter application policy. Optionally, specify the default-category-map and an out-of-credit-action.

```
configure
    subscriber-mgmt
        credit-control-policy "cc-policy-1" create
            description "Credit Control Policy"
            credit-control-server diameter "diameter-gy-policy-1"
            default-category-map "cat-map-1"
            out-of-credit-action change-service-level
        exit
    exit
```

5. Configure the diameter credit-control-policy in the sla-profile of the subscriber host for which credit control should be activated.

```
configure
    subscriber-mgmt
        sla-profile "sla-profile-3" create
            description "SLA profile"
            credit-control-policy "cc-policy-1"
        exit
    exit
```

The following are examples of Diameter on-line charging flows:

Scenario 1 — Depicts a redirect use-case:

When the quota is depleted, the subscriber is redirected to a web portal. When the credit is refilled, the OCS server will notify the BNG and provide new quota. Note that 7750SR will install the configured out-of-credit-action when receiving a Final Unit Indication with action different from Terminate.

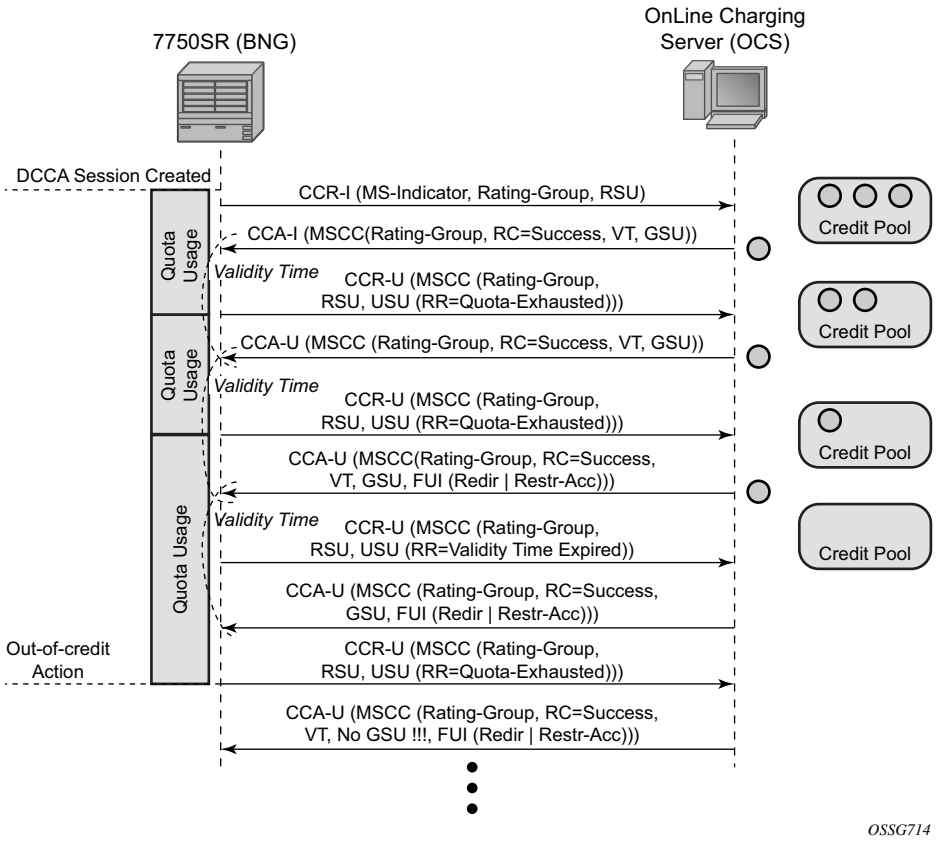


Figure 163: On-Line Charging Scenario 1 - Redirect (1/2)

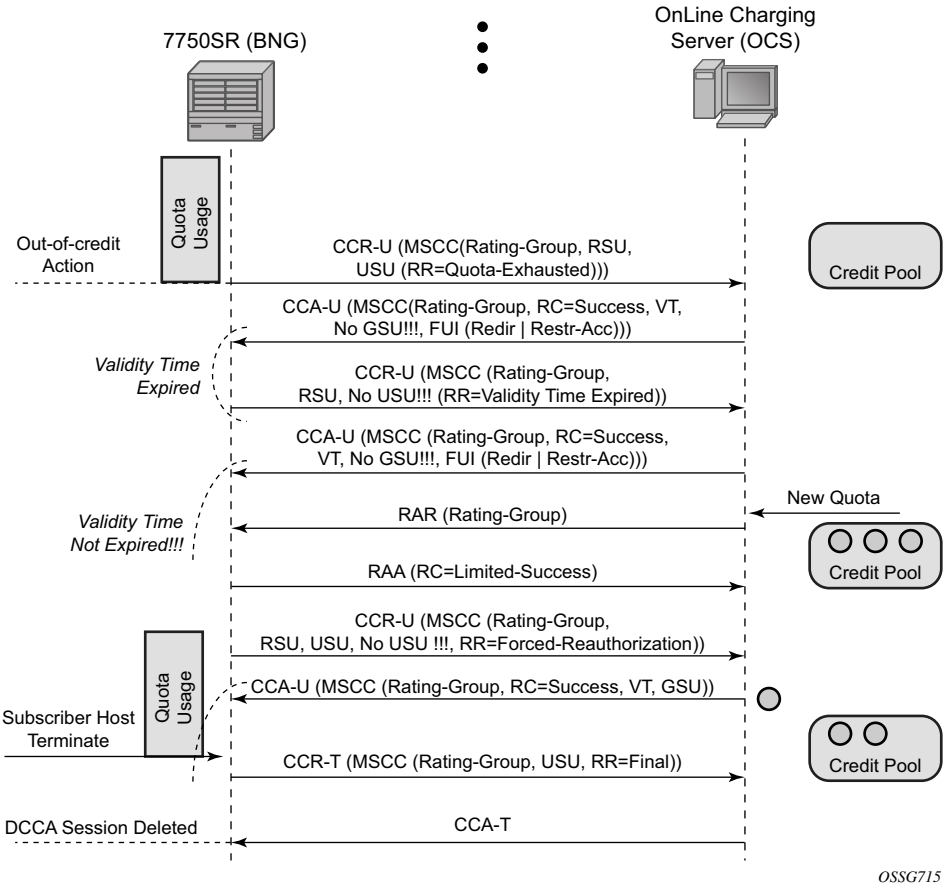


Figure 164: On-Line Charging Scenario 1 - Redirect (2/2)

Scenario 2 — Depicts a terminate use case:

When the quota is depleted after reception of a Final Unit Indication with action set to Terminate, the subscriber host is disconnected. The configured out-of-credit-action is ignored in this case.

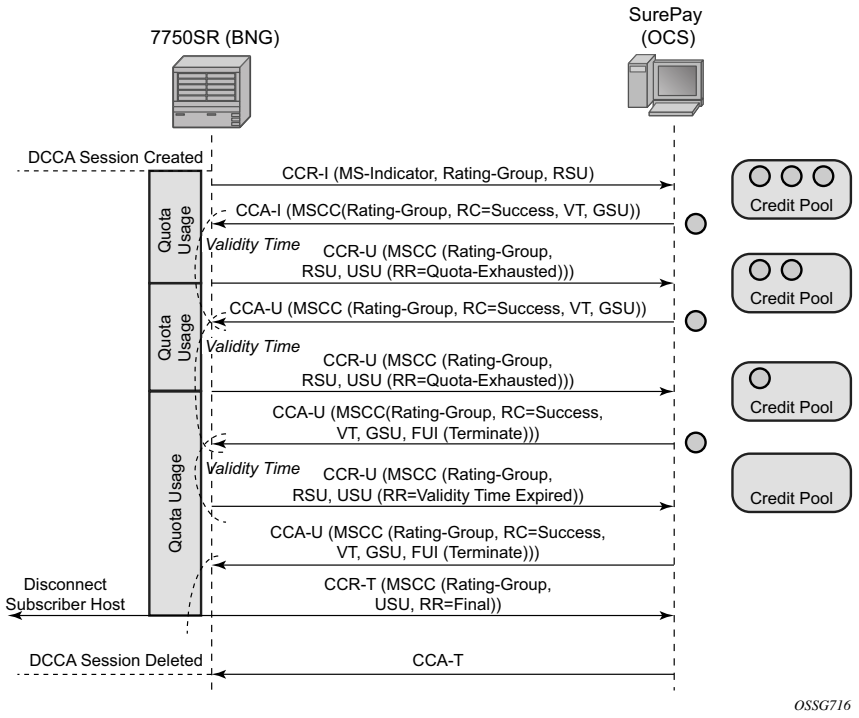


Figure 165: On-Line Charging Scenario 2 – Terminate

Abbreviations used in the previous drawings:

CCR	Credit Control Request (-Initial, -Update, -Terminate)
CCA	Credit Control Answer (-Initial, -Update, -Terminate)
RAR	Re-Authentication Request
RAA	Re-Authentication Answer
MSCC	Multiple Services Credit Control
GSU	Granted Service Unit
RSU	Requested Service Unit
USU	Used Service Unit
RC	Result Code
RR	Reporting Reason
VT	Validity Time

Policy Management via Gx Interface

Gx is a reference point in the network architecture model describing mobile service delivery. The network elements are described in various technical documents under the umbrella of 3GPP and are used to deliver, manage, report on and charge end-user traffic for mobile users. Gx reference point is used for policy control and charging control. As shown in Figure 166, it is placed between a policy server (Policy and Rule Charging Function (PCRF)) and a traffic forwarding node (7x50 – Policy and Charging Enforcement Function) that enforces rules set by the policy server.

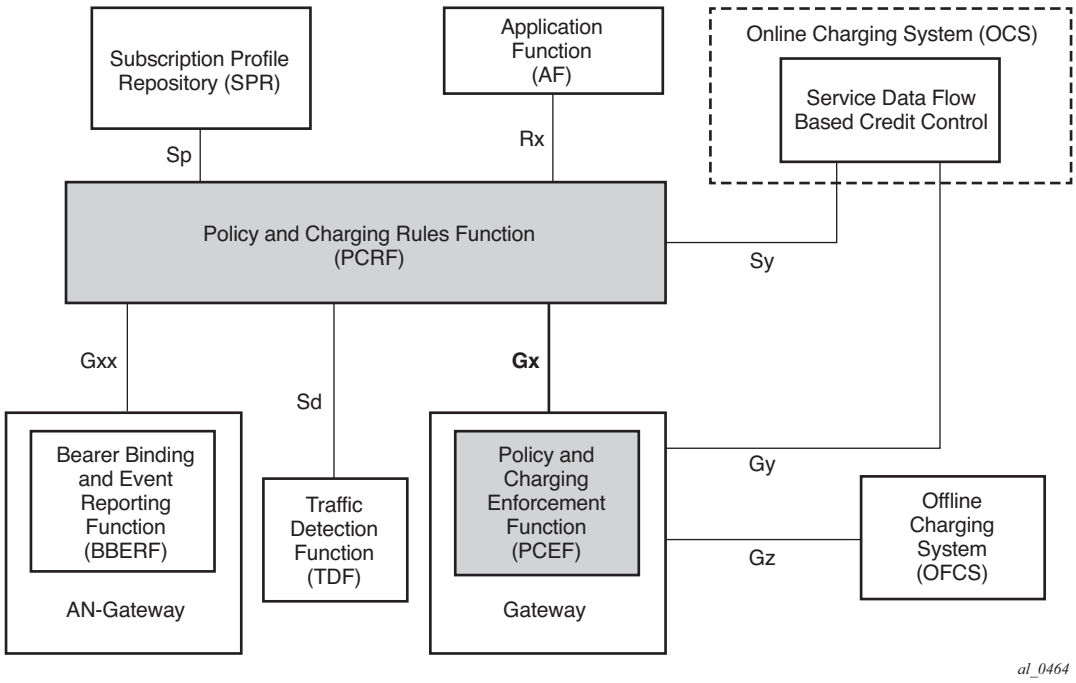


Figure 166: Gx Reference Point

The Gx reference point is defined in the Policy and Charging Control (PCC) architecture within 3GPP standardization body. The PCC architecture is defined in the document 23.203 while the Gx functionality is defined in the document 29.212. Gx is an application of the Diameter protocol (RFC 3588/6733).

Although Gx reference point is defined within 3GPP standardization body (spurred by mobile/ wireless industry) its applicability has spread to wire-line operation as well. For example, mobile operators that also have fixed line customers (residential + business) would like to streamline policy management in their mobile and non-mobile domains with a single and already existing Gx based policy management infrastructure. In other words they want to integrate policy management of nodes serving fixed line subscribers into the system that is currently managing mobile subscriber base.

In such mixed environments, the 7x50 node will play a role of a PCEF with an integrated TDF (Traffic Detection Function è or Application Awareness [AA] in ALU terminology) where policies and charging rules can be managed via PCRF.

With WiFi Offload as a new emerging application, supporting Gx reference point on 7x50 nodes is becoming even more important.

Gx Interface in 7x50 encompasses the following functionality:

- Per subscriber host policy management
- Usage monitoring

Gx will be applicable to Enhanced Subscriber Management (ESM) as well as to AA.

Gx Protocol

The Gx application is defined as a vendor specific Diameter application, where the vendor is 3GPP and the Application-ID for Gx application is 16777238. The vendor identifier assigned to 3GPP by IANA is 10415.

With regards to the Diameter protocol defined over the Gx interface, the 7x50 (PCEF) acts as a Diameter Client and the PCRF acts as a Diameter Server. The Gx Diameter Application uses existing Diameter Command Codes from the Diameter Base Protocol (RFC 6733) and Diameter Credit Control Application (RFC 4006), both of which are already implemented in 7x50.

Gx is using Attribute-Value Pairs (AVPs) for data representation within its messaging structures (command codes). AVPs in Gx come from various sources:

- Gx specific AVPs defined in 3GPP Gx specification TS 29.212.
- Re-used AVPs from other existing Diameter applications (RFC 4006, RFC 4005, etc), other 3GPP specs, ETSI, etc.
- Radius re-used attributes (AVP codes 0-255 are reserved for Radius re-used attributes)
- Vendor specific AVPs

The initialization and maintenance of the connection between the 7x50 (PCEF) and the PCRF is defined by the underlying Diameter protocol as defined in RFC 3588/6733.

Policy Assignment Models

Subscriber and AA policies in 7x50 (PCEF with integrated TDF) will be assigned via Gx protocol from the policy server (PCRF).

There are two modes of operation:

- Pull mode — Policy creation/modification is solicited by the 7x50 node (PCEF).
- Push mode — Policy change is unsolicited by the 7x50 node (CoA -ike approach)

In the pull mode, during the host creation process, a user is authenticated by the AAA server. This process is independent from PCRF. Once the user is authenticated and the IP address is allocated to it, the 7x50 sends a request for policies to the PCRF via CCR-i messages (initialization request message). This communication occurs via Gx interface. The subscriber-host must be uniquely identified in this request towards the PCRF. This sub identification over Gx interface could be by the means of IP address, username, SAP-id, etc.

Based on the user identification, PCRF will submit policies to the 7x50. Those policies can range from subscriber strings (sub/sla-profiles/AA-profiles) to qos and filter related parameters.

In the push mode, the PCRF initiates the mid-session policy change through the RAR (Re-Authentication Request) message.

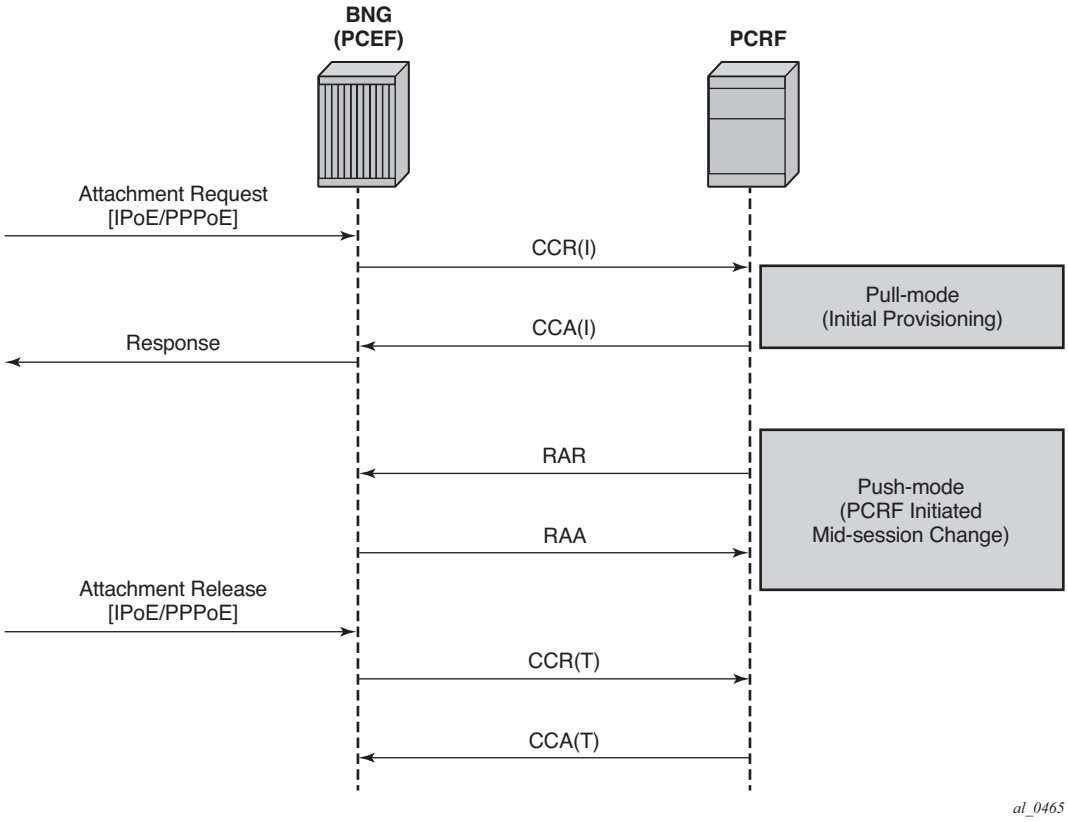


Figure 167: Policy Assignment Models

When usage monitoring is required, the PCRF submitted policy changes are triggered by the Credit Control Request (Update) messages. This is based on ESM or AA usage monitoring. Once the specified usage threshold is reached on the session-level, credit-category level or application level on the 7x50, the usage monitoring is reported from the 7x50 to the PCRF in the CCR-u message. Please refer to Application Assurance user's guide for details on AA based usage monitoring.

Alternatively, PCRF can request usage reporting on-demand via the RAR command.

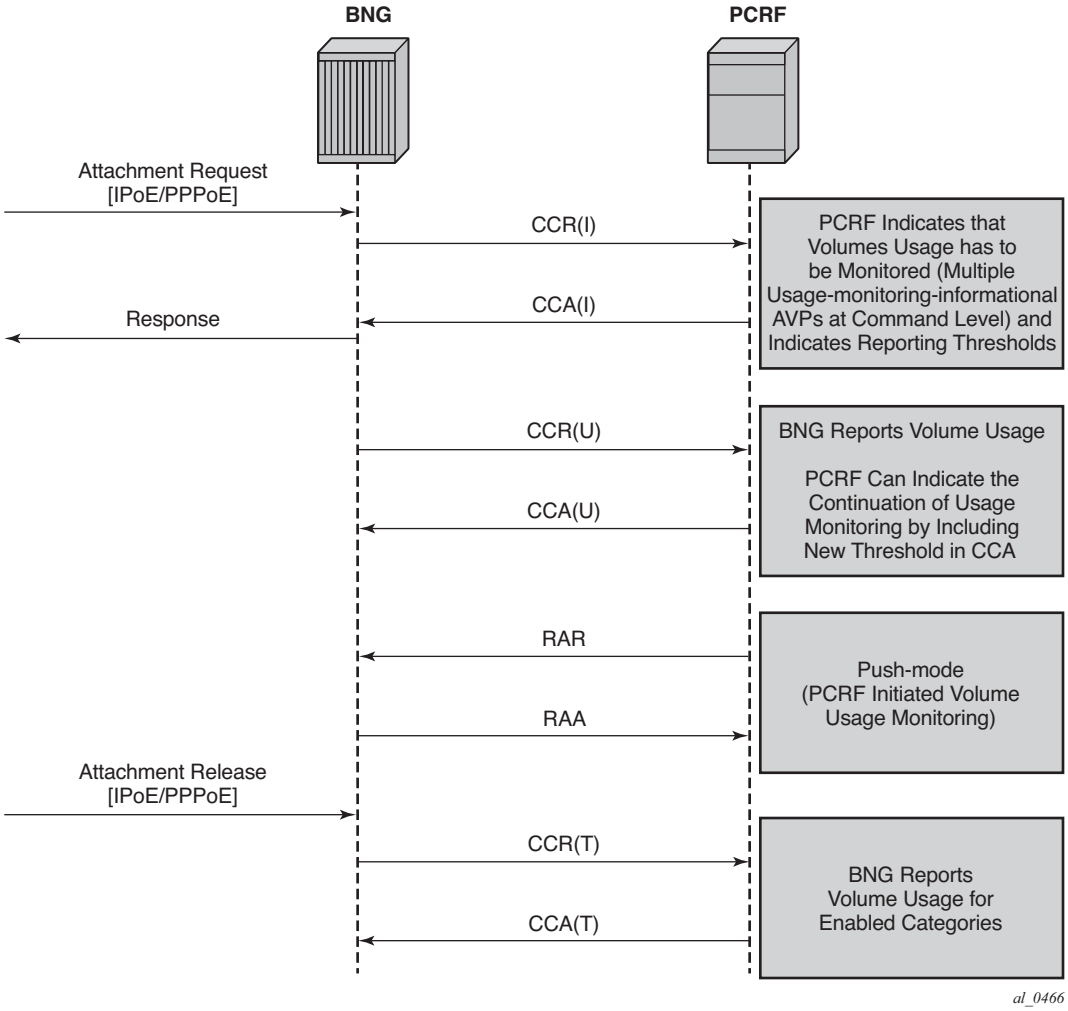


Figure 168: On-Demand Usage Reporting

IP-CAN Session – Gx Session Identification

IP Connectivity Access Network (IP-CAN) session is a concept that has roots in mobile applications. A policy rule via Gx interface can be applied/modified to an entity that is identified as IP-CAN session (in addition to individual bearers within the IP-CAN session – the bearer concept is currently not applicable to 7x50 BNG). For example, an UE (user interface or simply a mobile phone) can hosts several services, each of which appears as a separate IP-CAN session associated with the same IP address. For example in mobile world, an IP-CAN session can be defined as <IP_address, APN, IMSI>, where:

- APN (Access Point Name) is the service identifier
- IMSI (International Mobile Subscriber Identification) is the UE identifier (SIM Card)

In wireline environment (ESM deployments), an IP-CAN session will identify an entity to which the policy can be applied/modified, and currently, this is a subscriber-host instantiated in the 7x50.

For the purpose of identifying the host in 7x50 in all Gx related transactions, the 7x50 will generate a unique, per host (single or dual-stack) session-id AVP (RFC 6733, §8.8). The Gx session-id will in essence represent the IP-CAN session from the standpoint of 7x50. Note that the Gx session-id AVP is not the same as the acct-session-id attribute used in Radius accounting.

User Identification in PCRF

The following identification related AVPs will be sent to the PCRF via Gx messages to aid in IP-CAN session identification:

- **subscription-id** AVP (RFC 4006, §8,46) — This can be used to identify the subscribers on the PCRF. For the supported fields within the subscription-id AVP, refer to the SROS GX AVP Reference Guide.
- **NAS-Port-Id** AVP (RFC 2869 / §5.17; RFC 4005 / §4.3)
- **AN-GW-Address** AVP (3GPP 29.212 / § 5.3.49)
- **Calling-Station-ID** AVP (RFC 4005 / §4.6)
- **user-equipment-info** AVP (RFC 4006, §8.49)
- **logical-access-id** AVP (ETSI TS 283 034) — This will contain circuit-id from DHCPv4 Option (82,1) or interface-id from DHCPv6 option 18. The vendor-id will be set to ETSI (13019).
- **physical-access-id** AVP (ETSI TS 283 034) — This will contain remote-id from DHCPv4 option (82,2) or DHCPv6 option 37. The vendor-id will be set to ETSI (13019).

Physical and logical access IDs are also defined in BBF TR-134 (§7.1.4.1).

Table 23: PDP to PEP Direction Parameters

Parameter	Category	Type	Description
Logical access ID	User identification	Octet String	The identity of the logical access to which the user device is connected. It is stored temporarily in the AAA function connected to PDP. This corresponds to the Agent ID in case of IPv4 and to THR Interface Id of DHCP option 82 for IPv6
Physical Access ID	User identification	UTF8String	The identity of the physical access to which the user device is connected. It is stored temporarily in the AAA function connected to the PDP. This corresponds to the Agent Remote ID

A Subscription-id AVP is most commonly used to identify the subscriber but any combination of the above listed parameters can be used to uniquely identify the IP-CAN session on PCRF and consequently identify the subscriber.

In addition, NAS-Port, NAS-Port-Type, and Called-Station-ID AVPs from RFC 4005 (§4.2, §4.4, §4.5) can be passed to the PCRF.

NAS-Port-Id as Subscription-Id

7x50 allows NAS-Port-Id to be carried within Subscription-Id AVP. Since the NAS-Port-Id may not be unique network-wide (two independent 7750s may use the same NAS-Port-Id), there is a need for another identifier in conjunction with NAS-Port-Id to make the Subscription-Id unique across network. This additional identifier is a custom string that can be appended to the NAS-Port-Id. It is defined when the NAS-Port-Id is configured for inclusion in Gx messages. Refer to the 7750 SR RADIUS Attribute Reference Guide to learn how to format NAS-Port-Id AVP in the SR 7x50.

The string can be used to identify the location of the node. For example:

@ALU-MOV-SITE-1

An example of the augmented NAS-Port-Id would look like:

NAS-Port-Id = lag-1.1/1/2:23.2000*@ALU-MOV-SITE-1*

where: 'lag-1.1/1/2:23.2000' is the part referencing the SAP in 7x50 (port + vlan tags) and the '*@ALU-MOV-SITE-1*' is the node itself.

Such NAS-Port-Id can be then inserted in the Subscription-Id AVP.

Gx Interface and ESM Subscriber Instantiation

Policy management in the 7x50 via Gx enables operators to consolidate policy management systems used in wireline (mostly based on RADIUS/CoA) and wireless environment (PCRF) into a single system (PCRF).

The model for policy instantiation/modification via Gx is very similar to the one using Radius CoA. The authentication and IP address assignment is provided outside of Gx while the policy management function is provided via Gx.

Some PCRFs may require that the IP address information is passed from the 7x50 in CCR-i. This assumes that the IP address assignment phase (via LUDB, Radius or DHCP Server) is completed before the PCRF is contacted via CCR-i. Message flow for various protocols (DHCP, AAA, Gx) related to IPv4 subscriber-host instantiation phase is shown in Figure 169.

A **CCR-i** message is sent to the PCRF once DHCP Ack is received from the DHCP server. Relaying DHCP Ack to the client in the final phase of the host instantiation process will depend on the answer from the PCRF and the configuration settings of the fallback function in case that the answer is not received.

This model allows the IP address of the host to be sent in the CCR-i message, even though the subscriber-host is not fully instantiated at the time when the CCR-i message is generated.

AAA/LUDB must still be used for authentication and assignment of parameters necessary to place the subscriber host in the proper routing context (service-id, grp-id, msap-policy).

Start of the accounting process nicely fits into this model since the host is not instantiated until the policy information from all sources (Gx, AAA, defaults) is known. Once the final sub-profile (containing the acct-policy) is known, the host will be instantiated and accounting can consequently be activated.

The IP address itself cannot be assigned via Gx, and this functionality is outside of the Gx scope (3GPP TS 23.203 Rel12, Annex S, *IP-CAN Session Establishment*).

The purpose of the CCR-i message is the following:

- To notify the PCRF that the sub-host was about to be instantiated in 7x50. Consequently, the PCRF will create a Gx session for the subscriber host in case that the CCR-i is successfully processed by PCRF.
- To identify the subscriber host in the PCRF. The PCRF will use the subscriber host identification information to identify the policy (for the subscriber host) that needs to be submitted to 7x50. The policy rules can be sent via CCA-i immediately following the initial CCR-i or they can be modified at any time during the subscriber-host lifetime via RAR messages.

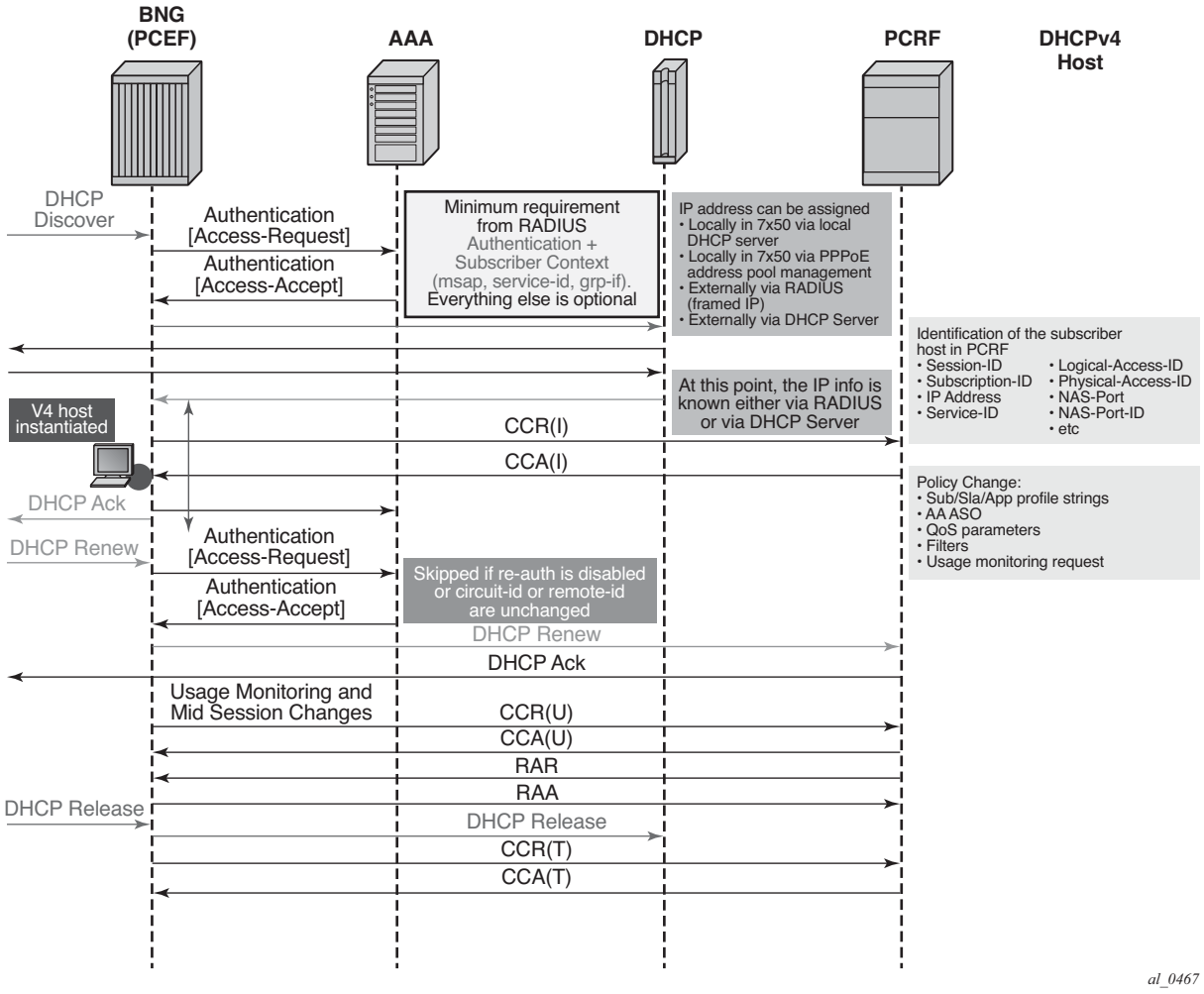


Figure 169: Messages Flow During DHCPv4 Host Instantiation Phase

Message flow for PPPoEv4 host is similar. The host will be instantiated once the answer from PCRF is received.

However, IPCP negotiation and Gx negotiation (CCR/CCA) are performed in parallel, independently of each other and therefore 7x50 will not wait for the Gx session to be established before the last IPCP ConfAck is sent (like it is the case for DHCP ACK).

Once the host is instantiated in 7x50 (after the CCA-i is received or as defined by the fallback action in case that the PCRF is not available), the Accounting-Start message will be sent by 7x50 (assuming that accounting is enabled).

The message flow is shown in Figure 170.

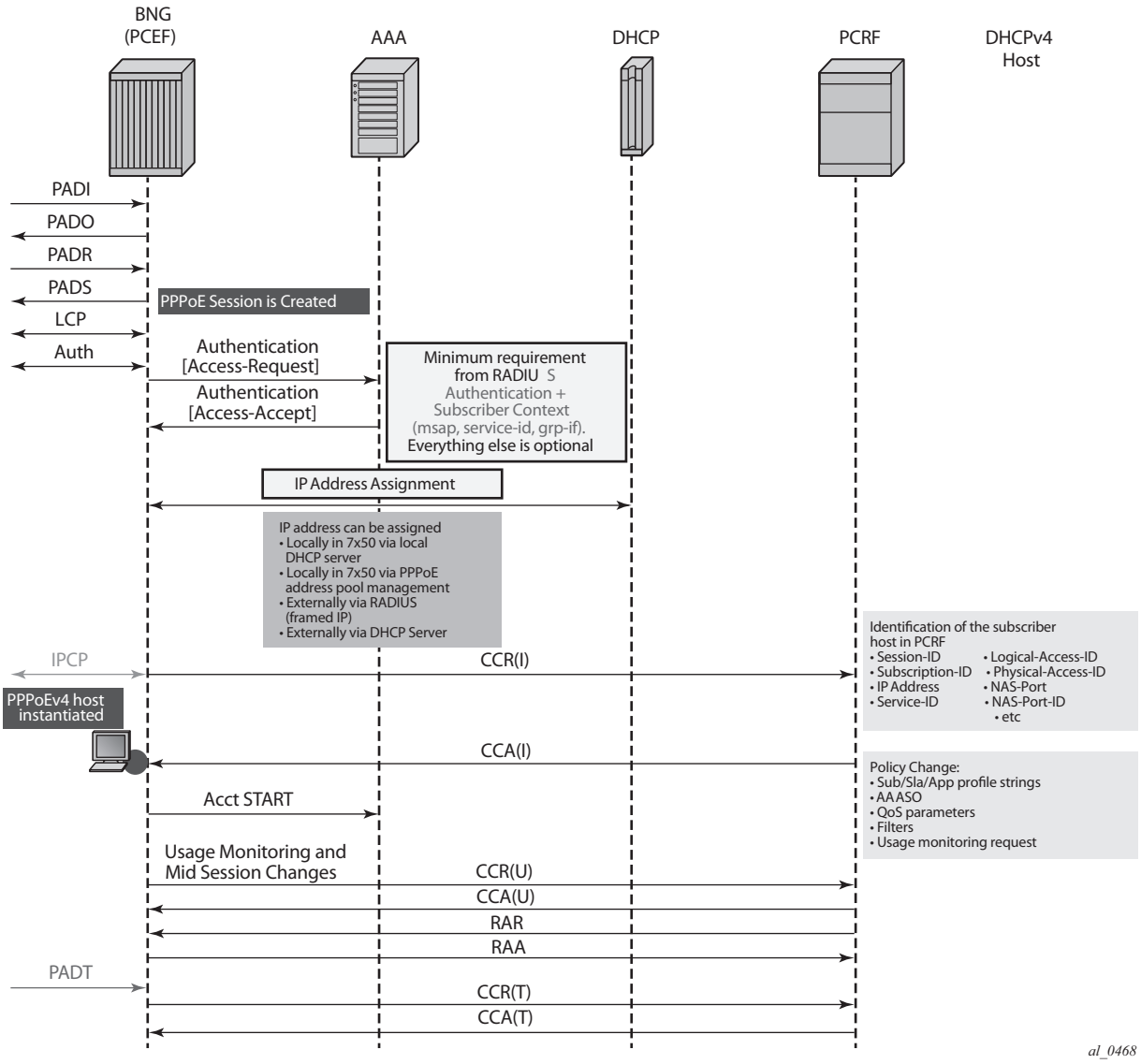


Figure 170: Message Flow During PPPoEv4 Host Instantiation Phase

The host is created when the Gx session is established and therefore the subscriber host will transition into the traffic forwarding state once the Gx processing is completed. In case that the PCRF is unavailable or unresponsive, the host creation/termination will be driven by the fallback configuration.

Gx and Dual-Stack Hosts

Dual-stack (DS) hosts are treated as a single session from the Gx perspective. The PCRF submits the policy rule that will be applied to DS host as a whole, regardless of the IP address (IPv4 or IPv6) that triggered the CCR-i message. DHCPv4 and DHCPv6 requests for DS host are linked by the same <SAP,MAC> combination which must be unique per system, while in PPPoE case the existing concept of the PPPoE session provides the v4/v6 linking natively.

The CCR-i will contain the IP address that was allocated first (the one that triggered the session creation). The request for the second IP address family will trigger (if enabled by configuration) an additional CCR-u that will carry the IP address allocation update to the PCRF along with the UE_IP_ADDRESS_ALLOCATE (18) event. Apart from that, the CCR-u content will mirror the content of the CCR-i with exception of already allocated IP address(es). There is a single Gx message (CCR-i or CCR-u) carrying the update for DHCPv6 IA-NA+IA-PD and DHCPv6/PPPoE NA+PD address/prefix, assuming that NA+PD is requested in a single DHCP message.

Similarly for the Gx session teardown, CCR-u messages will be sent carrying the UE_IP_ADDRESS_RELEASE event, followed by the CCR-t message.

The message flow is depicted in Figure 171.

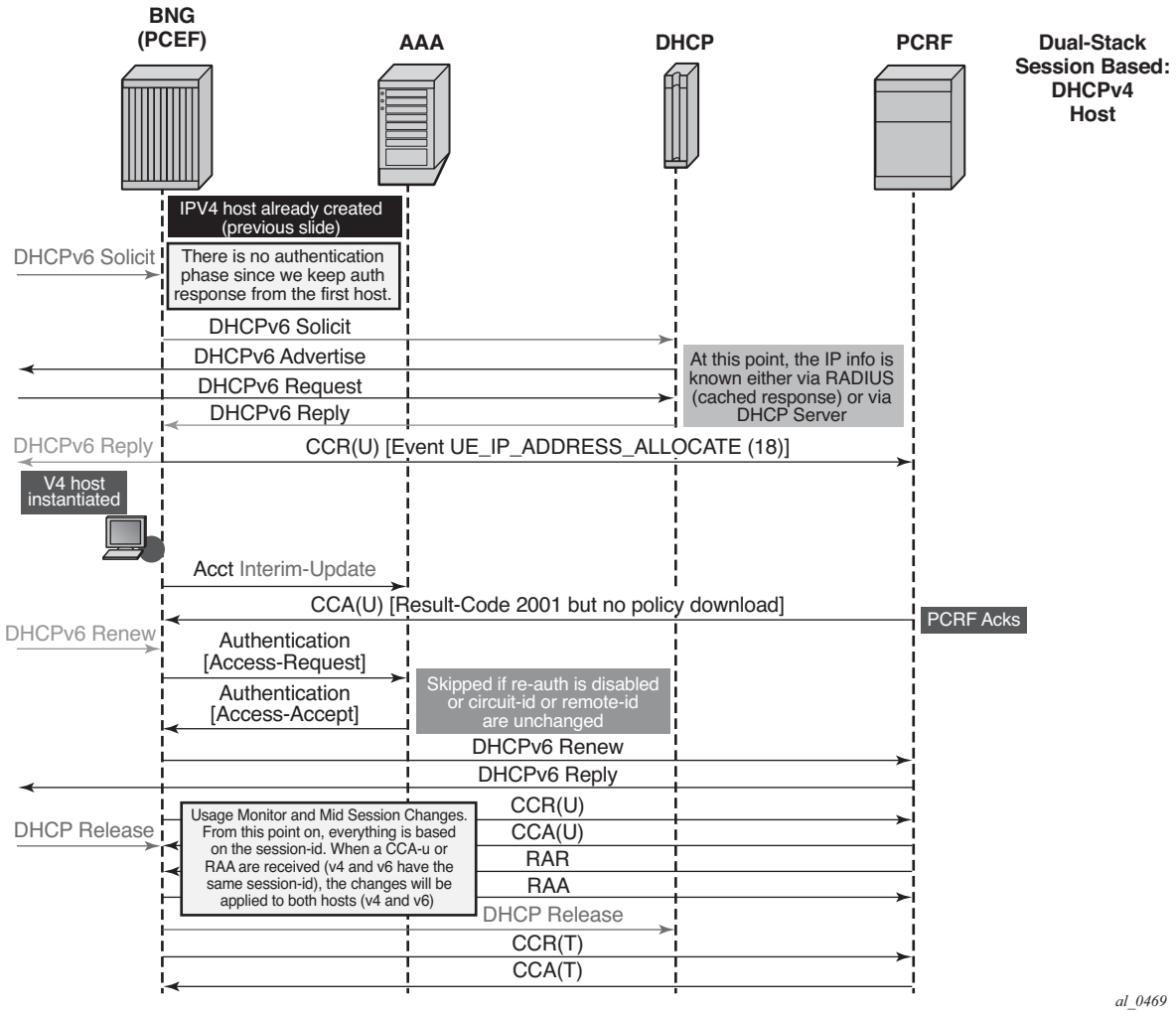


Figure 171: Gx and Dual Stack Session Instantiation

For Dual-Stack PPPoE host, the CCR-i is sent when the first IP address is assigned to the host. In the example in Figure 171, processing of the DHCPv6 Replay and CCR-u messages is performed in parallel. In other words, sending the DHCPv6 Reply message to the client will not be delayed until the response from the PCRF is received. The reason being is that the Gx session is already established (triggered by the IPv4 host in our example) and all parameters for IPv4 and IPv6 are already known as received in CCA-i. In this case, the CCR-u message is simply a notification message, informing the PCRF about the new IPv6 address/prefix being assigned to an existing client.

Gx and PPPoEv6-DHCP

For PPPoE v6 hosts, the IPv6 address is not obtained during IPCP phase (only interface-id is negotiated). In this case, the 7x50 will wait until the IPv6 address/prefix is allocated to the IPv6 hosts before it sends the CCR-I message. Otherwise the IP address would not be available in CCR-i.

This is shown in Figure 172.

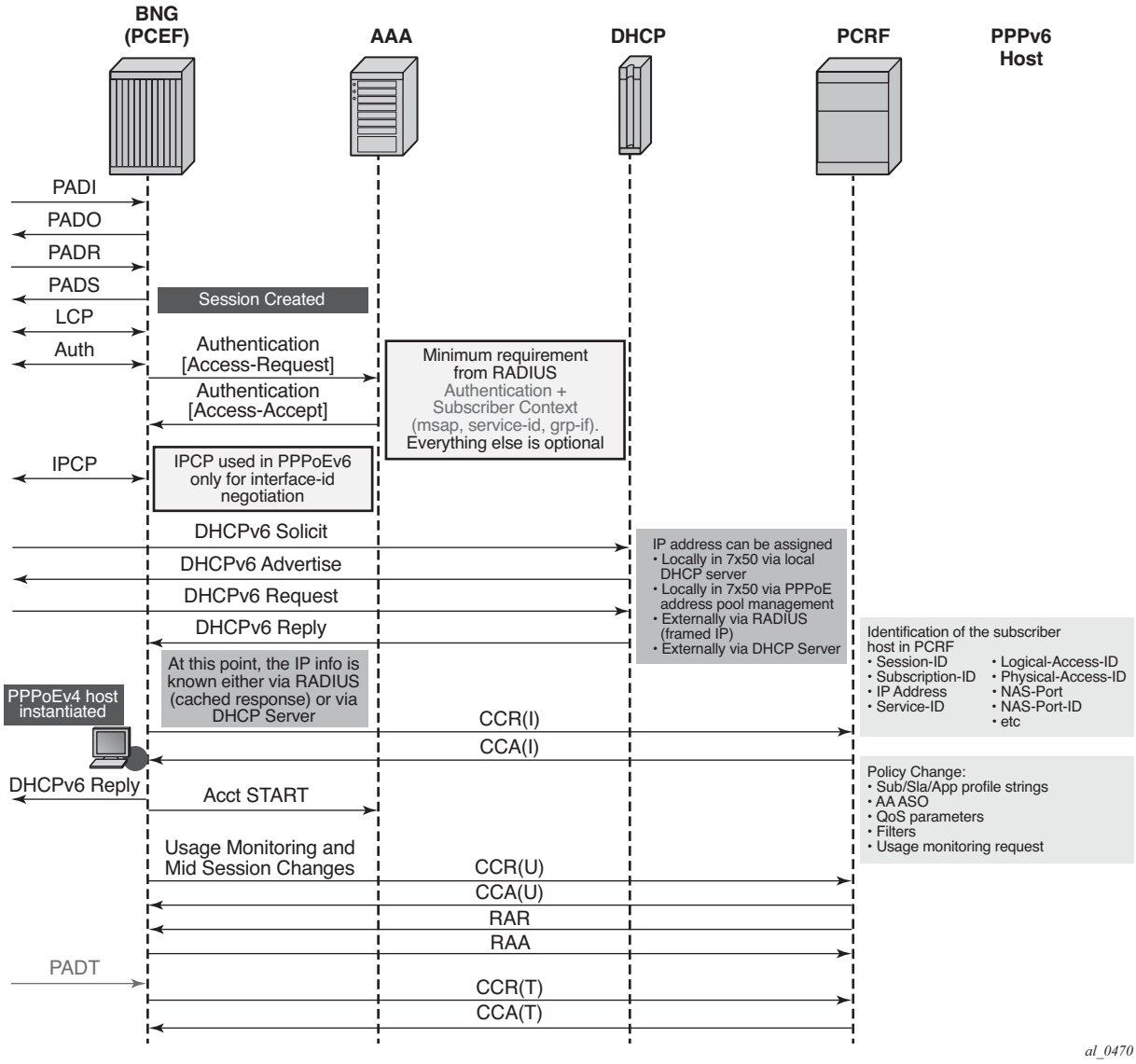


Figure 172: Gx and PPPoEv6 Host Instantiation

Gx Fallback Function

Gx fallback functionality refers to the behavior related to the subscriber host instantiation in situations where the PCRF is unresponsive while peering connection(s) are up or the PCRF is unavailable with all peering connections down. Note that this functionality affects only Gx session processing related to CCR-i messages in 7x50 and has no effect on already established Gx sessions.

The fallback behavior can be controlled via local configuration in 7x50 or can be controlled via certain AVPs provided by PCRF.

PCRF provided AVPs that control fallback behavior are:

- CC-Session-Failover AVP with the following values:
  - → FAILOVER_NOT_SUPPORTED
  - → FAILOVER_SUPPORTED
- Credit-Control-Failure-Handling AVP with the following values:
  - → TERMINATE
  - → CONTINUE
  - → RETRY_AND_TERMINATE

In case the fallback related AVPs are not provided via PCRF, the 7750 SR can provide local configuration option to define the fallback behavior. In case that the response from the PCRF cannot be obtained, the local configuration can allow the subscriber host to be instantiated with default parameters, or alternatively the local configuration can deny subscriber host instantiation.

PCRF provided AVPs will overrule local configuration.

The local configuration that defines Gx fallback behavior can be found under the following CLI hierarchy:

```
config
    subscr-mgmt
      diam-appl-plcy
        on-failure
          failover {enabled|disabled}
            handling {continue|retry-and-terminate|terminate}
```

The **failover** configuration option (equivalent to CC-Session-Failover AVP) controls whether the secondary peer will be used in case that the primary peer is unresponsive. The unresponsiveness is determined by the timeout of the previously sent message.

The **handling** configuration option (equivalent to Credit-Control-Failure-Handling AVP) controls whether the subscriber will be terminated or instantiated with default parameters in case that the PCRF is unresponsive.

	Handling: CONTINUE	**Handling: RETRY-AND-TERMINATE**	**Handling: TERMINATE**
Failover: ENABLED Once the message sent to the primary peer times out, the secondary peer (and consecutive peers after that) will be attempted. Once the message times out after it has been sent to all available peers, the HANDLING action will be examined in order to determine whether to terminate the host instantiation attempt or whether to use default parameters to instantiate the host.	Once the message times out after it has been sent to all available peers, the subscriber host will be instantiated with default parameters (if they are configured)	Once the message times out after it has been sent to all available peers, the subscriber host instantiation will be terminated.	Once the message sent to the primary peer times out, the subscriber host instantiation will be terminated.
Failover: DISABLED Once the message sent to the primary peer times out, the HANDLING action will be examined in order to determine whether to terminate the host instantiation attempt or whether to use default parameters to instantiate the host.	Once the message sent to the primary server times out, the subscriber host will be instantiated with default parameters (if they are configured)	Once the message sent to the primary peer times out, the subscriber host will be terminated.	Once the message sent to the primary peer times out, the subscriber host will be terminated.

The CCR retransmissions are controlled by the **tx-timer** command under the **diameter-application-policy**. Refer to the SR OS CLI reference for the description of **retransmission** handling.

In case that all peers are down (no connections are open), the **handling** action will determine the behavior. If the action is set to **continue**, the subscriber-host will be immediately instantiated with the default-settings (provided that the defaults are available). In all other action cases, the host instantiation will be immediately terminated.

Gx CCR-I Re-Plays

As described in the previous section, the subscriber host can be optionally (configuration controlled) established with default settings (sla-profile, sub-profile, app-profile) in the case where PCRF is not available to answer CCR-i. This results in a subscriber-host state mismatch between the 7750 SR and PCRF, where the subscriber-host is established in the 7750 SR but there is no corresponding Gx session established in PCRF.

In order to resolve this situation, ESM periodically sends CCR-i for the Gx orphaned subscriber-host until the response from PCRF is received. The CCR-i is periodically retransmitted every 60 s.

Automatic Updates for IP Address Allocation/De-allocation

During the subscriber-host setup phase, the first allocated IP address is sent in the CCR-i message from the 7x50 to the PCRF.

Each subsequent IP address allocation/de-allocation for the same host can optionally trigger a CCR-u, notifying the PCRF of the IP address allocation/de-allocation event.

This behavior can be enabled via the following CLI command:

```
configure
    subscriber-mgmt
      diameter-application-policy <pol-name>
        gx
          [no] report-ip-addr-event
```

The IP address allocation/de-allocation event driven CCR-u message will carry the respective event code [UE_IP_ADDRESS_ALLOCATE(18) or UE_IP_ADDRESS_RELEASE(19)] along with the corresponding IP address.

The IP address allocation/de-allocation events are applicable to the following addresses:

- Framed-IP-Address (AVP Code 8) IPv4
- Framed-IPv6-Prefix (AVP Code 97) SLAAC
- Delegated-IPv6Prefix (AVP Code 123) IA-PD
- Alc-IPv6-Address (AVP Code 1023) IA-NA

These event-codes will only be sent in CCR-u messages and not in CCR-i and CCR-t messages (when the host is instantiated and terminated).

Examples:

IPv6 attachment request arrives with two IP addresses: IA-NA and IA-PD. This is a new host. CCR-i will be generated with two IP addresses included (IA-NA and IA-PD, assuming that request for their allocation is carried in the same DHCPv6 message).

Some time later, the attachment request for an IPv4 address arrives on the same host. CCR-u will be generated with the event UI_IP_ADDRESS_ALLOCATE and corresponding AVP (framed-address) will be sent to the PCRF. No IP address other than this new IPv4 address will be sent.

RAR is received for the (any) policy change. 7x50 will reply with RAA and it will contain all three IP addresses (AVPs) that have been allocated to the host.

If the IP address notification event is enabled, 7x50 originated Gx message will carry all known IP addresses/prefixes associated with the subscriber-host (Gx session), unless those messages contain one of the two event codes:

UE_IP_ADDRESS_ALLOCATE(18) or UE_IP_ADDRESS_RELEASE(19). In the case that one of those two events is present in the Gx message, the IP address/prefix carried in that message will be only relevant to the event contained in the message (address/prefix allocated or released).

If the IP address notification event is disabled, 7x50 will only send the IP address from the first host. This IP address will be included in all messages related to the Gx session. If this IP address is removed (de-allocated) mid-session from the dual-stack host, 7x50 will stop advertising it, or any other address, from Gx messages for that particular session.

DHCPv4/v6 Re-Authentication and RADIUS CoA Interactions With Gx

In case that re-authentication for DHCPv4/v6 hosts is enabled, any policy changes that may be submitted during re-authentication (for example sla-profile update via Access-Accept) will overwrite the one previously applied, regardless of the source of the policy update. For example, in case that the Gx policy is applied to a subscriber host via RAR (mid-session policy update) and then some time later an overlapping policy with different values is submitted via RADIUS or LUDB during the re-authentication phase, the RADIUS/LUDB submitted policy will overwrite the one applied via Gx. In other words, the origin of the current policy in effect is not maintained internally in the system and therefore the overlapping policy update cannot be prioritized according to the source of the policy.

The following guidelines should be followed in case where the policy is provided via Gx:

- In case that LUDB access is enabled, there should be no overlap between the LUDB provided parameters and Gx provided parameters. LUDB is accessed during every DHCP lease renew process and consequently parameters configured via LUDB would overwrite parameters provided by Gx.
- In case that re-authentication is enabled, there should be no overlap between the RADIUS provided parameters and Gx provided parameters. With re-authentication enabled, RADIUS is contacted during every DHCP lease renew process and consequently parameters configured via RADIUS would overwrite parameters provided by Gx.

These guidelines are not applicable for PPPoE subscriber-hosts since re-authentication cannot be enabled for PPPoE hosts. Consequently, LUDB or RADIUS parameters cannot override Gx provided parameters.

Coexistence of RADIUS CoA and Gx for the same host is allowed. The two policy change mechanisms are independent of each other and as such they can override each other. For example, if the RADIUS CoA for policy change for the host is received, the policy will be updated but the PCRF (Gx) will not be notified of the change. If both policy management mechanisms are deployed simultaneously, then it is the operator's responsibility to synchronize the actions between the two.

Gx, ESM and AA

Although the ESM subscriber and the AA subscriber are two separate instantiations within the 7x50, their policy management and usage monitoring are handled uniformly through a single Gx session.

ESM Subscriber-host vs AA Subscriber

Since ESM and AA modules are part of integrated service offering (ESM with residential AA on the same node), they share the same subscriber-id string. However, Gx interface in ESM is primarily applicable to hosts (basic entity to which policy is applied) while AA has no awareness of hosts. AA is only aware of subscribers (which is, in broader terms, a collection of hosts within a residence). Refer to Multi-Service Integrated Services Adapter Guide for details on Application Assurance concepts.

AA Subscriber State

AA subscriber state must exist for App-profiles and ASO overrides to be applied.
The app-profile for the aa-sub is applied explicitly by an CCR-i or RAR message with an AVP AA-App-Profile-Name.

App-profiles interact with ASO characteristics in this way:

- The AA-App-Service-Options AVP within the app-profile assignment is optional at subscriber instantiation time and may be used later to modify the policy.
- The newly submitted AA-App-Profile-Name AVP will overwrite the one that is already applied. Any ASO AVPs that is received within the Gx message will be applied.

  Note that if an app-prof AVP is present, even if it is the same app-profile as currently applied, all previous ASO override policies are removed for the sub.

The state of the subscriber policy attributes is modified by ASO AVPs in this way:

- The app profile can define one or more ASO characteristics attributed to a subscriber
- If there are multiple ASO AVPs for the same characteristic in the message, the first one will take effect.
- There is no explicit delete of ASO overrides (PCRF can always resend or change the app-profile in order to delete all overrides).

Policy Management via Gx

Policy management via Gx interface refers to instantiation (or activation) and modification of the existing subscriber-host related objects in the 7x50. Policy updates can be implicitly requested by 7x50 at IP-Can session establishment time via CCR-i command. 7x50 will supply user identification attributes to the PCRF so that the PCRF can identify rules to be applied. Note that the 7x50 will not explicitly request rule update (for example via Event-Trigger = RESOURCE_MODIFICATION_REQUEST). Another way to request policy update in 7x50 is via RAR command in a PUSH model.
ESM (subscriber-host) related objects are shown in Figure 173.

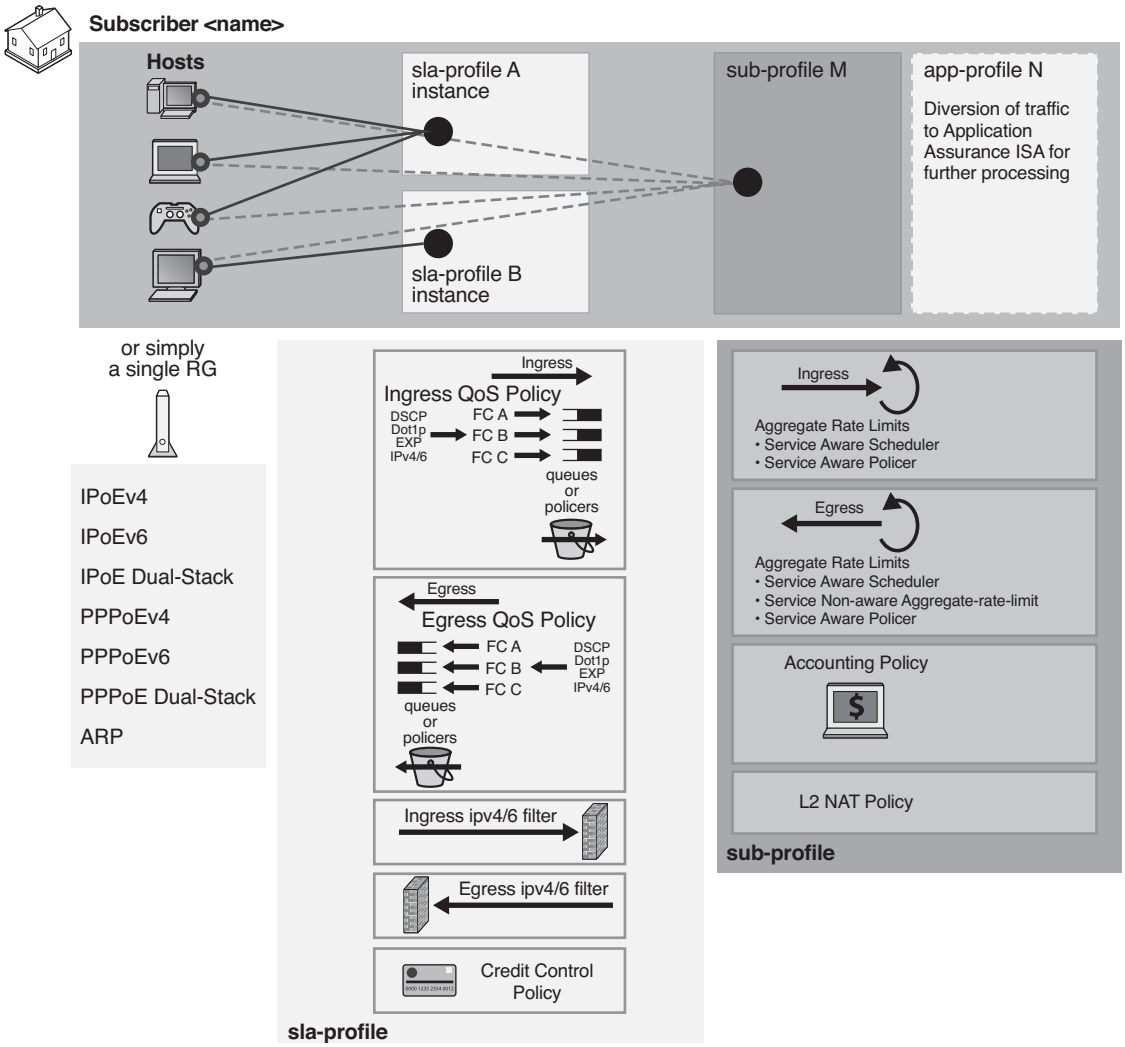


Figure 173: ESM Objects Managed via Various Policies and Profiles

The two basic concepts in ESM context are sla-profile with its associated objects and sub-profile with its associated objects.

Sla-profile defines a service level (rates, queues, filters) for a group of hosts sharing the same sla-profile instance within the subscriber. There can be multiple sla-profile instances per subscriber.

Sub-profile defines aggregate rate of the subscriber along with accounting policy. There is only one sub-profile per subscriber.

Gx interface is used to associate/de-associate subscriber-host with related policies and subsequently override them. The granularity of subscriber policy change is the following:

- Pointers to the pre-configured subscriber profiles (sla/sub/aa-profile)
- QoS overrides for sla-profiles
- Change of subscriber aggregate rate (arbiters and egress-aggregate-rates)
- Change of QoS class level parameters (queue/policer rates, burst sizes, etc).
- Change of subscriber filters
- Insertion of entries in an existing subscriber filter (up to 10 filter entries per filter).

Object Modifications and Object Association Changes via Gx

The term ESM (or subscriber-host) object modification in this context refers to the ability of a certain policy interface (RADIUS or Gx) to change the value of the parameters of an object that is already instantiated in 7x50. For example, characteristics of the queue (rate, depth, etc.) that is already instantiated and associated with the subscriber-host, can be modified on-the-fly via Gx.

On the other hand, the term object association change refers to the ability of a certain policy interface (RADIUS or Gx) to replace one object instantiation with another. For example, a sla-profile instance for a subscriber host can be replaced with another one on-the-fly. Similarly, sub-profile and app-profile can be replaced for the subscriber.

The object modifications and association changes are applicable to subscribers and, on a more granular level, to subscriber hosts.

In case of a routed RG where the RG is host itself, the subscriber host will equate to the residence (subscriber).

In case of a bridged RG, a collection of hosts will represent the residence (subscriber). In our ESM model all such host share the same sub-profile (sub-profile is applied per residence or the subscriber). In this case a sub-profile change for a single host will affect the all hosts within the residence (subscriber).

On the other hand, sla-profile instances may or may not be shared between the hosts within the subscriber. Policy changes that concern parameters that are implicitly referenced by the sla-profile (for example filter inserts in the filter applied under the sla-profile), will affect all hosts sharing this particular sla-profile instance.

Installation of the Policy Rules

For a list of Gx related AVPs supported in 7x50, refer to the SROS Gx AVP Reference Guide.

Every policy rule installation or modification within 7x50 is executed via Charging-Rule-Install AVP (for ESM or AA) or ADC-Rule-Install AVP (for AA only, 3GPP Release 11) sent from the PCRF to the 7x50.

AVP Format:

```
Charging-Rule-Install ::= < AVP Header: 1001 >
                          *[ Charging-Rule-Definition ]
                          *[ Charging-Rule-Name ]
                          *[ AVP ]

ADC-Rule-Install ::= < AVP Header: 1092 >
                          *[ ADC-Rule-Definition ]
                          *[ ADC-Rule-Name ]
                          *[ AVP ]
```

Every rule must have a Charging-Rule-Name (ESM, AA) or ADC-Rule-Name (AA – 3GPP R11) associated with it. AA Gx functionality is complaint to both 3GPP R11 and 3GPP R12. The PCRF can activate AA features and functions via either ADC rules or PCC rules.

The objects (subscriber-hosts) to which the new policy rules are applied must exists (be instantiated) in 7x50 otherwise the rule installation will fail.

Similarly, the policy rules that are defined as template/profiles (sub/sla/aa-profiles) must be predefined in 7x50.

The Charging-Rule-Definition AVP and ADC-Rule-Definition will be used to submit overrides (an override is yet another policy rule in the context of Gx) that are defined on the PCRF. For example, QoS overrides can be defined in the PCRF and submitted to the 7x50.

Removal of the aforementioned rules is not supported. The rules (or parameters) referenced in Charging-Rule-Install/ADC-Rule-Install AVPs will simply replace the existing rules (or parameters), without the need to remove the previously installed rule. This can be thought of as override approach instead of remove before install. Except for PCC rules (Charging-Rules) that are used for AA usage monitoring; these rules can be removed.

There are five types of policy rule changes that are currently supported via Gx:

- ESM profile installation/overrides — This has the largest scope (affect QoS and filters)
- Update of subscriber host QoS information (queue rate change, etc)
- Filter installation/override for the subscriber host (including **one-time http redirect**)
- Insertion of host-specific and shared filter entries
- Category-map installation/override

For all five rule types, the rule removal directive (Charging-Rule-Remove AVP), if received from the PCRF, will be ignored. Those rules can be only overwritten (by successive re-submission from PCRF) but they cannot be removed. For example, a subscriber-host cannot exist without the sla-profile or sub-profile.

Charging-Rule-Name AVP within the Charging-Rule-Install grouped AVP points to the preconfigured filter policy in the system, the preconfigured profiles or it simply represents the ESM string (such as inter-destination-string used to associate the subscriber host with a vPort construct – just another level in QoS hierarchy). The existing objects for the subscriber-host will be replaced with the referenced one.

It is important to distinguish two locations for invoking Charging-Rule-Name AVP:

1. Directly under the Charging-Rule-Install AVP – in this case the Charging-Rule-Name will reference the predefined structures (profiles, filter-ids, cat-maps, etc) within 7x50. The type of the structure is contained within the Charging-Rule-Name AVP in the form of a reserved keyword that has to be prepended (in bold below) to the identifier of structure:

   Filter installation/overrides:

   → Charging-Rule-Name = **Ingr-v4**:<id>

   → Charging-Rule-Name = **Ingr-v6**:<id>

   → Charging-Rule-Name = **Egr-v4**:<id>

   → Charging-Rule-Name = **Egr-v6**:<id>

   → Charging-Rule-Name = **In-Othr-v4**:<id> (othr - one-time-http-redirect)

   → Charging-Rule-Name = **In-Othr-v6**:<id> (othr - one-time-http-redirect)

   Profile installation/overrides:

   → Charging-Rule-Name = **Sla-Profile**:*sla-profile-name*

   → Charging-Rule-Name = **Sub-Profile**:*sub-profile-name*

   → Charging-Rule-Name = **Inter-Dest**:*inter-dest-string*

   Usage Monitoring:

   → Charging-Rule-Name = **Cat-Map**:*category-map-name*

AA:

→ Charging-Rule-Name= AA-UM:<string-name>

→ Charging-Rule-Name= AA-Functions:<string-name>

In summary, the reserved prefixes "**ingr-v4**:", "**ingr-v6**:", "**egr-v4**:", "**egr-v6**:", "**in-othr-v4**:", "**in-othr-v6**:", "**sla-profile**:", "**sub-profile**:", "**inter-dest**:", "**aa-um**:", "**aa-functions**:" and "**cat-map**:" have special meaning within the Charging-Rule-Name AVP in 7750 SR.

2. Under the Charging-Rule-Install — Charging-Rule-Definition AVP. In this case the rule itself is not pre-provisioned in 7x50 but instead directly defined in the Charging-Rule-Definition. This is normally used for overrides. Part of the rule definition is the name assignment via Charging-Rule-Name AVP - as opposed to a profile name referencing as shown in the above case. The Charging-Rule-Name AVP is used to report on the rule status.

   Filter Entry Inserts:

   → Charging-Rule-Name = filter-insert-rule-name
   Since there is no pre-defined filter-insert profile in 7x50, the Charging-Rule-Name for filter inserts is an arbitrary name. This AVP is part of Charging-Rule-Definition AVP in which NAS-Filter-Rule AVP or Alc-NAS-Filter-Rule-Shared is provided. Such Charging-Rule-Name will be used to report errors related to instantiation of the rule.

   QoS Overrides:

   → Charging-Rule-Name =qos-rule-name
   Since there is no pre-defined profile in 7x50 for QoS overrides, the Charging-Rule-Name for QoS overrides is an arbitrary name. This AVP is part of Charging-Rule-Definition AVP in which QoS-Information is provided. Such Charging-Rule-Name is used to report errors related to instantiation of the rule.

ADC-Rule-Name AVP within the ADC-Rule-Install grouped AVP handles application policy related processing (AA). This AVP is applicable under the ADC-Rule-Install — ADC-Rule-Definition AVP. In this case the ADC rule itself is not pre-provisioned in 7x50 but instead directly defined in the ADC-Rule-Definition. In AA, such rule definition can define AA overrides that will be applied to the subscriber. In other words, the existing objects for the subscriber will be replaced with the ones referenced in the rule. Part of the ADC rule definition is the ADC rule name assignment via ADC-Rule-Name AVP. The ADC-Rule-Name defined in such manner is used to report on the rule status.

"**AA-Functions**:" prefix in the ADC rule name is reserved for ADC rule definitions applicable to "AA-functions" (namely: app-profile and ASOs):

ADC-Rule-Name = **AA-Functions**:*aa-rule-name*

In this case, the aa-rule-name is an arbitrary name that will be used in rule status reporting.

In case that ADC-Rule-Name is used in AA usage monitoring, the "**AA-Functions**:" prefix must not be present (usage monitoring in AA is covered in details in the 7750 SR OS MS-ISA Guide). Note however, that AA-Function AVP and AA-usage monitoring cannot co-exist in the same ADC rule.

Similarly, "AA-Functions:" prefix can also be used in PCC rules names. In that case, the PCC rule is used to set the app-profile and ASOs, by include the AA-Functions AVP.

Charging-Rule-Definition AVP (AVP code 1003, 3GPP 29.212 §5.3.4) is of type Grouped, and it defines the policy rule sent by the PCRF to the 7x50. The Charging-Rule-Name AVP within the Charging-Rule-Definition AVP uniquely identifies the policy rule and it is used to reference to a policy rule in communication between the 7x50 and the PCRF within one IP CAN session.

The Charging-Rule-Name in this AVP can be arbitrarily set and it is used to uniquely identify the rule in error reporting.

```
Charging-Rule-Definition ::= < AVP Header: 1003 >
     { Charging-Rule-Name }
     [ QoS-Information ]
     [ Nas-Filter-Rule]
     [ Alc-NAS-Filter-Rule-Shared]
     [ TDF_Application_ID]
     [ AA-Functions]
     [ monitoring-Key]
     *[ AVP ]
```

ADC-Rule-Definition AVP (AVP code 1094, 3GPP 29.212 §5.3.87) is of type Grouped, and it defines the ADC policy rule sent by the PCRF to the 7x50. The ADC-Rule-Name AVP within the ADC-Rule-Definition AVP uniquely identifies the ADC policy rule and it is used to reference to a policy rule in communication between the 7x50 and the PCRF within one IP CAN session.

```
ADC-Rule-Definition ::=   < AVP Header: 1094 >
                          { ADC-Rule-Name }
                          [AA-Functions]
                          *[ AVP ]
```

In summary:

- Any Gx incurred change of objects within 7x50 is considered a policy rule change. This includes association of profiles/category-maps/filters with subscriber hosts, instantiation of sla-profiles, QoS modifications, Filter entry inserts (subscriber-specific and shared), AA modifications, etc.
- Central AVP for rule change in 7x50 is Charging-Rule-Install AVP. Multiple policy rule changes can be submitted to 7x50 via a single Charging-Rule-Install AVP or each policy rule change can be submitted via its own Charging-Rule-Install AVP.
- Policy rule changes are identified by Charging-Rule-Name AVP. This AVP is also used to report on the status of rule modification. The Charging-Rule-Name can reference a pre-

configured rule within 7x50 (profiles, cat-maps, filters) or it can be assigned by PCRF to identify the PCRF defined rule (QoS policy modifications, AA ASO modifications, etc. – mainly related to overrides and filter inserts) via a single AVP.

- Aforementioned rules cannot be removed by Charging-Rule-Remove AVP. They can only be overwritten. Charging-Rule-Remove AVP is ignored by the 7750 SR, except for charging-Rules that are used for AA-usage monitoring. These can be removed.

Filter Entry Inserts (NAS-Filter-Rule and Alc-NAS-Filter-Rule-Shared)

Gx filter entries inserted via NAS-Filter-Rule are subscriber-host specific entries. This means that in the upstream direction, the source IP address in the NAS-Filter-Rule will always be internally set by 7x50 to the IP address of the subscriber host itself. Similarly, in the downstream direction the destination IP address in the NAS-Filter-Rule will be set by 7x50 to be the IP address of the subscriber-host itself.

On the other hand, the entries in the Alc-NAS-Filter-Rule-Shared AVP are left unchanged (as received) by 7x50 which means that such entries will be shared with all hosts that have the same Alc-NAS-Filter-Rule-Shared applied.

Examples of Rule Installation

There are two ways of installing policy rules in 7x50 via Gx:

1. Multiple policy rules per single Charging-Rue-Install AVP
2. Single policy rule per Charging-Rule-Install AVP.

The following AVPs will identify policy rules that will be applied to a subscriber host. Those AVPs can be included in CCA-i, CCA-u or RAR message sent from the PCRF. Note that in the first approach, all rules are submitted under a single Charging-Rule-Install AVP:

```
Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Name <AVP Header: 1005> = "ingr-v4:7"
     Charging-Rule-Name <AVP Header: 1005> = "eggr-v6:5"
     Charging-Rule-Name <AVP Header: 1005> = "Sub-Profile:prem"
     Charging-Rule-Name <AVP Header: 1005> = "Sla-Profile:voip+data"
     Charging-Rule-Name <AVP Header: 1005> = "Inter-Dest:vport-AN-1"

     Charging-Rule-Definition <AVP Header: 1003>
          Charging-Rule-Name <AVP Header: 1005> = "premium-service"
          QoS-Information <AVP Header: 1016>
               Alc-Queue <AVP Header; vnd ALU; 1016>
               Alc-Queue-id <AVP Header; vnd ALU; 1007> = 5
               Max-Requested-Bandwidth-UL <AVP Header: 516> = 10000
               Max-Requested-Bandwidth-DL <AVP Header: 515> = 100000
               Guaranteed-Bitrate-UL <AVP Header: 1026> = 5000
               Guaranteed-Bitrate-DL <AVP Header: 1027> = 50000
               Alc-Committed-Burst-Size-UL <AVP Header; vnd ALU; 1008> = 1000
               Alc-Maximum-Burst-Size-UL <AVP Header; vnd ALU; 1009> = 2000
               Alc-Committed-Burst-Size-DL <AVP Header; vnd ALU; 1010> = 1000
               Alc-Maximum-Burst-Size-DL <AVP Header; vnd ALU; 1011> = 2000

     Alc-Queue <AVP Header; vnd ALU; 1006>
          Alc-Queue-id <AVP Header; vnd ALU; 1007> = 7
          Max-Requested-Bandwidth-UL <AVP Header: 516> = 10000
          Max-Requested-Bandwidth-DL <AVP Header: 515> = 100000
          Guaranteed-Bitrate-UL <AVP Header: 1026> = 5000
          Guaranteed-Bitrate-DL <AVP Header: 1027> = 50000
```

```
          Alc-Committed-Burst-Size-UL <AVP Header; vnd ALU; 1008> = 1000
          Alc-Maximum-Burst-Size-UL <AVP Header; vnd ALU; 1009> = 2000
          Alc-Committed-Burst-Size-DL <AVP Header; vnd ALU; 1010> = 1000
          Alc-Maximum-Burst-Size-DL <AVP Header; vnd ALU; 1011> = 2000

     Alc-Sub-Egress-Rate-Limit <AVP Header; vnd ALU; 1016> = 10000
Charging-Rule-Definition <AVP Header: 1003>
     Charging-Rule-Name <AVP Header: 1005> = "allow-all"
     NAS-Filter-Rule <AVP Header: 400> = "permit in ip from any to any "ASCII NUL" permit
out ip from any to any"


ADC-Rule-Install ::= <AVP Header: 1092>
     ADC-Rule-Definition <AVP Header: 1094>
          ADC-Rule-Name <AVP Header: 1096> = "AA-Functions:apps"
          AA-Functions
               AA-App-Profile-Name = "apps-prof"
               AA-App-Service-Options
                    AA-App-Serv-Options-Name = "bitttorent"
                    AA-App-Serv-Options-Value = "low-prio-1mbps"
               AA-App-Service-Options
                    AA-App-Service-Options-Name =  "ftp"
                    AA-App-Service-Options-Value = "hi-prio"
```

In this example various subscriber profiles (sub/sla) will be applied to the subscriber host and at the same time a new ingress v4 and egress v6 filter will be installed. Characteristics for queue 5 and 7 will be overridden and new filter entries will be inserted in the existing filters.

Also the egress rate limit for the subscriber will be overridden and the subscriber host will be associated with the Vport named vport-AN-1.

All PCC rules are aggregated under the same Charging/ADC-Rule-Install AVP.

There are several levels of nesting present in this example:

charging-rule-install -> charging-rule-definition->qos-information -> queue -> queue_parameters

In the second example all the rules are submitted via a separate Charging-Rule-Install AVP.

```
Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Name <AVP Header: 1005> = "ingr-v4:7"

Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Name <AVP Header: 1005> = "eggr-v6:5"

Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Name <AVP Header: 1005> = "Sub-Profile:prem"

Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Name <AVP Header: 1005> = "Sla-Profile:voip+data"

Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Name <AVP Header: 1005> = "Inter-Dest:vport-AN-1"
```

```
Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Definition <AVP Header: 1003>
          Charging-Rule-Name <AVP Header: 1005> = "premium-service"
          QoS-Information <AVP Header: 1016>
               Alc-Queue <AVP Header; vnd ALU; 1016>
                    Alc-Queue-id <AVP Header; vnd ALU; 1007> = 5
                    Max-Requested-Bandwidth-UL <AVP Header: 516> = 10000
                    Max-Requested-Bandwidth-DL <AVP Header: 515> = 100000
                    Guaranteed-Bitrate-UL <AVP Header: 1026> = 5000
                    Guaranteed-Bitrate-DL <AVP Header: 1027> = 50000
                    Alc-Committed-Burst-Size-UL <AVP Header; vnd ALU; 1008> = 1000
                    Alc-Maximum-Burst-Size-UL <AVP Header; vnd ALU; 1009> = 2000
                    Alc-Committed-Burst-Size-DL <AVP Header; vnd ALU; 1010> = 1000
                    Alc-Maximum-Burst-Size-DL <AVP Header; vnd ALU; 1011> = 2000

               Alc-Queue <AVP Header; vnd ALU; 1006>
                    Alc-Queue-id <AVP Header; vnd ALU; 1007> = 7
                    Max-Requested-Bandwidth-UL <AVP Header: 516> = 10000
                    Max-Requested-Bandwidth-DL <AVP Header: 515> = 100000
                    Guaranteed-Bitrate-UL <AVP Header: 1026> = 5000
                    Guaranteed-Bitrate-DL <AVP Header: 1027> = 50000
                    Alc-Committed-Burst-Size-UL <AVP Header; vnd ALU; 1008> = 1000
                    Alc-Maximum-Burst-Size-UL <AVP Header; vnd ALU; 1009> = 2000
                    Alc-Committed-Burst-Size-DL <AVP Header; vnd ALU; 1010> = 1000
                    Alc-Maximum-Burst-Size-DL <AVP Header; vnd ALU; 1011> = 2000

               Alc-Sub-Egress-Rate-Limit <AVP Header; vnd ALU; 1016>

Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Definition <AVP Header: 1003>
          Charging-Rule-Name <AVP Header: 1005> = "allow-all"
          NAS-Filter-Rule <AVP Header: 400> = "permit in ip from any to any "ASCII NUL"
permit out ip from any to any"

ADC-Rule-Install ::= <AVP Header: 1092>
     ADC-Rule-Definition <AVP Header: 1094>
          ADC-Rule-Name <AVP Header: 1096> = "AA-Functions:apps"
          AA-Functions
               AA-App-Profile-Name = "apps-prof"
               AA-App-Service-Options
                    AA-App-Service-Options-Name = "bitttorent"
                    AA-App-Service-Options-Value = "low-prio-1mbps"
               AA-App-Service-Options
                    AA-App-Service-Options-Name =  "ftp"
                    AA-App-Service-Options-Value = "hi-prio"
```

Each rule is contained in its own Charging/ADC-Rule-Install AVP.

Alternatively, AA-Functions AVPs can be included within a PCC rules such as:

```
Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Name <AVP Header: 1005> = "AA-Functions:apps"
          AA-Functions
               AA-App-Profile-Name = "apps-prof"
               AA-App-Service-Options
                    AA-App-Serv-Options-Name = "bitttorent"
                    AA-App-Serv-Options-Value = "low-prio-1mbps"
               AA-App-Service-Options
                    AA-App-Service-Options-Name = "ftp"
                    AA-App-Service-Options-Value = "hi-prio"
```

Error Handing and Rule Failure Reporting in ESM

Each submitted request for rule installation is evaluated first by the Gx module in 7x50. The Gx module will decode the AVPs and verify that all AVPs with the M-bit set (including the AVP content) are supported. Once this is determined, the rule request is submitted to the ESM module, the Volume Monitoring module (for usage-monitoring) and the AA module. Each of the three modules will examine its own directives and process them accordingly.

Consequently, the failure can be reported on four levels in 7x50:

- AVP decoding problem (Gx module) — If there is a problem in the Gx message itself (for example an unrecognized AVP with M-bit set), the entire message will be rejected and consequently no rules will be installed.
- ESM rule installation problem— If a message contains multiple ESM rules and one of rules fails to install in the ESM module, all ESM rules in the message will be rejected and failure will be reported to the PCRF.
- Usage-Monitoring (UM) rule installation problem — If a message contains multiple UM rules and one of rules fails to install in the UM module, all UM rules in the message will be rejected and failure will be reported to the PCRF.
- AA rule instantiation problem — If a message contains multiple AA rules and one of rules fails to install in the AA module, all AA rules in the message will be rejected and failure will be reported to the PCRF.

AVP Decoding Failure in Gx

Reporting an AVP decoding problem in Gx is described in the following example:

A directive is received to install two rules in 7x50. The two rules are supposed to change the sla and sub profiles for the subscriber host. The AVP that is used to change the sla-profile is miss-formatted. The predefined **sla-profile** keyword in the **Charging-Rule-Install AVP** is misspelled as s**p**a-profile instead of **sla-profile**.

```
Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Name <AVP Header: 1005> = "Sub-Profile:prem"
     Charging-Rule-Name <AVP Header: 1005> = "Spa-Profile:voip+data"
```

Since the Charging-Rule-Name AVP has the M-bit set, the whole message will fail and an error will be reported. No rules within this Gx message will be installed (not even the valid ones, in this case this would be the Charging-Rule-Name = "**Sub-Profile**:prem"). Note that if the M-bit was clear in the Charging-Rule-Name AVP, the erroneous AVP would be simply ignored and we would proceed with installation of the remaining, 'correctly formatted' rules.

The nature of the error will depend on the original directive sent by the PCRF (RAR or CCA – push or pull model)

- In case that the directive from the PCRF is passed via CCA command, the response will be CCR-u command with the following error related AVPs:

```
[ Error-Message ]   –     "Invalid value spa-profile:voip+data"

Charging-Rule-Report ::= < AVP Header: 1018 >
     *[ Charging-Rule-Name ]    – Spa-Profile:voip+data
     [ PCC-Rule-Status ]        – INACTIVE (1)
     [ Rule-Failure-Code ]      – GW/PCEF_MALFUNCTION (4)


Charging-Rule-Report ::= < AVP Header: 1018 >
     *[ Charging-Rule-Name ]    – Sub-Profile:prem
     [ PCC-Rule-Status ]        – INACTIVE (1)
     [ Rule-Failure-Code ]      – GW/PCEF_MALFUNCTION (4)


Failed-AVP ::= < AVP Header: 279 >
     Charging-Rule-Name = Spa-Profile:voip+data
```

In case that the directive is passed to 7x50 via RAR, the 7x50 will respond with the following RAA message:

```
Failed-AVP ::= < AVP Header: 279 >
     Charging-Rule-Name = Spa-Profile:voip+data

Result-Code ::= < AVP Header: 268 > = DIAMETER_INVALID_AVP_VALUE (5004)
```

Similarly, if the number of filter entries for each entry type (NAS-Filter-Rule — host-specific or Alc-NAS-Filter-Rule-Shared — shared) exceeds the maximum supported number (see the Gx AVP Reference Guide), the whole message will fail the decoding phase.

The reason that the Result-Code AVP is present in the RAA message and not in the CCR-u message is that this code is only allowed to be present in the answer messages, according to the standard.

ESM Rule-Installation Failure

This assumes that the rule installation directives are successfully passed from the Gx module to the ESM module and the failure to install rules occurs in the ESM module.

For example in this case below, the referenced sla-profile is unknown. In such case, all directives passed to the ESM module will fail and consequently no rules will be installed. The sub-profile change will fail as well although the prem sub-profile is known in the system.

```
Charging-Rule-Install ::= <AVP Header: 1001>
     Charging-Rule-Name <AVP Header: 1005> = "Sub-Profile:prem"
     Charging-Rule-Name <AVP Header: 1005> = "Sla-Profile:unknown"
```

The error reporting flow will be the following:

- In case that the directives are passed via CCA command, the response will be CCR-u command with the following error related AVPs:

```
[ Error-Message ]               – "sla-profile 'unknown' lookup failed"

Charging-Rule-Report ::= < AVP Header: 1018 >
     *[ Charging-Rule-Name ]    – Sla-Profile:unknown
     [ PCC-Rule-Status ]        – INACTIVE (1)
     [ Rule-Failure-Code ]      – GW/PCEF_MALFUNCTION (4)


Charging-Rule-Report ::= < AVP Header: 1018 >
     *[ Charging-Rule-Name ]    – Sub-Profile:prem
     [ PCC-Rule-Status ]        – INACTIVE (1)
     [ Rule-Failure-Code ]      – GW/PCEF_MALFUNCTION (4)
```

- In case that the directive is passed to 7x50 via RAR, the 7x50 will respond with the following messages:

  RAA = OK since the Gx module successfully processed the AVP parsing.
  The RAA will be followed by CCR-u, triggered by the rule instantiation failure in ESM module. CCR-u will contain the following AVP related to the rule status:

```
[ Error-Message ]               – "sla-profile 'unknown' lookup failed"

Charging-Rule-Report ::= < AVP Header: 1018 >
     *[ Charging-Rule-Name ]    – Sla-Profile:unknown
     [ PCC-Rule-Status ]        – INACTIVE (1)
     [ Rule-Failure-Code ]      – GW/PCEF_MALFUNCTION (4)


Charging-Rule-Report ::= < AVP Header: 1018 >
     *[ Charging-Rule-Name ]    – Sub-Profile:prem
     [ PCC-Rule-Status ]        – INACTIVE (1)
     [ Rule-Failure-Code ]      – GW/PCEF_MALFUNCTION (4)
```

Similar behavior would be exhibited if the directive is sent to the UM or AA modules. However, note that ESM, UM and AA are separate modules and failure to install rule in one module will not affect rule instantiation in another.

Failure Reporting in AA

Failure reporting in AA is performed in similar fashion as in ESM.

Instead of Charging-Rule-Report AVP, the ADC-Rule-Report will be used:

```
ADC-Rule-Report ::=< AVP Header: 1097 >
                    *[ ADC-Rule-Name ]
                    [ PCC-Rule-Status ]
                    [ Rule-Failure-Code ]
                    *[ AVP ]
```

Summary of Failure Reporting

Table 24 summarizes Gx failure reporting by the 7750 SR.

Table 24: Failure Reporting

Failure Event	Gx message received on 7x50 via CCA (Pull Model)	Gx message received on 7x50 via RAR (Push Model)
AVP decoding/interpreting failure; M-bit cleared	Ignore AVP	Ignore AVP
AVP decoding/interpreting failure; M-bit set	CCR-u will be sent by 7x50. CCR-u will contain: • *Charging-Rule-Report* AVP for all rules (all rules inactive) • First failed AVP in *Failed-AVP* AVP • *Error-Message* AVP at the top level describing the reason for the failure. • No rules within the message will be instantiated in 7x50.	RAA will be sent by 7x50. RAA will contain: • Result-Code AVP [DIAMETER_INVALUID_AVP_VALUE (5004), DIAMETER_AVP_UNSUPPORTED (5001), DIAMETR_UNAMBLE_TO_COMPLY (5012) First failed AVP in Failed-AVP AVP No rules within the message will be instantiated in 7x50.

Table 24: Failure Reporting (Continued)

Failure Event	Gx message received on 7x50 via CCA (Pull Model)	Gx message received on 7x50 via RAR (Push Model)
Rule failure in ESM	CCR-U will be sent by 7x50. CCR-u will contain: • Charging-Rule-Report AVP for all rules (all rules inactive) • Error-Message AVP at the top level describing the reason for the failure. No rules will be instantiated in the ESM module.	RAA with the *Result-Code* AVP 'success' (2001) will be sent by , followed by a CCR-u. CCR-u will contain: • *Charging-Rule-Report* AVP for all rules (all rules inactive) • *Error-Message* AVP at the top level describing the reason for the failure. No rules will be instantiated in the ESM module.
Rule failure in Usage-Monitoring (UM)	CCR-U will be sent by 7x50. CCR-u will contain: • *Charging-Rule-Report* AVP for all rules (all rules inactive) • *Error-Message* AVP at the top level describing the reason for the failure. No rules will be instantiated in the UM module.	RAA with the *Result-Code* AVP 'success' (2001) will be sent by the 7750 SR, followed by a CCR-u. CCR-u will contain: • *Charging-Rule-Report* AVP for all rules (all rules inactive) • *Error-Message* AVP at the top level describing the reason for the failure. No rules will be instantiated in the UM module.
Rule failure in AA	CCR-U will be sent by the 7750 SR. CCR-u will contain: • *ADC-Rule-Report* AVP for all rules (all rules inactive) • *Error-Message* AVP at the top level describing the reason for the failure. No AA rules will be instantiated in the AA module.	RAA with the Result-Code AVP 'success' (2001) will be sent by the 7750 SR, followed by CCR-u. CCR-u will contain: • ADC-Rule-Report AVP for all rules (all rules inactive) • Error-Message AVP at the top level describing the reason for the failure. No rules will be instantiated in the AA module.

Usage Monitoring and Reporting

Usage monitoring and reporting refers to the collection and reporting of octets (volume) that a service or application on the 7x50 has consumed during certain period. The usage on the 7x50 is reported via Gx interface to the PCRF. Based on this information, the PCRF can apply specific action (policy change) to the entity being monitored. For example, QoS can be modified, or the service can be blocked when specific thresholds are reached.

As is the case in policy management, usage monitoring and reporting occurs over a single Gx session for the EMS/AA subscriber. In other words, there is only a single session for an ESM subscriber(-host) and corresponding AA subscriber. Via this single Gx session, usage monitoring can be requested simultaneously in ESM context (service-category and/or IP-CAN session) and AA context (application based usage monitoring).

ESM Usage Monitoring - What is Being Monitored?

In the ESM context, volume consumption (octets - 3GPP 23.203 §4.4) will be monitored on two levels:

- per entire IP-CAN session
- per service category.

Usage monitoring can be monitored simultaneously on both levels.

IP-CAN session in 7x50 represents a subscriber-host whose service types are determined by the sla-profile instance. In per IP-CAN session volume monitoring, the aggregated queues/policers counters will be reported per direction (in | out). The queue/policers are applicable to an entire IP-CAN session (host).

In case that the sla-profile instance changes mid-session, the counters will be reset.

One obvious difference between regular RADIUS accounting and Gx Usage-Monitoring is that in RADIUS accounting the cumulative byte number for sla-profile instance is presented in each report (interim-updates or stop acct messages), while in Usage-Monitoring this count is incremental between the two reports (when the quota is reached, the usage report is triggered).

Per service monitoring deals with traffic volume of a single queue/policer or a set of queues/policers within the sla-profile instance. Each such queue/policer (or set of queues/policers as a subset of sla-profile instance) represents a service for which the usage monitoring is required. Those queues/policers (services) are organized within 7x50 in **credit categories**.

```
*A:7750>config>subscr-mgmt>cat-map# info
----------------------------------------------
            activity-threshold 1
            credit-exhaust-threshold 50
            category "queue1" create
                queue 1 ingress-egress
            exit
            category "queue3-5" create
                queue 3 ingress-egress
                queue 5 ingress-egress
            exit
            category "rest-queues" create
                queue 2 egress-only
                queue 4 egress-only
                queue 6 egress-only
                queue 7 egress-only
                queue 8 egress-only
            exit
----------------------------------------------
```

Up to three categories can be defined (and monitored) per subscriber host[1]. Each service category has a name (bold) that is used to reference the category in usage monitoring and reporting.

The category map is associated with the subscriber host. In Gx terms, the category-map is considered as a policy that needs to be installed in 7x50. As such, it is installed via Charging-Rule-Install AVP that references the category map in **Charging-Rule-Name = cat-map**:<*cat-map-name*>

Usage monitoring for the subscriber host can be configured on the 7x50 but it will not be active until it is turned on by the PCRF either via CCA-i, CCA-u or RAR.

Usage-monitoring can be enabled per ingress and/or egress direction or as total count. However monitoring the **total** count is mutually exclusive with per direction count. For example, **total** usage monitoring cannot be enabled simultaneously with **ingress** (or **egress**) usage monitoring for the same monitoring entity (session or category).

1. Multiple-hosts can share the same sla-profile instances and therefore the same queues.

AA Usage Monitoring – What is Being Monitored

In AA, charging groups (CG), application groups (AG) and applications are monitored. Refer to the 7750 SR OS MS-ISA Guide for details.

Requesting Usage Monitoring in ESM

Gx usage monitoring can be only activated explicitly from the PCRF via CCA-i, CCA-u or RAR.

PCRF will request usage monitoring by including the Usage-Monitoring-Information AVP as well as the Event-Trigger AVP set to value USAGE_REPORT in a CCA or RAR message.

There could be multiple instances of Usage-Monitoring-Information AVP present in a single CCA or RAR messages. For example, simultaneous usage-monitoring for IP-CAN session level and credit-category level can be requested.

The category-map can be associated with the subscriber-host in 7x50 via Gx, LUDB, RADIUS or it can be statically defined in the sla-profile (today this is used for idle-timeout). Even though the association between the category-map and the subscriber host can be made outside of Gx, the usage-monitoring (collecting counter information) can be activated only via Gx specific AVP (Usage-Monitoring-Information AVP).

The category-map (predefined in 7750) that is used in usage-monitoring can be associated with the subscriber-host via (in the order of priority):

- PCRF (Gx)
- LUDB
- RADIUSPython script

Reporting Accumulated Usage

The 7x50 reports usage information to the PCRF under the following conditions:

- When a usage threshold is reached
- When all pcc rules associated with the monitoring are removed or deactivated
- When usage monitoring is explicitly disabled by PCRF
- When a session is terminated
- When requested by PCRF (on demand)

To report accumulated usage for a specific monitoring key the 7x50 sends a CCR with the Usage-Monitoring-Information AVP containing the accumulated usage information since the last report. For each of the enabled monitoring keys to be reported, the Usage-Monitoring-Information AVP will include the monitoring key in the Monitoring-Key AVP and the accumulated volume usage in the Used-Service-Unit AVP.

Usage report on the 7x50 can be triggered by reaching the usage threshold communicated to the 7x50 by PCRF in CCR-u message carrying accumulated usage for that monitoring entity along with the Event-Trigger AVP set to USAGE_REPORT.

PCRF will in response to CCR-u message communicate to the 7x50 via CCA-u message whether the usage monitoring should continue:

- If the new thresholds for the currently monitored entity/levels are provided in Granted-Service-Units AVP, the usage monitoring will continue
- If the thresholds are not included in Granted-Service-Units AVP, the usage monitoring will stop.

Threshold are incremental. For example if the quota of 100MB is submitted to the 7x50, the usage should be reported when that quota is reached. At that point the user can be granted another 100MB. The new usage report on the 7x50 will be triggered when another 100MB are accumulated. Absence of the threshold for a given entity in CCA-u message is an indication that the usage monitoring should stop.

When the PCRF informs the 7x50 that usage monitoring should stop (by not including thresholds in CCA-u), the 7x50 will not report usage which has accumulated between sending the CCR and receiving the CCA.

Another possibility of usage reporting is **on-demand**. In such scenario, usage for one or more monitoring keys will be reported regardless of whether the usage threshold has been reached. This is achieved by sending to the 7x50 Usage-Monitoring-Report AVP (within the Usage-Monitoring-Information AVP) set to USAGE-MONITORING_REPORT_REQUIRED. If the Monitoring-Key AVP is omitted in such a request, usage monitoring for all enabled entities will be reported to the PCRF.

In case that the credit-category is removed from the subscriber host (the sla-profile instance referencing the category-map is changed for the subscriber host), the 7x50 will report the outstanding usage in CCR-u command with the Event-Trigger set to USAGE_REPORT.

Disabling Usage Monitoring

When the PCRF explicitly disables usage monitoring on the 7x50, the 7x50 will report the accumulated usage which has occurred while usage monitoring was enabled.

To disable usage monitoring for an entity, the PCRF sends the Usage-Monitoring-Information AVP referencing only the applicable monitoring entity with the Monitoring-Key AVP and the Usage-Monitoring-Support AVP set to USAGE_MONITORING_DISABLED.

When the PCRF disables usage monitoring in a RAR or CCA command, the 7x50 sends new CCR-U and the Event-Trigger AVP set to "USAGE_REPORT" to report accumulated usage for the disabled usage monitoring entities.

Session Termination

At IP-CAN session termination the 7x50 sends the accumulated usage information for all entities for which usage monitoring is enabled in the CCR-t.

Usage Monitoring Examples

For the description of the specific AVP, refer to the SROS GX AVP Reference Guide.

IP-CAN session usage monitoring

PCRF in RAR sends the following AVPs (among all the other mandatory ones: session-id, etc.)

```
Usage-Monitoring-Information
         Monitoring-Key = "any-string"
         Granted-Service-Unit
              CC-Input-Octets = 1000000
              CC-Output-Octets = 1000000
         Usage-Monitoring-Level = session_level(0)

Event-Trigger = USAGE_REPORT
```

The 7x50 reports usage when the thresholds are reached some time later in CCR-U. The usage is monitored internally on the 7x50 based on the current sla-profile instance.

```
Usage-Monitoring-Information
         Monitoring-Key = "any-string"
         Used-Service-Unit
              CC-Input-Octets = 1000000
              CC-Output-Octets = 1000000
```

PCRF instructs 7x50 to continue usage monitoring with the new thresholds in CCA-U:

```
Usage-Monitoring-Information
         Monitoring-Key = "any-string"
         Granted-Service-Unit
              CC-Input-Octets = 1000000
              CC-Output-Octets = 1000000
         Usage-Monitoring-Level = session_level(0)
```

Category usage monitoring

Assume that the following category-map is associated with the subscriber host:

```
*A:7750>config>subscr-mgmt>cat-map# info
----------------------------------------------
            activity-threshold 1
            credit-exhaust-threshold 50
            category "queue1" create
                queue 1 ingress-egress
            exit
            category "queue3-5" create
                queue 3 ingress-egress
                queue 5 ingress-egress
            exit
            category "rest-queues" create
                queue 2 egress-only
                queue 4 egress-only
                queue 6 egress-only
                queue 7 egress-only
                queue 8 egress-only
            exit
```

PCRF will send the following AVPs in the RAR message (among all the other mandatory ones: session-id, etc.)

```
Charging-Rule-Install
         Charging-Rule-Name = Cat-Map:cat1 cat-map rule install

Usage-Monitoring-Information
         Monitoring-Key = "queue-1"
         Granted-Service-Unit
              CC-Input-Octets = 1000000
              CC-Output-Octets = 1000000
         Usage-Monitoring-Level = PCC_RULE_LEVEL (1)

Usage-Monitoring-Information
         Monitoring-Key = "queue-3-5"
         Granted-Service-Unit
              CC-Input-Octets = 2000000
              CC-Output-Octets = 2000000
         Usage-Monitoring-Level = PCC_RULE_LEVEL (1)

Event-Trigger = USAGE_REPORT
```

The 7x50 reports usage when the thresholds are reached some time later in CCR-U:

```
Usage-Monitoring-Information
         Monitoring-Key = "queue-1"
         Used-Service-Unit
              CC-Input-Octets = 1000000
              CC-Output-Octets = 1000000

Usage-Monitoring-Information
         Monitoring-Key = "queue-3-5"
         Used-Service-Unit
              CC-Input-Octets = 2000000
              CC-Output-Octets = 2000000
```

The PCRF instructs the 7x50 to continue usage monitoring with the new thresholds in CCA-U:

```
Usage-Monitoring-Information
         Monitoring-Key = "queue-1"
         Granted-Service-Unit
              CC-Input-Octets = 1000000
              CC-Output-Octets = 1000000
         Usage-Monitoring-Level = PCC_RULE_LEVEL (1)

Usage-Monitoring-Information
         Monitoring-Key = "queue-3-5"
         Granted-Service-Unit
              CC-Input-Octets = 2000000
              CC-Output-Octets = 2000000
         Usage-Monitoring-Level = PCC_RULE_LEVEL (1)
```

Event Triggers

PCRF may subscribe to an event trigger in the 7x50. The PCRF subscribes to new event triggers or remove armed event triggers unsolicited at any time. When an event matching the event trigger occurs, the 7x50 reports the occurred event to the PCRF. The event triggers that are required in procedures will be unconditionally reported (for example IP address allocation/de-allocation) from the 7x50, while the PCRF may subscribe to the remaining events (for example usage monitoring).

When sent from the PCRF to the 7x50, the Event Trigger AVP indicates an Event that will trigger an action in 7x50. When sent from the 7x50 to the PCRF, the Event Trigger AVP indicates that the corresponding event has occurred. If no Event Trigger AVP is included in a CCA or RAR operation, any previously provisioned event trigger will be still applicable.

The PCRF may remove all previously provided event triggers by providing the Event-Trigger AVP set to the value NO_EVENT_TRIGGERS. When an Event-Trigger AVP is provided with this value, no other Event-Trigger AVP will be provided in the CCA or RAR command. Upon reception of an Event-Trigger AVP with this value, the 7x50 will not inform PCRF of any event except for those events that are always reported and do not require provisioning from the PCRF.

When the PCRF subscribes to one or more event triggers by using the RAR command, 7x50 will send the corresponding currently applicable values to the PCRF in the RAA if available, and in this case, the Event-Trigger AVPs will NOT be included.

For a list of the supported events in the 7x50, refer to the SR OS GX AVP Reference Guide.

Subscriber Verification

At any time, the PCRF can query 7x50 for the presence of the subscriber-host via a RAR message.

The 7x50 should respond with the following result-codes in RAA:

- DIAMETER_SUCCES (2001) — subscriber active
- DIAMETER_UNKNOWN_SESSION_ID (5002) — subscriber does not exist

Subscriber Termination

The PCRF can request IP-CAN session termination in the 7x50 via two messages:

- via a RAR directive with the Session-Release-Cause AVP to the 7x50.
- via ASR

Upon the arrival of either of those messages, the 7x50 will start the IP-CAN session termination procedure (CCR-t with corresponding Termination-Cause AVP will be sent to the PCRF). This is described in the 3GPP 29.212 document, §4.5.9.

For a list of the supported Termination-Cause AVP values in the 7x50, refer to the SROS GX AVP Reference Guide.

Mobility Support in WiFi

When a WiFi subscriber moves between the access points (APs), a CCR-u message is triggered on the 7x50, carrying the Called-Station-Id AVP. The Called-Station-Id AVP carries the MAC IP address of the new AP. This functionality allows the PCRF to make location based policy decision. This functionality is enabled via event trigger USER_LOCATION_CHANGE (13) [3GPP 29.212, §5.3.7] sent to 7x50 by PCRF in CCA or RAR message.

The same event will be reported back from 7x50 to the PCRF in CCR-u message when the user location changes.

Redundancy

Redundancy in Gx relies on the Diameter redundancy mechanisms described in Diameter Redundancy on page 2072.

Persistency and Origin-State-ID AVP (RFC 6733, §8.6 and §8.16)

Persistency (saving the state of IPoE hosts on the compact flash) for Gx sessions is not supported. This means that upon the reboot, the 7750 will restore the subscriber-hosts from the persistency but the Gx session awareness for the recovered hosts is lost. Any previously applied qos or filter overrides will be lost. However, subscriber-strings (sub-profile, sla-profile, aa-profile) can be made persistent and can be preserved across reboots.

The Origin-State-Id (OSI) AVP is NOT stored in persistency. In case that the 7x50 reboots, the Origin-State-ID AVP is set to boot time (UTC).

The Origin-State-Id AVP is contained in the CER messages and application messages that are sent from 7x50 to the PCRF/DRA. In the other direction, (sent by PCRF to 7x50) the OSI is ignored.

To restore lost session after the reboot, 7x50 will initiate CCR-i message for every host that is recovered from persistency. The CCR-i will contain the new session-id and origin-state-id. Based on this CCR-i, it is expected that the PCRF returns the most current policy for the host.

Overload Protection

7x50 has a receiving queue per Gx application (ESM, UM, AA). Each queue can hold 10K messages. While the queue is in the overloaded state, 7x50 replies to every new RAR message with the RAA message that contains the Result-Code AVP set to DIAMETER_TOO_BUSY (3004) value. This can be considered as explicit signaling towards the PCRF notifying it of the condition on the 7x50.

In case that the messages in the overwhelmed 7x50 queue do not require sending an answer (in case that the overwhelmed queue contains CCA-i/u messages), the TCP window will fill up, TCP ACKs will not be sent and consequently this will be an implicit notification to the PCRF to slow down.

If 7x50 receives a response from an overloaded PCRF (Result-Code = DIAMETER_TOO _BUSY), the 7x50 will timeout (**tx-timer**) the originally sent message. Once the message is timed out, the configuration settings (**on-failure**) will determine whether to trigger the peer-failover procedure or not (Peer-failover based on DIAMETER_TOO_BUSY Result-Code is recommended in RFC6733, §7.1.3.

Diameter NASREQ Application

The Diameter NASREQ application is used for Authentication, Authorization, and Accounting services in the Network Access Server (NAS) environment. SR OS supports a stateless operation of NASREQ authentication and authorization, interacting with a NASREQ server that does not maintain session state.

Subscriber host or session authentication results in an AA-Request (AAR) message being sent to the Diameter NASREQ server. An Auth-Session-State AVP with value equal to 1 (No State Maintained) is included in the AAR to inform the server of the stateless mode. The server responds with an AA-Answer (AAA) message and must include the Auth-Session-State AVP with value equal to 1 (No State Maintained), together with the authorization AVPs.

Diameter NASREQ accounting is not supported.

Table 25 lists the supported Diameter NASREQ messages.

Table 25: Supported Diameter NASREQ Messages

Diameter Message		Code
AAR	AA-Request	265
AAA	AA-Answer	265

Diameter NASREQ authentication is supported for IPoE hosts and sessions, PPPoE PTA PAP/CHAP authentication. Diameter NASREQ authentication is not supported for L2TP LAC/LNS.

NASREQ and RADIUS authentication cannot be configured simultaneously on a capture-sap, local-user-database, or group-interface. They have the same priority in the hierarchy of different sources (such as local user database, Gx, defaults, etc.) for obtaining the subscriber host or session authorization parameters.

Multi-chassis redundancy is supported via separate Diameter NASREQ peers on each redundant node. Each node of the multi-chassis redundancy pair has its own Diameter Identity (origin host/realm). The subscriber host or session is authenticated on the BNG where it is initially connected. Due to the stateless operation, there is no need to synchronize NASREQ session state. Alternatively, the Diameter proxy can be used if it is required to have a single Diameter Identity (origin host/realm) per pair of multi-chassis redundant nodes.

There is no NASREQ re-authentication for active subscriber hosts or sessions, except for a forced re-authentication when the circuit ID/interface ID or remote ID of a DHCP host is changed.

Stateless NASREQ authentication can be complemented with Diameter Gx policy management for policy control and mid-session changes. Diameter NASREQ and Gx applications are supported simultaneously on a single Diameter peer.

Figure 174 shows a sample call flow for a subscriber using Diameter NASREQ for authentication and Diameter Gx for policy management.

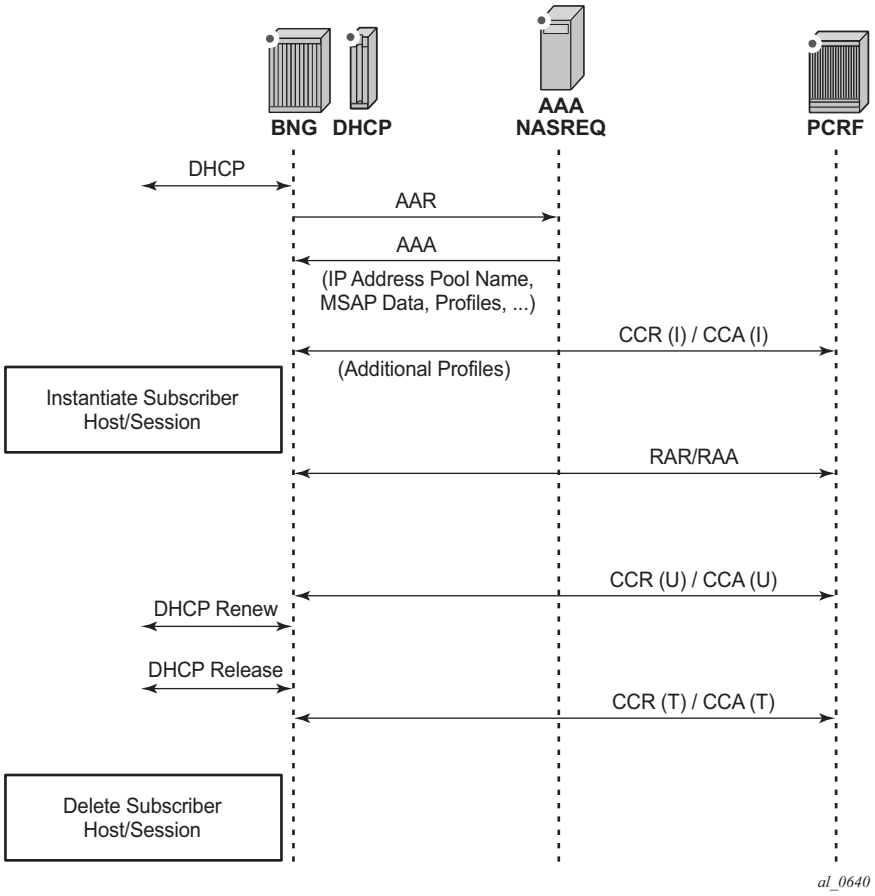


Figure 174: Sample Diameter NASREQ Call Flow

Table 26 lists the authorization AVPs that are accepted in a Diameter NASREQ AA-Answer message. Vendor-specific AVPs are shown in the table as: v-<vendor-id>-<AVP-id>.

Table 26: AA-Answer Message — Accepted Authorization AVPs

AVP ID	AVP Name	Description
1	User-Name	Overrides the “Radius User-Name”.
8	Framed-IP-Address	The IPv4 address of the subscriber host.
9	Framed-IP-Netmask	The IPv4 netmask of the subscriber host.

Table 26: AA-Answer Message — Accepted Authorization AVPs

AVP ID	AVP Name	Description
22	Framed-Route	IPv4 managed route to be configured on the NAS for a routed subscriber host.
25	Class	Opaque value; echoed in Radius accounting.
88	Framed-Pool	The name of an IPv4 address pool.
97	Framed-IPv6-Prefix	SLAAC IPv6 prefix (wan-host).
99	Framed-IPv6-Route	IPv6 managed route to be configured on the NAS for a v6 routed subscriber host..
100	Framed-IPv6-Pool	The name of an IPv6 IA-NA address pool (wan-host).
123	Delegated-IPv6-Prefix	DHCPv6 IA-PD IPv6 prefix (pd-host).
v-6527-9	Alc-Primary-Dns	The IPv4 address of the primary DNS server.
v-6527-10	Alc-Secondary-Dns	The IPv4 address of the secondary DNS server.
v-6527-11	Alc-Subsc-ID-Str	Unique subscriber ID string.
v-6527-12	Alc-Subsc-Prof-Str	Subscriber profile string.
v-6527-13	Alc-SLA-Prof-Str	SLA profile string.
v-6527-16	Alc-ANCP-Str	ACNP string.
v-6527-17	Alc-Retail-Serv-Id	The service-id of the retailer to which this subscriber host belongs.
v-6527-18	Alc-Default-Router	The default gateway for the user (DHCP option [3] default-router for a DHCPv4 proxy)
v-6527-28	Alc-Inc-Dest-Id-Str	Intermediate destination ID string.
v-6527-29	Alc-Primary-Nbns	The IPv4 address of the primary NetBios Name Server (NBNS).
v-6527-30	Alc-Secondary-Nbns	The IPv4 address of the secondary NetBios Name Server (NBNS).
v-6527-31	Alc-MSAP-Serv-Id	Service ID where the managed SAP is to be created.
v-6527-32	Alc-MSAP-Policy	Managed SAP policy used to create the MSAP.
v-6527-33	Alc-MSAP-Interface	Group-interface name where the managed SAP is to be created.

Table 26: AA-Answer Message — Accepted Authorization AVPs

AVP ID	AVP Name	Description
v-6527-45	Alc-App-Prof-Str	Application profile string.
v-6527-99	Alc-Ipv6-Address	DHCPv6 IA-NA IPv6 address (wan-host).
v-6527-105	Alc-Ipv6-Primary-Dns	The IPv6 address of the primary DNSv6 server.
v-6527-106	Alc-Ipv6-Secondary-Dns	The IPv6 address of the secondary DNSv6 server.
v-6527-131	Alc-Delegated-Ipv6-Pool	The name of an IPv6 IA-PD prefix pool (pd-host).
v-6527-161	Alc-Delegated-Ipv6-Prefix-Length	DHCPv6 IA-PD prefix length (pd-host).
v-6527-174	Alc-Lease-Time	The lease-time for proxy, in seconds.
v-6527-181	Alc-SLAAC-IPv6-Pool	The name of an IPv6 SLAAC prefix pool (wan-host).

Sample Configuration Steps

To specify the peers to reach the Diameter NASREQ server in a diameter peer policy:

```
configure
    aaa
        diameter-peer-policy "diameter-peer-policy-1" create
            description "Diameter NASREQ peer policy"
            applications nasreq
            origin-host "bng@alcatel-lucent.com"
            origin-realm "alcatel-lucent.com"
            peer "peer-1" create
                address 172.16.3.1
                destination-realm "myDSCRealm.com"
                no shutdown
            exit
        exit
```

To specify the Diameter NASREQ application specific parameters, such as AVP format and values, in a Diameter application policy:

```
configure
    subscriber-mgmt
        diameter-application-policy "diameter-nasreq-policy-1" create
            description "Diameter NASREQ application policy"
            application nasreq
            diameter-peer-policy "diameter-peer-policy-1"
            nasreq
```

```
                user-name-format mac
                include-avp
                    circuit-id
                    nas-port-id
                    nas-port-type
                    remote-id
                exit
            exit
        exit
```

To apply the Diameter NASREQ application policy as Diameter authentication policy at a VPLS capture SAP, at an IES/VPRN group-interface and/or at a local user database:

(**Note:** A Diameter authentication policy cannot be configured simultaneously with a RADIUS authentication policy on the same group-interface or capture SAP, nor for the same host in a local user database.)

```
configure
    service
        vpls 10 customer 1 create
            sap 1/1/4:*.* capture-sap create
                ---snip---
                diameter-auth-policy "diameter-nasreq-policy-1"
        ies 1000 customer 1 create
            subscriber-interface "sub-int-1" create
                ---snip---
                group-interface "group-int-1-1" create
                ---snip---
                    diameter-auth-policy "diameter-nasreq-policy-1"
        vprn 2000 customer 1 create
            subscriber-interface "sub-int-1" create
                ---snip---
                group-interface "group-int-1-1" create
                ---snip---
                    diameter-auth-policy "diameter-nasreq-policy-1"

configure
    subscriber-mgmt
        local-user-db "ludb-1" create
            ipoe
                host "ipoe-host-1" create
                    ---snip---
                    diameter-auth-policy "diameter-nasreq-policy-1"
            ppp
                host "ppp-host-1" create
                    diameter-auth-policy "diameter-nasreq-policy-1"
```

If no AA-Answer message is received from the primary or secondary Diameter peer, then the host or session can be instantiated with the configured defaults. This is achieved by the following NASREQ application policy configuration:

```
configure
    subscriber-mgmt
        diameter-application-policy "diameter-nasreq-policy-1" create
```

```
            on-failure failover enabled handling continue
```

To enable flexible integration with different NASREQ servers, a Python policy can be configured on the Diameter peer policy. The Python script can interact on the AVPs present in the AA-Request and AA-Answer messages.

```
configure
    python
        python-policy "py-policy-nasreq-1" create
            diameter aar direction egress script "NasreqAar"
            diameter aaa direction ingress script "NasreqAaa"
configure
    aaa
        diameter-peer-policy "diameter-peer-policy-1" create
            ---snip---
            python-policy "py-policy-nasreq-1"
```

Diameter Redundancy

Diameter redundancy is supported on multiple levels:

- **Diameter Peer Level Redundancy:** A Diameter client in 7x50 supports up to five open peers, two of which (primary and secondary) can actively participate in Diameter transactions. The purpose of the secondary peer is to protect the primary peer, should the primary peer experience problems.
- **Diameter Multi-Chassis Redundancy**: Diameter sessions are synchronized on the application level (via ESM in case of Gx and NASREQ) between two redundant 7x50 nodes. Only one of the 7750 SRs opens up a peering connection on behalf of the redundant 7750 SR pair towards DRA/PCRF.
- **High Availability (HA)**: This refers to control plane redundancy with dual Control Plane Modules (CPMs) in a single chassis configuration. Diameter transactions are fully synchronized between CPMs and the peering connection towards DRA/PCRF remains uninterrupted in case that one of the control plane modules fails.

Diameter Peer Level Redundancy

Once the peer in the Diameter policy (maximum five peers per policy) is administratively enabled (**no-shutdown**), the 7x50 starts connecting to it. If the establishment of the TCP connection fails, the 7x50 periodically retries to connect.

If creation of the TCP connection succeeds, the peer is placed in the **peer table**, and in that table the “preference” defines the **current usability** of the peers. All administratively enabled peers that are in the open state have keepalives (DWR/DWA) enabled to check the liveliness of the connection, but only the two open peers with the highest preference are considered as primary and secondary. In this fashion, the application messages (for example, DCCA or Gx) are sent only to the primary and/or the secondary peer.

Initially all messages are sent to the primary peer. If a session-failover occurs (timeout or primary peer closes), the messages are sent to the secondary peer (which could have become primary by that time). Once an (application) session has switched, the consecutive messages are sent to the peer where it had its last success request/answer (it sticks to the peer).

The status of primary and secondary peer is constantly re-evaluated, in case an error condition occurs at the primary or secondary peer.

The following example shows how DCCA messages are treated:

1. There are ten sessions that have been created; the primary peer at that moment is peer-a, secondary peer is peer-b, and peer-c, peer-d and peer-e are in state open (being kept alive with diameter watchdog request/watchdog-answer messages). Consequently, all CCR-i messages are sent to peer-a since this is the **preferred** peer at the time of handling CCA-i.
2. All ten sessions start requesting credit updates (CCR-u), but only six of them are successfully completed (CCR-u/CCA-u) by the peer-a. Their **preferred** peer will remain peer-a. Then, the connection to the peer-a fails (connection is closed). Peer-b becomes the primary, peer-c becomes the secondary. The remaining four CCR-u sessions that were pending will now be redirected to the peer-b with the retransmission bit (T) set in the diameter header. When these four outstanding transactions successfully complete (CCA-u received), they will have the peer-b as the **preferred** peer.
3. In the meantime, peer-a recovers, and the cooldown sequence is deactivated (by three successful DWR/DWAs). Peer-a becomes primary again and peer-b becomes secondary.
4. Now, the sessions need a new credit. Six of them will ask peer-a and four will ask peer-b.

   In case that peer-a did not become alive in time, peer-c would be used for re-transmissions. At some point later, when peer-a and peer-b become the primary and the secondary peers again, those sessions with the **preferred** peer-c will be redirected back to peer-a (as we only use peer-a and peer-b to send application messages).

   So in essence, a **revertive** mode is used for the peer recovery, where the sessions are reverted back to the peer on which the session was originally setup, as long as this peer is one of the two active peers (primary and secondary).

Diameter Multi-Chassis Redundancy

The Diameter Multi-Chassis Redundancy solution in the 7750 SR is based on the model where communication with the PCRF/DRA occurs over a single Diameter peering connection for the redundant pair of 7750 SR nodes; that is, an active Diameter proxy module running on the 7750 SR is front-ending the communication with the PCRF/DRA, and is relaying messages between the Diameter clients (in redundant 7750 SRs) and the DRA/PCRF. Both 7750 SR nodes run Diameter proxy module, but only the active one opens the TCP peering connection towards the DRA/PCRF.

The benefits of the Diameter proxy model are:

- The redundant pair of 7750 SR nodes appear as a single node to the PCRF/DRA.
- Diameter Identity is uniform across the pair of redundant 7750 SR nodes; that is, both 7750 SR nodes share the same origin-host/realm, a property that carries operational benefits.

- There is a robust and predictable failover of a single connection, as opposed to having separate diameter peering sessions per node.

The goal of this redundancy model is to provide a predictable and quick recovery after a 7750 SR nodal failure, PCRF failure, or relevant components within those two entities (such as line cards, MDAs, and physical ports).

Figure 175 illustrates the basic concept for Diameter Multi-Chassis Redundancy for a Gx application. The model shows two 7750 SRs (BNGs). Each BNG contains an ESM module and a Gx/Diameter module which have a peering connection to the active Diameter proxy module. The peering connections are IP connections. Both nodes communicate with the PCRF/DRA through the active Diameter proxy which maintains a peering connection with the PCRF/DRA.

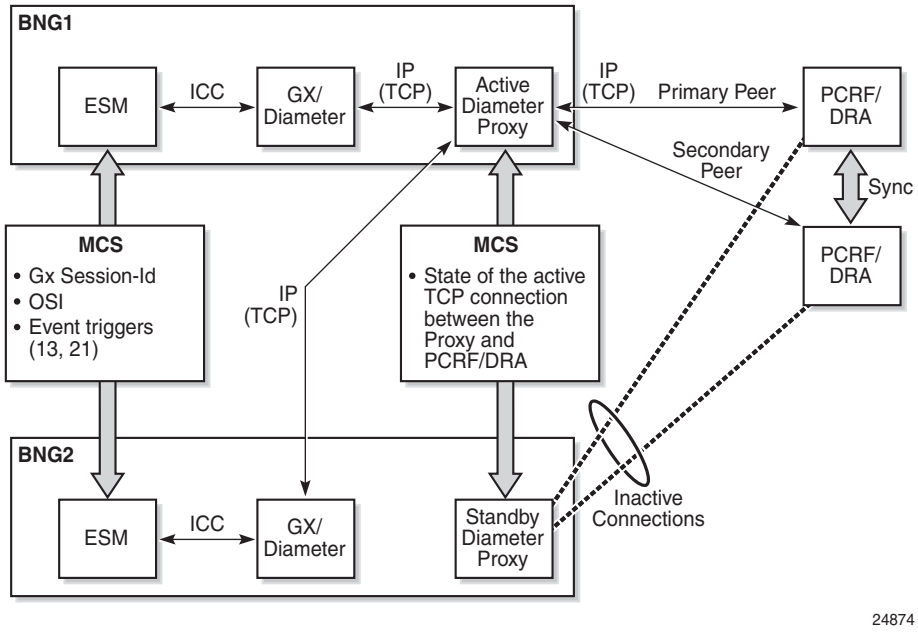


Figure 175: Proxy Gx Model

Diameter Proxy Model General Operational Principles

The fundamental principles of the Diameter proxy-based redundant solution are described below (also refer to Figure 175):

1. There can be only one active Diameter proxy per redundant pair of 7750 SRs. This active Diameter proxy maintains peering connections (primary/secondary) towards the PCRF/DRA at any given time. There are no peering connections open on the standby Diameter proxy. The active Diameter proxy accepts the connections from the client side, while the standby does not. The standby Diameter proxy ignores, without any reply, requests from the clients to open peering connections.
2. The activity selection is based on the system MAC address of each node and the current state of the Diameter proxy (Init, Active, Standby, Active-Wait, Standby-Wait and the Proxy-Switchover-Reg) in each node. This information is exchanged between the 7750 SR nodes via MCS. The system MAC address is unique per 7750 SR node. The activity selection is automatic and cannot be influenced via CLI, other than shutting down peers on the currently active Diameter proxy.

   Application level information (Gx session, NASREQ session, etc.) is not synchronized between Diameter proxies. Instead, synchronization of session level information is performed on the application level; for example, Gx session information is performed through subscriber management (ESM) synchronization.
3. Preemption is not supported in the case where a node coming up from a boot-up sequence would cause the MCS peer to transition from active to standby state. Only in the case where the two nodes are booting simultaneously, or are recovering from the MCS synchronization loss (both nodes are joining MCS while in the active state), would the node with a higher system MAC address transition into the active state (during the simultaneous node boot-up) or remain in the active state (after isolation re-synchronization).
4. When the Diameter proxy transitions from an active to standby state, the newly-transitioned standby Diameter proxy closes the TCP connections towards the Diameter clients. The clients then initiate a new connection towards the secondary peer, but only after the current connection-timer expires (30 s by default). For example, assume that the connection timer is set for 30 s. If the TCP RST is received when the running connection-timer is at 15th s, then the secondary peer is not initiated for another 15 s.
5. In the case where the active Diameter proxy receives messages from the client while it does not have any peers on the server side open, the Diameter proxy sends a DIAMETER_UNABLE_TO_DELIVER (3002) message to the client. The client then retransmits the message to the same peer since it has only one peer that is in the UP state. Upon receipt of the DIAMETER_UNABLE_TO_DELIVER (3002) message, the client leaves the original message to time out, and then retransmits it (that is, the message is NOT retransmitted from the client side immediately upon the arrival of the DIAMETER_UNABLE_TO_DELIVER (3002) message).

6. The TCP protocol handles retransmissions on the transport layer to the same peer. This is valid on the Diameter client side and on the Diameter proxy side. A TCP retransmission normally occurs at the intervals driven by an exponential back-off. The initial timeout depends on the implementation, but for the most common case, it can be assumed to be 1.5 s, followed by an exponential back-off capped at 64 s (1.5 s, 3 s, 6 s, 12 s, 24 s, 48 s, 64 s).
7. The Diameter client handles retransmissions on the Diameter level. The Diameter client will be able to retransmit on the same socket since it only has a single socket (to the active Diameter proxy). The T-bit in the Diameter header will be set for every retransmitted message. The watchdog interval should be set to 1 s, so that the dead TCP connection (dead proxy) can be quickly identified.

   The Diameter client will retransmit when:

   → The original request times out.

   → It receives a reply with the E-bit set. Such retransmissions will not be triggered immediately upon the arrival of the response with E-bit set. Instead, the original messages that need to be retransmitted will be left in the pending queue to time out and will be retransmitted after the timeout period, which is controlled by the tx-timer command.

   → The primary peer is closed and the secondary peer is available.
8. The Diameter proxy never retransmits a message on the Diameter level since it does not perform any buffering (Tx/Pending queue). However, it does retransmit on the TCP level (hop-by-hop).
9. The Diameter proxy only relays messages between the client (application) and the server side (DRA/PCRF). The two bits in the Diameter header that the proxy is reacting on are the T-bit and the E-bit.

   If the T-bit is set in the message coming from the client side, the Diameter proxy sends the message to the secondary peer (invokes the peer failover procedure). That is, the application level retransmissions is performed by the Diameter client (which is peering with the Diameter proxy). The client sets the T-bit (retransmission bit) in the Diameter header and this signals to the Diameter proxy that it needs to failover the message to the alternate peer. This operation is performed on a per message basis and not on a per session basis.

   The Diameter proxy initiates a failover procedure to the secondary peer when the primary peer on Diameter proxy is closed, or the watchdog timer on the primary peer expires.

   All messages in the DRA/PCRF-to client direction with the E-bit set (the E-bit can be present only in answer messages) are dropped in the proxy. Consequently, the client retransmits the request, upon timeout.

   The messages with the E-bit set that are traveling in the opposite direction are not dropped; they are transparently passed to the DRA/PCRF.
10. On an SRRP Switchover, the AN-GW-IP of the newly-transitioned Master can be reported in CCR-u as an indication of the switchover. This functionality is enabled by arming the 7750 SR with the event-trigger id 13 (USER_LOCATION_CHANGE) from PCRF.

11. On a Diameter proxy switchover, a SNMP Log/Trap is generated.
12. The standby client (SRRP standby) discards all messages received by the Diameter proxy.

Diameter Proxy Activity Selection

The Diameter proxy with the highest system MAC address assumes the controller role. The controller node decides which proxy becomes ACTIVE or STANDBY. Activity election information is processed by the controller node and then the controller node delegates the actual ACTIVE/STANDBY roles to Diameter proxies. The ACTIVE proxy may not necessarily be the same node as the controller node.

The activity selection (by the controller node) in the Diameter proxy is based on the current states of both Diameter Proxies (local and remote) and the system MAC.

Preemption is not supported, which means that newly brought up Diameter proxy does not overtake the activity state from the existing active Diameter proxy, regardless of the system MAC addresses.

Once the node becomes active, it advertises the new state to the MCS Diameter proxy peer and tries to open a DRA/PCRF peering connections and at the same time accept the client connections. The active Diameter proxy replies to the client with a DIAMETER_UNABLE_TO_DELIVER error-code in cases where server side peers cannot be opened.

Synchronization and MCS

All application level (Gx or NASREQ) sessions related parameters are synchronized on the ESM level via MCS.

The parameters synchronized on the ESM level are:

- Session-Id
- Event-Triggers
- CC-Request-Number

The Diameter proxy module is synchronized via MCS; the information passed between the two nodes is:

- System MAC address: this address plays a role in the Diameter proxy state selection
- Controller MAC address: the System MAC address of the node that is performing the Diameter proxy state selection. The node with the highest system MAC address assumes the controller role. Once the controller makes the state selection for both nodes, it delegates those states to Diameter proxies. The controller role is collocated with one of the Diameter proxy nodes.
- Origin-State-Id (OSI)
- Diameter proxy States

The above information is used to determine the activity of the Diameter proxy at each node.

In the case where an MCS link fails, the nodes become isolated. Each node acts independently and tries to become active. This scenario is described in Isolated Chassis on page 2088.

Retransmissions

The handling of Diameter retransmissions is crucial for the Diameter Multi-Chassis Redundancy operation. Retransmissions provide the means to recover a Diameter session that was left in an unacknowledged state due to failure of the path between the 7750 SR and the DRA/PCRF.

Retransmissions of Diameter messages are handled on two levels by a pair of redundant 7750 SR nodes:

1. At the TCP level: request and answer messages are retransmitted by TCP. These types of retransmissions are only significant between two directly connected peers, hop-by-hop retransmissions. For example, if the failure occurs beyond two directly connected peers, these type of retransmissions will not help.
2. At the application (Gx, Gy, NASREQ) level: only request messages are retransmitted. These types of retransmissions extend beyond two directly connected peers and can cover end-to-end failure cases.

A more detailed explanation of the processing that occurs on each level for a Gx application is given below.

1. The first level of retransmissions occurs at the TCP level. The Gx message is handed over to the TCP socket Base Diameter module. TCP tries to deliver this message in a connection-oriented (reliable) fashion. If a TCP ACK for the transmitted message is not received, the message, in the most common case, is retransmitted in intervals of 1.5 s, 3 s, 6 s, up to 64 s. After 10 s of trying to retransmit the message to the same peer at the TCP level, the Base Diameter tries to retransmit (configuration dependent) the message to the next

TCP socket (secondary peer). The assumption is that the primary peer is unavailable (busy, failed, or the network path to it is broken) after 10 s of trying. The TCP retransmissions are peer oriented and very localized (to the particular TCP connection on the particular BNG node). In the case of a network failure, TCP retransmissions cannot re-route the traffic to an alternate destination. As such, they cannot protect against the peer (PCRF) failure or the BNG node failure. They can, however, indirectly provide a clue that something is happening at the peer level, so that the upper layers can take adequate actions. Note that watchdogs are also used to detect peer failure and they can provide faster detection of the peer failure (after 2 s).

2. Re-routing of the traffic occurs at the Application/Diameter level. Once the peer is considered unavailable, or the original requests message times out, the Diameter has the ability to re-route the retransmitted message to an alternate (secondary) peer. The Diameter level retransmissions can protect against a PCRF/DRA failure. Traffic can be switched to the secondary peer (this functionality must be enabled via configuration).

   Since the Diameter proxy only relays the messages between the client and the DRA/PCRF, it never buffers and retransmits the Diameter message. Retransmissions are the responsibility of the Diameter peer (Diameter client) that sits behind the Diameter proxy. Retransmitting Diameter client sets the T-bit in the Diameter header of the retransmitted message (CC-req-num is kept the same in the original and retransmitted message). The T-bit in the message triggers the Diameter proxy to re-route the messages to the secondary peer while the primary peer is still active. This means that the Gx client has already retransmitted the message, and the Diameter proxy re-route its.

   In case of a single peer, the Diameter **client** retransmits the message to the same peer and it sets the T-bit in the Diameter header.

   In case of a single peer, the Diameter **proxy** sends the message with the T-bit set to the same peer.

   The Gx client typically re-routes the message to the secondary peer in the following cases:

   - → The primary peer is closed and the secondary peer is available.
   - → The Diameter message times out due to no response.
   - → The Diameter message times out due to a received answer with E-bit set in the Diameter header (E-bit can be only set in the answer messages and it indicates *protocol errors* with Result-Code from the 3xxx range). Once the reply with E-bit set is received, the corresponding request message is left on the pending queue where it times out after the interval controlled by the tx-timer statement in the diameter-application-policy. Upon message timeout, the 7750 SR retransmits the message to the secondary peer if the secondary peer is available. If not, the message will is retransmitted to the same (primary) peer.

In summary:

- TCP handles retransmissions towards the peer (hop-by-hop retransmissions).
- Diameter and Diameter applications (Gx, Gy, NASREQ) retransmit to the secondary peer in cases where the application level message times out, a protocol error is received (Result-Code 3xxx) in the answer from the DRA/PCRF, or the primary peer is 'closed'. In case that there is only one peer available (primary), the Diameter application retransmits to that peer. The T-bit in retransmitted messages is always set. Diameter level retransmissions cover failure cases that extend beyond two directly connected hops.
- The Diameter proxy never retransmits (retransmissions are handled by the Diameter client that sits behind the proxy). However, the Diameter proxy sends messages with the T-bit set to the secondary peer.

These scenarios are shown in Figure 176, Figure 177, and Figure 178.

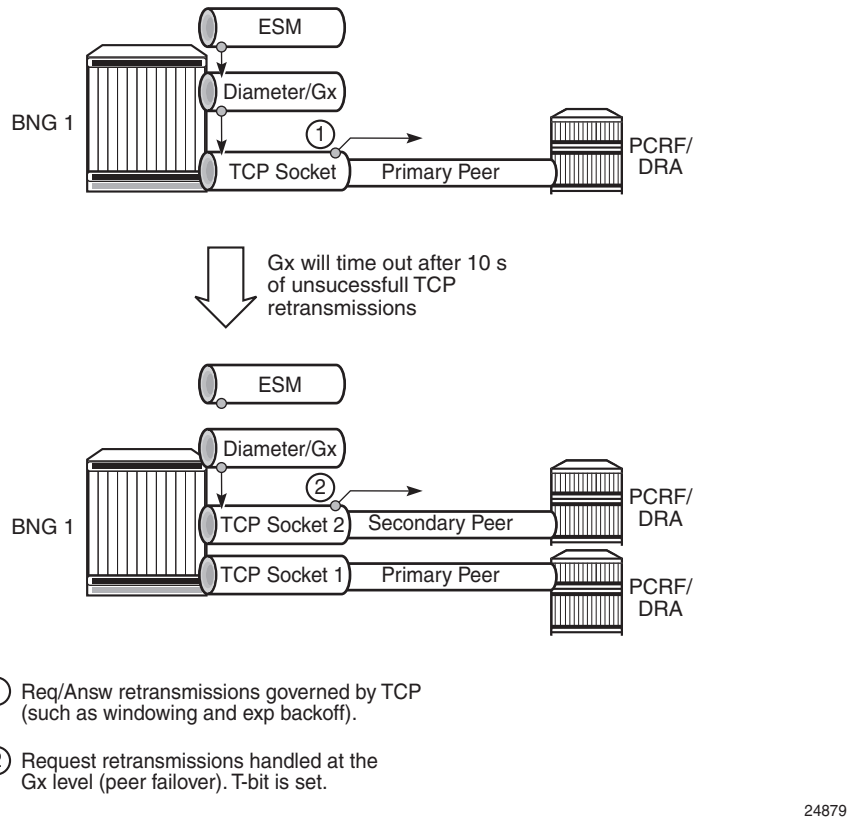


Figure 176: Retransmissions with Two Peers and no Diameter Proxy

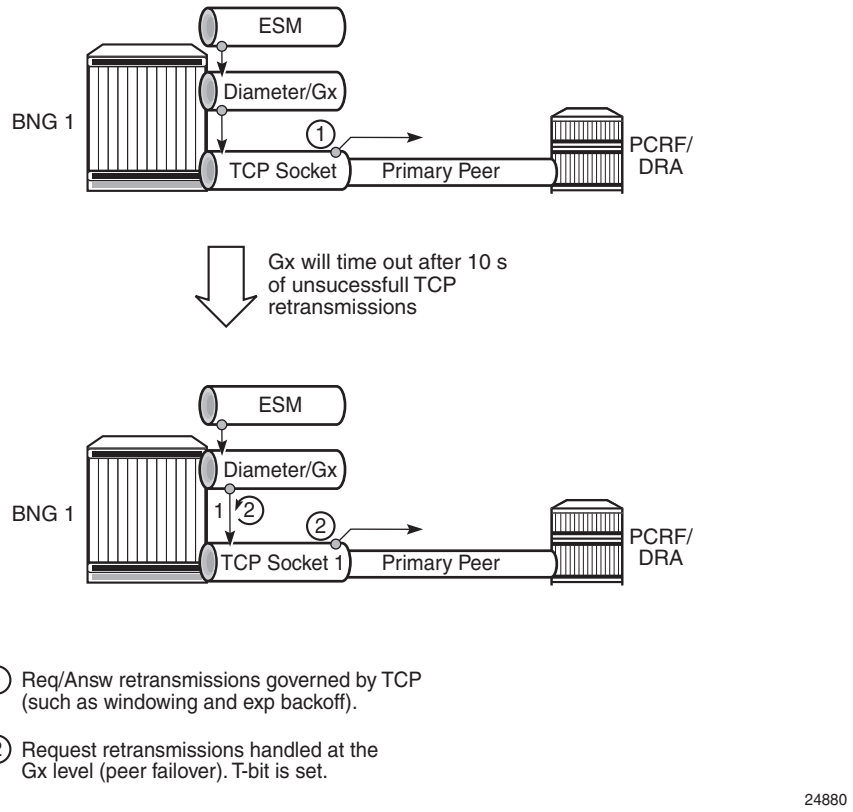


Figure 177: Retransmissions with a Single Peer and no Diameter Proxy

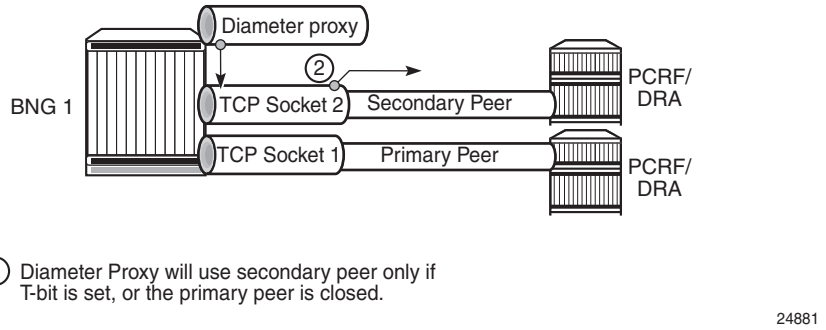


Figure 178: Redirection with Diameter Proxy (T-bit set)

Retransmissions and the T-bit

Multi-chassis redundancy is less concerned with the retransmissions of the answer messages (RAA) since, if the answer is not received, the PCRF retransmits the request (RAR). Retransmission of the **answer** messages is performed only on the TCP level within a single 7750 SR node. It is not performed on the Diameter level.

When the **request** message is retransmitted by the Diameter application (due to the Tx timer timeout, primary peer failure - DWR timeout, or receipt of the answer message with E-bit set), the content of the message stays the same, including the CC-Request numbers but the T-bit in the Diameter header is set. The T-bit indicates to the PCRF that the message is retransmitted (mostly used for accounting purposes so that the counting records are not duplicated). It also signals to the Diameter proxy that the message rerouting to the secondary peer should be performed.

Diameter Proxy Role

The Diameter proxy is applied to an IPv4 address within a routing-context on a 7750 SR. This IPv4 address is a Diameter proxy listening IPv4 address that is associated with an interface on a 7750 SR, including the system interface (system IPv4 address), or loopback interface (loopback IPv4 address).

The number of Diameter Proxies per listening IPv4 address is limited to one. That is, each proxy diameter-peer-policy requires a unique combination of source-ipv4 (listening IPv4 address) and the routing-context (router).

The number of Diameter-peer-policies on a 7750 SR is limited to 32. This means that the combined number of Diameter clients and Proxies on a 7750 SR cannot exceed 32.

The Diameter Proxy has the following role on a 7750 SR:

1. The active Diameter proxy relays messages between the application (Gx and NASREQ) module on a 7750 SR and the PCRF/DRA.
2. Only the active Diameter proxy allows peering connection with the client (the Diameter on a 7750 SR). The standby Diameter proxy refuses the client connection.
3. The Diameter proxy with open peering connections is referred to as the active Diameter proxy (ADP). Its counterpart is called the standby Diameter proxy.
4. The Diameter proxy retransmits the message on the TCP level towards the same peer.

5. However, the Diameter proxy does not perform application level message retransmission and the peer failover procedure due to the timeout of the application level message. Instead, the application level retransmission is performed by the Diameter client (which is peering with the Diameter proxy). The client sets the T-bit (retransmission bit) in the Diameter header of the retransmitted message (same CC-Req_Number) and this signals to the Diameter proxy that it needs to failover the message to the alternate peer. Note that this re-routing operation in the proxy is performed per message and not per sessions, as it is the case for a Diameter client.
6. When the primary peer is closed, or the watchdog timer on the primary peer expires, the Diameter proxy initiates failover procedure to the secondary peer.
7. The standby client (SRRP standby) discards received RAR messages.
8. The active Diameter proxy replies to the client with the error message UNABLE_TO_DELIVER in case that the peering connection towards the server cannot be open. The client retransmits the messages (since it has only one connection) after the timeout interval.

   Table 27 summarizes the differences between the regular Diameter client and the Diameter proxy.

Table 27: Summary of Differences Between the Regular Diameter Client and the Diameter Proxy

Regular Diameter Client	Diameter Proxy
Initiates messages.	Transparently passes all messages between the client and the server. Never initiates the messages.
Buffering is implemented, thus retransmissions are supported.	Buffering is not implemented (pending queue), thus messages are never retransmitted.
When retransmitting, it sets the T-bit in the Diameter Header.	Never retransmits the messages.
Failover to the secondary peer is triggered by: • Message timeout • Primary peer is down; immediate failover. • All messages with an E-bit set triggers failover after the message times out on the pending queue.	Failover to the secondary peer is triggered by: • Messages with T-bit set; immediate failover per message. • Primary peer shutdown
Diameter client performs peer failover per session.	Diameter proxy performs peer failover per message (with the T-bit set).

Diameter Proxy and CC-Request-Number AVP

CC-Request-Number AVP (RFC 4006, 8.2) are typically used to match requests with answers. Session-id and CC-Req-Num are a unique per-message pair. CC Request Numbers along with the session-id uniquely identify a transaction (matching requests and answer messages) on a global level.

The Diameter proxy does not re-write the CC-Request-Number in the messages received by the client.

CC-Req-numbers are synchronized at the ESM level. This is needed so that operation with proper CC-Req-Num can resume after the switchover.

For example, the the following CC-Req-Num sequence for the session is preserved across SRRP switch-overs:

- 1st host (e.g. IPv4) of a dual-stack host is setup
- CCR-I with CC-Req-Num = 1 is sent
- 2nd host (for example,. IPv6 IA-NA) of the same dual-stack host is set up
- CCR-U with CC-Req-Num=2 is sent
- SRRP switchover occurs
- 2nd host in the dual-host is removed (DHPCv6 release)
- CCR-U with CC-Req-Num=3 is sent from the new SRRP Master

Stateless Diameter Proxy

The Diameter proxy does not maintain any session state. Forwarding is based on transactions which are short lived. Transactions are based on a pairing request/answer messages matched by the same hop-by-hop identifier and the peer from which the request was received. In this fashion, answer messages coming from the DRA/PCRF can be unambiguously forwarded to the proper Diameter client (from which the request was received).

Since the session state is not kept in Diameter proxy, RAR request are be flooded to both Diameter clients. The Diameter client on the standby SRRP node will silently drop such RAR requests and only the master SRRP will r

Switchover Scenarios

The following are four types of switchovers that are most likely to occur:

1. Switchover to a new DRA/PCRF peer at a Diameter proxy
2. Diameter proxy switchover due to failed peers on the server side
3. Diameter proxy switchover due to Diameter proxy node failure
4. SRRP switchover

Each switchover type for a Gx application is discussed in more detail below:

1. Switchover to a new PCRF/DRA peer is handled at the Diameter proxy level. This scenario is shown in Figure 179.

   The Diameter proxy switches over to the new peer in the event of two cases:

   → It receives a Diameter message with the T-bit set (retransmission bit in the Diameter header) from the Diameter client.

   Retransmission due to the message timeout is performed at the Diameter **client** level, and setting the T-bit signals to the Diameter proxy that peer failover is needed for this particular message.

   → The TCP connection to the primary peer is explicitly closed (for example, due to TCP RST or watchdog timeouts). In this case, the Diameter proxy performs a fail-over of all sessions to the secondary peer immediately.

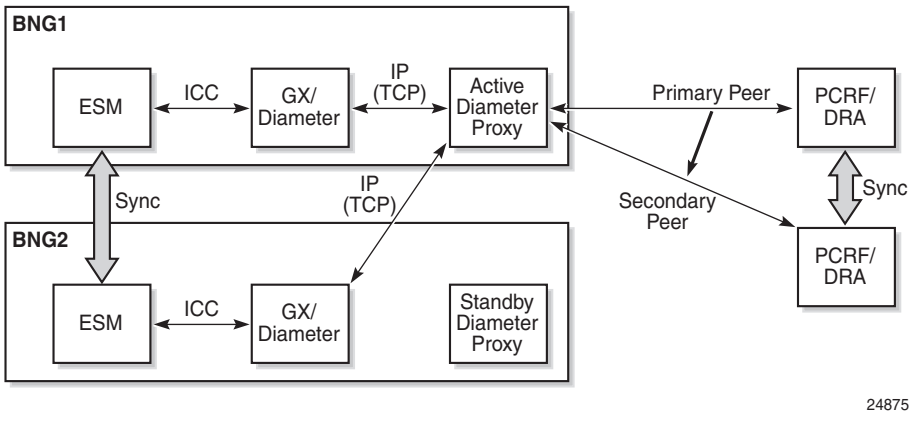


Figure 179: PCRF/DRA Peer Switchover

2. Activity switchover between the Diameter proxies occurs when the active Diameter proxy loses all peering connections to the PCRFs/DRAs while both 7750 SR nodes (including MCS) are operational.

   This type of switchover (without the node failure) is unlikely to occur. For example, a Diameter proxy switchover (without the node failure) would mean that all PCRFs/DRAs have failed, since normally the same pair of PCRF/DRA peers are configured in both Diameter proxy nodes. This would mean that all DRA/PCRFs are unavailable, which indicates a problem on the network side (either network paths to DRA/PCRFs are broken or all DRA/PCRFs have crashed).

   Another example where this scenario could occur is poor redundancy design practices. For example, the active Diameter proxy has a single peering connection to one PCRF (no secondary peer), while the standby Diameter proxy is configured with a separate PCRF peer (the two PCRFs are still synched). This scenario is shown in Figure 180.

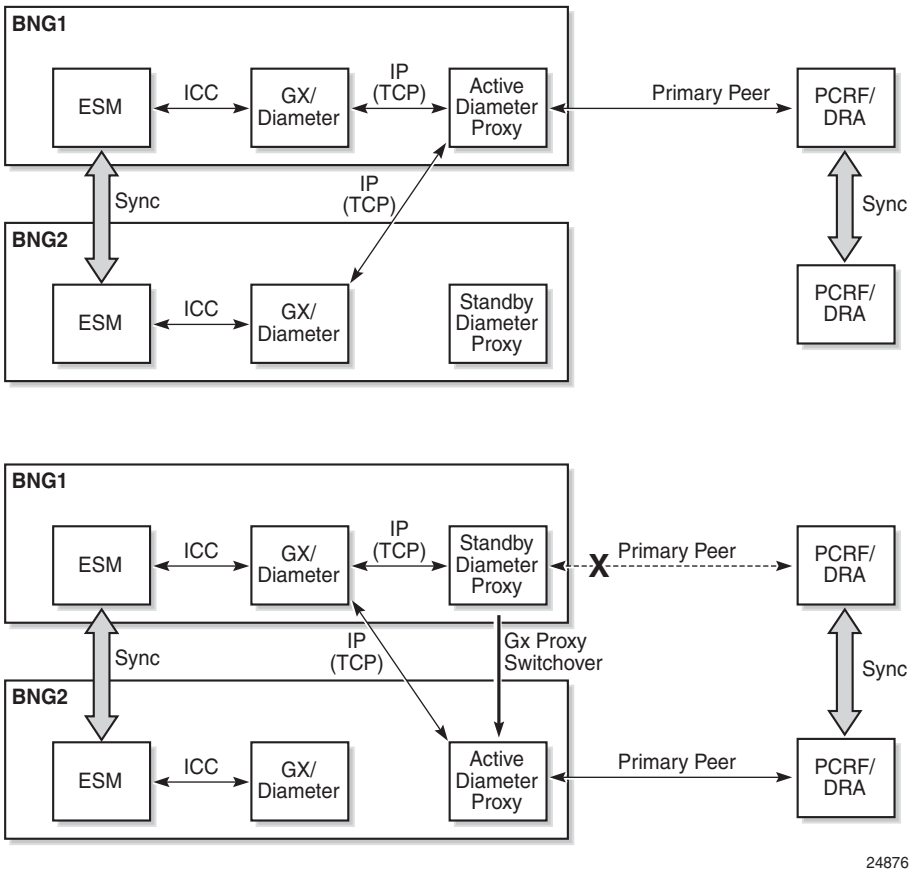


Figure 180: Diameter Proxy Switchover

As always, only the active Diameter proxy maintains an open TCP peering connection towards the PCRF/DRA. If this connection fails, the active proxy sends a TCP RST towards the client and transitions into standby state. The client then, upon expiry of connection-timer, open a new TCP connection towards the newly active Diameter proxy.

3. In this scenario, the entire proxy node fails, as shown in Figure 181. The surviving node resumes operation.

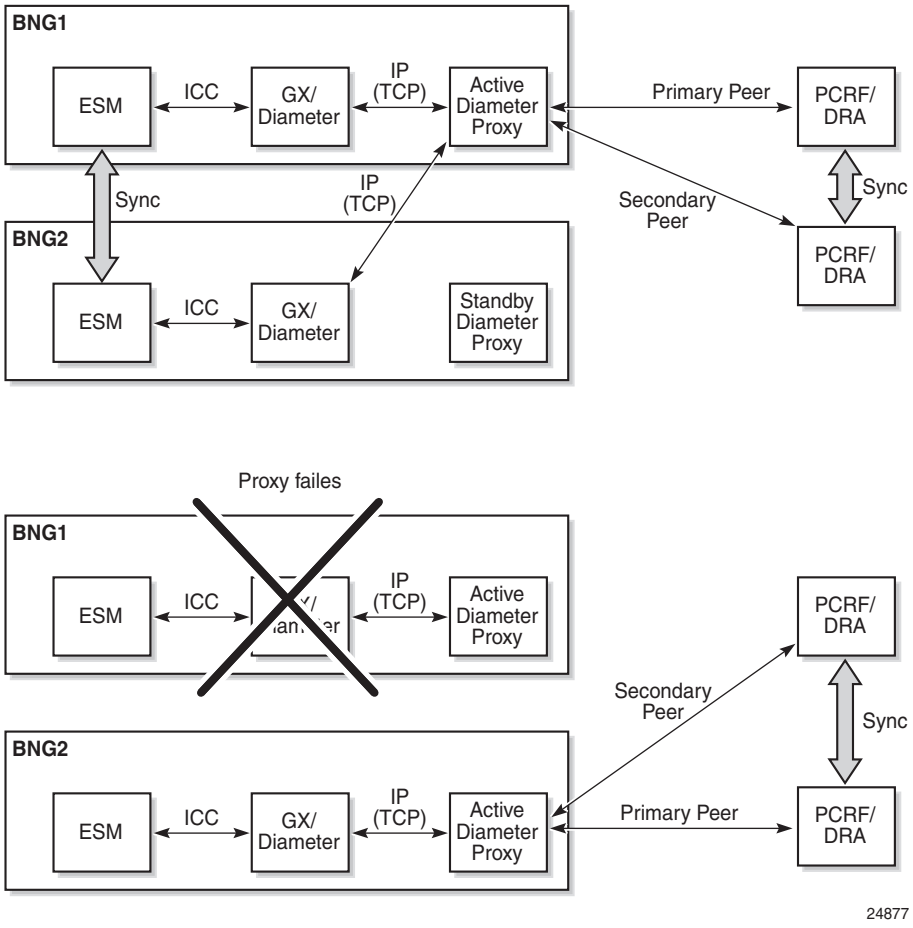


Figure 181: Node Failure

4. The last scenario is where the switchover occurs in the access and the SRRP switches activity. The new SRRP master resumes uninterrupted operation.

Log/Trap Generation Caused by Diameter Proxy State Change

In cases where the Diameter proxy changes its states (INIT, ACTIVE, STANDBY), a log/trap is generated. This log is enabled by default in log-event control. The notification name is `tmnxDiamProxyStateChange`.

Switchover Update Event (CCR-u)

The AN-GW-Address carried in the CCR-I message for the Diameter application session (for example, Gx) is the IP address of the node on which the underlying SRRP instance (for this Gx session) is in the SRRP master state.

When the SRRP switches over due to the failure in the access part of the network (including the ports on a 7750 SR), a CCR-U can be optionally (configuration dependent) sent with the AN-GW-Address AVP of the node on which an SRRP instance transitioned into the master state.

This behavior is controlled via the event trigger id 13 (USER_LOCATION_CHANGE).

Isolated Chassis

In cases where the MCS connection is broken, the Diameter proxy on both 7750 SR nodes try to become active since they each consider that they are the only functional node. From the local point of view, the MCS peer is dead.

While in isolation scenario, both nodes are most likely able to open the TCP peering session with the PCRF/DRA (see Figure 182).

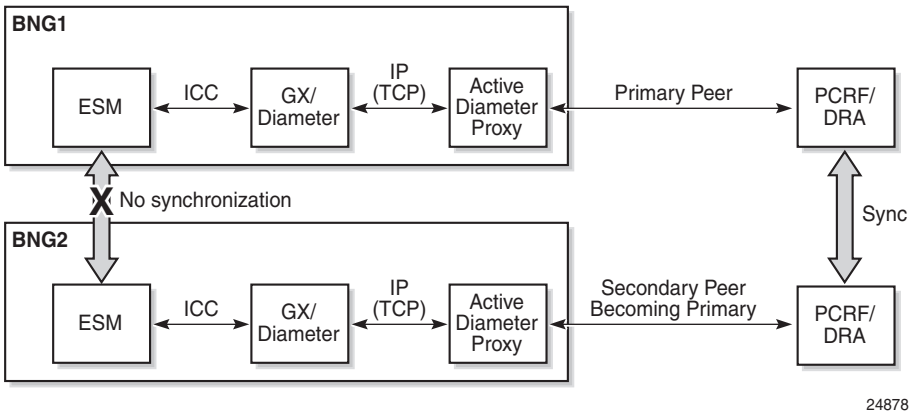


Figure 182: Isolated Nodes

Once the MCS is recovered, the states are re-synchronized.

Diameter Identities

Diameter identities (origin-host/realm) can be configured to be the same on both 7750 SR nodes. This ensures that the redundant pair of 7750 SRs appears as a single node at the Diameter level (Diameter Identities).

High Availability

A CPM switchover on the active Diameter proxy causes the peering connections between the client and the proxy to be lost. Consequently, the clients have to re-establish their peering connections. Peering connections on the active Diameter proxy towards the server remain uninterrupted.

Gx Specific Behavior

Gx specific behavior in a multi-chassis configuration is as follows:

1. A Gx client at a 7750 SR attempts to open a TCP connections to both Diameter proxies, but only the active Diameter proxy accepts accept the TCP request (see Diameter Multi-Chassis Redundancy on page 2073).
2. The standby Diameter proxy ignores the connection request and does not respond in any way (not even TCP RST).
3. The Gx client normally tries to reopen the configured connections (peers) every connection-timer interval (30 s by default).
4. Since the Gx client has only one peering connection open, retransmissions due to the application level message timeout occurs on that same peer. The T-bit is set and signals to the Diameter proxy that it needs to perform a peer failover procedure.
5. The Gx client discards/ignores all messages received on the standby node (standby SRRP).

Python Script Support for ESM

In This Chapter

This section describes the Python script support for Enhanced Subscriber Management (ESM).

The following topics are included:

Python Script Support for ESM

In order to provide programmable flexibility in ESM applications, the SR OS provides the following features with Python script support:

- sub-ident-policy
- radius-script-policy
- python-policy

Python in SR-OS Overview

The SR-OS python script support is based on Python version 2.4.2. Python has a set of language features (such as functions, lists and dictionaries) and a very large set of packages which provide most of the Python functionality. By keeping the language features intact and drastically reducing the number of packages available, the operator is provided with a flexible, although small, scripting language.

The only feature removed from the Python language is unicode support. The only packages provided to the operator are:

- **alc** — The SR OS-provided packages provide access to various ESM objects such as DHCPv4, DHCPv6 or RADIUS packets.
- **binascii** — Common ASCII decoding like base64.
- **re** — Regular expression support.
- **struct** — Parses and manipulates binary strings.
- **md5** — MD5 message digest algorithm.

Python Changes

Some changes have been made to Python in order to run on an embedded system:

- No files or sockets can be opened from inside Python scripts.
- No system calls can be made from inside Python scripts nor is the posix package available.
- The maximum recursion depth is fixed to twenty.
- The total amount of dynamic memory available for Python itself and Python scripts is capped at 2MB.
- The size of the script source file must be less than 16KB.

Python Support in sub-ident-policy

A Python script can be configured in sub-ident-policy to return following ESM attributes:

- sub-id
- sla-profile name
- sub-profile name
- ancp-string

The system will run the Python script configured in the sub-ident-policy against the received DHCPv4 ACK message. This is used as the input of the script. Within the script, the user can set the value with the above ESM attributes.

The alc package contains a DHCP object, and has the following members (Table 28).

Table 28: DHCP Object Members

Name	Read	Write	Class
htype	X		integer
hlen	X		integer
hops	X		integer
flags	X		integer
ciaddr	X		integer
yiaddr	X		integer
siaddr	X		integer
giaddr	X		integer
chaddr	X		string
sname	X		string
file	X		string
options	X		TLV
sub_ident		X	string
sub_profile_string		X	string
sla_profile_string		X	string
ancp_string		X	string
app_profile_string		X	string
category_map_name		X	string
int_dest_id		X	string

The TLV type provides easy access to the value part of a stream of type-length-value variables, as is the case for the DHCP option field. In the example on page 2096, the circuit-ID is accessed as alc.dhcp.options[82][1].

Some DHCP servers do not echo the relay agent option (option 82) when the DHCP message was snooped instead of relayed. For the convenience of the operator, the relay agent option from the request message is returned when alc.dhcp.options[82] is called.

Configuration

As an example consider script us5.py on page 2099 which sets the sub_ident variable based on the circuit ID of three different DSLAMs:

```
import re
import alc
import struct
# ASAM DSLAM circuit ID comes in three flavours:
#      FENT   string         "TLV1: ATM:3/0:100.33"
#      GELT   octet-stream   0x01010000A0A0A0A0000000640022
#      GENT   string         "ASAM11 atm 1/1/01:100.35"
#
# Script sets output ('subscriber') to 'sub-vpi.vci', e.g.: 'sub-100.33'. circuitid =
str(alc.dhcp.options[82][1])
m = re.search(r'(\d+\.\d+)$', circuitid)
if m:
# FENT and GENT
alc.dhcp.sub_ident = "sub-" + m.group()
elif len(circuitid) >= 3:
# GELT
# Note: what byte order does GELT use for the VCI?
# Assume network byte (big endian) order for now. vpi = struct.unpack('B', circuitid[-3:-
2])[0]
vci = struct.unpack('>H', circuitid[-2:])[0]
alc.dhcp.sub_ident = "sub-%d.%d" % (vpi, vci)
```

Configure the url to this script in a sub-ident-policy as follows:

```
-----------------------------------------------
     sub-ident-policy "DSLAM" create
          description "Parse circuit IDs from different DSLAMs"
          primary

               script-url "ftp://xxx.xxx.xxx.xx/py/us5.py"
               no shutdown
          exit
     exit
-----------------------------------------------
```

And attach this sub-ident-policy to the sub-sla-mgmt from a SAP:

```
A:dut-A>config>service>vpls>sap# info
-----------------------------------------------
     dhcp
          description "client side"
          lease-populate 50

          no shutdown
     exit
     anti-spoof ip-mac
     sub-sla-mgmt
          sub-ident-policy "DSLAM"
          no shutdown
```

```
    exit
-----------------------------------------------
```

Note that DHCP snooping/relaying should be configured properly in order for this to work.

Operator Debugging

Verbose debug output is sent to debug-trace on compile errors, execution errors, execution output and the exported result variables.

```
A:dut-A>config>subscr-mgmt>sub-ident-pol>primary# script-url "ftp://xxx.xxx.xx.xx/py/
parsefail1.py"
A:dut-A>config>subscr-mgmt>sub-ident-pol>primary# no shutdown

1 2006/07/30 01:17:33.14 UTC MINOR: DEBUG #2001 - Python Compile Error
"Python Compile Error: parsefail1.py
     File "ftp://xxx.xxx.xx.xx/py/parsefail1.py", line 2 def invalid_function():
          ^
IndentationError: expected an indented block
"

A:dut-A>config>subscr-mgmt>sub-ident-pol>primary# script-url "ftp://xxx.xxx.xx.xx/py/
dump.py"

2 2006/07/30 01:24:55.50 UTC MINOR: DEBUG #2001 - Python Output
"Python Output: dump.py htype   = 0
hlen    = 0 hops    = 0 flags   = 0
ciaddr  = '0.0.0.0' yiaddr  = '0.0.0.0' siaddr  = '0.0.0.0' giaddr  = '0.0.0.0' chaddr  =
''
sname   = ''
file    = ''
options = '5\x01\x056\x04\n\x01\x07\n3\x04\x00\x00\x00\xb4\x01\x04\xff\xff\xff
\x00\x1c\x04\n\x02\x02\xffR\x0f\x01\rdut-A|1|1/1/1\xff' "

3 2006/07/30 01:24:55.50 UTC MINOR: DEBUG #2001 - Python Result
"Python Result: dump.py
"

A:dut-A>config>subscr-mgmt>sub-ident-pol>primary# script-url "ftp://xxx.xxx.xx.xx/py/end-
less.py"

4 2006/07/30 01:30:17.27 UTC MINOR: DEBUG #2001 - Python Output
"Python Output: endless.py
"

5 2006/07/30 01:30:17.27 UTC MINOR: DEBUG #2001 - Python Error
"Python Error: endless.py
Traceback (most recent call last):
File "ftp://xxx.xxx.xx.xx/py/endless.py", line 2, in ? FatalError: script interrupted
(timeout)
"
```

Note that all the Python Result events are empty because none of the scripts set any of the output variables.

Python Scripts

Note that the scripts in this section are test scripts and not scripts which the operator would normally use.

dump.py — `from alc import dhcp`

```
def print_field(key, value):
print '%-8s = %r' % (key, value)

def ipaddr2a(ipaddr):
return '%d.%d.%d.%d' % (
(ipaddr & 0xFF000000) >> 24, (ipaddr & 0x00FF0000) >> 16, (ipaddr & 0x0000FF00) >> 8,
(ipaddr & 0x000000FF))

print_field('htype',   dhcp.htype) print_field('hlen',    dhcp.hlen) print_-
field('hops',    dhcp.hops) print_field('flags',   dhcp.flags) print_field('ciaddr',
ipaddr2a(dhcp.ciaddr)) print_field('yiaddr', ipaddr2a(dhcp.yiaddr)) print_field('siaddr',
ipaddr2a(dhcp.siaddr)) print_field('giaddr', ipaddr2a(dhcp.giaddr)) print_field('chaddr',
dhcp.chaddr) print_field('sname',   dhcp.sname) print_field('file',    dhcp.file) print_-
field('options', str(dhcp.options))
```

us5.py — `import re import alc import struct`

```
# ASAM DSLAM circuit ID comes in three flavors:
#       FENT   string         "TLV1: ATM:3/0:100.33"
#       GELT   octet-stream   0x01010000A0A0A0A0000000640022
#       GENT   string         "ASAM11 atm 1/1/01:100.35"
#
# Script sets output ('subscriber') to 'sub-vpi.vci', e.g.: 'sub-100.33'. circuitid =
str(alc.dhcp.options[82][1])
m = re.search(r'(\d+\.\d+)$', circuitid)
if m:
# FENT and GENT
alc.dhcp.sub_ident = "sub-" + m.group()
elif len(circuitid) >= 3:
# GELT
# Note: what byte order does GELT use for the VCI?
# Assume network byte (big endian) order for now. vpi = struct.unpack('B', circuitid[-3:-
2])[0]
vci = struct.unpack('>H', circuitid[-2:])[0]
alc.dhcp.sub_ident = "sub-%d.%d" % (vpi, vci)
```

Sample Python Scripts

This section provides examples to show how the script can be used in the context of Enhanced Subscriber Management.

Note that these scripts are included for informational purposes only. The operator must customize the script to match their own network and processes.

Example

This script uses the IP address assigned by the DHCP server to derive both *sub_ident* and *sla_profile_string*.

Script:

```
1.  import alc
2.  yiaddr = alc.dhcp.yiaddr
3.  # Subscriber ID equals full client IP address.
4.  # Note: IP address 10.10.10.10 yields 'sub-168430090'
5.  # and not 'sub-10.10.10.10'
6.  alc.dhcp.sub_ident = 'sub-' + str(yiaddr)
7.  # DHCP server is configured such that the third byte (field) of the IP
8.  # address indicates the session Profile ID.
9.  alc.dhcp.sla_profile_string = 'sp-' + str((yiaddr & 0x0000FF00) >> 8)
```

Explanation:

Line 1 — Imports the library “alc” – Library imports can reside anywhere in the script as long as the items are imported before they are used.

Line 2— Assigns the decimal value of the host’s IP address to a temporary variable “yiaddr”. Line 6: The text “sub_“ followed by yiaddr is assigned to “sub_ident” string.

Line 9— The text “sp-“ followed with the third byte of the IP address is assigned to the “sla-profile” string.

If this script is run, for example, with a DHCP-assigned IP address of:

```
yiaddr = 10.10.0.2
```

The following variables are returned:

```
sub_ident: sub-168427522(hex = A0A00002 = 10.10.0.2)
sla_ident: sp-0
```

Example

This script returns the *sub_profile_string* and *sla_profile_string*, which are coded directly in the Option 82 string.

Script:

```
1.  import re
2.  import alc
3.  # option 82 formatted as follows:
4.  # "<subscriber Profile>-<sla-profile>"
5.  ident = str(alc.dhcp.options[82][1])
6.  alc.dhcp.sub_ident = ident
7.  tmp = re.match("(?P<sub>.+)-(?P<sla>.+)", str(ident))
8.  alc.dhcp.sub_profile_string = tmp.group("sub")
9.  alc.dhcp.sla_profile_string = tmp.group("sla")
```

Explanation:

Line 1-2 — Import the libraries “re” and “alc”. Library imports can reside anywhere in the script as long as the items are imported before they are used.

Line 6 — Assigns the full contents of the DHCP Option 82 field to the “sub_ident” variable.

Line 7 — Splits the options 82 string into two parts, separated by “-”.

Line 8 — Assigns the first part of the string to the variable “sub_profile_string”.

Line 9 — Assigns the second part of the string to the variable “sla_profile_string”.

If this script is run, for example, with DHCP option field:

```
options = \x52\x0D\x01\0x0Bmydsl-video
```

The following variables are returned:

```
sub_ident: mydsl-video
sub_profile_string: mydsl
sla_profile_string: video
```

Example

This script parses the Option82 “circuit-id” info inserted in the DHCP packet by a DSLAM, and returns the *sub_ident* string.

Script:

```
1.  import re
2.  import alc
3.  import struct
4.  # Alcatel 7300 ASAM circuit ID comes in three flavors:
5.  #      FENT   string         "TLV1: ATM:3/0:100.33"
6.  #      GELT   octet-stream   0x01010000A0A0A0A0000000640022
7.  #      GENT   string         "ASAM11 atm 1/1/01:100.35"
8.  #
9.  # Script sets output ('subscriber') to 'sub-vpi.vci',
10. # e.g.: 'sub- 100.33'.
11. circuitid = str(alc.dhcp.options[82][1])
12. m = re.search(r'(\d+\.\d+)$', circuitid)
13. if m:
14.    # FENT and GENT
15.    alc.dhcp.sub_ident = "sub-" + m.group()
16. elif len(circuitid) >= 3:
17.    # GELT
18.    # Note: GELT uses network byte (big endian) order for the VCI
19.    vpi = struct.unpack('B', circuitid[-3:-2])[0]
20.    vci = struct.unpack('>H', circuitid[-2:])[0]
21.    alc.dhcp.sub_ident = "sub-%d.%d" % (vpi, vci)
```

Explanation:

Line 1-2 — Import the libraries “re” and “alc” – Library imports can reside anywhere in the script as long as the items are imported before they are used. Needed if regular expressions are used.

Line 3 — Imports the “struct” library, needed if regular expressions are used.

Line 11 — Assigns the contents of the DHCP Option 82 Circuit-ID field to a temporary variable called “circuitid”.

Line 12 — Parses the “circuitid” and checks for the existence of the regular expression “digit.digit” at the end of the string.

Line 15 — If found, a string containing the text “sub-” followed by these two digits is assigned to the variable “sub-ident”.

Line 16 — If not found, and the length of circuit-id is at least 3.

Line 19 — Parses the “circuitid” and assigns the third-last byte to the temporary variable “vpi”.

Line 20 — Parses the “circuitid” and assigns the last two bytes to the temporary variable “vci”.

Line 21 — Assigns a string containing the text “sub-” followed by vpi and vci to the variable “sub-ident”.

If this script is run, for example, with DHCP option field (assigned by an ASAM with FENT card) containing:

```
options = \x52\x16\x01\x14TLV1: ATM:3/0:100.33
```

(in decimal: 80, 22, 1, 20TLV…)

The following variables are returned:

```
sub_ident: sub-100.33
```

If the above script is run, for example, with a DHCP option field (assigned by an ASAM with GELT card) containing:

```
options = \x52\x10\x01\x0E\x01\x01\x00\x00\xA0\xA0\xA0\xA0\x00\x00\x00\x64 \x00\x22
```

(in decimal: 82, 16, 1, 15, 1, 1, 0, 0, 160, 160, 160, 160, 0, 0, 0, 100, 0, 34; corresponding to VPI 100, VCI 34)

Python returns the following variables:

```
sub_ident: sub-100.34
```

If the above script is run, for example, with a DHCP option field (assigned by an ASAM with GENT card) containing:

```
options = \x52\x1A\x01\x18ASAM11 atm 1/1/01:100.35
```

The following variables are returned:

```
sub_ident: sub-100.35
```

Limitations

'%' operator — While %f is supported, %g and %e are not supported.

Floating Point Arithmetic — The floating point arithmetic precision on the box is less than the precision required by the regression suites of Python. For example, pow(2., 30) equals to

1024.*1024.*1024. until five numbers after the point instead of seven and sqrt(9) equals to 3. for the first seven numbers after the point.

Using the round operator fixes these problems. For example, round(pow(2., 30)) equals round(1024.*1024.*1024.) and round(sqrt(9)) equals 3.

RADIUS Script Policy Overview

Python scripts for RADIUS AAA packets support manipulation in subscriber management application. This feature is supported on 7750 SRs and 7450 ESSes in mixed mode. A Python script can be executed in following cases:

- Before the system sends an access-request packet.
- After the system receives an access-accept packet.
- After the system receives an CoA-request packet.
- Before the system sends an accounting-request packet.

The input of the script is the corresponding original packet; and the output of packet will be used as the new corresponding packet for further ESM AAA process.

The **radius-script-policy** contains URLs of a primary and optionally a secondary Python script, which could be a local CF file path or a FTP URL. The configured radius-script-policy could be used in different ESM polices like authentication-policy or radius-accounting-policy.

The following operations are supported within the script:

- Obtain the value of an existing attribute or VSA.
- Modify the value of an existing attribute or VSA.
- Add a new attribute or VSA.
- Remove an existing attribute or VSA.

Note that the following RADIUS attributes or VSA are read-only to Python script:

- Message-Authenticator
- Alc-LI-Action
- Alc-LI-Direction
- Alc-LI-Destination
- Alc-LI-FC
- Alc-LI-Intercept-Id
- Alc-LI-Session-Id

Since R12.0R1, users should use a Python policy (instead of a RADIUS script policy) for RADIUS packet manipulation.

Python RADIUS API

The following new Python objects, alc.radius.attributes, have the following methods:

- drop(): drop the packet
- header(): Return the a dictionary object includes RADIUS header information
- get(type): Return the first attribute with specified type as a string.
- getTuple(type): The same as above but returns a tuple of strings.
- getVSA(vendor, type): Return the first VSA as a string.
- getVSATuple(vendor, type): The same as above but returns a tuple of strings.
- set(type, value): Set the specified attribute to the value. The value must be either a string or a tuple of strings.
- setVSA(vendor, type, value): Set the specified VSA to the value. The value must be either a string or a tuple of strings.
- clear(type): Remove the specified attribute.
- clearVSA(vendor, type): Remove the specified VSA.

Sample Script

From alc import radius

#1. Get the value of an existing Attribute

```
Username=radius.attributes.get(1)
```

#2. Modify an existing attribute

```
radius.attributes.set(1, 'Tom')
```

#3. Remove an existing attribute

```
radius.attributes.clear(1)
```

#4. Add a new attribute

```
radius.attributes.set(126,”WIFI-operator”)
```

Python Policy Overview

The Python policy represents a general framework to support all existing and new python features. A Python policy allows users to configure a Python script for specified ESM packet type (such as DHCP, RADIUS, etc.) in a specified direction (ingress/egress). The system will execute the configured script when sending or receiving the specified type of packet.

Within the script, the corresponding original packet will be used as input. The user can use the system-provided API to manipulate the input packet (such as add/change/remove option/attribute) and the changed packet is the output for further ESM processing. And in case of a DHCP transaction cache, the script could also return ESM attributes.

Python policies support following ESM packet types and application:

- RADIUS
- DHCPv4
- DHCPv6
- DHCP Transaction Cache
- Diameter
- Python cache

The following is an example configuration on a specified group interface. The system will execute cf1:/dhcpv4.py after received DHCPv4 discovery and before system forward DHCPv4 request packet.

```
config>python# info
----------------------------------------------
        python-script "dhcpv4" create
            primary-url "cf1:/dhcpv4.py"
            no shutdown
        exit
        python-policy "dhcp" create
            dhcp discover direction ingress script "dhcpv4"
            dhcp request direction egress script "dhcpv4"
        exit
----------------------------------------------
config>service>vprn>sub-if>grp-if>dhcp# info
----------------------------------------------
                        python-policy "dhcp"
                        server 9.9.9.9
                        lease-populate 100
                        gi-address 192.168.100.1
                        no shutdown
----------------------------------------------
```

Python Policy – RADIUS API

The RADIUS API in Python policy uses the same API of the radius-script-policy.

Python Policy – DHCPv4 API

- The system will provide a Python object for input DHCPv4 packet: alc.dhcpv4.
- alc.dhcpv4 has following attributes to represent the DHCPv4 header fields:

Table 29: alc.dhcpv4 Attributes

Class Attrs	DHCPv4 Header Field	Access
alc.dhcpv4.pkt_len	int, Total length of original DHCPv4 packet(UDP/IP header excluded, including pad option) in bytes	read
alc.dhcpv4.pkt_netlen	int, Total length of original DHCPv4 packet(UDP/IP header excluded, pad option in the “options” field excluded) in bytes	read
alc.dhcpv4.op	op	read
alc.dhcpv4.htype	htype	read/write
alc.dhcpv4.hlen	hlen	read/write
alc.dhcpv4.hops	hops	read/write
alc.dhcpv4.xid	xid	read
alc.dhcpv4.secs	secs	read/write
alc.dhcpv4.flags	flags	read/write
alc.dhcpv4.ciaddr	ciaddr	read/write
alc.dhcpv4.yiaddr	yiaddr	read/write
alc.dhcpv4.siaddr	siaddr	read/write
alc.dhcpv4.giaddr	giaddr	read/write
alc.dhcpv4.chaddr	chaddr	read/write
alc.dhcpv4.sname	sname	read/write
alc.dhcpv4.file	file	read/write

All attributes, except alc.dhcpv4.pkt_len and alc.dhcpv4.pkt_netlen, are string with value of the actual bytes in the header.

The following is a list all functions of alc.dhcpv4:

- alc.dhcpv4.drop()
- alc.dhcpv4. getOptionList()
- alc.dhcpv4.pad(min_size=300)
- alc.dhcpv4. get(op_code)
- alc.dhcpv4. set(op_code,valTuple)
- alc.dhcpv4. clear(op_code)
- alc.dhcpv4.get_relayagent() / alc.dhcpv4.set_relayagent(D4OL)
- alc.dhcpv4.get_vendorspecific() / alc.dhcpv4.set_vendorspecific (D4OL)

DHCPv4 allows using sname and file fields to store options. However all DHCPv4 functions will only operate with the “options” field. If a customer wants to manipulate options in the sname/file field, they need to do the parsing work in the script. (extended string.tlvxy method could help here)

- alc.dhcpv4. drop(): The system will drop the result packet
- alc.dhcpv4. getOptionList(): Returns a tuple that includes the option-code of the existing top level DHCPv4 options in the packet.
  - → The order of the element in the tuple is as same as the options that appear in the packet.
  - → If there are multiple instances of the same option, then each instance is one element in the tuple.
  - → Pad option(0) is excluded.
  - → End option(255) is included
  - → Example: A DHCP discovery packet with msg-type/lease-time/request-addr/ parameter-request-list/agent-info/end will return (53,51,50,55,82,255)
- alc.dhcpv4.pad(min_size=300): This function will pad the resulting DHCPv4 packet to the specified min_size with pad option(0) after executing the whole script. Padding will not be added if the result packet is already >=min_size. The default value of min_size is 300. Although not defined in DHCPv4 RFC, many DHCPv4 implementation has a minimal length requirement of 300 bytes. So this function could pad the result packet to the specified min_size.

- alc.dhcpv4. get(op_code): Returns a tuple that includes all instances of the specified top level option as a string. The value of this string is the exact bytes of the option as it appears in packet(excludes option-code and option-len).
  - → If the specified option does not exist, then the function will return ()
  - → If the certain instance of specified option does not have the value (len=0 or doesn't have len and value part), then the function will return "" for that instance in the tuple.
  - → Example: There is an address lease time option(51) in the packet, with value 60, then alc.dhcpv4.get(51) should return: ('\x00\x00\x00\x3c',)
- alc.dhcpv4. set(op-code,valTuple): This function will in fact remove the all existing instances of specified top level option and insert a list of new options. Each element in valTuple is a string, representing one instance of the new option to be inserted; For each new option, the option-code is specified in op-code. The option-len is the length of the element. The rest of option is the element itself.
  - → Example: To insert an address lease time option(51) in the packet, with the value 60; use alc.dhcpv4.set(51, ('\x00\x00\x00\x3c',))
- alc.dhcpv4. clear(op-code): This function will remove the all existing instances of specified top level option.
- Although alc.dhcpv4.get() and alc.dhcpv4.set() provide a generic way to manipulate DHCPv4 top level options, but some DHCPv4 options have a complex/hierarchical structure like option82 and option43. To provide a friendly access to these kinds of options, the system provides the following options' specific functions:
  - → alc.dhcpv4.get_relayagent() / alc.dhcpv4.set_relayagent(D4OL)
  - → alc.dhcpv4.get_vendorspecific() / alc.dhcpv4.set_vendorspecific (D4OL)

  All alc.dhcpv4.get_XXX() will return a data structure:"D4OL" (DHCPv4 Option List)
  - → D4OL is a list. Each element in the list represents an instance of that option. For example, if there are 3 option82 in the "options" field of packet, then get_relayagent() will return a list of 3 elements. Each element represents one instance of the option in the packet.
  - → Each element in D4OL is a dict (called dict as "D4O" in this example):
    - – The key of D4O is the sub-option- code. The value is a list of strings of sub-option-value of all instance of the sub-option.

  All alc.dhcpv4.set_XX(OPDL) will accept D4OL as the parameter. Remove all existing instances of the corresponding options and then insert the new options represented by specified D4OL.

Examples:

For a packet with an option82 like following

```
Option: (82) Agent Information Option
     Length: 22
     Option (82) Suboption: (1) Agent Circuit ID
          Length: 8
          Agent Circuit ID: 4a616e737656e73
     Option 82 Suboption: (2) Agent Remote ID
          Length: 10
          Agent Remote ID 62617369632364617461
```

The option-data is (hex formatted)
“01:08:4a:61:6e:73:73:65:6e:73:02:0a:62:61:73:69:63:23:64:61:74:61”

The following is an example script:

```
import alc

option82_list=alc.dhcpv4.get_relayagent()
#option82_list will be
[{1:['\x4a\x61\x6e:73\x73\x65\x6e\x73',],2:['\x62\x61\x73\x69\x63\x23\x64\x61\x74\x61',]}
,]
Option82_list[0][2][0]='basic#video' #change remote-id to 'basic#video'
alc.dhcpv4.set_relayagent(option82_list)#update the option82
```

Python Policy – DHCPv6 API

- The system provides a Python object for input DHCPv6 packet: alc.dhcpv6
- alc.dhcpv6 has following attributes to represent the DHCPv6 header fields:

Table 30: DHCPv6 Header Fields

Class Attrs	DHCPv6 Header Field	Client/ Server Msg	Relay Msg	Access
alc.dhcpv6.pkt_len	int, Total length of original DHCPv4 packet(UDP/IP header excluded) in bytes	●	●	Read
alc.dhcpv6.msg_type	msg-type	●	●	Read
alc.dhcpv6.transaction_id	transaction-id	●		Read
alc.dhcpv6.hop_count	hop-count		●	read/write
alc.dhcpv6.link_addr	link-address		●	read/write
alc.dhcpv6.peer_addr	peer-address		●	read/write

All header fields (as the attribute of alc.dhcpv6 class) are strings(except pkt_len) with exact bytes as it appears in the packet.

If certain attribute does not exist in the given msg-type, for example if the link_attr does not exist in client/server message(C/S msg), then its value should be None.

- The following is a list of all functions in the class:
  - → alc.dhcpv6.drop()
  - → alc.dhcpv6. getOptionList()
  - → alc.dhcpv6. get(op-code)
  - → alc.dhcpv6. set(op-code,valTuple)
  - → alc.dhcpv6. clear(op-code)
  - → alc.dhcpv6.get_iana() / alc.dhcpv6.set_iana(OPDL)
  - → alc.dhcpv6.get_iata() / alc.dhcpv6.set_iata(OPDL)
  - → alc.dhcpv6.get_vendoropts() / alc.dhcpv6.set_vendoropts(OPDL)
  - → alc.dhcpv6.get_iapd() / alc.dhcpv6.set_iapd(OPDL)
  - → alc.dhcpv6.get_relaymsg()
  - → alc.dhcpv6.set_relaymsg(packet)
- alc.dhcpv6. drop(): The system will drop the resulting packet.

- alc.dhcpv6. getOptionList(): Returns a tuple that includes the option-code of the existing top level DHCPv6 options in the packet. The order of the element in the tuple is as same as the options appear in the packet. If there are multiple instances of same option, then each instance is one element in the tuple. For example:

  → A C/S Msg with Elapsed Time/Client Identifier/IANA/FQDN/Vendor Class/Option Request will return (8,1,3,39,16,6).

  → A Relay Msg with Relay Message option only will return (9)

- alc.dhcpv6. get(op-code): Returns a tuple that includes all instances of the specified top level option as string The value of this string is the exact bytes of the option as it appears in packet(excludes option-code and option-len). If the specified option does not exist in the input packet, then it will return ().

  Examples:

  → If there is a Status Code option in the packet, status-code 0 and status-msg:"Address Assigned"; then alc.dhcpv6.get(13) should return: ('\x00\x00Address Assigned',)

- alc.dhcpv6. set(op-code,valTuple): This function will remove the all existing instances of the specified top level option and insert a list of new options. Each element in valTuple is a string, representing one instance of the new option to be inserted. For each new option, the option-code is specified in op-code, the option-len is the length of the element, reset of option is the element itself.

  → To insert a Status Code options with status-code 0 and status-msg:"Address Assigned"; use alc.dhcpv6.set(13, ('\x00\x00Address Assigned',))

- alc.dhcpv6. clear(op-code): This function will remove the all existing instances of specified top level option.

- Although alc.dhcpv6.get() and alc.dhcpv6.set() provide a generic way to manipulate DHCPv6 top level options, but some DHCPv6 options have more complex/hierarchical structure like IA_NA/IA_TA, etc. To provide a friendly access to these kinds of options, the system provides the following options specific functions:

  → alc.dhcpv6.get_iana() / alc.dhcpv6.set_iana(OPDL)

  → alc.dhcpv6.get_iata() / alc.dhcpv6.set_iata(OPDL)

  → alc.dhcpv6.get_vendoropts() / alc.dhcpv6.set_vendoropts(OPDL)

  → alc.dhcpv6.get_iapd() / alc.dhcpv6.set_iapd(OPDL)

All alc.dhcpv6.get_XXX() will return a data structure:“OPDL” (Option Data structure List)

→ OPDL is a list. Each element in the list represents an instance of that option. For example, if there are 3 IANA in the packet, then get_iana() will return a list of 3 elements, each element represent one instance of IANA option in the packet.

→ Each element in OPDL is a list, referred to as “OPD” in this list.

- Each element in OPD represent one field in the option(option-code and option-len are not included), the order of the element is as same as the fields appear in the option
- For field that could be parsed into sub-option by RFC, then the element is a dict, the key of this dict is the sub-option type, if sub-option is one of following supported-sub-option, the value to the key is a sub-option_OPDL represent the list of that specific sub-option
  - IAADDR(5)
  - Status Code(13)
  - IAPREFIX(26)

Else, if the sub-option is **not** one of above, then the value to the key is a list of string of sub-option-data, each string represent one instance of the sub-option.

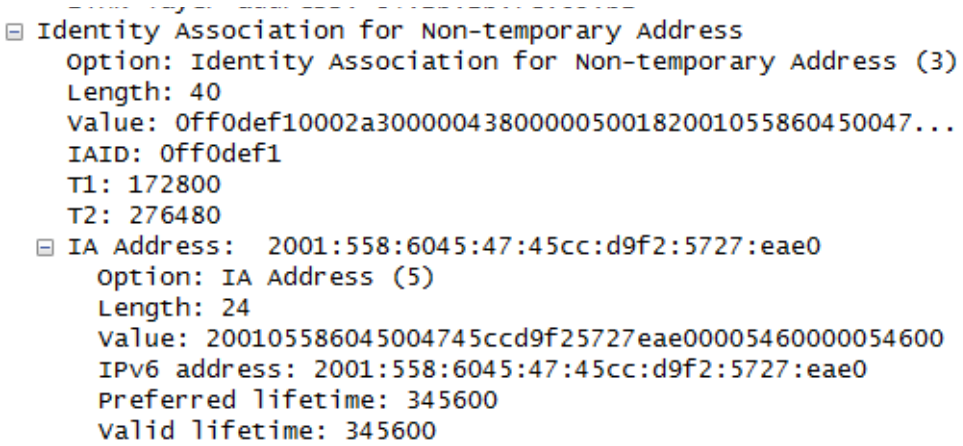
- The structure of sub-option_OPDL of IAADDR is: [[v6_addr,prefer_lifetime, valid_lifetime,sub-option_OPDL], etc.]
- The structure of sub-option_OPDL of Status Code is: [[status-code,status-msg], etc.]
- The structure of sub-option_OPDL of IAPREFIX is: [[prefer_lifetime,valid_lifetime,prefix-len,v6prefix,sub-option_OPDL],..]
- For the field (by RFC definition) could be parsed into sub-options, but it does not actually exist, then the dict will be empty {}
- For field that cannot be parsed into sub-option by RFC, the element is a string of exact bytes of that field

All alc.dhcpv6.set_XX(OPDL) will accept an OPDL as the parameter. Remove all existing instances of the corresponding options and then insert new options represented by the specified OPDL.

- alc.dhcpv6.get_iana()/alc.dhcpv6.get_iana(OPDL)
- The general OPDL structure for these two functions is: [[IAID_val,T1_val,T2_val, sub-option_dict]]
- The structure of sub-option_dict is:{sub-option-type:sub-option_val}
- If sub-option is supported-sub-option, then sub-option_val is a sub-option_OPDL
- For all other sub-options, the sub-option_val is a list of string of sub-option-data

Examples:

For a packet with an IANA option like following:



The option-data is (hex formatted)

```
"0f:f0:de:f1:00:02:a3:00:00:04:38:00:00:05:00:18:20:01:05:58:60:45:00:47:45:cc:d9:f2:57:2
7:ea:e0:00:05:46:00:00:05:46:00"
```

The following is an example script:

```
import alc

iana_list=alc.dhcpv6.get_iana()
#iana_list will be
[['\x0f\xf0\xde\xf1','\x00\x02\xa3\x00','\x00\x04\\x38\x00',{5:[['\x20\x01\x05\x58\x60\x4
5\x00\x47\x45\xcc\xd9\xf2\x57\x27\xea\xe0','\x00\x05\x46\x00','\x00\x05\x46\x00',{}]]}]]
iana_list[0][1]='\x00\x00\x04\xb0' #change T1 to 1200
alc.dhcpv6.set_iana(iana_list)#update the iana
```

- alc.dhcpv6.get_iata()/alc.dhcpv6.get_iata(OPDL)

  → The general OPDL structure for these two functions is: [[IAID_val, sub-option_dict]]

  → The structure of sub-option_dict is:{sub-option-type:sub-option_val}

  → If sub-option is supported-sub-option, then sub-option_val is a sub-option_OPDL

  → For all other sub-options, the sub-option_val is a list of string of sub-option-data

  Examples: These two function are very similar with IANA, so the examples are skipped here.

- alc.dhcpv6.get_iapd()/alc.dhcpv6.get_iapd(OPDL)
- The general OPDL structure for these two functions is: [[IAID_val,T1_va1,T2_val, sub-option_dict]]
- The structure of sub-option_dict is:{sub-option-type:sub-option_val}
- If sub-option is supported-sub-option, then sub-option_val is a sub-option_OPDL

- For all other sub-options, the sub-option_val is a list of string of sub-option-data

Examples: For a packet with IA_PD like following:

```
Identity Association for Prefix Delegation
  Option: Identity Association for Prefix Delegation (25)
  Length: 41
  Value: 0000000100000708000000b40001a001900000e1000015180...
  IAID: 00000001
  T1: 1800
  T2: 2880
  IA Prefix
    Option: IA Prefix (26)
    Length: 25
    Value: 00000e10000151803820010db80002000000000000000000...
    Preferred lifetime: 3600
    Valid lifetime: 86400
    Prefix length: 56
    Prefix address: 2001:db8:2::
```

The option-data is (hex formatted)

```
"00:00:00:01:00:00:07:08:00:00:0b:40:00:1a:00:19:00:00:0e:10:00:01:51:80:38:20:01:0d:b8:0
0:02:00:00:00:00:00:00:00:00:00:00"
```

Following is an example script:

```
import alc

iapd_list=alc.dhcpv6.get_iapd()
#iapd_list will be
[['\x00\x00\x00\x01','\x00\x00\x07\x08','\x00\x00\x0b\x40',{26:[['\x00\x00\x0e\x10','\x00
\x01\x51\x80','\x38', '\x20\x01\x0d\xb8\x00\x02\x00\x
00\x00\x00\x00\x00\x00\x00\x00\x00',{}]]}]]
iapd_list[0][1]='\x00\x00\x04\xb0' #change T1 to 1200
alc.dhcpv6.set_iapd(iapd_list)#update the iapd
```

- alc.dhcpv6.get_vendoropts()/alc.dhcpv6.get_vendoropts (OPDL)
  - → The general OPDL structure for these two functions is: [[enterpriseid_val, sub-option_dict]]
  - → The structure of sub-option_dict is: {sub-option-type:sub-option_val}
  - → If sub-option is supported-sub-option, then sub-option_val is a sub-option_OPDL
  - → For all other sub-options, the sub-option_val is a list of string of sub-option-data

Examples: For a packet with vendor options like following:

```
Vendor-specific Information
  Option: Vendor-specific Information (17)
  Length: 40
  Value: 0000197f0001000969612d6e615f303031000200969612d...
  Enterprise ID: Panthera Networks, Inc. (6527)
  option
    option code: 1
    option length: 9
    option-data
  option
    option code: 2
    option length: 9
    option-data
  option
    option code: 3
    option length: 1
    option-data
  option
    option code: 4
    option length: 1
    option-data
```

The option-data is (hex formatted)

```
"00:00:19:7f:00:01:00:09:69:61:2d:6e:61:5f:30:30:31:00:02:00:09:69:61:2d:70:64:5f:30:30:3
1:00:03:00:01:38:00:04:00:01:40"
```

The following is an example script:

```
import alc

vendoropts_list=alc.dhcpv6.get_vendoropts()
# vendoropts_list will be [['\x00\x00\x19\x7f',
{1:['\x69\x61\x2d\x6e\x61\x5f\x30\x30\x31'],2:[
'\x69\x61\x2d\x70\x64\x5f\x30\x30\x31'],3:['\x38'], 4:['\x40']}]]
iapd_list[0][1][4][0]='\x60' #change sub-option 4's value to 0x60
alc.dhcpv6.set_vendoropts(vendoropts_list)#update the vendor options
```

- For DHCPv6 relay message, the "Relay Message" option embedded a full DHCPv6 packet and the embedded packet could itself have a "Replay Message" option which embedded another DHCPv6 packet.

  To provide direct access to embedded DHCPv6 packet, the system provides following functions:

  → alc.dhcpv6.get_relaymsg()

  → alc.dhcpv6.set_relaymsg(packet)

- alc.dhcpv6. get_relaymsg(): This function will return a populated alc.dhcpv6 object. which means the returned object was initialized with the DHCPv6 packet embedded in "Relay Message" option as the input.
- alc.dhcpv6. set_relaymsg(packet): This function will accept an alc.dhcpv6 object as a parameter. This object will replace existing "Relay Message" option.

- Example-1 script for single relay message:

```
import alc
#input packet is a relay-reply msg
embed_dhcpv6_packet=alc.dhcpv6.get_relaymsg()
iana_list=embed_dhcpv6_packet.get_iana()
iana_list[0][1]='\x00\x00\x04\xb0' #change T1 to 1200
embed_dhcpv6_packet.set_iana(iana_list)#update the iana of the embedded packet
alc.dhcpv6.set_relaymsg(embed_dhcpv6_packet)#update the Relay Message option
```

- Example-2 script for double relay message (relay of relay):

```
import alc
#input packet is a relay-reply msg
embed_lv1_packet=alc.dhcpv6.get_relaymsg() #get the level=1 embedded packet
embed_lv2_packet= embed_lv1_packet.get_relaymsg()#get level-2 packet embedded in level-1
packet
iana_list=embed_dhcpv6_packet.get_iana()
iana_list[0][1]='\x00\x00\x04\xb0' #change T1 to 1200
embed_dhcpv6_packet.set_iana(iana_list)#update the iana
embed_lv1_packet.set_relaymsg(embed_lv2_packet)#update the Relay Message option of lv1 msg
alc.dhcpv6.set_relaymsg(embed_lv1_packet)#update the Relay Message option of the top level
msg
```

Python Policy – Diameter API

The alc.diameter Python module provides an API for Diameter message manipulation.

Terminology used in the API description:

- **top-level-AVP** — AVP appearing at the top level in a Diameter message, i.e. not embedded in the Data field of a grouped AVP
- **embedded-AVP** — AVP embedded in the Data field of a grouped AVP. An embedded AVP can be a grouped AVP. This is called nesting.
- **AVP-tuple —** Python tuple with following values:
  (AVP code, vendor id, flags)
  AVP code : integer, AVP header field
  vendor id : integer, AVP header field
  flags : string, AVP header field
- **AVP-value-tuple —** Python tuple with following values:
  (flags, data)
  flags: string, AVP header field
  data: string, AVP data field
- **AVP-key-tuple —** Python tuple with following values:
  (AVP code, vendor id)
  AVP code: integer, AVP header field
  vendor id : integer, AVP header field
- **grouped-AVP-value-tuple —** Python tuple with following values:
  (flags, grouped-AVP-dictionary)
  flags: string, AVP header field
- **grouped-AVP-dictionary** - Python dictionary with following key:value pairs:

  {AVP-key-tuple : [AVP-value-tuple or grouped-AVP-value-tuple, …], ... }
  key = AVP-key-tuple
  value = list of AVP-value-tuples or list of grouped-AVP-value-tuples
- **grouped-AVP-decode-tuple —** Python tuple with following values:

  (AVP-key-tuple, …)
  tuple of AVP-key-tuples
- **AVP-order-tuple —** Python tuple with following values:

  (AVP-key-tuple, …)
  tuple of AVP-key-tuples

Table 31 displays attributes available in **alc.diameter** module providing access to the Diameter message header:

Table 31: Diameter Message Header alc.diameter Attributes

Attribute	Description	Type	Access
application_id	Diameter message header field	string	Read/Write
code	Diameter message header field	string	Read/Write
end_to_end_id	Diameter message header field	string	Read/Write
flags	Diameter message header field	string	Read/Write
hop_by_hop_id	Diameter message header field	string	Read/Write
msg_length	Diameter message header field. The value is the message length of the original diameter message.	string	Read
version	Diameter message header field	string	Read/Write

Table 32 displays methods available in **alc.diameter** module providing message and AVP manipulation functionality:

Table 32: Message and AVP Manipulation Functionality alc.diameter Methods

Method	Description
clear_avps(AVP code, vendor id) AVP code, vendor id = top-level-AVP	Remove all instances of the specified AVP from the message. Applies to top-level-AVP's only. If the specified AVP is not present, no python error is generated. Vendor id value zero matches top-level-AVP's without Vendor Id field. Return value: None For example: diameter.clear_avps(256, 12645)
drop()	Drop the Diameter message. Packet is consumed at TCP level (ack send). A drop will trigger retransmits on Diameter level. Return value: None For example: diameter.drop()

Table 32: Message and AVP Manipulation Functionality alc.diameter Methods (Continued)

Method	Description
get_avps(AVP code, vendor id) AVP code, vendor id = top-level-AVP	Returns a list of AVP-value-tuples. Each AVP-value-tuple represents an instance of the specified AVP in the message. Applies to top-level-AVP's only. The position in the list corresponds with the position of the AVP instance in the message at that stage in the script. When executed before any clear or set AVP method, the list order corresponds with the AVP order in the received message. If the specified AVP is a grouped AVP, then the data will contain all the embedded-AVP's. An empty list is returned if the specified AVP is not present. Vendor id value zero matches top-level-AVP's without Vendor Id field. For example: diameter.get_avps(263, 0) [('@', 'bng.alcatel-lucent.com;1398156449;28')]
get_avps_list()	Returns a list of AVP-tuples. Each AVP-tuple represents an instance of an AVP in the message. Applies to top-level-AVP's only. The position in the list corresponds with the position of the AVP in the message at that stage in the script. When executed before any clear or set AVP method, the list order corresponds with the AVP order in the received message. When multiple instances of an AVP are present in the message, then there will be multiple instances in the list. The Vendor Id has value zero when not present. Grouped AVPs cannot be distinguished from other AVPs in the list. For example: diameter.get_avps_list() [(263, 0, '@'), (264, 0, '@'), (296, 0, '@'), (258, 0, '@'), (416, 0, '@'), (415, 0, '@'), (268, 0, '@'), (55, 0, '@'), (456, 0, '@'), (456, 0, '@'), (456, 0, '@'), (293, 0, '@'), (256, 12645, '\x80')]

Table 32: Message and AVP Manipulation Functionality alc.diameter Methods (Continued)

Method	Description
get_grouped_avps(AVP code, vendor id, grouped-AVP-decode-tuple) AVP code, vendor id = top-level-AVP	Returns a list of grouped-AVP-value-tuples with each grouped-AVP-dictionary entry representing an embedded AVP. Each grouped-AVP-value-tuple represents an instance of the specified AVP in the message. Applies to top-level-AVP's of type grouped only. The position in the list corresponds with the position of the grouped AVP instance in the message at that stage in the script. When executed before any clear or set AVP method, the list order corresponds with the AVP order in the received message. If the grouped-AVP-decode-tuple is empty, only the specified top-level-AVP is expanded in a grouped-AVP-value-tuple, with each grouped-AVP-dictionary entry representing an embedded AVP and all dictionary values of type "list of AVP-value-tuples" To expand nested AVPs (grouped AVPs embedded in a grouped AVP), the grouped top-level-AVP and grouped embedded-AVP to expand must be added to the grouped-AVP-decode-tuple. All grouped AVP's in the grouped-AVP-decode-tuple will be expanded in a list of grouped-AVP-value-tuples provided that their embedding AVP is also in the list. The position of the embedded AVPs in the grouped-AVP-dictionary does not correspond with the position in the grouped AVP. If the specified top-level-AVP is not a grouped AVP, then a Python error is generated: 'ValueError: malformed diameter message". For example: To expand the Multiple Services Credit Control (456) grouped top level AVP: diameter.get_grouped_avps(456,0,()) [('@', {(432, 0): [('@', '\x00\x00\x00\x01')], (431, 0): [('@', '\x00\x00\x01\xa4@\x00\x00\x0c\x00\x00\x00d')], (448, 0): [('@', '\x00\x00\x04\xb0')], (268, 0): [('@', '\x00\x00\x07\xd1')]}), ('@', {(432, 0): [('@', '\x00\x00\x00\x02')], (431, 0): [('@', '\x00\x00\x01\xa4@\x00\x00\x0c\x00\x00\x03\x84')], (448, 0): [('@', '\x00\x00\x04\xb0')], (268, 0): [('@', '\x00\x00\x07\xd1')]}), ('@', {(432, 0): [('@', '\x00\x00\x00\x03')], (431, 0): [('@', '\x00\x00\x01\xa4@\x00\x00\x0c\x00\x00\x00<')], (448, 0): [('@', '\x00\x00\x04\xb0')], (268, 0): [('@', '\x00\x00\x07\xd1')]})]

Table 32: Message and AVP Manipulation Functionality alc.diameter Methods (Continued)

Method	Description
	To expand the nested Granted-Service-Unit AVP (code 431) in the grouped Multiple Services Credit Control top level AVP (code 456): diameter.get_grouped_avps(456,0,((456,0),(431,0))) [('@', {(432, 0): [('@', '\x00\x00\x00\x01')], (431, 0): [('@', {(420, 0): [('@', '\x00\x00\x00d')]})], (448, 0): [('@', '\x00\x00\x04\xb0')], (268, 0): [('@', '\x00\x00\x07\xd1')]}), ('@', {(432, 0): [('@', '\x00\x00\x00\x02')], (431, 0): [('@', {(420, 0): [('@', '\x00\x00\x03\x84')]})], (448, 0): [('@', '\x00\x00\x04\xb0')], (268, 0): [('@', '\x00\x00\x07\xd1')]}), ('@', {(432, 0): [('@', '\x00\x00\x00\x03')], (431, 0): [('@', {(420, 0): [('@', '\x00\x00\x00<')]})], (448, 0): [('@', '\x00\x00\x04\xb0')], (268, 0): [('@', '\x00\x00\x07\xd1')]})]
set_avps(AVP code, vendor id, list of AVP-value-tuples) AVP code, vendor id = top-level-AVP	Remove all instances of the specified top-level-AVP from the message. For each entry in the AVP-value-tuple list, a top-level-AVP instance is inserted. If the specified vendor id value is zero, then no vendor id field is inserted and setting the Vendor-Specific bit in the flags field of the AVP value tuple will then result in a Python error: "ValueError: no vendor ID but vendor flag set". If the specified vendor id value is non-zero, then a vendor id field is inserted and not setting the Vendor-Specific bit in the flags field of the AVP value tuple will result in a Python error: "ValueError: vendor ID but vendor flag not set". Padding between AVPs, AVP length and Diameter message length are adapted accordingly by the system. Return value is None. For example: diameter.set_avps(461,0,[('\x40', 'Pytho.n-1'), ('\x40', 'Python-2')])
set_fixed_position_avps(AVP-order-tuple)	Put the specified top-level-AVPs at the beginning of the message in the order as specified in the AVP-order-tuple. This method overrides the order of the top-level-AVPs in the resulting Diameter message. If for example the session-id AVP must appear as first in the message, then the corresponding AVP-key-tuple must be included in the first position of the AVP-order-tuple. AVPs not present in the message but specified in the AVP-order-tuple are ignored.

Table 32: Message and AVP Manipulation Functionality alc.diameter Methods (Continued)

Method	Description
	AVPs present in the message and not specified in the AVP-order-tuple will be included in the final message after the AVPs listed in the AVP-order-tuple. The order is deterministic but implementation specific. This method can appear at any point in the script. The last call will override the previous one. From a black box viewpoint, this method is executed at the end of the script: the result of the call is not reflected in the list returned by a subsequent get_avp_list() call. Return value: None For example: diameter.set_fixed_position_avps(((263,0), (264,0), (296,0), (268,0)
set_grouped_avps(AVP code, vendor id, list of grouped-AVP-value-tuples) AVP code, vendor id = top-level-AVP	Remove all instances of the specified grouped top-level-AVP from the message. For each entry in the grouped-AVP-value-tuples list, a grouped top-level-AVP instance is inserted. The order of the embedded-AVPs in the grouped AVP cannot be specified.If the specified vendor id value is zero, then no vendor id field is inserted and setting the Vendor-Specific bit in the flags field of the AVP value tuple will then result in a Python error: “ValueError: no vendor ID but vendor flag set”. If the specified vendor id value is non-zero, then a vendor id field is inserted and not setting the Vendor-Specific bit in the flags field of the AVP value tuple will result in a Python error: “ValueError: vendor ID but vendor flag not set”. Padding between AVPs, AVP length and Diameter message length are adapted accordingly. Return value is None. For example: diameter.set_grouped_avps(456,0,[('@', {(432, 0): [('@', '\x00\x00\x00\x01')], (431, 0): [('@', {(420, 0): [('@', '\x00\x00\x00\x2b')]})], (448, 0): [('@', '\x00\x00\x04\xb0')], (268, 0): [('@', '\x00\x00\x07\xd1')]}), ('@', {(432, 0): [('@', '\x00\x00\x00\x03')], (431, 0): [('@', {(420, 0): [('@', '\x00\x00\x00\x53')]})], (448, 0): [('@', '\x00\x00\x04\xb0')], (268, 0): [('@', '\x00\x00\x07\xd1')]})])

To enable Diameter message manipulation using Python, a python-policy must be configured in the diameter-peer-policy. For example:

```
configure
    aaa
        diameter-peer-policy "diameter-peer-policy-1" create
            description "Diameter peer policy"
            applications gy
            origin-host "bng.alcatel-lucent.com"
            origin-realm "alcatel-lucent.com"
            python-policy "py-policy-diam-1"
            source-address 192.0.2.5
            peer "peer-1" create
                address 172.16.1.1
                destination-host "server.alcatel-lucent.com"
                destination-realm "alcatel-lucent.com"
                no shutdown
            exit
        exit
    exit
```

The python-policy specifies the python-script to use for each Diameter message type received or transmitted on a Diameter peer. In the ingress direction, the Python script is executed when the corresponding packet type is received on the Diameter peer but prior to further processing in the system. In the egress direction, the Python script is executed prior to sending the corresponding packet type on the Diameter peer. For example:

```
configure
    python
        python-policy "py-policy-diam-1" create
            description "Python policy"
            diameter ccr direction egress script "diameter-1"
            diameter cca direction ingress script "diameter-2"
        exit
    exit
```

The python-script specifies the location of the script and optional protection mechanism. For example:

```
configure
    python
        python-script "diameter-1" create
            primary-url "ftp://usr:pwd@192.0.2.1/./py/diam-1.py"
            no shutdown
        exit
    exit
```

As an example, the diam-1.py script, clears the M-bit from the Event-Timestamp AVP (code 55):

```
from alc import diameter
avp55=diameter.get_avps(55,0)
diameter.set_avps(55,0,[('\x00',avp55[0][1])])
```

Python Policy – DHCP Transaction Cache API

A DHCP transaction cache (DTC) is a short-lived cache during DHCPv4/v6 transaction. The cache could be used to store user-chosen information or return ESM attributes via a Python script. The DTC's lifetime is only during a single DHCP transaction (for example, only between discovery-offer, request-reply). This includes both alc.dtc.store() data and alc.dtc.setESM() data. DTC is also a transaction specific cache, which means the cached information could only be accessed by the Python script running in same DHCP transaction.

The following are the DTC APIs:

- alc.dtc.derivedId: A string used as a LUDB lookup key
- alc.dtc.store(cache-key, cache-value): Store the value with the specified cache-key in DTC, both key and value are string.
- alc.dtc.retrieve(cache-key): Returns the cached value string according to the specified cache-key, raise exception if specified key does not exist.
- alc.dtc.setESM(ESM-key, value): Sets the specified ESM attribute, which could be used when system creating the ESM host. Note that due to the short-live nature of DTC, setESM should be used in final DHCP transaction before system create ESM host., such as DHCPv4 REQUEST-ACK.

- The following is a list of supported ESM-key and its corresponding python type:
  - → alc.dtc.accountingPolicy:str
  - → alc.dtc.ancpString:str
  - → alc.dtc.appProfileString:str
  - → alc.dtc.catMapString:str
  - → alc.dtc.defGw:str
  - → alc.dtc.dhcpv4GIAddr:str
  - → alc.dtc.dhcpv4Pool:str
  - → alc.dtc.dhcpv4ServerAddr:str
  - → alc.dtc.dhcpv6LinkAddr:str
  - → alc.dtc.dhcpv6ServerAddr:str
  - → alc.dtc.intDestId:str
  - → alc.dtc.ipAddress:str
  - → alc.dtc.ipv4LeaseTime:int
  - → alc.dtc.ipv4PrimDns:str
  - → alc.dtc.ipv4SecDns:str
  - → alc.dtc.ipv6Address:str
  - → alc.dtc.ipv6DelegatedPrefix:str
  - → alc.dtc.ipv6DelegatedPrefixLength:int
  - → alc.dtc.ipv6PrefixPool:str
  - → alc.dtc.ipv6PrimDns:str
  - → alc.dtc.ipv6SecDns:str
  - → alc.dtc.ipv6SlaacPrefix:str
  - → alc.dtc.ipv6WanPool:str
  - → alc.dtc.msapGroupInterface:str
  - → alc.dtc.msapPolicy:str
  - → alc.dtc.msapServiceId:str
  - → alc.dtc.primNbns:str
  - → alc.dtc.retailServiceId:str
  - → alc.dtc.secNbns:str
  - → alc.dtc.slaProfileString:str
  - → alc.dtc.subIdent:str
  - → alc.dtc.subProfileString:str
  - → alc.dtc.subnetMask:str

Python Cache Support

Python cache support allows information to be shared across different run times of the same python script or even different python scripts in a programmatic way. It essentially provides a central memory cache and a set of APIs which let the user store and retrieve strings. For example, a DHCP python-script could store a DHCP option into cache and later a RADIUS python-script could retrieve stored string and add it into access-request.

Each cached entry in the cache is a tuple of (**key**, **val**). **key** is used as entry id. **val** is the string to be cached. Both **key** and **val** are strings. The max length of the key is 512 bytes. Future more, the combine length of key+val is limited by the configured value of **entry-size** *size* command in the python-policy.

The Python cache can be enabled per python-policy. Each python policy has its own cache memory which script in other python-policy cannot access. This also implies that the key of a cached entry in different a python policy could overlap.

The user can also specify the max number cache entry per python policy the command **max-entries** command. System has a global limit for python cache memory of 256MB.

The cached entries could be made persistent by saving it to CF card. This can be enabled with the **persistence** command in the python policy.

Note: From memory consumption point of view, with MCS enabled, each cached entry will have a corresponding MCS record, so each entry will consume twice amount of memory.

The system also supports syncing the python cache across chassis with MCS. This can be configured per python policy with the **mcs-peer** command in the python policy.

Each cached entry has a remaining lifetime. If it decreases over time, the system will remove the cached entry if its remaining lifetime is 0. The remaining lifetime can be changed using a system-provided API. The initial lifetime of a newly created cache entry is 600 seconds.

The following are the python cache APIs in a module alc.cache:

- alc.cache.save(val,key): Saves the val identified by the key into the cache. If there is an existing cache entry with same key, then it will be overwritten with the new val. An exception will be raised if the save failed (for example, due to exceeding the max number of entries).
- alc.cache.retrieve(key): Returns the stored entry’s val identified by the key. A KeyError exception will be raised if the specified entry does not exist.
- alc.cache.clear(key): Removes the cached entry identified by the key. Raise KeyError exception if the specified entry does not exist.
- cache.get_lifetime(key): The system will return a integer as seconds of remaining lifetime of the specified entry. It will return none if the specified entry does not exist. An exception will be raised for any other error.

- cache.set_lifetime(key,new_lifetime): The new_lifetime value is an integer. The system will set the remaining lifetime of the specified entry to the number of seconds of the new_lifetime. An exception will be raised for any error including specified entry does not exist. If the new_lifetime>=max_lifetime(configurable using the **max-entry-life** command in the python policy), then the system will set the actual lifetime to the max_lifetime.

Applying a Python Policy

The following is a list of places that a Python policy could be applied:

- Under capture SAP — Apply to the DHCPv4/v6 packets sent/received on the capture SAP.
- Under group-interface — Apply to DHCPv4/v6 packets sent/received on the group-interface.
- Under subscriber-interface — Apply to DHCPv4 packets on the retail subscriber interface.
- In the radius-server-policy — Apply to the RADIUS packets sent/received to/from the RADIUS servers configured in the radius-server-policy.
- In the radius-proxy-server — Apply to the RADIUS packets on the client side of proxy.
- In the diameter-peer-policy — Apply to the Diameter packets send/received on the Diameter peers configured in the policy.

Python Script Protection

In order to protect the Python script from unintended changes, the SR-OS supports a new Python script file format:SRPY. Since 12.0R1, SRPY includes a key based hash(HMAC) of the original script content. When the system loads a script with SRPY format, a hash will be computed by using a configured key and script content. The result hash will be compared to the embedded hash. If it is the same, then this script is considered valid. Otherwise, the system will abort with a warning message.

Users can configure **protection hmac-sha256 key <***key***>** within a Python script. To mandate, all configured scripts must be in SRPY format.

The system provides a tool command (**tool perform python-script protect**) to convert a Python script into SRPY format.

Tips and Tricks

- Use xrange() instead of range().
- Avoid too many string operations. The following scripts provide the same output:

```
# This script takes 2.5 seconds. s = ""
for c in 'A'*50000:
s += str(ord(c)) + ', ' print '[' + s[:-2] + ']'

# This script takes 0.1 seconds. print map(ord, 'A'*50000)
```

Python Commands


```
config
    — python
        — python-policy name [create]
        — no python-policy name
            — [no] cache
                — entry-size size
                — no entry-size
                — max-entries count
                — no max-entries
                — max-entry-lifetime [days days] [hrs hours] [min minutes] [sec seconds]
                — no max-entry-lifetime
                — mcs-peer ip-address sync-tag [32 chars max]
                — no mcs-peer
                — minimum-lifetimes
                    — high-availability seconds
                    — no high-availability
                    — multi-chassis-redundancy seconds
                    — no multi-chassis-redundancy
                    — persistence seconds
                    — no persistence
                — [no] persistence
                — [no] shutdown
            — description description-string
            — no description
            — dhcp type direction {ingress | egress} script script
            — no dhcp type direction {ingress | egress}
            — dhcp6 type direction {ingress | egress} script script
            — no dhcp6 type direction {ingress | egress}
            — diameter diameter type direction {ingress|egress} script [32 chars max]
            — no diameter type direction {ingress|egress}
            — radius type direction {ingress | egress} script script
            — no radius type direction {ingress | egress}
```

```
config
    — python
        — python-script name [create]
        — no python-script name
            — action-on-fail {drop | passthrough}
            — no action-on-fail
            — description description-string
            — no description
            — primary-url url
            — no primary-url
            — protection none
            — protection hmac-sha256 key key [hash|hash2]
            — no protection
            — secondary-url url
```

```
                    — no secondary-url
                    — [no] shutdown
                    — [no] tertiary-url url
                    — no tertiary-url

config
    — aaa
        — radius-server-policy policy-name [create]
        — no radius-server-policy policy-name
            — python-policy name
            — no python-policy
config
    — router router-name
        — radius-proxy
            — server server-name [create] [purpose {[accounting][authentication]} [wlan-gw-
              group wlan-gw-group-id]
            — no server server-name
                — python-policy name
                — no python-policy
config
    — system
        — persistence
            — python
                — description description-string
                — no description
                — location cflash-id
                — no location
config
    — redundancy
        — multi-chassis
            — peer
                — sync
                    — [no] python
```

Services Commands

Refer to the 7x50 SR OS Services Guide for information on command syntax and CLI descriptions.

```
config
    — service
        — vpls service-id
        — no vpls service-id
            — sap sap-id [create] [capture-sap]
            — no sap sap-id
                — dhcp-python-policy policy-name
                — no dhcp-python-policy
                — dhcp6-python-policy policy-name
                — no dhcp6-python-policy
config
    — service
        — ies service-id [create]
        — no ies service-id
        — vprn service-id [create]
        — no vprn service-id
            — subscriber-interface ip-int-name
            — no subscriber-interface ip-int-name
                — dhcp
                    — python-policy name
                    — no python-policy
                — group-interface ip-int-name
                — no group-interface ip-int-name
                    — dhcp
                        — python-policy name
                        — no python-policy
                    — ipv6
                        — dhcp6
                            — python-policy name
                            — no python-policy
config
    — service
        — vprn service-id [create]
        — no vprn service-id
            — radius-proxy
                — server server-name [create] [purpose {[accounting][authentication]}
                  [wlan-gw-group wlan-gw-group-id]
                — no server server-name
                    — python-policy name
                    — no python-policy
```

Tools Commands

tools
- — **dump**
  - — **python-policy** *name* **cache**
  - — **python-policy** *name* **cache hex-key** *hex-string*
  - — **python-policy** *name* **cache** *string-key* [512 chars max]
- — **perform**
  - — **python-policy** *name* **cache hex-key** *hex-string* **set-lifetime** [0..2147483647]
  - — **python-policy** *name* **cache** *string-key* [512 chars max] **set-lifetime** [0..2147483647]
  - — **python-script protect input** *file-url* **hmac-sha256 key** *secret-key* **output** *file-url*
  - — **python-script protect** *name*

Show Commands

show
- — **python**
  - — **python-policy**
  - — **python-policy** *policy-name* [**association**]|
  - — **python-script**
  - — **python-script** *script-name* [**association** | **source-in-use**]

Debug Commands

debug
- — **python**
  - — [**no**] **python-script** *name*
  - — **script-all-info**
  - — [**no**] **script-compile-error**
  - — [**no**] **script-export-variables**
  - — [**no**] **script-output**
  - — [**no**] **script-output-on-error**

Clear Commands

clear
- — **python**
  - — **python-policy** *name* **cache**
  - — **python-policy** *name* **cache hex-key** *hex-string*
  - — **python-policy** *name* **cache string-key** [512 chars max]

Python Configuration Commands

Global Commands

description

Syntax **description** *description-string*
no description

Context config>python>python-policy
config>python>python-script

config>system>persistence>python-policy-cache

Description This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the context in the configuration file.

The **no** form of this command removes any description string from the context.

Default No description is associated with the configuration context.

Parameters *description-string* — A text string describing the entity. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

shutdown

Syntax [**no**] **shutdown**

Context config>python>python-policy>cache
config>python>python-script

Description Shutting down a Python script triggers the system to load and compile the script from the configured location(s). Since the system supports three locations, the primary, secondary and tertiary, the system will try to load the Python script in that order.

Shutting down a Python script will disable the Python script and cause the corresponding packet to pass through without any modification.

Default no shutdown

python

Syntax **python**

Context config

Description This command enables the context to configure Python parameters.

Python Policy Commands

python-policy

Syntax **python-policy** *name* [**create**]
no python-policy *name*

Context config>python

Description This command configures a Python policy which will select Python scripts to modify specific messages of different protocols.

The **no** form of the command removes the Python policy.

Parameters *name* — Specifies the Python policy name up to 32 characters in length.

create — This keyword is required when first creating the Python policy. Once the context is created, it is possible to navigate into the context without the **create** keyword.

cache

Syntax [**no**] **cache**

Context config>python>python-policy

Description This command enables the context to configure the limits of the caching API inside the Python scripts

entry-size

Syntax **entry-size** *size*
no entry-size

Context config>python>python-policy>cache

Description This command configures the maximum size of the data structure that can be stored in a single Python cache entry which includes both a value and key.

When requesting to store a data structure the size of the serialized object is compared with the value specified. If larger, the object will not be stored and Python will return exception.

The **no** form of the command reverts to the default value.

Default 256

Parameters *size* — Configures the maximum accepted size of a single cache entry.

Values 32 — 2048

max-entries

Syntax **max-entries** *count*
no max-entries

Context config>python>py-pol>cache

Description This command configures the maximum number of Python cache entries that can be stored in the cache of this Python policy.

If the limit has been reached, a Python exception will be thrown when requested to store another data structure.

Default 128000

Parameters *count* — Specifies the maximum number of cache entries allowed.

Values 1 — 1000000

max-entry-lifetime

Syntax **max-entry-lifetime** [**days** *days*] [**hrs** *hours*] [**min** *minutes*] [**sec** *seconds*]
no max-entry-lifetime

Context config>python>py-pol>cache

Description This command configures the maximum allowed lifetime for each entry of the Python cache of this Python policy.

When adding data to the Python cache the lifetime of the given object must always be specified. If the specified lifetime is bigger than the configured value, then the value of the **max-entry-lifetime** will be used instead of the lifetime that was specified.

The **no** form of the command reverts to the default.

Parameters **days** *days* **—** Specifies the maximum lifetime that can be set on a cache entry in days.

Values 0 — 7

Default 1

hrs *hours* **—** Specifies the maximum lifetime that can be set on a cache entry in hours.

Values 0 — 23

min *minutes* **—** Specifies the maximum lifetime that can be set on a cache entry in minutes.

Values 0 — 59

sec *seconds* **—** Specifies the maximum lifetime that can be set on a cache entry in seconds.

Values 0 — 59

mcs-peer

Syntax **mcs-peer** *ip-address* **sync-tag** [32 chars max]
no mcs-peer

Context config>python>py-pol>cache

Description This command specifies the MCS peer's address and sync-tag for syncing the cached entries of the python-policy. The sync-tag must be match on both chassis.

Default no mcs-peer

Parameters *ip-address* — Specifies the IPv4 address of the MCS peer.

sync-tag — Specifies the tag for sync up to 32 characters max.

minimum-lifetimes

Syntax **minimum-lifetimes**

Context config>python>py-pol>cache

Description This command enables the context to configure minimum-lifetime of python cache information.

Default none

high-availability

Syntax **high-availability** *seconds*
no high-availability

Context config>python>py-pol>cache>min-lifetimes

Description This command specifies the minimum lifetime of an entry that it could be synced across CPM.

Default no high-availability

Parameters *seconds* — Specifies the minimal lifetime in seconds.

Values 1 — 600

multi-chassis-redundancy

Syntax **multi-chassis-redundancy** *seconds*
no multi-chassis-redundancy

Context config>python>py-pol>cache>min-lifetimes

Description This command specifies the minimum lifetime for a cache entry to be synchronized with the MCS peer.

Default no multi-chassis-redundancy

Parameters *seconds* — Specifies the multi-chassis redundancy time in seconds.

Values 1 — 600

persistence

Syntax **persistence** *seconds*
no persistence

Context config>python>py-pol>cache>min-lifetimes

Description This command configures the minimum lifetime for a cache entry to be made persistent.

Default no persistence

Parameters *persistence* — The minimum lifetime in seconds.

Values 1 — 600

persistence

Syntax [**no**] **persistence**

Context config>python>py-pol>cache

Description This command enables persistency support for the cached entries of the python-policy.

Default no persistence

dhcp

Syntax **dhcp** *type* **direction** {**ingress** | **egress**} **script** *script*
no dhcp *type* **direction** {**ingress** | **egress**}

Context config>python>py-policy

Description This command specifies the Python script for the specified DHCPv4 packet type in the specified direction.

Multiple **dhcp** command configurations are allowed in the same Python policy.

The **no** form of the command reverts to the default.

Default none

Parameters *type* — Specifies the message type of the event.

Values discover, offer, request, decline, ack, nak, release, inform, force-renew, lease-query, lease-unassigned, lease-unknown, lease-active

direction {**ingress** | **egress**} **—** specifies whether the packetis being received by the system or or being sent by the system.

script *script* **—** Specifies the name of the Python script up to 32 characters in length, that will be used to handle the specified message.

dhcp6

Syntax **dhcp6** *type* **direction** {**ingress** | **egress**} **script** *script*
no dhcp6 *type* **direction** {**ingress** | **egress**}

Context config>python>py-policy

Description This command specifies the Python script for the specified DHCPv6 packet type in the specified direction.

Multiple **dhcps** command configurations are allowed in the same Python policy.

Default none

Parameters *type* — Specifies the message type of the event.

Values solicit, advertise, request, confirm, renew, rebind, reply, release, decline, reconfigure, info-request, relay-forward, relay-reply

direction {**ingress** | **egress**} — specifies whether the event is incoming or outgoing.

script *script* — Specifies the name of the Python script up to 32 characters in length, that will be used to handle the specified message.

diameter

Syntax **diameter** *type* **direction** {**ingress**|**egress**} **script** *script*
no diameter *type* **direction** {**ingress**|**egress**}

Context config>python>py-policy

Description This command specifies the Python script to use for the specified Diameter message type in the specified direction.

Multiple diameter command configurations are allowed in the same Python policy.

Default none

Parameters *type* — Specifies the message type.

Message type	Application	Direction
aaa – AA Answer	Nasreq	ingress
aar – AA Request	Nasreq	egress
asa – Abort Session Answer	Gx, Gy	egress
asr – Abort Session Request	Gx, Gy	ingress
cca – Credit Control Answer	Gx, Gy	ingress
ccr – Credit Control Request	Gx, Gy	egress
cea – Capabilities Exchange Answer	Base	ingress
cer – Capabilities Exchange Request	Base	egress
dpa – Disconnect Peer Answer	Base	ingress / egress
dpr – Disconnect Peer Request	Base	ingress / egress

dwa – Device Watchdog Answer	Base	ingress / egress
dwr – Device Watchdog Request	Base	ingress / egress
raa – Re-Authentication Answer	Gx, Gy	egress
rar – Re-Authentication Request	Gx, Gy	ingress

direction {**ingress**|**egress**} **—** Specifies if the message is incoming or outgoing.

script *script* **—** Specifies the name of the Python script up to 32 characters in length, that will be used to handle the specified message.

radius

Syntax **radius** *type* **direction** {**ingress** | **egress**} **script** *script*
no radius *type* **direction** {**ingress** | **egress**}

Context config>python>py-policy

Description This command specifies the Python script for the specified RADIUS packet type in the specified direction.

Multiple **radius** command configurations are allowed in the same Python policy.

Parameters *type* — Specifies the message type of the event.

access-request, access-accept, access-reject, accounting-request, accounting-response, access-challenge, disconnect-request, change-of-authorization-request

direction {**ingress** | **egress**} **—** specifies whether the event is incoming or outgoing.

script *script* **—** Specifies the name of the Python script up to 32 characters in length, that will be used to handle the specified message.

python-script

Syntax **python-script** *name* [**create**]
no python-script *name*

Context config>python

Description This command enables the context to configure Python scripts to modify messages of different protocols.

The **no** form of the command removes the Python script name from the configuration.

Parameters **name —** Specifies the name of this Python script policy.

create — This keyword is required when first creating the Python script. Once the context is created, it is possible to navigate into the context without the **create** keyword.

action-on-fail

Syntax **action-on-fail** {**drop** | **passthrough**}

no action-on-fail

Context config>python>python-script

Description This command specifies the action taken when Python fails to modify the given message.

The **no** form of the command reverts to the default.

Default drop

Parameters **drop —** Specifies that the packet will be dropped.

passthrough — Specifies that he packet will be sent out without any modifications.

primary-url

Syntax **primary-url** *url*
no primary-url

Context config>python>python-script

Description This command specifies the location of the primary Python script. The system supports three locations for each Python script. Users can store the script file on either a local CF card or an FTP server.

The **no** form of the command removes the URL.

Default no primary-url

Parameters **url —** Specifes the primary URL of the Python script up to 180 characters in length, either a local CF card url or a FTP server URL.

protection

Syntax **protection none**
protection hmac-sha256 key *key* [**hash**|**hash2**]
no protection

Context config>python>python-script

Description This command specifies the format of the Python script file(s) in this python-script. Unintentional changing of Python script file could be prevented by using protected format.

The **no** form of this command equals to **protection none**.

Default none

Parameters **none —** Indicates the Python script is stored in plain-text, without any mechanism in place to ensure the integrity nor the confidentiality of the content of the Python script.

hmac-sha256 — Indicates the first line of the Python script must consist of the hash value obtained by hashing the rest of the Python script using the hmac-sha256 hashing algorithm given the key specified in tmnxPythonScriptProtectionKey.

key *key* — The specified key along with original Python script file content are used to compute the hash. The computed hash will be compared to the hash in the Python script file. If there is no match, then system will fail to load the script.

hash — Specifies the key is entered in an encrypted form. If the hash parameter is not used, the key is assumed to be in a non-encrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the hash parameter specified.

hash2 — Specifies the key is entered in a more complex encrypted form. If the hash2 parameter is not used, the less encrypted hash form is assumed.

secondary-url

Syntax **secondary-url** *url*
no secondary-url

Context config>python>python-script

Description This command specifies the location of secondary Python script. The system supports three locations for each Python-script. Users can store scripts file on either a local CF card or a FTP server.

The **no** form of the command removes the URL.

Default no secondary-url

Parameters **url** — Specifes the secondary URL of the Python script up to 180 characters in length, either a local CF card url or a FTP server URL.

tertiary-url

Syntax **tertiary-url** *url*
no tertiary-url

Context config>python>python-script

Description This command specifies the location of tertiary Python script. The system supports three locations for each Python-script. Users can store scripts file on either a local CF card or a FTP server.

The **no** form of the command removes the URL.

Default no tertiary-url

Parameters **url** — Specifes the tertiary URL of the Python script up to 180 characters in length, either a local CF card url or a FTP server URL.

dhcp-python-policy

Syntax **dhcp-python-policy** *policy-name*
no dhcp-python-policy

Context config>service>vpls>sap

Description This command specified the Python policy for DHCPv4 packets sent/received on the capture SAP.

Default none

Parameters *policy name* — Specifies an existing Python policy name.

dhcp6-python-policy

Syntax **dhcp6-python-policy** *policy-name*
no dhcp6-python-policy

Description This command specified the Python policy for DHCPv6 packets sent/received on the capture SAP.

Default none

Parameters *policy name* — Specifies an existing Python policy name.

python-policy

Syntax **python-policy** *name*
no python-policy

Context config>service>vprn>sub-if>grp-if>ipv4>dhcp4
config>service>ies>sub-if>grp-if>ipv4>dhcp4

Description This command specified the python-policy for DHCPv4 packets sent/received on the group interface.

The **no** form of the command removes the policy name from the configuration.

Default none

Parameters *name* — Specifies an existing Python policy name.

python-policy

Syntax **python-policy** *name*
no python-policy

Context config>service>vprn>sub-if>grp-if>ipv6>dhcp6
config>service>ies>sub-if>grp-if>ipv6>dhcp6

Description This command specified the python-policy for DHCPv6 packets sent/received on the group interface.

The **no** form of the command removes the policy name from the configuration.

Default none

Parameters *name* — Specifies an existing Python policy name.

python-policy

Syntax **python-policy** *name*
no python-policy

Context config>service>vprn>sub-if>dhcp
config>service>ies>sub-if>dhcp

Description This command specified the Python policy for DHCPv4 packets sent/received on the retail subscriber interface.

Default none

Parameters *name* — Specifies the name of the Python policy.

python-policy

Syntax **python-policy** *name*
no python-policy

Context config>aaa>radius-srv-plcy

Description This command specified the python-policy for RADIUS packets to/from the RADIUS servers defined in the specified radius-server-policy.

Default none

Parameters *name* — Specifies the name of the Python policy.

python-policy

Syntax **python-policy** *name*
no python-policy

Context config>service>vprn>radius-proxy>server
config>router>radius-proxy>server

Description This command specified the python-policy for RADIUS packets sent/received on the client side of the RADIUS proxy server.

Default none

Parameters *name* — Specifies the name of the Python policy.

persistence

Syntax [**no**] **persistence**

Context config>system

Description This command enables the context to configure persistence parameters on the system.

The persistence feature enables state on information learned through DHCP snooping across reboots to be retained. This information includes data such as the IP address and MAC binding information, lease-length information, and ingress sap information (required for VPLS snooping to identify the ingress interface).

If persistence is enabled when there are no DHCP relay or snooping commands enabled, it will simply create an empty file.

Default no persistence

python-policy-cache

Syntax **python-policy-cache**

Context config>system>persistence

Description This command configures Python policy cache persistency parameters.

python

Syntax **python**

Context config>redundancy>multi-chassis>peer>sync

Description This command enables syncing of python-policy cached entries to the peer.

Use the **mcs-peer** command in the python-policy to enable syncing for a specific python-policy.

Default no python

location

Syntax **location** *cflash-id*
no location

Context config>system>persistence>persistence

Description This command instructs the system where to write the file. The name of the file is: dhcp-persistence.db. On boot the system scans the file systems looking for dhcp-persistence.db, if it finds it starts to load it.

In the subscriber management context, the location specifies the flash device on a CPMCFM card where the data for handling subscriber management persistency is stored.

The **no** form of this command returns the system to the default. If there is a change in file location while persistence is running, a new file will be written on the new flash, and then the old file will be removed.

Default no location

Tools Commands

python-policy

Syntax **python-policy** *name* **cache**
python-policy *name* **cache hex-key** *hex-string*
python-policy *name* **cache** *string-key* [512 chars max]

Context tools>dump

Description This command dumps all cached entries or a specified entry of a specified Python policy.

The DDP key in the output is the python cache persistency record key.

Note that the DDP Key in the output could be used for the tools>**dump>persistence>python** command.

Parameters *name* — Specifies the name of the Python policy.

string-key — Specifies the key of the entry to be updated in ASCII strong format.

hex-key — Specifies the key of the entry to be updated in hex string format.

python-policy

Syntax **python-policy** *name* **cache hex-key** *hex-string* **set-lifetime** [0..2147483647]
python-policy *name* **cache** *string-key* [512 chars max] **set-lifetime** [0..2147483647]

Context tools>perform

Description This command set the lifetime of a specified python cache entry.

Parameters *name* — Specifies the name of the Python policy.

string-key — Specifies the key of the entry to be updated in ASCII strong format.

hex-key *hex-string* **—** Specifies the key of the entry to be updated in hex string format.

set-lifetime — Specifies the new lifetime of the entry.

python-script protect

Syntax **python-script protect input** *file-url* **hmac-sha256 key** *secret-key* **output** *file-url*

Context tools>perform

Description This command converts a normal (unprotected) Python script file into an SRPY format with specified key.

Parameters **input** *file-url* **—** Specifies the URL of the input script file.

key *secret-key* **—** Specifies the key used to compute the hash

output *file-url* **—** Specifies the URL of the output script file

python-script reload

Syntax **python-script reload** *name*

Context tools>perform

Description This command will try to reload/recompile the primary/secondary/tertiary scripts in the specified Python script in order. The system will use the first script that comes up.

Parameters *name* — Specifies the name of the python-script to be reloaded.

Show Commands

python

Syntax **python**

Context show

Description This command enables the context to display Python information.

python-policy

Syntax **python-policy**
python-policy *policy-name* [**association**]|

Context show>python

Description This command displays information about the currently configured Python policy.

The system will display a list of currently configured Python policy names if no parameter is specified.

Parameters *policy-name* — Specifies the Python policy name to display.

association — Displays the associations of the specified Python policy.

Sample Output

```
show python python-policy "dhcp"
===============================================================================
Python policy "dhcp"
===============================================================================
Description   : (Not Specified)
-------------------------------------------------------------------------------
Messages
-------------------------------------------------------------------------------
Type                                Dir     Script
-------------------------------------------------------------------------------
dhcpDiscover                        egress  dhcpv4
dhcpRequest                         egress  dhcpv4
dhcpAck                             ingress dtc
-------------------------------------------------------------------------------
No. of Messages: 3
-------------------------------------------------------------------------------
===============================================================================


show python python-policy "dhcp" association
===============================================================================
Python Policy Association
===============================================================================
Location
-------------------------------------------------------------------------------
Service: 500, GrpIf g1, dhcp
```

```
-------------------------------------------------------------------------------
No. of Python policy association: 1
===============================================================================
```

python-script

Syntax **python-script**
python-script *script-name* [**association** | **source-in-use**

Context show>python

Description This command displays information about the currently configured Python script.

The system will display a list of currently configured Python script names if no parameter is specified.

Parameters *script-name* — Specifies the Python script name to display information.

association — Displays the associations of the specified Python script.

source-in-use — Displays the Python source code in use.

Sample Output

```
show python python-script "dhcpv4"
===============================================================================
Python script "dhcpv4"
===============================================================================
Description   : (Not Specified)
Admin state   : inService
Oper state    : inService
Action on fail: drop
Protection    : none
Primary URL   : cf1:/dhcpv4.py
Secondary URL : (Not Specified)
Tertiary URL  : (Not Specified)
Active URL    : primary
Last changed  : 01/26/2014 05:02:10
===============================================================================


show python python-script "dhcpv4" association
===============================================================================
Python Script Association
===============================================================================
Policy                          Type                                    Dir
-------------------------------------------------------------------------------
dhcp                            dhcpDiscover                            egress
dhcp                            dhcpRequest                             egress
-------------------------------------------------------------------------------
No. of Python script association: 2
===============================================================================
```

Debug Commands

python-script

Syntax **python-script** *script-name*

Context debug>python

Description This command enters the debug context the specified Python script

Parameters *policy-name* — Specifies the Python script name.

script-all-info

Syntax **script-all-info**

Context debug>python>py-script

Description This command enables the script-compile-error, script-export-variables, script-output, script-outputon-error, and script-runtime-error functionalities.

script-compile-error

Syntax [**no**] **script-compile-error**

Context debug>python>py-script

Description This command sends the traceback of the compile error to the logger. The traceback contains detailed information about where and why the compilation fails. The compilation takes place when the CLI user changes the admin state of the Python script from shutdown to no-shutdown.

script-export-variables

Syntax [**no**] **script-export-variables**

Context debug>python>py-script

Description This command sends the output variables of the Python script to the logger when the script ran successfully.

script-output

Syntax [**no**] **script-output**

Context debug>python>py-script

Description This command sends the output (such as from 'print' statements) of the Python script to the logger.

script-output-on-error

Syntax [**no**] **script-output-on-error**

Context debug>python>py-script

Description This command sends the output (such as traceback data) of the Python script to the logger, but only when the script fails.

script-output

Syntax [**no**] **script-output**

Context debug>python>py-script

Description This command sends the traceback of the Python script failure to the logger.

Clear Commands

python-policy

Syntax **python-policy** *name* **cache**
python-policy *name* **cache hex-key** *hex-string*
python-policy *name* **cache** *string-key* [512 chars max]

Context clear>python

Description This command clears Python policy data.

Parameters *name* — Specifies the name of the Python policy.

string-key — Specifies the key of the entry to be updated in ASCII strong format.

hex-key — Specifies the key of the entry to be updated in hex string format.

Python RADIUS Commands

```
configure
    — aaa
        — radius-script-policy policy-name [create]
        — no radius-script-policy policy-name
            — action-on-fail {drop|passthrough}
            — no action-on-fail
            — description description
            — no description
            — primary
                — script-url primary-script-url
                — no script-url
                — [no] shutdown
            — secondary
                — script-url secondary-script-url
                — no script-url
                — [no] shutdown
```

```
configure
    — aaa
        — l2tp-accounting-policy policy-name [create]
        — no l2tp-accounting-policy policy-name
            — request-script-policy policy-name
            — no request-script-policy
        — radius-server-policy policy-name [create]
        — no radius-server-policy policy-name
            — accept-script-policy policy-name
            — no accept-script-policy
            — request-script-policy policy-name
            — no request-script-policy
            —
```

```
configure
    — subscriber-mgmt
        — authentication-policy name [create]
        — no authentication-policy name
            — accept-script-policy policy-name
            — no accept-script-policy
            — coa-script-policy policy-name
            — no coa-script-policy
            — request-script-policy policy-name
            — no request-script-policy
        — radius-accounting-policy name [create]
        — no radius-accounting-policy name
            — acct-request-script-policy policy-name
            — no acct-request-script-policy
```

Python RADIUS CLI Command Descriptions

Generic Commands

description

Syntax **description** *description-string*
no description

Context confif>aaa>radius-script-policy

This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the context in the configuration file.

The **no** form of this command removes any description string from the context.

Default No description is associated with the configuration context.

Parameters *description-string* — A text string describing the entity. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters excluding double quotes. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

shutdown

Syntax [**no**] **shutdown**

Context config>aaa>radius-scr-plcy>primary
config>aaa>radius-scr-plcy>secondary

Description The **shutdown** command administratively disables the entity. When disabled, an entity does not change, reset, or remove any configuration settings or statistics. Many entities must be explicitly enabled using the **no shutdown** command.

The **shutdown** command administratively disables an entity. The operational state of the entity is disabled as well as the operational state of any entities contained within. Many objects must be shut down before they can be deleted.

Unlike other commands and parameters where the default state is not indicated in the configuration file, **shutdown** and **no shutdown** are always indicated in system generated configuration files.

The **no** form of the command puts an entity into the administratively enabled state.

Default no shutdown

Script Commands

radius-script-policy

Syntax **radius-script-policy** *policy-name* [**create**]
no radius-script-policy *policy-name*

Context config>aaa

Description This command configures a RADIUS script policy.

The no form of the command removes the scrip policy from the configuration.

Default none

Parameters *policy-name* — Configures Python scripts to modify RADIUS messages.

create — This keyword is required when first creating the configuration context. Once the context is created, it is possible to navigate into the context without the **create** keyword.

action-on-fail

Syntax **action-on-fail** {**drop**|**passthrough**}
no action-on-fail

Context config>aaa>radius-scr-plcy

Description specifies the action taken when Python fails to modify the RADIUS message.

The **no** form of the command reverts to the default.

Default drop

Parameters **drop —** Specifies that the packet will be dropped.

passthrough — Specifies that the packet will be sent out without any modifications.

primary

Syntax **primary**

Context config>aaa>radius-scr-plcy

Description This command enables the context to configure a primary script.

Default none

script-url

Syntax **script-url** *primary-script-url*
no script-url

Context config>aaa>radius-scr-plcy>primary

Description This command configures the URL of the primary script.
The no form of the command removes the URL from the configuration.

Default no script-url

Parameters *primary-script-url* — Specifies the URL of the secondary script to change RADIUS attributes of the RADIUS message.

secondary

Syntax **secondary**

Context config>aaa>radius-scr-plcy

Description This command enables the context to configure a secondary script.

Default none

script-url

Syntax **script-url** *secondary-script-url*
no script-url

Context config>aaa>radius-scr-plcy>secondary

Description Specifies the URL of the secondary script to change RADIUS attributes of the RADIUS message.
The no form of the command removes the URL from the configuration.

Default no script-url

Parameters *secondary-script-url* — Specifies the URL of the secondary script to change RADIUS attributes of the RADIUS message.

l2tp-accounting-policy

Syntax **l2tp-accounting-policy** *policy-name* [**create**]
no l2tp-accounting-policy *policy-name*

Context config>aaa

Description This command configures an L2TP accounting policy.
The **no** form of the command removes the policy-name from the configuration.

Default none

Parameters *policy-name* — Specifies a policy name

create — This keyword is required when first creating the configuration context. Once the context is created, it is possible to navigate into the context without the **create** keyword.

request-script-policy

Syntax **request-script-policy** *script-policy*
no request-script-policy

Context config>aaa>l2tp-accounting-policy
config>aaa>radius-srv-plcy

Description This command configures a Python script policy to modify Access-Request.

The **no** form of the command removes the policy-name from the configuration.

Default none

Parameters *script-policy* — Specifies a the RADIUS script policy used to change the RADIUS attributes of the outgoing Access-Request messages.

radius-server-policy

Syntax **radius-server-policy** *policy-name* [**create**]
no radius-server-policy *policy-name*

Context config>aaa

Description This command configures the RADIUS script policy used to change the RADIUS attributes of the outgoing Access-Accept messages.

The **no** form of the command removes the policy-name from the configuration.

Default none

Parameters *policy-name* — Specifies a the RADIUS script policy used to change the RADIUS attributes of the outgoing Access-Request messages.

create — This keyword is required when first creating the configuration context. Once the context is created, it is possible to navigate into the context without the **create** keyword.

authentication-policy

Syntax **authentication-policy** *name* [**create**]
no authentication-policy

Context config>subscr-mgmt

Description This command creates the context to configure RADIUS server parameters for session authentication.

The **no** form of the command removes the RADIUS server configuration for session authentication.

RADIUS servers can be configured for three different applications:

1. For authentication of dynamic Triple Play subscriber sessions, under `config>subscr-mgmt>authentication-plcy`
2. For 802.1x port authentication, under `config>system>security>dot1x>radius-plcy`
3. For CLI login users, under `config>system>radius`

Default none

Parameters *name* — The name of the profile. The string is case sensitive and limited to 32 ASCII 7-bit printable characters with no spaces.

accept-script-policy

Syntax **accept-script-policy** *policy-name*
no accept-script-policy

Context config>aaa>radius-srv-plcy

Description This command configures the the RADIUS script policy used to change the RADIUS attributes of the outgoing Access-Accept messages.

The **no** form of the command removes the policy name from the configuration.

Default no accept-script-policy

Parameters *policy-name* — Specifies the Python script policy to modify Access-Accept.

radius-accounting-policy

Syntax **radius-accounting-policy** *name* [**create**]
no radius-accounting-policy

Context config>subscr-mgmt

Description This command specifies a subscriber RADIUS based accounting policy.

Parameters *name* — The name of the policy. The string is case sensitive and limited to 32 ASCII 7-bit printable characters with no spaces.

coa-script-policy

Syntax **coa-script-policy** *policy-name*
no coa-script-policy

Context config>subscr-mgmt>auth-plcy

Description This command configures the RADIUS script policy used to change the RADIUS attributes of the Change-of-Authorization messages.

The **no** form of the command removes the policy name from the configuration.

Default none

Parameters *policy-name* — Specifies the Python script policy to modify the Change-of-Authorization messages.

request-script-policy

Syntax **request-script-policy** *policy-name*
no request-script-policy

Context config>subscr-mgmt>auth-plcy

Description This command configures the RADIUS script policy used to change the RADIUS attributes of the outgoing Access-Request messages.

The **no** form of the command removes the policy name from the configuration.

Default none

Parameters *policy-name* — Specifies the Python script policy to modify Access-Request messages.

acct-request-script-policy

Syntax **acct-request-script-policy** *policy-name*
no acct-request-script-policy

Context config>subscr-mgmt>acct-plcy#

Description This command configures the Python script policy to modify Accounting-Request messages.

The **no** form of the command removes the policy name from the configuration.

Default none

Parameters *policy-name* — Specifies the Python script policy to modify Accounting-Request messages.

Common CLI Command Descriptions

In This Chapter

This section provides information about common Command Line Interface (CLI) syntax and command usage.

Topics in this chapter include:

Common Service Commands

sap

Syntax **[no] sap** *sap-id*

Description This command specifies the physical port identifier portion of the SAP definition.

Parameters *sap-id* — The *sap-id* can be configured in one of the following formats:

Type	Syntax	Example
port-id	*slot*/*mda*/*port*[.*channel*]	2/1/11 1/2/3.1
null	[*port-id* | *bundle-id*| *bpgrp-id* | *lag-id* | *aps-id*]	*port-id*: 1/1/3 *bundle-id*: bundle-ppp-1/1.1 *bpgrp-id*: bpgrp-ima-1 *lag-id*: lag-63 *aps-id*: aps-1
dot1q	[*port-id* | *bundle-id*| *bpgrp-id* | *lag-id* | *aps-id*]:qtag1	*port-id*:qtag1: 1/1/3:100 *bundle-id*: bundle-ppp-1/1.1 *bpgrp-id*: bpgrp-ima-1 *lag-id*:qtag1:lag-63:102 *aps-id*:qtag1: aps-1:27
qinq	[*port-id* | *bundle-id*| *bpgrp-id* | *lag-id*]:*qtag1.qtag2*	*port-id*:qtag1.qtag2: 1/1/3:100.10 *bundle-id*: bundle-ppp-1/1.1 *bpgrp-id*: bpgrp-ima-1 *lag-id*:qtag1.qtag2:lag-10:
atm	[*port-id* | *aps-id* | *bundle-id* | *bpgrp-id*][:vpi/vci |vpi |vpi1.vpi2]	port-id: 1/1/1 aps-id: aps-1 *bundle-id*: bundle-ima-1/1.1 bundle-ppp-1/1.1 *bpgrp-id*: bpgrp-ima-1 vpi/vci: 16/26 vpi: 16 vpi1.vpi2: 16.200
frame-relay	[*port-id* | *aps-id*]:*dlci*	*port-id*: 1/1/1:100 *aps-id*: aps-1 *dlci*: 16
cisco-hdlc	*slot/mda/port.channel*	*port-id*: 1/1/3.1

Values: *sap-id*:

null	[*port-id* | *bundle-id* | *bpgrp-id* | *lag-id* | *aps-id*]
dot1q	[*port-id* | *bundle-id* | *bpgrp-id* | *lag-id* | *aps-id*]:*qtag1*
qinq	[*port-id* | *bundle-id* | *bpgrp-id* | *lag-id*]:*qtag1.qtag2*
atm	[*port-id* | *aps-id*][:*vpi/vci*|*vpi*| *vpi1.vpi2*]

frame	[*port-id* | *aps-id*]:*dlci*
cisco-hdlc	*slot/mda/port.channel*
cem	*slot/mda/port.channel*
ima-grp	[*bundle-id*[:vpi/vci|vpi|*vpi1.vpi2*]
port-id	*slot/mda/port*[*.channel*]
bundle-id	bundle-*type-slot/mda.bundle-num*
	bundle keyword
	type ima, fr, ppp
	bundle-num 1 — 256
bpgrp-id	bpgrp-*type-bpgrp-num*
	bpgrp keyword
	type ima, ppp
	bpgrp-num 1 — 1280
aps-id	aps-*group-id*[*.channel*]
	aps keyword
	group-id 1 — 64
ccag-id	ccag-*id.path-id*[*cc-type*]:*cc-id*
	ccag keyword
	id 1 — 8
	path-id a, b
	cc-type .sap-net, .net-sap
	cc-id 0 — 4094
eth-tunnel	eth-tunnel-tunnel-id
	tunnel-id 1 — 1024
	eth-tunnel-sap-id 0 — 4094
lag-*id*	lag-*id*
	lag keyword
	id 1 — 800
qtag1	0 — 4094
qtag2	*, 0 — 4094
vpi	NNI: 0 — 4095
	UNI: 0 — 255
vci	1, 2, 5 — 65535
dlci	16 — 1022
ipsec-id	ipsec-*id*.private | public:tag
	ipsec keyword
	id 1 — 4
	tag 0 — 4094
tunnel-id	tunnel-*id*.private|public:*tag*
	tunnel keyword
	id 1..16
	tag 0..4094

bundle-id — Specifies the multilink bundle to be associated with this IP interface. The **bundle** keyword must be entered at the beginning of the parameter.
The command syntax must be configured as follows:

bundle-id: **bundle-***type-slot-id*/*mda-slot*.*bundle-num*
bundle-id value range: 1 — 256

For example:

```
*A:ALA-12>config#  port bundle-ppp-5/1.1
*A:ALA-12>config>port# multilink-bundle
```

bgprp-id — Specifies the bundle protection group ID to be associated with this IP interface. The **bpgrp** keyword must be entered at the beginning of the parameter.

The command syntax must be configured as follows:

bpgrp-id:	bpgrp-*type-bpgrp-num*
type:	ima
bpgrp-num value range:	1 — 1280

For example:

```
*A:ALA-12>config# port bpgrp-ima-1
*A:ALA-12>config>service>vpls$ sap bpgrp-ima-1
```

qtag1, qtag2 — Specifies the encapsulation value used to identify the SAP on the port or sub-port. If this parameter is not specificially defined, the default value is 0.

Values

qtag1:	0 — 4094
qtag2 :	* | 0 — 4094

The values depends on the encapsulation type configured for the interface. The following table describes the allowed values for the port and encapsulation types.

Port Type	Encap-Type	Allowed Values	Comments
Ethernet	Null	0	The SAP is identified by the port.
Ethernet	Dot1q	0 — 4094	The SAP is identified by the 802.1Q tag on the port. Note that a 0 qtag1 value also accepts untagged packets on the dot1q port.
Ethernet	QinQ	qtag1: 0 — 4094 qtag2: 0 — 4094	The SAP is identified by two 802.1Q tags on the port. Note that a 0 qtag1 value also accepts untagged packets on the dot1q port.
SONET/SDH	IPCP	-	The SAP is identified by the channel. No BCP is deployed and all traffic is IP.
SONET/SDH TDM	BCP-Null	0	The SAP is identified with a single service on the channel. Tags are assumed to be part of the customer packet and not a service delimiter.
SONET/SDH TDM	BCP-Dot1q	0 — 4094	The SAP is identified by the 802.1Q tag on the channel.
SONET/SDH TDM	Frame Relay	16 — 991	The SAP is identified by the data link connection identifier (DLCI).
SONET/SDH ATM	ATM	vpi (NNI) 0 — 4095 vpi (UNI) 0 — 255 vci 1, 2, 5 — 65535 -	The SAP is identified by port or by PVPC or PVCC identifier (vpi, vpi/vci, or vpi range)

sap ipsec-*id*.private|public:*tag* — This parameter associates an IPSec group SAP with this interface. This is the public side for an IPSec tunnel. Tunnels referencing this IPSec group in the private side may be created if their local IP is in the subnet of the interface subnet and the routing context specified matches with the one of the interface.

This context will provide a SAP to the tunnel. The operator may associate an ingress and egress QoS policies as well as filters and virtual scheduling contexts. Internally this creates an Ethernet SAP that will be used to send and receive encrypted traffic to and from the MDA. Multiple tunnels can be associated with this SAP. The “tag” will be a dot1q value. The operator may see it as an identifier. The range is limited to 1 — 4095.

port

Syntax **port** *port-id*

Description This command specifies a port identifier.

Parameters *port-id* — The *port-id* can be configured in one of the following formats:

Values

port-id	slot/mda/port[.channel]	
bundle-id	bundle-*type-slot/mda.bundle-num*	
	bundle	keyword
	type	ima|ppp
	bundle-num	1 — 256
bpgrp-id	bpgrp-*type-bpgrp-num*	
	bpgrp	keyword
	type	ima, ppp
	bpgrp-num	1 — 256
aps-id	aps-*group-id*[*.channel*]	
	aps	keyword
	group-id	1 — 64
ccag-id	ccag-*id.*<*path-id*>[*cc-type*]	
	ccag	keyword
	id	1 — 8
	path-id	a, b
	cc-type	[.sap-net|.net-sap]
eth-tunnel-id	- eth-tunnel-*id*	
	eth-tunnel	keyword
	id	1 — 1024
lag-id	lag-*id*	
	lag	keyword
	id	1— 800

Standards and Protocol Support

Note that the information presented is subject to change without notice.
Alcatel-Lucent assumes no responsibility for inaccuracies contained herein.

Ethernet Standards

IEEE 1588 Precision Clock Synchronization Protocol
IEEE 802.1AB Station and Media Access Control Connectivity Discovery
IEEE 802.1ad Provider Bridges
IEEE 802.1ag Connectivity Fault Management
IEEE 802.1ah Provider Backbone Bridges
IEEE 802.1ak Multiple Registration Protocol
IEEE 802.1aq Shortest Path Bridging
IEEE 802.1ax Link Aggregation
IEEE 802.1D MAC Bridges
IEEE 802.1p Traffic Class Expediting
IEEE 802.1Q Virtual LANs
IEEE 802.1s Multiple Spanning Trees
IEEE 802.1w Rapid Reconfiguration of Spanning Tree
IEEE 802.1X Port Based Network Access Control
IEEE 802.3ab 1000BASE-T
IEEE 802.3ac VLAN Tag
IEEE 802.3ad Link Aggregation
IEEE 802.3ae 10 Gb/s Ethernet
IEEE 802.3ah Ethernet in the First Mile
IEEE 802.3ba 40 Gb/s and 100 Gb/s Ethernet
IEEE 802.3i Ethernet
IEEE 802.3u Fast Ethernet
IEEE 802.3x Ethernet Flow Control
IEEE 802.3z Gigabit Ethernet
ITU-T G.8031 Ethernet Linear Protection Switching
ITU-T G.8032 Ethernet Ring Protection Switching
ITU-T Y.1731 OAM functions and mechanisms for Ethernet based networks

OSPF

RFC 1586 Guidelines for Running OSPF Over Frame Relay Networks
RFC 1765 OSPF Database Overflow
RFC 2328 OSPF Version 2
RFC 3101 The OSPF Not-So-Stubby Area (NSSA) Option
RFC 3509 Alternative Implementations of OSPF Area Border Routers
RFC 3623 Graceful OSPF Restart (Helper Mode)
RFC 3630 Traffic Engineering (TE) Extensions to OSPF Version 2
RFC 4203 OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)
RFC 4222 Prioritized Treatment of Specific OSPF Version 2 Packets and Congestion Avoidance
RFC 4576 Using a Link State Advertisement (LSA) Options Bit to Prevent Looping in BGP/MPLS IP Virtual Private Networks (VPNs)
RFC 4970 Extensions to OSPF for Advertising Optional Router Capabilities
RFC 5185 OSPF Multi-Area Adjacency
RFC 5243 OSPF Database Exchange Summary List Optimization
RFC 5250 The OSPF Opaque LSA Option
RFC 5709 OSPFv2 HMAC-SHA Cryptographic Authentication
RFC 6987 OSPF Stub Router Advertisement

BGP

RFC 1397 BGP Default Route Advertisement
RFC 1772 Application of BGP in the Internet
RFC 1965 Confederations for BGP
RFC 1997 BGP Communities Attribute
RFC 2385 Protection of BGP Sessions via MD5
RFC 2439 BGP Route Flap Dampening
RFC 2858 Multiprotocol Extensions for BGP-4
RFC 2918 Route Refresh Capability for BGP-4
RFC 3107 Carrying Label Information in BGP-4
RFC 3392 Capabilities Advertisement with BGP4
RFC 4271 BGP-4 (previously RFC 1771)
RFC 4360 BGP Extended Communities Attribute
RFC 4364 BGP/MPLS IP Virtual Private Networks (VPNs)(previously RFC 2547bis BGP/MPLS VPNs)
RFC 4456 BGP Route Reflection: Alternative to Full-mesh IBGP
RFC 4486 Subcodes for BGP Cease Notification Message
RFC 4577 OSPF as the Provider/ Customer Edge Protocol for BGP/ MPLS IP Virtual Private Networks (VPNs)
RFC 4659 BGP-MPLS IP Virtual Private Network (VPN) Extension for IPv6 VPN
RFC 4684 Constrained Route Distribution for Border Gateway Protocol/MultiProtocol Label Switching (BGP/MPLS) Internet Protocol (IP) Virtual Private Networks (VPNs)
RFC 4724 Graceful Restart Mechanism for BGP – GR helper
RFC 4760 Multi-protocol Extensions for BGP
RFC 4798 Connecting IPv6 Islands over IPv4 MPLS Using IPv6 Provider Edge Routers (6PE)
RFC 4893 BGP Support for Four-octet AS Number Space
RFC 5004 Avoid BGP Best Path Transitions from One External to Another
RFC 5065 Confederations for BGP (obsoletes 3065)
RFC 5291 Outbound Route Filtering Capability for BGP-4

RFC 5575 Dissemination of Flow Specification Rules
RFC 5668 4-Octet AS Specific BGP Extended Community
draft-ietf-idr-add-paths Advertisement of Multiple Paths in BGP
draft-ietf-idr-best-external Advertisement of the Best External Route in BGP

IS-IS

ISO/IEC 10589:2002, Second Edition, Nov. 2002 Intermediate System to Intermediate System Intra-Domain Routeing Information Exchange Protocol
RFC 1195 Use of OSI IS-IS for Routing in TCP/IP and Dual Environments
RFC 2973 IS-IS Mesh Groups
RFC 3359 Reserved Type, Length and Value (TLV) Codepoints in Intermediate System to Intermediate System
RFC 3719 Recommendations for Interoperable Networks using Intermediate System to Intermediate System (IS-IS)
RFC 3787 Recommendations for Interoperable IP Networks using Intermediate System to Intermediate System (IS-IS)
RFC 4971 Intermediate System to Intermediate System (IS-IS) Extensions for Advertising Router Information
RFC 5120 M-ISIS: Multi Topology (MT) Routing in IS-IS
RFC 5130 A Policy Control Mechanism in IS-IS Using Administrative Tags
RFC 5301 Dynamic Hostname Exchange Mechanism for IS-IS
RFC 5302 Domain-wide Prefix Distribution with Two-Level IS-IS
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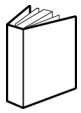

Customer documentation

http://documentation.alcatel-lucent.com

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