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Virtualized Service Router
Release 25.10.R1

Gy AVPs Reference Guide

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Nokia is committed to diversity and inclusion. We are continuously reviewing our customer documentation and consulting with standards bodies to ensure that terminology is inclusive and aligned with the industry. Our future customer documentation will be updated accordingly.

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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	RADIUS username
		The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy aaa-user-name`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp radius-user-name`
		default: not included

8	Framed-IP-Address	The IP address of the IPv4 subscriber host that triggered the creation of the Diameter Gy session.
		The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp address-avp`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp address-avp`
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`

AVP code	AVP name	Description
		• **classic CLI** `configure subscriber-mgmt diameter-application-policy gy include-avp ps-information` default: included

30	Called-Station-Id	The AVP is included if configured in the diameter application policy command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp called-station-id`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp called-station-id`
		Included at the command level or embedded within the [3GPP – 873] Service-Information / [3GPP – 874] PS-Information grouped AVPs using the following commands:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		value: string up to 64 characters
		default: no called-station-id

55	Event-Timestamp	Timestamp when the request was generated.
97	Framed-IPv6-Prefix	The IPv6 prefix of the SLAAC subscriber host that triggered the creation of the Diameter Gy session. The AVP is included if configured in the diameter application policy using the following command: • **MD-CLI** `configure subscriber-mgmt diameter-gy-policy gy include-avp address-avp` • **classic CLI** `configure subscriber-mgmt diameter-gy-policy gy include-avp address-avp`

AVP code	AVP name	Description

		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		default: included

123	Delegated-IPv6-Prefix	The IPv6 prefix of the DHCPv6 IA-PD subscriber host that triggered the creation of the Diameter Gy session.
		The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp address-avp`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp address-avp`
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		default: included

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:

AVP code	AVP name	Description
		<DiameterIdentity>; <high 32 bits>; <low 32 bits> • <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 Example: bng.nokia.com;1326398325;1
264	Origin-Host	Diameter Identity. As configured in the corresponding diameter-peer-policy. Example: bng.nokia.com
278	Origin-State-Id	Initialized to the Diameter process startup time. Encoded as number of seconds since 1 January, 1970.
283	Destination-Realm	Diameter Identity. As configured in the corresponding diameter-peer-policy or learned from CCA/RAR. Example: nokia.com
293	Destination-Host	Diameter Identity. As configured in the corresponding diameter-peer-policy or learned from CCA/RAR. Omitted in CCR-I if not configured. Example: server.nokia.com
295	Termination-Cause	(CCR-T only) Indicates the reason that the credit control session was terminated. Values: 1 = Diameter Logout 4 = Diameter Administrative - a diameter session could not be created because of category mismatch or system resources
296	Origin-Realm	Diameter Identity. As configured in the corresponding diameter-peer-policy. Example: nokia.com
415	CC-Request-Number	Initial Request: 0 Update and Termination Request: sequence number
416	CC-Request-Type	1 = Initial Request 2 = Update Request 3 = Termination Request
443	Subscription-Id	Identifies the subscriber host or session. The value is as configured in the diameter application policy:

AVP code	AVP name	Description

	↳ (grouped AVP)	• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy avp-subscription-id origin`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy avp-subscription-id origin`
		If no data is available for the specified origin, then the subscriber-id is used instead.
		default: avp-subscription-id subscriber-id type private
		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.

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. `configure subscriber-mgmt category-map category rating-group`

458	User-Equipment-Info
	↳ (grouped AVP)
		(GTP access only)
		The AVP is included if configured in the diameter application policy:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp user-equipment-info-type type imeisv`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp user-equipment-info type imeisv`
		value: IMEI as signaled in the GTP Create Session Request message.
		default: not included

461	Service-Context-Id	The AVP is included if configured in the diameter application policy using the following command:

AVP code	AVP name	Description

		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp service-context-id`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp service-context-id`
		value: string of up to 32 characters
		default: no service-context-id

NOKIA – 99	Alc-IPv6-Address	The IPv6 address of the DHCPv6 IA-NA subscriber host that triggered the creation of the Diameter Gy session.
		The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp address-avp`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp address-avp`
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		default: included

3GPP – 1	3GPP-IMSI	The AVP is included if configured in the diameter application policy using the following command: • **MD-CLI** `configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-imsi`

AVP code	AVP name	Description

		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-imsi`
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		values:
		• circuit-id
		• imsi
		• subscriber-id
		default: included with value subscriber-id

3GPP – 2	3GPP-Charging-Id	The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-charging-id`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-charging-id`
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		.

AVP code	AVP name	Description
		values: • 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 default: included with esm-info value (auto)

3GPP – 5	3GPP-GPRS-QoS-Negotiated-Profile	The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-gprs-negotiated-qos-profile`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-gprs-negotiated-qos-profile`
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		value: the active SLA profile name
		default: included

3GPP – 7	3GPP-GGSN-Address	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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-ggsn-ipv4-address`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-ggsn-address`

AVP code	AVP name	Description

		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		Value:
		1. Use the configured IPv4 source address:
		• **MD-CLI**
		`configure aaa diameter-peer-policy ipv4-source-address`
		• **classic CLI**
		`configure aaa diameter-peer-policy source-address`
		2. If the router equals base or vprn 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
		default: included

3GPP – 10	3GPP-NSAPI	The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-nsapi`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-nsapi`
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`

AVP code	AVP name	Description
		• **classic CLI** `configure subscriber-mgmt diameter-application-policy gy include-avp ps-information` value: <system name>;<service-id>;<sap-id> default: included

3GPP – 11	3GPP-Session-Stop-Indicator	(CCR-T only)
		The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-session-stop-indicator`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-session-stop-indicator`
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		Fixed value: 0x FF
		default: included

3GPP – 12	3GPP-Selection-Mode	The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-selection-mode`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-selection-mode`

AVP code	AVP name	Description

		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		Fixed value: 0x 00 00 00 00 (MS or network provided APN, subscribed verified)
		default: included

3GPP – 13	3GPP-Charging-Characteristics	The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-charging-characteristics`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-charging-characteristics`
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		Fixed value: "0000”
		default: included

3GPP – 16	3GPP-GGSN-v6-Address	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:

AVP code	AVP name	Description

		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-ggsn-ipv6-address`
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ps-information`
		value:
		1. Use the configured IPv6 source address:
		`configure aaa diameter peer-policy ipv6-source-address`
		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
		default: not included

3GPP – 21	3GPP-RAT-Type	The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp three-gpp-rat-type`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp 3gpp-rat-type`

AVP code	AVP name	Description
		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: `gy include-avp ps-information` value: [1 to 255] default: not included 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.

3GPP - 22	3GPP-User-Location-Info	(GTP access only)
		Provides UE location details
		The AVP is included if configured in the diameter application policy:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp 3gpp-user-location-info`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp three-gpp-user-location-info`
		value: ULI learned from the GTP Create Session Request message.
		default: not included

3GPP – 847	GGSN-Address	The local address used to setup the diameter peer.
		The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp ggsn-address type (ipv4 | ipv6)`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy include-avp ggsn-address {ipv4 | ipv6}`
		Either IPv4 or IPv6 address can be included.

AVP code	AVP name	Description

		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:
		`gy include-avp ps-information`
		value:
		1. Use the configured IP source address:
		• **MD-CLI**
		`configure aaa diameter peer-policy ipv6-source-address`
		`configure aaa diameter peer-policy ipv4-source-address`
		• **classic CLI**
		`configure aaa diameter-peer-policy ipv6-source-address`
		`configure aaa diameter-peer-policy ipv4-source-address`
		2. 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
		default: not included

3GPP – 873	Service-Information ↳ (grouped AVP)	Grouped AVP containing the [3GPP – 874] PS-Information grouped AVP and embedding following AVPs: • [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
		• [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 The AVP is included if configured in the diameter application policy using the following command: • **MD-CLI** `configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information` • **classic CLI** `configure subscriber-mgmt diameter-gy-policy gy include-avp ps-information` When not configured the above listed AVPs are included at command level. default: no ps-information

3GPP – 1004	Charging-Rule-Base-Name	The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp charging-rule-base-name category-map`
		• **classic CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp charging-rule-base-name category-map-name`
		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:
		`gy include-avp ps-information`
		value:
		• category-map-name: the name of the category-map in use for this session
		• string: a string of max. 64 characters.
		default: charging-rule-base-name category-map-name

AVP code	AVP name	Description

3GPP – 1247	PDP-Context-Type	(CCR-I only)
		The AVP is included if configured in the diameter application policy using the following command:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp pdp-context-type`
		• **classic CLI**
		`configure subscriber-mgmt diameter-gy-policy gy include-avp pdp-context-type`
		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:
		`gy include-avp ps-information`
		Fixed value: 0 (primary)
		default: included

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	Value as configured in the diameter application policy:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy avp-subscription-id origin`
		`configure subscriber-mgmt diameter-gy-policy gy avp-subscription-id type`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy avp-subscription-id origin (circuit-id|dual-stack-remote-id|imei|imsi|mac|msisdn|nas-port-id|subscriber-id|username) [type (e164|imsi|nai|private)]`
		values:
		• 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
		default: type private
		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.

444	Subscription-Id-Data	The value as configured in the diameter application policy: • **MD-CLI** `configure subscriber-mgmt diameter-gy-policy gy avp-subscription-id origin`

AVP code	AVP name	Description

		`configure subscriber-mgmt diameter-gy-policy gy avp-subscription-id type`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy avp-subscription-id origin [type]`
		Note that there is no check if the provided data is in the format of the following configured type.
		values:
		• circuit-id
		• subscriber-id
		• imsi
		• msisdn
		• imei
		default: avp-subscription-id subscriber-id
		For GTP access, the Subscription ID data is learned from GTP and contains the IMSI and MSISDN.

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	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. `configure subscriber-mgmt category-map category rating-group`
437	Requested-Service-Unit ↳ (grouped AVP)	(CCR-I and CCR-U only) When included, the Requested-Service-Unit AVP has an empty data field in all CCR Initial/Update messages.
446	Used-Service-Unit ↳ (grouped AVP)	(CCR-U and CCR-T only) Amount of used service units measured for a specified category or rating group to a specified quota type. 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).
3GPP – 872	Reporting-Reason	Specifies the reason for which the Used-Service-Units are reported. CCR-U and CCR-T only. Values • 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. ~~Strikethough~~ 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

		• **MD-CLI**
		`configure subscriber-mgmt category-map category ingress policer value`
		`configure subscriber-mgmt category-map category ingress queue value`
		• classic CLI
		`configure subscriber-mgmt category-map category queue queue-id {ingress-only}`
		`configure subscriber-mgmt category-map category policer policer-id {ingress-only}`
		Value equals zero when credit type is time or when no queues/policers are monitored in ingress direction.

414	CC-Output-Octets	Number of egress bytes forwarded via queues or policers that are monitored in egress direction for this rating group.
		• **MD-CLI**
		`configure subscriber-mgmt category-map category egress policer value`
		`configure subscriber-mgmt category-map category egress queue value`
		• classic CLI
		`configure subscriber-mgmt category-map category queue queue-id {egress-only}`
		`configure subscriber-mgmt category-map category policer policer-id {egress-only}`
		Value equals zero when credit type is time. Or when no queues/policers are monitored in egress direction.

420	CC-Time	Total number of seconds during which activity is detected for queues or policers that are monitored for this rating group.
		• **MD-CLI**
		`configure subscriber-mgmt category-map category ingress policer value`
		`configure subscriber-mgmt category-map category ingress queue value`
		• **classic CLI**
		`configure subscriber-mgmt category-map category queue queue-id {ingress-only | egress-only | ingress-egress}`

AVP code	AVP name	Description

		`configure subscriber-mgmt category-map category policer policer-id {ingress-only | egress-only | ingress-egress}`
		Only sampling periods exceeding the configured activity-threshold are counted:
		`configure subscriber-mgmt category-map activity-threshold`
		Value equals zero when credit type is volume.

421	CC-Total-Octets	Total number of bytes used for this rating-group. Corresponds with the sum of CC-Input-Octets and CC-Output-Octets. Value equals zero when credit type is time.

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	(GTP access only) fixed value: IMEISV (0)
460	User-Equipment-Info-Value	(GTP access only) The Internet Mobile Equipment Identifier (IMEI) as signaled in the GTP Create Session Request message.

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	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> • <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 Example: bng.nokia.com;1326398325;1
264	Origin-Host	Diameter Identity. Used as destination host in the next Diameter message. Example: server.nokia.com
268	Result-Code	Values: 2001 = Diameter Success 3xxx = Protocol Errors 4001 = Diameter Authentication Rejected 4010 = Diameter End User Service Denied (CCA-U only) 4011 = Diameter Credit Control Not Applicable 4012 = Diameter Credit Limit Reached (CCA-U only) 5003 = Diameter Authorization Rejected 5030 = Diameter User Unknown 5031 = Diameter Rating Failed (CCA-U only) Values not listed result in a Diameter Session Failure and the Credit Control Failure Handling action is executed.
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	Diameter Identity. Used as destination host in the next Diameter message. Example: nokia.com
415	CC-Request-Number	Values: CCA-Initial: 0

AVP code	AVP name	Description
		CCA-Update and CCA-Termination: sequence number
416	CC-Request-Type	Values: 1 = Initial Answer 2 = Update Answer 3 = Termination Answer

418	CC-Session-Failover	Specifies if a secondary peer should be attempted in case of Credit Control Failure Handling.
		Use the commands in the following context to override the configured failover value:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy on-failure failover [true | false] handling [terminate | continue | retry-and-terminate]`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy on-failure [failover {enabled | disabled}] [handling {continue | retry-and-terminate | terminate}]`
		Values:
		0 = Failover Not Supported
		1 = Failover Supported

427	Credit-Control-Failure-Handling	Action to take when the Credit Control client does not receive a valid CCA message within the interval specified with tx-timer (default 10s).
		Use the following commands to override the configured failure handling:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy on-failure failover enabled handling [terminate | continue | retry-and-terminate]`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy on-failure [failover {enabled|disabled}] [handling {continue | retry-and-terminate | terminate}]`
		Values:
		0 = Terminate
		1 = Continue

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)
		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:
		• **MD-CLI**
		`configure subscriber-mgmt diameter-gy-policy gy out-of-credit-reporting quota-exhausted`
		• **classic CLI**
		`configure subscriber-mgmt diameter-application-policy gy out-of-credit-reporting quota-exhausted`

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	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. `configure subscriber-mgmt category-map category rating-group`
448	Validity-Time	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). Value in seconds
3GPP – 868	Time-Quota-Threshold	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). Value in seconds
3GPP – 869	Volume-Quota-Threshold	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). Value in octets
3GPP – 871	Quota-Holding-Time	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. Value in seconds

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)	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: • **MD-CLI** `configure subscriber-mgmt category-map category exhausted-credit-service-level ingress ip-filter entry 1 action http-redirect`

AVP code	AVP name	Description
		• **classic CLI** `configure subscriber-mgmt category-map category exhausted-credit-service-level ingress-ip-filter-entries entry action http-redirect url allow-override` 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.

449	Final-Unit-Action	If the value is Terminate, then the session is terminated and the corresponding subscriber host deleted.
		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:
		`configure subscriber-mgmt credit-control-policy out-of-credit-action`
		Alternately, the following command can be used to configure out of credit action:
		`configure subscriber-mgmt category-map category out-of-credit-action-override`
		Values:
		0 = Terminate
		1 = Redirect
		2 = Restrict Access

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	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.
		The URL specified in the Redirect-Server-Address AVP is only used when all following conditions are met:
		• 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:
		`configure subscriber-mgmt credit-control-policy out-of-credit-action change-service-level`
		Alternately, the following command can be used to set the change service level:
		`configure subscriber-mgmt category-map category out-of-credit-action-override change-service-level`
		• An IPv4 HTTP redirect action with allow-override is specified as exhausted-credit-service-level for the corresponding rating group:
		– **MD-CLI**
		`configure subscriber-mgmt category-map category exhausted-credit-`

AVP code	AVP name	Description
		service-level ingress ip-filter entry action http-redirect url allow-override – **classic CLI** configure subscriber-mgmt category-map category exhausted-credit-service-level ingress-ip-filter-entries entry action http-redirect url allow-override
435 (continued)		In all other cases, the Redirect-Server-Address AVP is ignored. 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.

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	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> • <DiameterIdentity> is the configured origin host

AVP code	AVP name	Description
		• <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 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
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	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> • <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> • <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
		• <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	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> • <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-attrib-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*

RFC 1772, *Application of the Border Gateway Protocol in the Internet*

RFC 1997, *BGP Communities Attribute*

RFC 2385, *Protection of BGP Sessions via the TCP MD5 Signature Option*

RFC 2439, *BGP Route Flap Damping*

RFC 2545, *Use of BGP-4 Multiprotocol Extensions for IPv6 Inter-Domain Routing*

RFC 2858, *Multiprotocol Extensions for BGP-4*

RFC 2918, *Route Refresh Capability for BGP-4*

RFC 4271, *A Border Gateway Protocol 4 (BGP-4)*

RFC 4360, *BGP Extended Communities Attribute*

RFC 4364, *BGP/MPLS IP Virtual Private Networks (VPNs)*

RFC 4456, *BGP Route Reflection: An Alternative to Full Mesh Internal BGP (IBGP)*

RFC 4486, *Subcodes for BGP Cease Notification Message*

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* – helper mode

RFC 4760, *Multiprotocol Extensions for BGP-4*

RFC 4798, *Connecting IPv6 Islands over IPv4 MPLS Using IPv6 Provider Edge Routers (6PE)*

RFC 5004, *Avoid BGP Best Path Transitions from One External to Another*

RFC 5065, *Autonomous System Confederations for BGP*

RFC 5291, *Outbound Route Filtering Capability for BGP-4*

RFC 5396, *Textual Representation of Autonomous System (AS) Numbers* – asplain

RFC 5492, *Capabilities Advertisement with BGP-4*

RFC 5668, *4-Octet AS Specific BGP Extended Community*

RFC 6286, *Autonomous-System-Wide Unique BGP Identifier for BGP-4*

RFC 6368, *Internal BGP as the Provider/Customer Edge Protocol for BGP/MPLS IP Virtual Private Networks (VPNs)*

RFC 6793, *BGP Support for Four-Octet Autonomous System (AS) Number Space*

RFC 6810, *The Resource Public Key Infrastructure (RPKI) to Router Protocol*

RFC 6811, *Prefix Origin Validation*

RFC 6996, *Autonomous System (AS) Reservation for Private Use*

RFC 7311, *The Accumulated IGP Metric Attribute for BGP*

RFC 7606, *Revised Error Handling for BGP UPDATE Messages*

RFC 7607, *Codification of AS 0 Processing*

RFC 7674, *Clarification of the Flowspec Redirect Extended Community*

RFC 7854, *BGP Monitoring Protocol (BMP)*

RFC 7911, *Advertisement of Multiple Paths in BGP*

RFC 7999, *BLACKHOLE Community*

RFC 8092, *BGP Large Communities Attribute*

RFC 8097, *BGP Prefix Origin Validation State Extended Community*

RFC 8212, *Default External BGP (EBGP) Route Propagation Behavior without Policies*

RFC 8277, *Using BGP to Bind MPLS Labels to Address Prefixes*

RFC 8571, *BGP - Link State (BGP-LS) Advertisement of IGP Traffic Engineering Performance Metric Extensions*

RFC 8950, *Advertising IPv4 Network Layer Reachability Information (NLRI) with an IPv6 Next Hop*

RFC 8955, *Dissemination of Flow Specification Rules*

RFC 8956, *Dissemination of Flow Specification Rules for IPv6*

RFC 9086, *Border Gateway Protocol - Link State (BGP-LS) Extensions for Segment Routing BGP Egress Peer Engineering*

RFC 9294, *Application-Specific Link Attributes Advertisement Using the Border Gateway Protocol - Link State (BGP LS)*

RFC 9351, *Border Gateway Protocol - Link State (BGP-LS) Extensions for Flexible Algorithm Advertisement*

RFC 9494, *Long-Lived Graceful Restart for BGP*

RFC 9552, *Distribution of Link-State and Traffic Engineering Information Using BGP*

9.4 Bridging and management

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*

9.5 Broadband Network Gateway (BNG) Control and User Plane Separation (CUPS)

3GPP TS 23.003, *Numbering, addressing and identification*

3GPP TS 23.007, *Restoration procedures*

3GPP TS 23.402, *Architecture enhancements for non-3GPP accesses* – S2a roaming based on GPRS

3GPP TS 23.501, *System architecture for the 5G System (5GS)*

3GPP TS 23.502, *Procedures for the 5G System (5GS)*

3GPP TS 23.503, *Policy and charging control framework for the 5G System (5GS)*

3GPP TS 24.501, *Non-Access-Stratum (NAS) protocol for 5G System (5GS)*

3GPP TS 29.244, *Interface between the Control Plane and the User Plane nodes*

3GPP TS 29.281, *General Packet Radio System (GPRS) Tunnelling Protocol User Plane (GTPv1-U)*

3GPP TS 29.500, *Technical Realization of Service Based Architecture*

3GPP TS 29.501, *Principles and Guidelines for Services Definition*

3GPP TS 29.502, *Session Management Services*

3GPP TS 29.503, *Unified Data Management Services*

3GPP TS 29.512, *Session Management Policy Control Service*

3GPP TS 29.518, *Access and Mobility Management Services*

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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 0.15.0, *OpenConfig Platform Model*

openconfig-platform-fan.yang version 0.1.1, *OpenConfig Platform Fan Model*

openconfig-platform-linecard.yang version 0.1.2, *OpenConfig Platform Linecard Model*

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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 0.10.1, *OpenConfig System Model*
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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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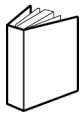

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