



7750 Service Router

Virtualized Service Router

Release 26.10.R1

Gy AVPs Reference Guide

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Table of contents

1	Getting started.....	6
1.1	About this guide.....	6
1.1.1	Audience.....	6
1.1.2	References.....	6
2	Diameter Gy interface specification.....	7
3	Diameter Gy - Credit-Control-Request (CCR) command.....	8
3.1	Diameter Gy – CCR message top level AVPs.....	9
3.2	Diameter Gy – CCR message grouped AVPs.....	26
3.2.1	Diameter Gy CCR – Subscription-Id grouped AVP.....	26
3.2.2	Diameter Gy CCR – Multiple-Services-Credit-Control grouped AVP.....	27
3.2.3	Diameter Gy CCR – Requested-Service-Unit grouped AVP.....	29
3.2.4	Diameter Gy CCR – Used-Service-Unit grouped AVP.....	29
3.2.5	Diameter Gy CCR - User-Equipment-Info grouped AVP.....	31
3.2.6	Diameter Gy CCR – Service-Information grouped AVP.....	32
3.2.7	Diameter Gy CCR – PS-Information grouped AVP.....	32
4	Diameter Gy – Credit-Control-Answer (CCA) command.....	34
4.1	Diameter Gy – CCA message top level AVPs.....	34
4.2	Diameter Gy – CCA message grouped AVPs.....	38
4.2.1	Diameter Gy CCA – Failed-AVP grouped AVP.....	38
4.2.2	Diameter Gy CCA – Multiple-Services-Credit-Control grouped AVP.....	38
4.2.3	Diameter Gy CCA – Final-Unit-Indication grouped AVP.....	40
4.2.4	Diameter Gy CCA - Redirect-Server grouped AVP.....	42
4.2.5	Diameter Gy CCA – Granted-Service-Unit grouped AVP.....	43
5	Diameter Gy – Re-Auth-Request (RAR) command.....	45
5.1	Diameter Gy – RAR message format.....	45
5.2	Diameter Gy – RAR message top level AVPs.....	45
6	Diameter Gy – Re-Auth-Answer (RAA) command.....	47
6.1	Diameter Gy – RAA message format.....	47
6.2	Diameter Gy – RAA message top level AVPs.....	47

7	Diameter Gy – Abort-Session-Request (ASR) command.....	49
7.1	Diameter Gy – ASR message format.....	49
7.2	Diameter Gy – ASR message top level AVPs.....	49
8	Diameter Gy – Abort-Session-Answer (ASA) command.....	51
8.1	Diameter Gy – ASA message format.....	51
8.2	Diameter Gy – ASA message top level AVPs.....	51
9	Standards and protocol support.....	53
9.1	Access Node Control Protocol (ANCP).....	53
9.2	Bidirectional Forwarding Detection (BFD).....	53
9.3	Border Gateway Protocol (BGP).....	53
9.4	Bridging and management.....	55
9.5	Broadband Network Gateway (BNG) Control and User Plane Separation (CUPS).....	56
9.6	Certificate management.....	56
9.7	Circuit emulation.....	57
9.8	Ethernet.....	57
9.9	Ethernet VPN (EVPN).....	57
9.10	gRPC Remote Procedure Calls (gRPC).....	58
9.11	Intermediate System to Intermediate System (IS-IS).....	58
9.12	Internet Protocol (IP) Fast Reroute (FRR).....	60
9.13	Internet Protocol (IP) general.....	60
9.14	Internet Protocol (IP) multicast.....	61
9.15	Internet Protocol (IP) version 4.....	63
9.16	Internet Protocol (IP) version 6.....	63
9.17	Internet Protocol Security (IPsec).....	64
9.18	Label Distribution Protocol (LDP).....	66
9.19	Layer Two Tunneling Protocol (L2TP) Network Server (LNS).....	66
9.20	Multiprotocol Label Switching (MPLS).....	67
9.21	Multiprotocol Label Switching - Transport Profile (MPLS-TP).....	67
9.22	Network Address Translation (NAT).....	68
9.23	Network Configuration Protocol (NETCONF).....	68
9.24	Open Shortest Path First (OSPF).....	69
9.25	Path Computation Element Protocol (PCEP).....	69
9.26	Point-to-Point Protocol (PPP).....	70

9.27	Policy management and credit control.....	70
9.28	Pseudowire (PW).....	71
9.29	Quality of Service (QoS).....	71
9.30	Remote Authentication Dial In User Service (RADIUS).....	72
9.31	Resource Reservation Protocol - Traffic Engineering (RSVP-TE).....	72
9.32	Routing Information Protocol (RIP).....	73
9.33	Segment Routing (SR).....	73
9.34	Simple Network Management Protocol (SNMP).....	74
9.35	Storage sanitization.....	76
9.36	Timing.....	77
9.37	Two-Way Active Measurement Protocol (TWAMP).....	77
9.38	Virtual Private LAN Service (VPLS).....	78
9.39	Voice and video.....	78
9.40	Yet Another Next Generation (YANG).....	78
9.41	Yet Another Next Generation (YANG) OpenConfig Models.....	78

1 Getting started

1.1 About this guide

This document details the Diameter Gy interface specification. The Diameter Gy application is also referred to as Diameter Credit Control Application (DCCA).

The tables in this document provide Attribute Value Pair (AVP) details organized per message type.

The SR OS also provides a Diameter Python interface that enables flexible insertion, deletion, and formatting of AVPs received from and sent to a Diameter application server. For more information about the Diameter Python API, see the *7450 ESS, 7750 SR, and VSR Triple Play Service Delivery Architecture Guide*.



Note: Unless otherwise indicated, CLI commands, contexts, and configuration examples in this guide apply for both the MD-CLI and the classic CLI.

1.1.1 Audience

This document is intended for network administrators who are responsible for configuring and operating 7750 SR and VSR service routers and using Diameter applications. It is assumed that the network administrators have an understanding of networking principles and configurations, routing processes, protocols, and standards.

1.1.2 References

RFC 2865, "Remote Authentication Dial In User Service (RADIUS)", June 2000

RFC 4006, "Diameter Credit-Control Application", August 2005

RFC 6733, "Diameter Base Protocol", October 2012

3GPP TS 32.299 v9.4.0, "Diameter charging applications", June 2010

7450 ESS, 7750 SR, and VSR RADIUS Attributes Reference Guide

2 Diameter Gy interface specification

Table 1: Diameter Gy application messages provides a summary of the Diameter Gy application messages.

Table 1: Diameter Gy application messages

Diameter message		Code	RFC
CCR	Credit-Control-Request	272	RFC 4006
CCA	Credit-Control-Answer	272	RFC 4006
RAR	Re-Auth-Request	258	RFC 6733
RAA	Re-Auth-Answer	258	RFC 6733
ASR	Abort-Session-Request	274	RFC 6733
ASA	Abort-Session-Answer	274	RFC 6733

3 Diameter Gy - Credit-Control-Request (CCR) command

This section describes the Diameter Gy CCR message format as defined in RFC 4006, *Diameter Credit-Control Application*. Strikethrough formatted AVPs are not included in CCR. AVPs listed in *italics* appearing after [AVP] and are not defined in RFC 4006.

```

<Credit-Control-Request> ::= < Diameter Header: 272, REQ, PXY >
    < Session-Id >
    { Origin-Host }
    { Origin-Realm }
    { Destination-Realm }
    { Auth-Application-Id }
    { Service-Context-Id }
    { CC-Request-Type }
    { CC-Request-Number }
    [ Destination-Host ]
    [ User-Name ]
    { CC-Sub-Session-Id }
    { Acct-Multi-Session-Id }
    [ Origin-State-Id ]
    [ Event-Timestamp ]
    *[ Subscription-Id ]
    { Service-Identifier }
    [ Termination-Cause ]
    { Requested-Service-Unit }
    { Requested-Action }
    *[ Used-Service-Unit ]
    [ Multiple-Services-Indicator ]
    *[ Multiple-Services-Credit-Control ]
    *[ Service-Parameter-Info ]
    { CC-Correlation-Id }
    [ User-Equipment-Info ]
    *[ Proxy-Info ]
    *[ Route-Record ]
    *[ AVP ]
    [ Framed-IP-Address ]
    [ Called-Station-Id ]
    [ Framed-IPv6-Prefix ]
    [ Delegated-IPv6-Prefix ]
    [ Alc-IPv6-Address ]
    [ 3GPP-IMSI ]
    [ 3GPP-Charging-Id ]
    [ 3GPP-GPRS-QoS-Negotiated-Profile ]
    [ 3GPP-GGSN-Address ]
    [ 3GPP-NSAPI ]
    [ 3GPP-Session-Stop-Indicator ]
    [ 3GPP-Selection-Mode ]
    [ 3GPP-Charging-Characteristics ]
    [ 3GPP-GGSN-v6-Address ]
    [ 3GPP-RAT-Type ]
    [ 3GPP-User-Location-Info ]
    [ GGSN-Address ]
    [ Service-Information ]
    [ Charging-Rule-Base-Name ]
    [ PDP-Context-Type ]

```

3.1 Diameter Gy – CCR message top level AVPs

[Table 2: Diameter Gy CCR: top level AVP description](#) provides a detailed description of each top-level AVP present in a Diameter Gy CCR message. Unless mentioned in the description, the AVP is present in Initial, Update, and Terminate messages. Grouped AVPs are marked with "↳ (grouped AVP)". The grouped AVP format and embedded AVP description and format are described in [Diameter Gy – CCR message grouped AVPs](#).

Table 2: Diameter Gy CCR: top level AVP description

AVP code	AVP name	Description
1	User-Name	<p>RADIUS username</p> <p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy aaa-user-name</pre> <ul style="list-style-type: none"> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp radius-user-name</pre> <p>default: not included</p>
8	Framed-IP-Address	<p>The IP address of the IPv4 subscriber host that triggered the creation of the Diameter Gy session.</p> <p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp address-avp</pre> <ul style="list-style-type: none"> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp address-avp</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured with the following commands:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre>

AVP code	AVP name	Description
		<ul style="list-style-type: none"> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>default: included</p>
30	Called-Station-Id	<p>The AVP is included if configured in the diameter application policy command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp called-station-id</pre> <ul style="list-style-type: none"> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp called-station-id</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs using the following commands:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> <ul style="list-style-type: none"> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>value: string up to 64 characters default: no called-station-id</p>
55	Event-Timestamp	Timestamp when the request was generated.
97	Framed-IPv6-Prefix	<p>The IPv6 prefix of the SLAAC subscriber host that triggered the creation of the Diameter Gy session.</p> <p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp address-avp</pre> <ul style="list-style-type: none"> classic CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp address-avp</pre>

AVP code	AVP name	Description
		<p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>default: included</p>
123	Delegated-IPv6-Prefix	<p>The IPv6 prefix of the DHCPv6 IA-PD subscriber host that triggered the creation of the Diameter Gy session.</p> <p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp address-avp</pre> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp address-avp</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>default: included</p>
258	Auth-Application-Id	Fixed value: 4 = Diameter Credit Control Application
263	Session-Id	<p>A session is a logical concept at the application layer that exists between the Diameter client and the Diameter server; it is identified via the Session-Id AVP.</p> <p>Format:</p>

AVP code	AVP name	Description
		<p><DiameterIdentity>; <high 32 bits>; <low 32 bits></p> <ul style="list-style-type: none"> <DiameterIdentity> is the configured origin host <high 32 bits> are encoded as the Diameter initialization time (number of seconds because 1 January, 1970) <low 32 bits> are encoded as a sequentially increasing number starting at 1 <p>Example: bng.nokia.com;1326398325;1</p>
264	Origin-Host	<p>Diameter Identity. As configured in the corresponding diameter-peer-policy.</p> <p>Example: bng.nokia.com</p>
278	Origin-State-Id	<p>Initialized to the Diameter process startup time. Encoded as number of seconds since 1 January, 1970.</p>
283	Destination-Realm	<p>Diameter Identity. As configured in the corresponding diameter-peer-policy or learned from CCA/RAR.</p> <p>Example: nokia.com</p>
293	Destination-Host	<p>Diameter Identity. As configured in the corresponding diameter-peer-policy or learned from CCA/RAR. Omitted in CCR-I if not configured.</p> <p>Example: server.nokia.com</p>
295	Termination-Cause	<p>(CCR-T only)</p> <p>Indicates the reason that the credit control session was terminated.</p> <p>Values:</p> <p>1 = Diameter Logout</p> <p>4 = Diameter Administrative - a diameter session could not be created because of category mismatch or system resources</p>
296	Origin-Realm	<p>Diameter Identity. As configured in the corresponding diameter-peer-policy.</p> <p>Example: nokia.com</p>
415	CC-Request-Number	<p>Initial Request: 0</p> <p>Update and Termination Request: sequence number</p>
416	CC-Request-Type	<p>1 = Initial Request</p> <p>2 = Update Request</p> <p>3 = Termination Request</p>
443	Subscription-Id	<p>Identifies the subscriber host or session.</p> <p>The value is as configured in the diameter application policy:</p>

AVP code	AVP name	Description
	↳ (grouped AVP)	<ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy avp-subscription-id origin</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy avp-subscription-id origin</pre> <p>If no data is available for the specified origin, then the subscriber-id is used instead.</p> <p>default: avp-subscription-id subscriber-id type private</p> <p>For GTP access, the configured value is ignored and two Subscription-Id AVPs are included: IMSI (type imsi) and MSISDN (type e164) with the corresponding values learned from the GTP Create Session Request message.</p>
455	Multiple-Services-Indicator	(CCR-I only) Fixed value: 1 = MULTIPLE_SERVICES_SUPPORTED
456	Multiple-Services-Credit-Control ↳ (grouped AVP)	Up to 16 Multiple-Services-Credit-Control AVPs, each corresponding with a single rating group. A rating group maps to a category configured in a category-map using the following commands. <pre>configure subscriber-mgmt category-map category rating-group</pre>
458	User-Equipment-Info ↳ (grouped AVP)	(GTP access only) The AVP is included if configured in the diameter application policy: <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp user-equipment-info-type type imeisv</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp user-equipment-info type imeisv</pre> <p>value: IMEI as signaled in the GTP Create Session Request message.</p> <p>default: not included</p>
461	Service-Context-Id	The AVP is included if configured in the diameter application policy using the following command:

AVP code	AVP name	Description
		<ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp service-context-id</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp service-context-id</pre> <p>value: string of up to 32 characters default: no service-context-id</p>
NOKIA – 99	Alc-IPv6-Address	<p>The IPv6 address of the DHCPv6 IA-NA subscriber host that triggered the creation of the Diameter Gy session.</p> <p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp address-avp</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp address-avp</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>default: included</p>
3GPP – 1	3GPP-IMSI	<p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-imsi</pre>

AVP code	AVP name	Description
		<ul style="list-style-type: none"> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-imsi</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>values:</p> <ul style="list-style-type: none"> • circuit-id • imsi • subscriber-id <p>default: included with value subscriber-id</p>
3GPP – 2	3GPP-Charging-Id	<p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-charging-id</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-charging-id</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre>

AVP code	AVP name	Description
		<p>values:</p> <ul style="list-style-type: none"> • auto: defaults to esm-info for vendor-support three-gpp • esm-info: <subscriber-id>;<sap-id>;<sla-profile>[<SPI sharing id>] • id: a unique 32 bit integer value per session <p>default: included with esm-info value (auto)</p>
3GPP – 5	3GPP-GPRS-QoS-Negotiated-Profile	<p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-gprs-negotiated-qos-profile</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-gprs-negotiated-qos-profile</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>value: the active SLA profile name</p> <p>default: included</p>
3GPP – 7	3GPP-GGSN-Address	<p>The local IPv4 address used to setup the diameter peer. The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-ggsn-ipv4-address</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-ggsn-address</pre>

AVP code	AVP name	Description
		<p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>Value:</p> <ol style="list-style-type: none"> Use the configured IPv4 source address: <ul style="list-style-type: none"> MD-CLI <pre>configure aaa diameter-peer-policy ipv4-source-address</pre> classic CLI <pre>configure aaa diameter-peer-policy source-address</pre> If the router equals base or vpm service id, use the system interface IPv4 address else if the router equals management, use the active management port IP address configured in the BOF <p>default: included</p>
3GPP – 10	3GPP-NSAPI	<p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-nsapi</pre> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-nsapi</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre>

AVP code	AVP name	Description
		<ul style="list-style-type: none"> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>value: <system name>;<service-id>;<sap-id></p> <p>default: included</p>
3GPP – 11	3GPP-Session-Stop-Indicator	<p>(CCR-T only)</p> <p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-session-stop-indicator</pre> <ul style="list-style-type: none"> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-session-stop-indicator</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> <ul style="list-style-type: none"> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>Fixed value: 0x FF</p> <p>default: included</p>
3GPP – 12	3GPP-Selection-Mode	<p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-selection-mode</pre> <ul style="list-style-type: none"> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-selection-mode</pre>

AVP code	AVP name	Description
		<p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>Fixed value: 0x 00 00 00 00 (MS or network provided APN, subscribed verified) default: included</p>
3GPP – 13	3GPP-Charging-Characteristics	<p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-charging-characteristics</pre> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-charging-characteristics</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>Fixed value: "0000" default: included</p>
3GPP – 16	3GPP-GGSN-v6-Address	<p>The local IPv6 address used to setup the diameter peer. The AVP is included if configured in the diameter application policy using the following command:</p>

AVP code	AVP name	Description
		<ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-ggsn-ipv6-address</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ps-information</pre> <p>value:</p> <ol style="list-style-type: none"> 1. Use the configured IPv6 source address: <pre>configure aaa diameter peer-policy ipv6-source-address</pre> 2. If router = base or vprn service id: use the system interface IPv6 address else if router = management: use the active management port IP address configured in the BOF <p>default: not included</p>
3GPP – 21	3GPP-RAT-Type	<p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-rat-type</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-rat-type</pre>

AVP code	AVP name	Description
		<p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured with the following command options:</p> <pre>gy include-avp ps-information</pre> <p>value: [1 to 255] default: not included</p> <p>For GTP access, the RAT-Type value is learned from the GTP Create Session Request message. The configured value is used when the GTP learned value is unknown or invalid.</p>
3GPP - 22	3GPP-User-Location-Info	<p>(GTP access only)</p> <p>Provides UE location details</p> <p>The AVP is included if configured in the diameter application policy:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp 3gpp-user-location-info</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp three-gpp-user-location-info</pre> <p>value: ULI learned from the GTP Create Session Request message. default: not included</p>
3GPP – 847	GGSN-Address	<p>The local address used to setup the diameter peer.</p> <p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ggsn-address type (ipv4 ipv6)</pre> • classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy include-avp ggsn-address {ipv4 ipv6}</pre> <p>Either IPv4 or IPv6 address can be included.</p>

AVP code	AVP name	Description
		<p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured with the following command options:</p> <pre>gy include-avp ps-information</pre> <p>value:</p> <ol style="list-style-type: none"> Use the configured IP source address: <ul style="list-style-type: none"> MD-CLI <pre>configure aaa diameter peer-policy ipv6-source-address</pre> <pre>configure aaa diameter peer-policy ipv4-source-address</pre> classic CLI <pre>configure aaa diameter-peer-policy ipv6-source-address</pre> <pre>configure aaa diameter-peer-policy ipv4-source-address</pre> If router = base or vprn service id: use the system interface IP address else if router = management: use the active management port IP address configured in the BOF <p>default: not included</p>
3GPP – 873	Service-Information ↳ (grouped AVP)	<p>Grouped AVP containing the [3GPP – 874] PS-Information grouped AVP and embedding following AVPs:</p> <ul style="list-style-type: none"> [8] Framed-IP-Address [30] Called-Station-Id [97] Framed-IPv6-Prefix [123] Delegated-IPv6-Prefix [NOKIA – 99] Alc-IPv6-Address [3GPP – 1] 3GPP-IMSI [3GPP – 2] 3GPP-Charging-Id [3GPP – 5] 3GPP-GPRS-Negotiated-QoS-profile [3GPP – 7] 3GPP-GGSN-Address [3GPP – 10] GGSN-NSAPI [3GPP – 11] 3GPP-Session-Stop-Indicator [3GPP – 12] 3GPP-Selection-Mode

AVP code	AVP name	Description
		<ul style="list-style-type: none"> [3GPP – 13] 3GPP-Charging-Characteristics [3GPP – 16] 3GPP-GGSN-IPv6-Address [3GPP – 21] 3GPP-RAT-Type [3GPP – 847] GGSN-Address [3GPP – 1004] Charging-Rule-Base-Name [3GPP – 1247] PDP-Context-Type <p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> classic CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information</pre> <p>When not configured the above listed AVPs are included at command level.</p> <p>default: no ps-information</p>
3GPP – 1004	Charging-Rule-Base-Name	<p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp charging-rule-base-name category-map</pre> classic CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp charging-rule-base-name category-map-name</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured with the following command options:</p> <pre>gy include-avp ps-information</pre> <p>value:</p> <ul style="list-style-type: none"> category-map-name: the name of the category-map in use for this session string: a string of max. 64 characters. <p>default: charging-rule-base-name category-map-name</p>

AVP code	AVP name	Description
3GPP – 1247	PDP-Context-Type	<p>(CCR-I only)</p> <p>The AVP is included if configured in the diameter application policy using the following command:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp pdp-context-type</pre> classic CLI <pre>configure subscriber-mgmt diameter-gy-policy gy include-avp pdp-context-type</pre> <p>Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs when configured with the following command options:</p> <pre>gy include-avp ps-information</pre> <p>Fixed value: 0 (primary) default: included</p>

Table 3: Diameter Gy CCR: top level AVP format

AVP code	AVP name	Standard	Data format	Flags
1	User-Name	RFC 2865/RFC 6733	UTF8 String	M
8	Framed-IP-Address	RFC 2865	Octet String	M
30	Called-Station-Id	RFC 2865	UTF8 String	M
55	Event-Timestamp	RFC 6733/RFC 4006	Time	M
97	Framed-IPv6-Prefix	RFC 3162	Octet String	M
123	Delegated-IPv6-Prefix	RFC 4818	Octet String	M
258	Auth-Application-Id	RFC 6733/RFC 4006	Unsigned 32	M
263	Session-Id	RFC 6733	UTF8 String	M
264	Origin-Host	RFC 6733	Diameter Identity	M
278	Origin-State-Id	RFC 6733	Unsigned 32	M
283	Destination-Realm	RFC 6733	Diameter Identity	M
293	Destination-Host	RFC 6733	Diameter Identity	M
295	Termination-Cause	RFC 6733	Enumerated	M

AVP code	AVP name	Standard	Data format	Flags
296	Origin-Realm	RFC 6733	Diameter Identity	M
415	CC-Request-Number	RFC 4006	Unsigned 32	M
416	CC-Request-Type	RFC 4006	Enumerated	M
443	Subscription-Id ↳ (grouped AVP)	RFC 4006	Grouped	M
455	Multiple-Services-Indicator	RFC 4006	Enumerated	M
456	Multiple-Services-Credit-Control ↳ (grouped AVP)	RFC 4006	Grouped	M
458	User-Equipment-Info ↳ (grouped AVP)	RFC 4006	Grouped	M
461	Service-Context-Id	RFC 4006	UTF8 String	M
NOKIA – 99	Alc-IPv6-Address	–	Octet String	V
3GPP – 1	3GPP-IMSI	TS 29.061/ TS 32.299	UTF8 String	V
3GPP – 2	3GPP-Charging-Id	TS 29.061/ TS 32.299	UTF8 String	V
3GPP – 5	3GPP-GPRS-QoS-Negotiated-Profile	TS 29.061	UTF8 String	V
3GPP – 7	3GPP-GGSN-Address	TS 29.061	Octet String	V
3GPP – 10	3GPP-NSAPI	TS 29.061	UTF8 String	V
3GPP – 11	3GPP-Session-Stop-Indicator	TS 29.061	UTF8 String	V
3GPP – 12	3GPP-Selection-Mode	TS 29.061	UTF8 String	V
3GPP – 13	3GPP-Charging-Characteristics	TS 29.061	UTF8 String	V
3GPP – 16	3GPP-GGSN-v6-Address	TS 29.061	Octet String	V
3GPP – 21	3GPP-RAT-Type	TS 29.061	Octet String	V
3GPP – 22	3GPP-User-Location-Info	TS 29.061	Octet String	V
3GPP – 847	GGSN-Address	TS 32.299	Address	V
3GPP – 873	Service-Information ↳ (grouped AVP)	TS 32.299	Grouped	V
3GPP – 1004	Charging-Rule-Base-Name	TS 29.212	Octet String	V, M
3GPP – 1247	PDP-Context-Type	TS 32.299	Enumerated	V, M

3.2 Diameter Gy – CCR message grouped AVPs

This section provides an overview of CCR message grouped AVPs.

3.2.1 Diameter Gy CCR – Subscription-Id grouped AVP

Grouped AVP format as defined in RFC 4006:

```
Subscription-Id ::= < AVP Header: 443 >
                { Subscription-Id-Type }
                { Subscription-Id-Data }
```

Table 4: Diameter Gy CCR: Subscription-Id grouped AVP description

AVP code	AVP name	Description
450	Subscription-Id-Type	<p>Value as configured in the diameter application policy:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy avp- subscription-id origin configure subscriber-mgmt diameter-gy-policy gy avp- subscription-id type</pre> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy avp-subscription-id <i>origin</i> (circuit-id dual-stack- remote-id imei imsi mac msisdn nas-port-id subscriber- id username) [type (e164 imsi nai private)]</pre> <p>values:</p> <ul style="list-style-type: none"> e164: identifier in international E.164 format (ITU-T E.164) imsi: identifier in international IMSI format (ITU-T E.212) nai: identifier in the form of a Network Access Identifier (RFC 2486) private: a credit control server private identifier <p>default: type private</p> <p>For GTP access, the configured value is ignored and the type is set to imsi and msisdn respectively for each of the two included Subscription-Id AVPs.</p>
444	Subscription-Id-Data	<p>The value as configured in the diameter application policy:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy avp- subscription-id origin</pre>

AVP code	AVP name	Description
		<pre>configure subscriber-mgmt diameter-gy-policy gy avp-subscription-id type</pre> <ul style="list-style-type: none"> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy avp-subscription-id origin [type]</pre> <p>Note that there is no check if the provided data is in the format of the following configured type.</p> <p>values:</p> <ul style="list-style-type: none"> circuit-id subscriber-id imsi msisdn imei <p>default: avp-subscription-id subscriber-id</p> <p>For GTP access, the Subscription ID data is learned from GTP and contains the IMSI and MSISDN.</p>

Table 5: Diameter Gy CCR: Subscription-Id grouped AVP format

AVP code	AVP name	Standard	Data format	Flags
450	Subscription-Id-Type	RFC 4006	Enumerated	M
444	Subscription-Id-Data	RFC 4006	UTF8 String	M

3.2.2 Diameter Gy CCR – Multiple-Services-Credit-Control grouped AVP

Grouped AVP format as defined in RFC 4006. ~~Strikethrough~~ formatted AVPs are not included in CCR. *Italic* formatted AVPs listed after [AVP] are not defined in RFC 4006.

```
Multiple-Services-Credit-Control ::= < AVP Header: 456 >
    [Granted-Service-Unit]
    [ Requested-Service-Unit ]
    *[ Used-Service-Unit ]
    [Tariff-Change-Usage]
    *[ Service-Identifier ]
    [ Rating-Group ]
    *[ G-S-U-Pool-Reference ]

    { Validity-Time }
    { Result-Code }
    { Final-Unit-Indication }

    *[ AVP ]
    [ Reporting-Reason ]
```

Table 6: Diameter Gy CCR: Multiple-Services-Credit-Control Grouped AVP description

AVP code	AVP name	Description
432	Rating-Group	<p>Rating group for which the quota is requested or reported. Corresponds with a category within a category-map defining the queues and policers and direction to monitor.</p> <pre>configure subscriber-mgmt category-map category rating-group</pre>
437	Requested-Service-Unit ↳ (grouped AVP)	<p>(CCR-I and CCR-U only)</p> <p>When included, the Requested-Service-Unit AVP has an empty data field in all CCR Initial/Update messages.</p>
446	Used-Service-Unit ↳ (grouped AVP)	<p>(CCR-U and CCR-T only)</p> <p>Amount of used service units measured for a specified category or rating group to a specified quota type.</p> <p>The Used-Service-Unit AVP is not present in CCR-U when all contained AVP values are zero and the Reporting-Reason = Validity Time (4) or Forced Reauthorization (7).</p>
3GPP – 872	Reporting-Reason	<p>Specifies the reason for which the Used-Service-Units are reported. CCR-U and CCR-T only.</p> <p>Values</p> <ul style="list-style-type: none"> • 0 (Threshold): used quota reached time or volume threshold value (threshold value different from zero) • 1 (Quota Holding Time): expiration of the Quota Holding Time • 2 (Final): Diameter session termination; can be client or server initiated. • 3 (Quota Exhausted): no threshold or threshold is zero and quota exhausted. • 4 (Validity Time): expiration of the Validity Time • 5 (Other Quota Type): not supported • 6 (Rating Condition Change): not supported • 7 (Forced Reauthorization): reception of a RAR message • 8 (Pool Exhausted): not supported

Table 7: Diameter Gy CCR: Multiple-Services-Credit-Control grouped AVP format

AVP code	AVP name	Standard	Data format	Flags
432	Rating-Group	RFC 4006	Unsigned 32	M
437	Requested-Service-Unit ↳ (grouped AVP)	RFC 4006	Grouped	M
446	Used-Service-Unit ↳ (grouped AVP)	RFC 4006	Grouped	M
3GPP – 872	Reporting-Reason	TS 32.299	Enumerated	V, M

3.2.3 Diameter Gy CCR – Requested-Service-Unit grouped AVP

Grouped AVP format as defined in RFC 4006. Strikethrough formatted AVPs are not included in CCR.

```
Requested-Service-Unit ::= < AVP Header: 437 >
    [CC-Time]
    [CC-Money]
    [CC-Total-Octets]
    [CC-Input-Octets]
    [CC-Output-Octets]
    [CC-Service-Specific-Units]
    *[ AVP ]
```

The Requested-Service-Unit AVP has an empty data field in all CCR Initial/Update messages and is not present in a CCR Terminate message.

3.2.4 Diameter Gy CCR – Used-Service-Unit grouped AVP

Grouped AVP format as defined in RFC 4006. Strikethrough formatted AVPs are not included in CCR.

```
Used-Service-Unit ::= < AVP Header: 446 >
    [Tariff-Change-Usage]
    [ CC-Time ]
    [CC-Money]
    [ CC-Total-Octets ]
    [ CC-Input-Octets ]
    [ CC-Output-Octets ]
    [CC-Service-Specific-Units]
    *[ AVP ]
```

Table 8: Diameter Gy CCR: Used-Service-Unit grouped AVP description

AVP code	AVP name	Description
412	CC-Input-Octets	Number of ingress bytes forwarded via queues or policers that are monitored in the ingress direction for this rating group.

AVP code	AVP name	Description
		<ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt category-map category ingress policer <i>value</i> configure subscriber-mgmt category-map category ingress queue <i>value</i></pre> • classic CLI <pre>configure subscriber-mgmt category-map category queue <i>queue-id</i> {ingress-only} configure subscriber-mgmt category-map category policer <i>policer-id</i> {ingress-only}</pre> <p>Value equals zero when credit type is time or when no queues/policers are monitored in ingress direction.</p>
414	CC-Output-Octets	<p>Number of egress bytes forwarded via queues or policers that are monitored in egress direction for this rating group.</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt category-map category egress policer <i>value</i> configure subscriber-mgmt category-map category egress queue <i>value</i></pre> • classic CLI <pre>configure subscriber-mgmt category-map category queue <i>queue-id</i> {egress-only} configure subscriber-mgmt category-map category policer <i>policer-id</i> {egress-only}</pre> <p>Value equals zero when credit type is time. Or when no queues/policers are monitored in egress direction.</p>
420	CC-Time	<p>Total number of seconds during which activity is detected for queues or policers that are monitored for this rating group.</p> <ul style="list-style-type: none"> • MD-CLI <pre>configure subscriber-mgmt category-map category ingress policer <i>value</i> configure subscriber-mgmt category-map category ingress queue <i>value</i></pre> • classic CLI <pre>configure subscriber-mgmt category-map category queue <i>queue-id</i> {ingress-only egress-only ingress-egress}</pre>

AVP code	AVP name	Description
		<pre>configure subscriber-mgmt category-map category policer <i>policer-id</i> {ingress-only egress-only ingress-egress}</pre> <p>Only sampling periods exceeding the configured activity-threshold are counted:</p> <pre>configure subscriber-mgmt category-map activity- threshold</pre> <p>Value equals zero when credit type is volume.</p>
421	CC-Total-Octets	<p>Total number of bytes used for this rating-group. Corresponds with the sum of CC-Input-Octets and CC-Output-Octets.</p> <p>Value equals zero when credit type is time.</p>

Table 9: Diameter Gy CCR: Used-Service-Unit grouped AVP format

AVP code	AVP name	Standard	Data format	Flags
412	CC-Input-Octets	RFC 4006	Unsigned 64	M
414	CC-Output-Octets	RFC 4006	Unsigned 64	M
420	CC-Time	RFC 4006	Unsigned 32	M
421	CC-Total-Octets	RFC 4006	Unsigned 64	M

3.2.5 Diameter Gy CCR - User-Equipment-Info grouped AVP

Grouped AVP format as defined in RFC 4006.

```
User-Equipment-Info ::= < AVP Header: 458 >
  { User-Equipment-Info-Type }
  { User-Equipment-Info-Value }
```

Table 10: Diameter Gy CCR: User-Equipment-Info grouped AVP description

AVP code	AVP name	Description
459	User-Equipment-Info-Type	<p>(GTP access only)</p> <p>fixed value: IMEISV (0)</p>
460	User-Equipment-Info-Value	<p>(GTP access only)</p> <p>The Internet Mobile Equipment Identifier (IMEI) as signaled in the GTP Create Session Request message.</p>

Table 11: Diameter Gy CCR: User-Equipment-Info grouped AVP format

AVP code	AVP name	Standard	Data format	Flags
459	User-Equipment-Info-Type	RFC 4006	Enumerated	
460	User-Equipment-Info-Value	RFC 4006	UTF8 String	

3.2.6 Diameter Gy CCR – Service-Information grouped AVP

Grouped AVP format as defined in TS 32.29. Strikethrough formatted AVPs are not included in CCR.

```
Service-Information ::= < AVP Header: 873>
                        * { Subscription-Id }
{ AoC-Information }
                        [ PS-Information ]
                        { WLAN-Information }
{ IMS-Information }
{ LCS-Information }
{ PoC-Information }
{ MBMS-Information }
{ SMS-Information }
{ MMTel-Information }
{ Service-Generic-Information }
{ IM-Information }
{ DCD-Information }
```

Table 12: Diameter Gy CCR: Service-Information grouped AVP description

AVP code	AVP name	Description
3GPP – 874	PS-Information ↳ (grouped AVP)	Allows the transmission of additional Packet Switched service-specific information elements.

Table 13: Diameter Gy CCR: Service-Information grouped AVP format

AVP code	AVP name	Standard	Data format	Flags
3GPP – 874	PS-Information ↳ (grouped AVP)	TS 32.299	Grouped	V

3.2.7 Diameter Gy CCR – PS-Information grouped AVP

Grouped AVP format as defined in TS 32.299:

Strikethrough formatted AVPs are not included in CCR. *Italic* formatted AVPs listed at the end are not defined in TS 32.299.

For a description and format of the AVPs embedded in the grouped PS-Information AVP, see [Table 2: Diameter Gy CCR: top level AVP description](#) and [Table 3: Diameter Gy CCR: top level AVP format](#).

```

PS-Information ::= < AVP Header: 874>
    [ 3GPP-Charging-Id ]
    { PDN-Connection-ID }

{ Node-Id }
{ 3GPP-PDP-Type }
{ PDP-Address }
{ Dynamic-Address-Flag }
{ QoS-Information }
{ SGSN-Address }
    [ GGSN-Address ]
    { CG-Address }

{ Serving-Node-Type }
{ SGW-Change }
{ 3GPP-IMSI-MCC-MNC }
{ IMSI-Unauthenticated-Flag }
{ 3GPP-GGSN-MCC-MNC }
    [ 3GPP-NSAPI ]
    [ Called-Station-Id ]
    [ 3GPP-Session-Stop-Indicator ]
    [ 3GPP-Selection-Mode ]
    [ 3GPP-Charging-Characteristics ]
    { Charging-Characteristics-Selection-Mode }

{ 3GPP-SGSN-MCC-MNC }
{ 3GPP-MS-TimeZone }
    * [ Charging-Rule-Base-Name ]
    { 3GPP-User-Location-Info }

{ User-CSG-Information }
{ 3GPP2-BSID }
    [ 3GPP-RAT-Type ]
    { PS-Furnish-Charging-Information }
    [ PDP-Context-Type ]
    { Offline-Charging }
    * { Traffic-Data-Volumes }
    * { Service-Data-Container }

{ User-Equipment-Info }
{ Terminal-Information }
{ Start-Time }
{ Stop-Time }
{ Change-Condition }
{ Diagnostics }
[ Framed-IP-Address ]
[ Framed-IPv6-Prefix ]
[ Delegated-IPv6-Prefix ]
[ Alc-IPv6-Address ]
[ 3GPP-IMSI ]
[ 3GPP-GPRS-Negotiated-QoS-profile ]
[ 3GPP-GGSN-Address ]
[ 3GPP-GGSN-IPv6-Address ]

```

4 Diameter Gy – Credit-Control-Answer (CCA) command

This section describes the Diameter Gy CCA message format as defined in RFC 4006. Strikethrough formatted AVPs should not appear or are ignored in CCA. *Italic* formatted AVPs listed after [AVP] are not defined in RFC 4006.

```

<Credit-Control-Answer> ::= < Diameter Header: 272, PXY >
                                < Session-Id >
                                { Result-Code }
                                { Origin-Host }
                                { Origin-Realm }
                                { Auth-Application-Id }
                                { CC-Request-Type }
                                { CC-Request-Number }
                                { User-Name }
                                [ CC-Session-Failover ]
                                { CC-Sub-Session-Id }

{ Acct-Multi-Session-Id }
{ Origin-State-Id }
{ Event-Timestamp }
{ Granted-Service-Unit }

                                *[ Multiple-Services-Credit-Control ]
                                { Cost-Information }

{ Final-Unit-Indication }
{ Check-Balance-Result }

                                [ Credit-Control-Failure-Handling ]
                                { Direct-Debiting-Failure-Handling }

{ Validity-Time }

                                *{ Redirect-Host }

{ Redirect-Host-Usage }
{ Redirect-Max-Cache-Time }

                                *{ Proxy-Info }
                                *{ Route-Record }
                                *[ Failed-AVP ]
                                *[ AVP ]
                                [ Charging-Rule-Base-Name ]

```

4.1 Diameter Gy – CCA message top level AVPs

Table 14: Diameter Gy CCA: top level AVP description provides a detailed description for each top level AVP present in a Diameter Gy CCA message. Unless mentioned different in the description, the AVP is present in Initial, Update and Terminate messages. Grouped AVPs are marked with “↳ (grouped AVP)”. The grouped AVP format and embedded AVP description and format are described in section [Diameter Gy – CCA message grouped AVPs](#).

Table 14: Diameter Gy CCA: top level AVP description

AVP code	AVP name	Description
258	Auth-Application-Id	Fixed value: 4 = Diameter Credit Control Application

AVP code	AVP name	Description
263	Session-id	<p>A session is a logical concept at the application layer that exists between the Diameter client and the Diameter server; it is identified via the Session-Id AVP.</p> <p>Format:</p> <p><DiameterIdentity>;<high 32 bits>;<low 32 bits></p> <ul style="list-style-type: none"> • <DiameterIdentity> is the configured origin host • <high 32 bits> are encoded as the Diameter initialization time (the number of seconds since 1 Jan 1970) • <low 32 bits> are encoded as a sequentially increasing number starting at 1 <p>Example: bng.nokia.com;1326398325;1</p>
264	Origin-Host	<p>Diameter Identity. Used as destination host in the next Diameter message.</p> <p>Example: server.nokia.com</p>
268	Result-Code	<p>Values:</p> <p>2001 = Diameter Success</p> <p>3xxx = Protocol Errors</p> <p>4001 = Diameter Authentication Rejected</p> <p>4010 = Diameter End User Service Denied (CCA-U only)</p> <p>4011 = Diameter Credit Control Not Applicable</p> <p>4012 = Diameter Credit Limit Reached (CCA-U only)</p> <p>5003 = Diameter Authorization Rejected</p> <p>5030 = Diameter User Unknown</p> <p>5031 = Diameter Rating Failed (CCA-U only)</p> <p>Values not listed result in a Diameter Session Failure and the Credit Control Failure Handling action is executed.</p>
278	Failed-AVP ↳ (grouped AVP)	Provides debugging information when CCR is rejected or not fully processed because of unsupported AVP or AVP value.
296	Origin-Realm	<p>Diameter Identity. Used as destination host in the next Diameter message.</p> <p>Example: nokia.com</p>
415	CC-Request-Number	<p>Values:</p> <p>CCA-Initial: 0</p>

AVP code	AVP name	Description
		CCA-Update and CCA-Termination: sequence number
416	CC-Request-Type	<p>Values:</p> <p>1 = Initial Answer</p> <p>2 = Update Answer</p> <p>3 = Termination Answer</p>
418	CC-Session-Failover	<p>Specifies if a secondary peer should be attempted in case of Credit Control Failure Handling.</p> <p>Use the commands in the following context to override the configured failover value:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy on-failure failover [true false] handling [terminate continue retry-and-terminate]</pre> classic CLI <pre>configure subscriber-mgmt diameter- application-policy on-failure [failover {enabled disabled}] [handling {continue retry-and-terminate terminate}]</pre> <p>Values:</p> <p>0 = Failover Not Supported</p> <p>1 = Failover Supported</p>
427	Credit-Control-Failure-Handling	<p>Action to take when the Credit Control client does not receive a valid CCA message within the interval specified with tx-timer (default 10s).</p> <p>Use the following commands to override the configured failure handling:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy- policy on-failure failover enabled handling [terminate continue retry-and-terminate]</pre> classic CLI <pre>configure subscriber-mgmt diameter- application-policy on-failure [failover {enabled disabled}] [handling {continue retry-and-terminate terminate}]</pre> <p>Values:</p> <p>0 = Terminate</p> <p>1 = Continue</p>

AVP code	AVP name	Description
		2 = Retry and terminate
456	Multiple-Services-Credit-Control ↳ (grouped AVP)	Up to sixteen Multiple-Services-Credit-Control AVPs, each corresponding to a rating group. A rating group maps to a category configured in a category-map: configure subscriber-mgmt category-map category rating-group
3GPP – 1004	Charging-Rule-Base-Name	(CCA-I only) Assigns the category-map or overrides the category-map obtained in authentication. value: category-map-name: the name of the category-map to be used for this session

Table 15: Diameter Gy CCA: top level AVP format

AVP code	AVP name	Standard	Data format	Flags
258	Auth-Application-Id	RFC 6733/RFC 4006	Unsigned 32	M
263	Session-id	RFC 6733	UTF8 String	M
264	Origin-Host	RFC 6733	Diameter Identity	M
268	Result-Code	RFC 6733/RFC 4006	Unsigned 32	M
278	Failed-AVP ↳ (grouped AVP)	RFC 6733	Grouped	M
296	Origin-Realm	RFC 6733	Diameter Identity	M
415	CC-Request-Number	RFC 4006	Unsigned 32	M
416	CC-Request-Type	RFC 4006	Enumerated	M
418	CC-Session-Failover	RFC 4006	Enumerated	M
427	Credit-Control-Failure-Handling	RFC 4006	Enumerated	M
456	Multiple-Services-Credit-Control ↳ (grouped AVP)	RFC 4006	Grouped	M
3GPP – 1004	Charging-Rule-Base-Name	TS 29.212	Octet String	V, M

4.2 Diameter Gy – CCA message grouped AVPs

This section provides an overview of CCA message grouped AVPs.

4.2.1 Diameter Gy CCA – Failed-AVP grouped AVP

Grouped AVP format as defined in RFC 6733:

```
<Failed-AVP> ::= < AVP Header: 279 >
                1* {AVP}
```

The failed-AVP AVP contains the entire AVP that could not be processed successfully.

4.2.2 Diameter Gy CCA – Multiple-Services-Credit-Control grouped AVP

Grouped AVP format as defined in RFC 4006: ~~Strikethrough~~ formatted AVPs should not appear or are ignored in CCA. *Italic* formatted AVPs listed after [AVP] are not defined in RFC 4006.

```
Multiple-Services-Credit-Control ::= < AVP Header: 456 >
                                     [ Granted-Service-Unit ]
                                     [ Requested-Service-Unit ]
                                     *[ Used-Service-Unit ]
[ Tariff-Change-Usage ]
                                     *[ Service-Identifier ]
                                     [ Rating-Group ]
                                     *[ G-S-U-Pool-Reference ]
                                     [ Validity-Time ]
                                     [ Result-Code ]
                                     [ Final-Unit-Indication ]
                                     *[ AVP ]
                                     [ Time-Quota-Threshold ]
                                     [ Volume-Quota-Threshold ]
                                     [ Quota-Holding-Time ]
```

Table 16: Diameter Gy CCA: Multiple-Services-Credit-Control grouped AVP description

AVP code	AVP name	Description
268	Result-Code	Values: 2001 = Diameter Success 4010 = Diameter End User Service Denied 4011 = Diameter Credit Control Not Applicable 4012 = Diameter Credit Limit Reached 5003 = Diameter Authorization Rejected 5031 = Diameter Rating Failed Values not listed result in a Diameter Session Failure and the Credit Control Failure Handling action is executed.

AVP code	AVP name	Description
430	Final-Unit-Indication ↳ (grouped AVP)	<p>This AVP indicates that the Granted-Service-Unit contains the final units for the service. When this quota is consumed, a final reporting is started (CCR-U or CCR-T) with reporting reason "Final". The final reporting can be disabled with the following commands:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt diameter-gy-policy gy out-of-credit-reporting quota-exhausted</pre> classic CLI <pre>configure subscriber-mgmt diameter-application-policy gy out-of-credit-reporting quota-exhausted</pre>
431	Granted-Service-Unit ↳ (grouped AVP)	Amount of service units that the Diameter credit control client can provide to the end user until the service must be released or a new CCR message must be sent.
432	Rating-Group	<p>Rating group for which the quota is allocated. The rating group corresponds with a category within a category-map defining the queues and policers and direction to monitor.</p> <pre>configure subscriber-mgmt category-map category rating-group</pre>
448	Validity-Time	<p>If the granted service units have not been consumed within the validity time, a CCR-U is triggered with Reporting Reason AVP set to 4 (Validity Time).</p> <p>Value in seconds</p>
3GPP – 868	Time-Quota-Threshold	<p>Threshold preventing time quota exhaustion before refreshing. When the used time quota exceeds the threshold, a CCR-U is triggered with Reporting Reason AVP set to 0 (Threshold).</p> <p>Value in seconds</p>
3GPP – 869	Volume-Quota-Threshold	<p>Threshold preventing volume quota exhaustion before refreshing. When the used volume quota exceeds the threshold, a CCR-U is triggered with Reporting Reason AVP set to 0 (Threshold).</p> <p>Value in octets</p>
3GPP – 871	Quota-Holding-Time	<p>Specifies an idle-timeout associated with the granted service units. If no traffic associated with the quota is observed for the time specified by the quota holding time, then a CCR-U is triggered with Reporting Reason AVP set to 1 (Quota Holding Time). The idle time is measured per sampling period.</p> <p>Value in seconds</p>

Table 17: Diameter Gy CCA: Multiple-Services-Credit-Control grouped AVP format

AVP code	AVP name	Standard	Data format	Flags
268	Result-Code	RFC 6733/RFC 4006	Unsigned 32	M
430	Final-Unit-Indication ↳ (grouped AVP)	RFC 4006	Grouped	M
431	Granted-Service-Unit ↳ (grouped AVP)	RFC 4006	Grouped	M
432	Rating-Group	RFC 4006	Unsigned 32	M
448	Validity-Time	RFC 4006	Unsigned 32	M
3GPP – 868	Time-Quota-Threshold	TS 32.299	Unsigned 32	V, M
3GPP – 869	Volume-Quota-Threshold	TS 32.299	Unsigned 32	V, M
3GPP – 871	Quota-Holding-Time	TS 32.299	Unsigned 32	V, M

4.2.3 Diameter Gy CCA – Final-Unit-Indication grouped AVP

Grouped AVP format as defined in RFC 4006: ~~Strikethrough~~ formatted AVPs should not appear or are ignored in CCA.

```
Final-Unit-Indication ::= < AVP Header: 430 >
    { Final-Unit-Action }
    *{ Restriction-Filter-Rule }
    *{ Filter-Id }
    [ Redirect-Server ]
```

Table 18: Diameter Gy CCA: Final-Unit-Indication grouped AVP description

AVP code	AVP name	Description
434	Redirect-Server ↳ (grouped AVP)	<p>This AVP is included when the Final-Unit-Action AVP is set to REDIRECT (1) and contains the URL to which the user must be redirected. The URL overrides the URL specified with the following commands:</p> <ul style="list-style-type: none"> MD-CLI <pre>configure subscriber-mgmt category-map category exhausted-credit-service- level ingress ip-filter entry 1 action http-redirect</pre>

AVP code	AVP name	Description
		<ul style="list-style-type: none"> classic CLI <pre>configure subscriber-mgmt category-map category exhausted-credit-service- level ingress-ip-filter-entries entry action http-redirect url allow- override</pre> <p>The AVP is ignored when the out-of-credit action is different from change-service-level or when no http-redirect action with allow-override is configured.</p>
449	Final-Unit-Action	<p>If the value is Terminate, then the session is terminated and the corresponding subscriber host deleted.</p> <p>If the value is Redirect or Restrict Access, then the out-of-credit action as configured for that rating group (category) is executed using the following command:</p> <pre>configure subscriber-mgmt credit-control- policy out-of-credit-action</pre> <p>Alternately, the following command can be used to configure out of credit action:</p> <pre>configure subscriber-mgmt category-map category out-of-credit-action-override</pre> <p>Values:</p> <p>0 = Terminate</p> <p>1 = Redirect</p> <p>2 = Restrict Access</p>

Table 19: Diameter Gy CCA: Final-Unit-Indication grouped AVP format

AVP code	AVP name	Standard	Data format	Flags
434	Redirect-Server ↳ (grouped AVP)	RFC 4006	Enumerated	M
449	Final-Unit-Action	RFC 4006	Enumerated	M

4.2.4 Diameter Gy CCA - Redirect-Server grouped AVP

Grouped AVP format as defined in RFC 4006.

```
Redirect-Server ::= < AVP Header: 434 >
    { Redirect-Address-Type }
    { Redirect-Server-Address }
```

Table 20: Diameter Gy CCA: Redirect-Server grouped AVP description

AVP code	AVP name	Description
433	Redirect-Address-Type	Must be set to URL (2). The Redirect-Server-Address AVP is ignored when set to a different value.
435	Redirect-Server-Address	<p>Contains the IPv4 HTTP redirect URL that is used when the Final-Unit-Action REDIRECT is triggered for the rating group that corresponds with the MSCC in which the Final-Unit-Indication AVP is included.</p> <p>The URL specified in the Redirect-Server-Address AVP is only used when all following conditions are met:</p> <ul style="list-style-type: none"> • The Final-Unit-Indication AVP is present in the Multiple-Services-Credit-Control AVP • The Final-Unit-Action is set to REDIRECT (1) • The Redirect-Address-Type is set to URL (2) • The out-of-credit action for the corresponding rating group is set to change-service-level: <pre>configure subscriber-mgmt credit-control-policy out-of-credit-action change-service-level</pre> <p>Alternately, the following command can be used to set the change service level:</p> <pre>configure subscriber-mgmt category-map category out-of-credit-action-override change-service-level</pre> <ul style="list-style-type: none"> • An IPv4 HTTP redirect action with allow-override is specified as exhausted-credit-service-level for the corresponding rating group: <p>– MD-CLI</p> <pre>configure subscriber-mgmt category-map category exhausted-credit-</pre>

AVP code	AVP name	Description
		<pre>service-level ingress ip-filter entry action http-redirect url allow-override</pre> <p>– classic CLI</p> <pre>configure subscriber-mgmt category- map category exhausted-credit- service-level ingress-ip-filter- entries entry action http-redirect url allow-override</pre>
435 (continued)		<p>In all other cases, the Redirect-Server-Address AVP is ignored.</p> <p>The maximum URL length is 255 characters and can include the same macro substitutions such as \$IP (customer's IP address), \$MAC (customer's MAC address), \$URL (original requested URL), as supported for a static configured HTTP redirect URL.</p>

Table 21: Diameter Gy CCA: Redirect-Server grouped AVP format

AVP code	AVP name	Standard	Data format	Flags
433	Redirect-Address-Type	RFC 4006	Enumerated	M
435	Redirect-Server-Address	RFC 4006	Enumerated	M

4.2.5 Diameter Gy CCA – Granted-Service-Unit grouped AVP

Grouped AVP format as defined in RFC 4006. Strikethrough formatted AVPs should not appear or are ignored in CCA.

```
Granted-Service-Unit ::= < AVP Header: 431 >
    [ Tariff-Time-Change ]
    [ CC-Time ]
    [ CC-Money ]
    [ CC-Total-Octets ]
    [ CC-Input-Octets ]
    [ CC-Output-Octets ]
    [ CC-Service-Specific-Units ]
    * [ AVP ]
```

For a single rating group (category), either Volume or Time quota can be granted. Granting both time and volume quota for a single rating group is not supported and results in a Diameter Session Failure and the execution of the Credit Control Failure Handling action.

Table 22: Diameter Gy CCA: Granted-Service-Unit grouped AVP description

AVP code	AVP name	Description
420	CC-Time	Amount of granted time Value: in seconds
421	CC-Total-Octets	Total number of octets regardless of the direction (quota can be consumed for ingress or egress) Value: in octets

Table 23: Diameter Gy CCA: Granted-Service-Unit grouped AVP format

AVP code	AVP name	Standard	Data format	Flags
420	CC-Time	RFC 4006	Unsigned 32	M
421	CC-Total-Octets	RFC 4006	Unsigned 64	M

5 Diameter Gy – Re-Auth-Request (RAR) command

5.1 Diameter Gy – RAR message format

This section describes the Diameter Gy RAR message format as defined in RFC 6733. Strikethrough formatted AVPs should not appear or are ignored in RAR.

A RAR message triggers an intermediate interrogation (CCR-U) with Reporting-Reason set to "Forced Reauthorization".

```
<RAR> ::= < Diameter Header: 258, REQ, PXY >
        < Session-Id >
        { Origin-Host }
        { Origin-Realm }
        { Destination-Realm }
        { Destination-Host }
        { Auth-Application-Id }
        { Re-Auth-Request-Type }
        { User-Name }
{ Origin-State-Id }
        * { Proxy-Info }
        * { Route-Record }
        * { AVP }
```

5.2 Diameter Gy – RAR message top level AVPs

[Table 24: Diameter Gy RAR: top level AVP description](#) provides a detailed description for each top level AVP present in a Diameter Gy RAR message.

Table 24: Diameter Gy RAR: top level AVP description

AVP code	AVP name	Description
258	Auth-Application-Id	Fixed value: 4 = Diameter Credit Control Application
263	Session-id	<div>A session is a logical concept at the application layer that exists between the Diameter client and the Diameter server; it is identified via the Session-Id AVP.</div> <div>Format:</div> <div><DiameterIdentity>;<high 32 bits>;<low 32 bits></div> <div><ul style="list-style-type: none"><DiameterIdentity> is the configured origin host</div>

AVP code	AVP name	Description
		<ul style="list-style-type: none"> <high 32 bits> are encoded as the Diameter initialization time (the number of seconds since 1 January, 1970) <low 32 bits> are encoded as a sequentially increasing number starting at 1 <p>Example: bng.nokia.com;1326398325;1</p>
264	Origin-Host	Diameter Identity. Used as destination host in the next Diameter message. Example: server.nokia.com
283	Destination-Realm	Diameter Identity. Example: nokia.com
285	Re-Auth-Request-Type	Values: 0 = Authorize-Only
293	Destination-Host	Diameter Identity. Example: bng.nokia.com
296	Origin-Realm	Diameter Identity. Used as destination realm in the next Diameter message. Example: nokia.com

Table 25: Diameter Gy RAR: top level AVP format

AVP code	AVP name	Standard	Data format	Flags
258	Auth-Application-Id	RFC 6733/RFC 4006	Unsigned 32	M
263	Session-id	RFC 6733	UTF8 String	M
264	Origin-Host	RFC 6733	Diameter Identity	M
283	Destination-Realm	RFC 6733	Diameter Identity	M
285	Re-Auth-Request-Type	RFC 6733	Enumerated	M
293	Destination-Host	RFC 6733	Diameter Identity	M
296	Origin-Realm	RFC 6733	Diameter Identity	M

6 Diameter Gy – Re-Auth-Answer (RAA) command

6.1 Diameter Gy – RAA message format

This section describes the Diameter Gy RAA message format as defined in RFC 6733. Strikethrough formatted AVPs are not included in RAA.

```
<RAA> ::= < Diameter Header: 258, PXY >
        < Session-Id >
        { Result-Code }
        { Origin-Host }
        { Origin-Realm }
        { User-Name }
{ Origin-State-Id }
{ Error-Message }
{ Error-Reporting-Host }
{ Failed-AVP }
        * { Redirect-Host }
{ Redirect-Host-Usage }
{ Redirect-Max-Cache-Time }
        * { Proxy-Info }
        * { AVP }
```

6.2 Diameter Gy – RAA message top level AVPs

[Table 26: Diameter Gy RAA: top level AVP description](#) provides a detailed description for each top level AVP present in a Diameter Gy RAA message.

Table 26: Diameter Gy RAA: top level AVP description

AVP code	AVP name	Description
263	Session-id	<p>A session is a logical concept at the application layer that exists between the Diameter client and the Diameter server; it is identified via the Session-Id AVP.</p> <p>Format:</p> <p><DiameterIdentity>;<high 32 bits>;<low 32 bits></p> <ul style="list-style-type: none"><DiameterIdentity> is the configured origin host<high 32 bits> are encoded as the Diameter initialization time (the number of seconds since 1 January, 1970)<low 32 bits> are encoded as a sequentially increasing number starting at 1

AVP code	AVP name	Description
		Example: bng.nokia.com;1326398325;1
264	Origin-Host	Diameter Identity. As configured in the corresponding diameter-peer-policy Example: bng.nokia.com
268	Result-Code	Values: 2002 = Diameter Limited Success 5002 = Diameter Unknown Session ID 5012 = Diameter Unable To Comply - AVP parsing errors or message errors
296	Origin-Realm	Diameter Identity. As configured in the corresponding diameter-peer-policy Example: nokia.com

Table 27: Diameter Gy RAA: top level AVP format

AVP code	AVP name	Standard	Data format	Flags
263	Session-id	RFC 6733	UTF8 String	M
264	Origin-Host	RFC 6733	Diameter Identity	M
268	Result-Code	RFC 6733/RFC 4006	Unsigned 32	M
296	Origin-Realm	RFC 6733	Diameter Identity	M

7 Diameter Gy – Abort-Session-Request (ASR) command

7.1 Diameter Gy – ASR message format

This section describes the Diameter Gy ASR message format as defined in RFC 6733. Strikethrough formatted AVPs should not appear or are ignored in ASR.

An Abort-Session-Request message triggers a deletion of the Diameter session: an Abort-Session-Answer is generated, followed by a CCR-T. The corresponding subscriber host is deleted from the system.

```
<ASR> ::= < Diameter Header: 274, REQ, PXY >
        < Session-Id >
        { Origin-Host }
        { Origin-Realm }
        { Destination-Realm }
        { Destination-Host }
        { Auth-Application-Id }
        { User-Name }
{ Origin-State-Id }
* { Proxy-Info }
* { Route-Record }
* { AVP }
```

7.2 Diameter Gy – ASR message top level AVPs

[Table 28: Diameter Gy ASR: top level AVP description](#) provides a detailed description for each top level AVP present in a Diameter Gy ASR message.

Table 28: Diameter Gy ASR: top level AVP description

AVP code	AVP name	Description
258	Auth-Application-Id	Fixed value: 4 = Diameter Credit Control Application
263	Session-id	A session is a logical concept at the application layer that exists between the Diameter client and the Diameter server; it is identified via the Session-Id AVP. Format: <DiameterIdentity>;<high 32 bits>;<low 32 bits> <ul style="list-style-type: none"><DiameterIdentity> is the configured origin host<high 32 bits> are encoded as the Diameter initialization time (the number of seconds since 1 Jan 1970)

AVP code	AVP name	Description
		<ul style="list-style-type: none"> <low 32 bits> are encoded as a sequentially increasing number starting at 1 Example: bng.nokia.com;1326398325;1
264	Origin-Host	Diameter Identity. Used as destination host in the next Diameter message. Example: server.nokia.com
283	Destination-Realm	Diameter Identity. Example: nokia.com
293	Destination-Host	Diameter Identity. Example: bng.nokia.com
296	Origin-Realm	Diameter Identity. Used as destination realm in the next Diameter message. Example: nokia.com

Table 29: Diameter Gy ASR: top level AVP format

AVP code	AVP name	Standard	Data format	Flags
258	Auth-Application-Id	RFC 6733/RFC 4006	Unsigned 32	M
263	Session-id	RFC 6733	UTF8 String	M
264	Origin-Host	RFC 6733	Diameter Identity	M
283	Destination-Realm	RFC 6733	Diameter Identity	M
293	Destination-Host	RFC 6733	Diameter Identity	M
296	Origin-Realm	RFC 6733	Diameter Identity	M

8 Diameter Gy – Abort-Session-Answer (ASA) command

8.1 Diameter Gy – ASA message format

This section describes the Diameter Gy ASA message format as defined in RFC 6733. Strikethrough formatted AVPs are not included in ASA.

```
<ASA> ::= < Diameter Header: 274, PXY >
        < Session-Id >
        { Result-Code }
        { Origin-Host }
        { Origin-Realm }
        { User-Name }
{ Origin-State-Id }
{ Error-Message }
{ Error-Reporting-Host }
{ Failed-AVP }
        * { Redirect-Host }
{ Redirect-Host-Usage }
{ Redirect-Max-Cache-Time }
        * { Proxy-Info }
        * { AVP }
```

8.2 Diameter Gy – ASA message top level AVPs

[Table 30: Diameter Gy ASA: top level AVP description](#) provides a detailed description for each top level AVP present in a Diameter Gy ASA message.

Table 30: Diameter Gy ASA: top level AVP description

AVP code	AVP name	Description
263	Session-id	<p>A session is a logical concept at the application layer that exists between the Diameter client and the Diameter server; it is identified via the Session-Id AVP.</p> <p>Format:</p> <p><DiameterIdentity>;<high 32 bits>;<low 32 bits></p> <ul style="list-style-type: none"><DiameterIdentity> is the configured origin host<high 32 bits> are encoded as the Diameter initialization time (the number of seconds since 1 Jan 1970)<low 32 bits> are encoded as a sequentially increasing number starting at 1

AVP code	AVP name	Description
		Example: bng.nokia.com;1326398325;1
264	Origin-Host	Diameter Identity. As configured in the corresponding diameter-peer-policy Example: bng.nokia.com
268	Result-Code	Values: 2002 = Diameter Limited Success 5002 = Diameter Unknown Session ID 5012 = Diameter Unable To Comply — AVP parsing errors or message errors
296	Origin-Realm	Diameter Identity. As configured in the corresponding diameter-peer-policy Example: nokia.com

Table 31: Diameter Gy ASA: top level AVP format

AVP code	AVP name	Standard	Data format	Flags
263	Session-id	RFC 6733	UTF8 String	M
264	Origin-Host	RFC 6733	Diameter Identity	M
268	Result-Code	RFC 6733/RFC 4006	Unsigned 32	M
296	Origin-Realm	RFC 6733	Diameter Identity	M

9 Standards and protocol support

**Note:**

The information provided in this chapter is subject to change without notice and may not apply to all platforms.

Nokia assumes no responsibility for inaccuracies.

9.1 Access Node Control Protocol (ANCP)

draft-ietf-ancp-protocol-02, *Protocol for Access Node Control Mechanism in Broadband Networks*

RFC 5851, *Framework and Requirements for an Access Node Control Mechanism in Broadband Multi-Service Networks*

9.2 Bidirectional Forwarding Detection (BFD)

draft-ietf-lsr-ospf-bfd-strict-mode-10, *OSPF BFD Strict-Mode*

RFC 5880, *Bidirectional Forwarding Detection (BFD)*

RFC 5881, *Bidirectional Forwarding Detection (BFD) IPv4 and IPv6 (Single Hop)*

RFC 5882, *Generic Application of Bidirectional Forwarding Detection (BFD)*

RFC 5883, *Bidirectional Forwarding Detection (BFD) for Multihop Paths*

RFC 7130, *Bidirectional Forwarding Detection (BFD) on Link Aggregation Group (LAG) Interfaces*

RFC 7880, *Seamless Bidirectional Forwarding Detection (S-BFD)*

RFC 7881, *Seamless Bidirectional Forwarding Detection (S-BFD) for IPv4, IPv6, and MPLS*

RFC 7883, *Advertising Seamless Bidirectional Forwarding Detection (S-BFD) Discriminators in IS-IS*

RFC 7884, *OSPF Extensions to Advertise Seamless Bidirectional Forwarding Detection (S-BFD) Target Discriminators*

RFC 9247, *BGP - Link State (BGP-LS) Extensions for Seamless Bidirectional Forwarding Detection (S-BFD)*

9.3 Border Gateway Protocol (BGP)

draft-gredler-idr-bgplu-epe-14, *Egress Peer Engineering using BGP-LU*

draft-hares-idr-update-attr-low-bits-fix-01, *Update Attribute Flag Low Bits Clarification*

draft-ietf-idr-add-paths-guidelines-08, *Best Practices for Advertisement of Multiple Paths in IBGP*

draft-ietf-idr-best-external-03, *Advertisement of the best external route in BGP*

draft-ietf-idr-bgp-flowspec-oid-03, *Revised Validation Procedure for BGP Flow Specifications*
draft-ietf-idr-bgp-gr-notification-01, *Notification Message support for BGP Graceful Restart*
draft-ietf-idr-bgp-optimal-route-reflection-10, *BGP Optimal Route Reflection (BGP-ORR)*
draft-ietf-idr-error-handling-03, *Revised Error Handling for BGP UPDATE Messages*
draft-ietf-idr-flowspec-interfaceset-03, *Applying BGP flowspec rules on a specific interface set*
draft-ietf-idr-flowspec-path-redirect-05, *Flowspec Indirection-id Redirect – localised ID*
draft-ietf-idr-flowspec-redirect-ip-02, *BGP Flow-Spec Redirect to IP Action*
draft-ietf-idr-link-bandwidth-03, *BGP Link Bandwidth Extended Community*
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RFC 1997, *BGP Communities Attribute*
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ITU-T G.8265.1, *Precision time protocol telecom profile for frequency synchronization*
ITU-T G.8272 , *Timing characteristics of primary reference time clocks – PRTC-A, PRTC-B*
ITU-T G.8275.1, *Precision time protocol telecom profile for phase/time synchronization with full timing support from the network*
ITU-T G.8275.2, *Precision time protocol telecom profile for phase/time synchronization with partial timing support from the network*
RFC 3339, *Date and Time on the Internet: Timestamps*
RFC 5905, *Network Time Protocol Version 4: Protocol and Algorithms Specification*
RFC 8573, *Message Authentication Code for the Network Time Protocol*

9.37 Two-Way Active Measurement Protocol (TWAMP)

RFC 5357, *A Two-Way Active Measurement Protocol (TWAMP) – server, unauthenticated mode*
RFC 5938, *Individual Session Control Feature for the Two-Way Active Measurement Protocol (TWAMP)*
RFC 6038, *Two-Way Active Measurement Protocol (TWAMP) Reflect Octets and Symmetrical Size Features*
RFC 8545, *Well-Known Port Assignments for the One-Way Active Measurement Protocol (OWAMP) and the Two-Way Active Measurement Protocol (TWAMP) – TWAMP*
RFC 8762, *Simple Two-Way Active Measurement Protocol – unauthenticated*
RFC 8972, *Simple Two-Way Active Measurement Protocol Optional Extensions – unauthenticated*
RFC 9503, *Simple Two-Way Active Measurement Protocol (STAMP) Extensions for Segment Routing Networks – excluding Sections 3, 4.1.2 and 4.1.3*
RFC 9534, *Simple Two-Way Active Measurement Protocol Extensions for Performance Measurement on a Link Aggregation Group*

9.38 Virtual Private LAN Service (VPLS)

RFC 4761, *Virtual Private LAN Service (VPLS) Using BGP for Auto-Discovery and Signaling*

RFC 4762, *Virtual Private LAN Service (VPLS) Using Label Distribution Protocol (LDP) Signaling*

RFC 5501, *Requirements for Multicast Support in Virtual Private LAN Services*

RFC 6074, *Provisioning, Auto-Discovery, and Signaling in Layer 2 Virtual Private Networks (L2VPNs)*

RFC 7041, *Extensions to the Virtual Private LAN Service (VPLS) Provider Edge (PE) Model for Provider Backbone Bridging*

RFC 7117, *Multicast in Virtual Private LAN Service (VPLS)*

9.39 Voice and video

DVB BlueBook A86, *Transport of MPEG-2 TS Based DVB Services over IP Based Networks*

ETSI TS 101 329-5 Annex E, *QoS Measurement for VoIP - Method for determining an Equipment Impairment Factor using Passive Monitoring*

ITU-T G.1020 Appendix I, *Performance Parameter Definitions for Quality of Speech and other Voiceband Applications Utilizing IP Networks - Mean Absolute Packet Delay Variation & Markov Models*

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ITU-T P.564, *Conformance testing for voice over IP transmission quality assessment models*

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RFC 4585, *Extended RTP Profile for Real-time Transport Control Protocol (RTCP)-Based Feedback (RTP/AVPF)*

RFC 4588, *RTP Retransmission Payload Format*

9.40 Yet Another Next Generation (YANG)

RFC 6991, *Common YANG Data Types*

RFC 7950, *The YANG 1.1 Data Modeling Language*

RFC 7951, *JSON Encoding of Data Modeled with YANG*

9.41 Yet Another Next Generation (YANG) OpenConfig Models

openconfig-aaa.yang version 0.4.0, *OpenConfig AAA Model*

openconfig-aaa-radius.yang version 0.3.0, *OpenConfig AAA RADIUS Model*

openconfig-aaa-tacacs.yang version 0.3.0, *OpenConfig AAA TACACS+ Model*

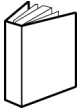
openconfig-acl.yang version 1.0.0, *OpenConfig ACL Model*

openconfig-alarms.yang version 0.3.2, *OpenConfig Alarms Model*

openconfig-bfd.yang version 0.2.2, *OpenConfig BFD Model*
openconfig-bgp.yang version 6.1.0, *OpenConfig BGP Model*
openconfig-bgp-common.yang version 6.0.0, *OpenConfig BGP Common Model*
openconfig-bgp-common-multiprotocol.yang version 6.0.0, *OpenConfig BGP Common Multiprotocol Model*
openconfig-bgp-common-structure.yang version 6.0.0, *OpenConfig BGP Common Structure Model*
openconfig-bgp-global.yang version 6.0.0, *OpenConfig BGP Global Model*
openconfig-bgp-neighbor.yang version 6.1.0, *OpenConfig BGP Neighbor Model*
openconfig-bgp-peer-group.yang version 6.1.0, *OpenConfig BGP Peer Group Model*
openconfig-bgp-policy.yang version 4.0.1, *OpenConfig BGP Policy Model*
openconfig-if-aggregate.yang version 2.4.3, *OpenConfig Interfaces Aggregated Model*
openconfig-if-ethernet.yang version 2.12.2, *OpenConfig Interfaces Ethernet Model*
openconfig-if-ip.yang version 3.9.0, *OpenConfig Interfaces IP Model*
openconfig-if-ip-ext.yang version 2.3.1, *OpenConfig Interfaces IP Extensions Model*
openconfig-igmp.yang version 0.3.1, *OpenConfig IGMP Model*
openconfig-interfaces.yang version 3.8.0, *OpenConfig Interfaces Model*
openconfig-isis.yang version 1.1.0, *OpenConfig IS-IS Model*
openconfig-isis-policy.yang version 0.5.0, *OpenConfig IS-IS Policy Model*
openconfig-isis-routing.yang version 1.1.0, *OpenConfig IS-IS Routing Model*
openconfig-lacp.yang version 2.1.0, *OpenConfig LACP Model*
openconfig-ldp.yang version 0.1.0, *OpenConfig LLDP Model*
openconfig-local-routing.yang version 1.2.0, *OpenConfig Local Routing Model*
openconfig-messages.yang version 0.0.1, *OpenConfig Messages Model*
openconfig-mpls.yang version 2.3.0, *OpenConfig MPLS Model*
openconfig-mpls-ldp.yang version 3.0.2, *OpenConfig MPLS LDP Model*
openconfig-mpls-rsvp.yang version 2.3.0, *OpenConfig MPLS RSVP Model*
openconfig-mpls-te.yang version 2.3.0, *OpenConfig MPLS TE Model*
openconfig-network-instance.yang version 1.1.0, *OpenConfig Network Instance Model*
openconfig-network-instance-l3.yang version 0.11.1, *OpenConfig L3 Network Instance Model – static routes*
openconfig-ospfv2.yang version 0.4.0, *OpenConfig OSPFv2 Model*
openconfig-ospfv2-area.yang version 0.4.0, *OpenConfig OSPFv2 Area Model*
openconfig-ospfv2-area-interface.yang version 0.4.0, *OpenConfig OSPFv2 Area Interface Model*
openconfig-ospfv2-common.yang version 0.4.0, *OpenConfig OSPFv2 Common Model*
openconfig-ospfv2-global.yang version 0.4.0, *OpenConfig OSPFv2 Global Model*
openconfig-packet-match.yang version 1.1.0, *OpenConfig Packet Match Model*
openconfig-pim.yang version 0.4.3, *OpenConfig PIM Model*
openconfig-platform.yang version 0.32.0, *OpenConfig Platform Model*

openconfig-platform-common.yang version 0.32.0, *OpenConfig Common Platform Model*
openconfig-platform-cpu.yang version 0.1.1, *OpenConfig Platform CPU Module*
openconfig-platform-fan.yang version 0.1.1, *OpenConfig Platform Fan Model*
openconfig-platform-linecard.yang version 0.1.2, *OpenConfig Platform Linecard Model*
openconfig-platform-port.yang version 0.4.2, *OpenConfig Port Model*
openconfig-platform-psu.yang version 0.2.1, *OpenConfig Platform PSU Module*
openconfig-platform-transceiver.yang version 0.18.0, *OpenConfig Transceiver Model*
openconfig-procmon.yang version 0.4.0, *OpenConfig Process Monitoring Model*
openconfig-qos.yang version 0.11.2, *OpenConfig QoS Model*
openconfig-qos-elements.yang version 0.11.2, *OpenConfig QoS Elements Model*
openconfig-qos-interfaces.yang version 0.11.2, *OpenConfig QoS Interfaces Model*
openconfig-qos-mem-mgmt.yang version 0.11.2, *OpenConfig QoS Memory Management Model*
openconfig-relay-agent.yang version 0.1.0, *OpenConfig Relay Agent Model*
openconfig-routing-policy.yang version 3.0.0, *OpenConfig Routing Policy Model*
openconfig-rsvp-sr-ext.yang version 0.1.0, *OpenConfig RSVP-TE and SR Extensions Model*
openconfig-system.yang version 3.0.0, *OpenConfig System Model*
openconfig-system-grpc.yang version 1.0.0, *OpenConfig System gRPC Model*
openconfig-system-logging.yang version 0.3.1, *OpenConfig System Logging Model*
openconfig-system-terminal.yang version 0.3.0, *OpenConfig System Terminal Model*
openconfig-telemetry.yang version 0.5.0, *OpenConfig Telemetry Model*
openconfig-terminal-device.yang version 1.9.0, *OpenConfig Terminal Device Model*
openconfig-vlan.yang version 3.2.2, *OpenConfig VLAN Model*

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