



Diameter Configuration

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Diameter Configuration

The Diameter Configuration section allows for the configuration of the diameter plug-in. We recommend configuring the diameter plug-in at system level.

At System Level

In order to define a Diameter Configuration at system level, you need to perform the following steps:

1. Login into Policy Builder.
2. Select **Reference Data** tab.
3. From the left pane, select **Systems**.
4. Select and expand your *system name*.
5. Select **Plugin Configurations**.
6. Select **Diameter Configuration**.

At Cluster Level

In order to define a Diameter Configuration at cluster level you need to perform the following steps:

1. Log in into Policy Builder.
2. Select **Reference Data** tab.
3. From the left pane, select **Systems**.
4. Select and expand your *system name*.
5. Select and expand your *cluster name*. If no cluster has been created, create one by selecting the **Cluster** action.
6. Select **Plugin Configurations**.
7. Select **Diameter Configuration**.

The following parameters can be configured under Diameter Configuration.

Table 1: Diameter Configuration Parameters

Parameter	Description
Default Gx Stale Session Timer Minutes	<p>This timer is armed every time a message is received or sent for any given Gx session. When the timer expires (or more precisely within the next minute after the timer expires) a Gx RAR having the Re-Auth-Request-Type AVP set to AUTHORIZE_ONLY (0) message is triggered for that Gx session. If a Gx RAA is received having Result-Code AVP value set to DIAMETER_UNKNOWN_SESSION_ID (5002) or DIAMETER_UNABLE_TO_COMPLY (5012) the Gx session is deemed as stale and removed from the PCRF internal database. On any activity over Gx interface (RAR/CCR) the timer is reset.</p> <p>Default value is 180 minutes.</p> <p>Note</p> <ul style="list-style-type: none"> • This timer unit is minute. • Stale Gx session removal triggers the PCRF session termination procedure for any other diameter sessions that were bound to the Gx session.
Use V9 Event Trigger Mapping	<p>This option allows for a different set of list of valid values and their interpretation to be used for the Event-Trigger enumerated AVP in order to accommodate the change that occurred in the Gx specification between 3GPP TS 29.212 v9.5 (and prior) and 3GPP TS 29.212 v9.7 (and following including v10 v11 and v12). Default value is checked.</p> <p>List of valid values is provided in Table 2: Use V9 Event Trigger Mapping Valid Values, on page 3.</p> <p>Note</p> <ul style="list-style-type: none"> • The Event-Trigger AVP list of valid values and their interpretation defined in 3GPP TS 29.212 v9.6 is not supported. • Use V9 Event Trigger Mapping checked uses 3GPP TS 29.212 v9.5 as a reference while 3GPP TS 29.212 v110.10 is used as a reference when not checked.
Rel8 Usage Monitoring Supported	<p>This option allows for the Gx usage monitoring feature to be supported even when the PCEF advertises support for Rel8 feature under Supported-Features AVP in Gx CCR-i.</p> <p>Default value is checked.</p>
Rel15 Ext Bw Nr Supported	<p>When checked, it enables the support for 3GPP Rel-15 Extended BW-NR feature. PCRF sends response to AF/PCEF with Rel-15 Extended BW-NR feature bit set when the feature is enabled and AF/PCEF has also set the bit in the request message. PCRF sends extended QoS AVPs only if the configuration is enabled.</p> <p>When unchecked, it disabled the support for 3GPP Rel-15 Extended BW-NR feature.</p> <p>Default value is unchecked (disabled).</p>

Parameter	Description
Stale Session Configuration	<p>When a new row is added in “Stale Session Configuration” table the default value for the GX_TGPP SD_V11 and SY_V11 Stale session timer is 180 minutes.</p> <p>Note The maximum value allowed for the Stale Session Timer parameter is 35000 minutes.</p> <p>If GX_TGPP Stale Session Timer value is not configured in this table, then the value is selected from the retained/old variable “Default Gx Stale Session Timer Minutes”.</p> <p>If there are multiple values configured against any interface then the lowest among all would be considered as the stale session timer.</p>
DRMP Prioritization	<p>When enabled allows you to configure different message processing priorities based on the DRMP value received in the incoming request.</p> <ul style="list-style-type: none"> • Default Inbound Priority - The default inbound priority value. • Inbound DRMP Prioritization <ul style="list-style-type: none"> • DRMP - DRMP AVP value in the incoming request. • Priority - Priority value assigned to the incoming message. Based on this value the message processing is prioritized. Higher Priority messages are be processed first compared to lower priority messages.



Note If Gx stale session timer is set for both “Default Gx Stale Session timer Minutes” and “Stale Session Configuration” then the value configured Under “Stale Session Configuration” would take the precedence.

Table 2: Use V9 Event Trigger Mapping Valid Values

Interpretation - Use V9 Event Trigger Mapping is checked	Value	Interpretation - Use V9 Event Trigger Mapping is not checked
SGSN_CHANGE	0	SGSN_CHANGE
QOS_CHANGE	1	QOS_CHANGE
RAT_CHANGE	2	RAT_CHANGE
TFT_CHANGE	3	TFT_CHANGE
PLMN_CHANGE	4	PLMN_CHANGE
LOSS_OF_BEARER	5	LOSS_OF_BEARER
RECOVERY_OF_BEARER	6	RECOVERY_OF_BEARER
IP_CAN_CHANGE	7	IP_CAN_CHANGE

Interpretation - Use V9 Event Trigger Mapping is checked	Value	Interpretation - Use V9 Event Trigger Mapping is not checked
QOS_CHANGE_EXCEEDING _AUTHORIZATION	11	QOS_CHANGE_EXCEEDING _AUTHORIZATION
RAI_CHANGE	12	RAI_CHANGE
USER_LOCATION_CHANGE	13	USER_LOCATION_CHANGE
NO_EVENT_TRIGGERS	14	NO_EVENT_TRIGGERS
OUT_OF_CREDIT	15	OUT_OF_CREDIT
REALLOCATION_OF_CREDIT	16	REALLOCATION_OF_CREDIT
REVALIDATION_TIMEOUT	17	REVALIDATION_TIMEOUT
UE_IP_ADDRESS_ALLOCATE	18	UE_IP_ADDRESS_ALLOCATE
UE_IP_ADDRESS_RELEASE	19	UE_IP_ADDRESS_RELEASE
DEFAULT_EPS_BEARER _QOS_CHANGE	20	DEFAULT_EPS_BEARER _QOS_CHANGE
AN_GW_CHANGE	21	AN_GW_CHANGE
SUCCESSFUL_RESOURCE _ALLOCATION	22	SUCCESSFUL_RESOURCE _ALLOCATION
RESOURCE_MODIFICATION _REQUEST	23	RESOURCE_MODIFICATION _REQUEST
PGW_TRACE_CONTROL	24	PGW_TRACE_CONTROL
UE_TIME_ZONE_CHANGE	25	UE_TIME_ZONE_CHANGE
USAGE_REPORT	26	TAI_CHANGE
TAI_CHANGE	27	ECGI_CHANGE
ECGI_CHANGE	28	CHARGING_CORRELATION _EXCHANGE
CHARGING_CORRELATION _EXCHANGE	29	APN_AMBR_MODIFICATION _FAILURE
USER_CSG_INFORMATION _CHANGE	30	USER_CSG_INFORMATION _CHANGE

Interpretation - Use V9 Event Trigger Mapping is checked	Value	Interpretation - Use V9 Event Trigger Mapping is not checked
DEFAULT_EPS_BEARER _QOS_MODIFICATION_FAILURE	31	NA
NA	33	USAGE_REPORT
	34	DEFAULT_EPS_BEARER _QOS_MODIFICATION_FAILURE
	35	USER_CSG_HYBRID _SUBSCRIBED_INFORMATION _CHANGE
	36	USER_CSG_HYBRID _UNSUBSCRIBED _INFORMATION_CHANGE
	37	ROUTING_RULE_CHANGE
	39	APPLICATION_START
	40	APPLICATION_STOP
	42	CS_TO_PS_HANDOVER
	43	UE_LOCAL_IP_ ADDRESS_CHANGE
	44	HENB_LOCAL_IP_ ADDRESS_CHANGE
	45	ACCESS_NETWORK_ INFO_REPORT

Inbound Message Overload Handling

This feature provides a mechanism for the OAM (PCRF) protection when the configured value of handling incoming messages exceeds. It provides a way to prioritize the incoming messages and selectively process them.

The following parameters can be configured under Inbound Message Overload Handling window:

Table 3: Inbound Message Overload Handling Parameters

Parameter	Description
Default Priority	<p>Default priority to be assigned to an incoming message if no specific priority is defined in the Message Handling Rules table.</p> <p>Default value is 0.</p>
Message Sla Ms	<p>Service Level Agreement (SLA) in milliseconds, defines the number of milliseconds that are associated with an incoming event or message within which Policy Director (load balancer) has to submit it to Policy Server (QNS) for processing. In case the configured duration times out, the Default Discard Behavior is applied.</p> <p>Maximum time (in millisec) that a message has in an inbound message handling queue waiting for a worker thread. Configuring this value avoids processing a message to time out by a remote peer.</p> <p>An SLA time that is too large can result in wasted processing on messages already timed out on a remote peer (i.e. PGW) and creation of stale sessions.</p> <p>An SLA time that is too small can result in dropping the messages that could have been successfully processed.</p> <p>Default value is 1500 ms.</p> <p>Note The value must be less than timeout configured at Gateway.</p> <p>If you have not selected Inbound Message Overload Handling check box under Diameter Configuration, you can define <code>inboundMessageSlaMs</code> and <code>inboundMessageQueueSize</code> in <code>/etc/broadhop/qns.conf</code> file. If <code>inboundMessageSlaMs</code> is not defined in <code>qns.conf</code> file, then default value of 9000 is used.</p> <p>Example: <code>-DinboundMessageSlaMs=2000</code></p> <p>After modifying the configuration on Cluster Manager execute <code>reinit.sh</code> or <code>copytoall.sh</code> scripts for applying the changes on all VMs as described in the <i>CPS Installation Guide for VMware</i> for this release.</p> <p>If you select Inbound Message Overload Handling check box under Diameter Configuration, then the value you configured in Policy Builder is used.</p> <p>The "Message Sla Ms" time out configuration value should be less than the timeout value in PGW or PCSF.</p>

Parameter	Description
Inbound Message Queue Size	<p>Number of messages waiting to be processed before the inbound overload feature is activated.</p> <p>Default value is 1000.</p> <p>If Inbound Message Overload Handling check box is not selected under Diameter Configuration, define <code>inboundMessageSlams</code> and <code>inboundMessageQueueSize</code> in <code>/etc/broadhop/qns.conf</code> file. If <code>inboundMessageQueueSize</code> is not defined in <code>qns.conf</code> file, then default value of 1000 is used.</p> <p>Example: <code>-DinboundMessageQueueSize=5000</code></p> <p>After modifying the configuration on Cluster Manager execute <code>reinit.sh</code> or <code>copytoall.sh</code> scripts for applying the changes on all VMs as described in the <i>CPS Installation Guide for VMware</i> for this release.</p> <p>If InboundMessage Overload Handling check box is selected under Diameter Configuration, then the value you configured in Policy Builder is used.</p> <p>Note It is recommended not to increase this queue size beyond the default value. This queue size is applicable per Policy Server (qns) node.</p> <p>Configure the message queue size to allow buffering for a burst of messages that can be processed before SLA expiry. A queue size that is too large consumes memory resources. A queue size that is too small drops messages.</p> <p>Configure this parameter help to prevent unnecessary consumption of memory resources for messages that cannot be processed in time.</p>
Default Instance Rate Limit	<p>Use this parameter to trigger the overload protection handling. If this is configured to value x TPS, then whenever x exceeds CPS applies message handling rules to additional requests. 0 (default) TPS indicates no limit.</p> <p>Note It is recommended to use the default value to avoid limit on the performance of Policy Server (QNS).</p> <p>Default value is 0.</p>

Parameter	Description
Gx Emergency Message Priority	<p>Default priority assigned to messages related to an emergency session.</p> <p>This parameter categorizes Gx messages as emergency priority based on APN. Emergency priority messages are queued ahead of non-emergency service messages for quick servicing and prevent them from being dropped using overload controls.</p> <p>If the queue is full, the lowest-priority message is dropped.</p> <p>Recommended Value: Regex match of SOS APNs for emergency priority classification. Set emergency priority to highest for priority handling in Policy Server (QNS) Inbound Message Queue.</p> <p>Default value is 1.</p>
Default Discard Behavior	<p>Default behavior to be applied to an incoming message if no specific priority is defined in the Message Handling Rules table.</p> <ul style="list-style-type: none"> • MESSAGE_DROP: Discards the request. • DIAMETER_TOO_BUSY: Sends a response message having Result-Code AVP value set to DIAMETER_TOO_BUSY (3004) <p>Default value is MESSAGE_DROP.</p>
Apply Discard Behavior For Emergency Messages	<p>Indicates if Emergency Messages can be discarded under overload conditions.</p> <p>Default value is not checked.</p>
Rx Message Prioritization	<p>Defines Rx eMPS message handling priority under overload condition based on Rx AAR MPS-Identifier and Reservation-Priority AVPs.</p> <p>When Rx Message Prioritization is enabled and if MPS-Identifier and Reservation-Priority AVPs are available in Rx_AAR, then the messages are not dropped even in overload condition. Depending on the message Priority defined in table, the message can be moved to the front in the inbound queue.</p> <p>This feature indicates that, the Rx_AAR is prioritized based on MPS-Identifier and Reservation-Priority AVPs configured only. If the inbound message doesn't have these parameters included, the message is not prioritized. Prioritization of messages is only applicable to incoming request messages.</p> <p>For more information on parameters, see Table 4: Rx Message Prioritization Parameters, on page 9.</p>
Message Handling Rules	<p>Defines specific inbound message overload handling rules based on different criteria. For more information, see Table 5: Message Handling Rules Parameters, on page 10.</p>



Note If you do not select Inbound Message Overload Handling check box in Diameter Configuration, you can define inboundMessageSlams and inboundMessageQueueSize in /etc/broadhop/qns.conf file. For more information, see [Table 3: Inbound Message Overload Handling Parameters, on page 6](#).

Table 4: Rx Message Prioritization Parameters

Parameter	Description
MPS Identifier	MPS-Identifier indicates that an AF session relates to an MPS session. It contains the national variant for MPS service name. MPS-Identifier value = <NS (National Security) Specific To Deployment>
Reservation Priority	The AF specifies the Reservation-Priority AVP at request level in the AA-Request in order to assign a priority to the AF session as well as specify the Reservation-Priority AVP at the media-component-description AVP level to assign a priority to the IP flow. The Reservation-Priority AVP available at the request level only is used under Rx Message Prioritization table. Range: Any number Example: 10
Priority	A user defined priority based on MPS-Identifier and Reservation-Priority combination. Make sure that the Message priority defined in Rx Message Prioritization table and should be unique per row. Higher Priority messages are processed first compared to lower priority messages. Range: Any number (User priority) Example: 10



Note Rx Message Prioritization table does not supports multiple values in a single column. Rx Message Prioritization table must be configured with unique combination for each row.

Table 5: Message Handling Rules Parameters

Parameter Type	Attribute	Description
INPUT	Diameter Client	(Optional) This field is used to configure different priorities for different clients based on realms. For more information, see Diameter Clients, on page 47 .
	Protocol	Specific application id value to be used for scoring. This value is used to match Auth-Application-Id AVP value. For more information, see Table 6: Protocols, on page 11 .
	Command Code	Specific command code value to be used for scoring. This value is used to match the Command-Code field. These command codes map to different types of Diameter messages (CCR = 272 RAR = 258 etc). Default value is 0.
	Request Type	Specific request type value to be used for scoring. This value should match the value of the CC-Request-Type AVP for Gx CCR messages. <ul style="list-style-type: none"> • 0: Request Type not used for scoring • 1: INITIAL_REQUEST (1) • 2: UPDATE_REQUEST (2) • 3: TERMINATION_REQUEST (3) <p>Default value is 0.</p> <p>Request type should match the value of the Rx-Request-Type AVP for Rx AAR messages.</p> <ul style="list-style-type: none"> • 0 INITIAL_REQUEST (0) • 1 UPDATE_REQUEST (1) <p>Request type should match the value of SL-Request-Type AVP for Sy SLR messages. The possible values are:</p> <ul style="list-style-type: none"> • INITIAL_REQUEST (0) • INTERMEDIATE_REQUEST (1) <p>It has to be configured to zero if the incoming message does not have a request type AVP. For example, Rx STR does not have a request type AVP or Rx-Request-Type AVP is unavailable in Rx AAR as it is not a mandatory AVP per 3GPP TS 29.214.</p>

Parameter Type	Attribute	Description
OUTPUT	Priority	Priority value assigned to the message. Higher numerical value has the higher priority. Default value is 0. For example, 10, 20, 100, 200, 300, 500 and so on.
	Per Instance Tps	Transactions per second limit per process. This value is the TPS that these messages are limited to. Note that this is per CPS process so if there are 20 Policy Server VM's with 1 Policy Server java process the total TPS is this number x 20. The actual system's transaction per second limit can be calculated using the following formula: Per Instance Tps x Number of instances per VM x Number of VMs. Default value is 0. For example, 1000, 2000, 5000 and so on.
	Discard Behavior	Behavior to be applied to an incoming message. <ul style="list-style-type: none"> • MESSAGE_DROP: Discards the request. • DIAMETER_TOO_BUSY: Sends a response message having Result-Code AVP value configured to DIAMETER_TOO_BUSY (3004). Default value is MESSAGE_DROP.



Note A Diameter message even if prioritized under an overload condition could be dropped by CPS if one of the following conditions are met:

- Per Instance TPS configured limit exceeds except for Gx Emergency/Rx eMPS/DRMP calls.
- Inbound Message Queue size exceeds for a message.
- Inbound Message Sla Ms exceeds for a message.

Table 6: Protocols

Attribute	Description
GY_V8	Standard Gy application as per 3GPP TS 32.299
GX_SCE	Custom Gx implementation
RF_V10	Not supported

Attribute	Description
RF_VERIZON	Not supported
RX_TGPP	Standard Rx application as per 3GPP TS 29.214
SH_TGPP	Standard Sh application as per 3GPP TS 29.329
SY_V11	Standard Sy application as per 3GPP TS 29.219
SD_V11	Standard Sd application as per 3GPP TS 29.212
GX_TGPP (default)	Standard Gx application as per 3GPP TS 29.212
GXX_TGPP	Not supported
RX_CLIENT	Local MINE adapter
GY_V8_PROXY	Gy proxy implementation as per RFC 3588
GX_TGPP_PROXY	Gx proxy implementation as per RFC 3588
SY_TGPP_PROXY	Sy proxy implementation as per RFC 3588
SY_OCS	Sy Proxy from OAM (PCRF) end
GY_RECHARGE_WALLET	Support Gy client functionality with external OCS (ECUR model only)
SY_PRIME	Custom Sy implementation as per RFC 3588
RX_TGPP_PROXY	Rx proxy implementation as per RFC 3588
SY_OCS_SERVER	OCS Sy server endpoint conforming to 3GPP TS 29.219



Note When a Diameter Stack with a diameter realm is imported with unassigned protocol, the default value of GX_TGPP is used.

Stale Session Message Handling Configuration

This feature enables CPS application to act according to the configuration when request processing crosses the given SLA time period for the incoming request. When the feature is enabled the request or responses which are crossing the configured SLA are dropped.

By default, stale session message handling is disabled. To enable this configuration, you need to configure the Stale Session Message Handling configuration in Policy Builder and publish the changes.



Note The configuration changes are reflected at the run time and no process restart is required.

The following table describes the parameters under **Stale Session Message Handling Configuration**.

Table 7: Stale Session Message Handling Configuration Parameters

Parameter	Description
End to End Sla Ms	Maximum time in milliseconds the CPS system must take for request processing. The request processing time for this value must be LB > QNS > DB > QNS > LB round trip. Default: 2000 ms
Include Request LB queue time in QNS SLA	When checked, LB - QNS request queue time is considered in QNS SLA when enabled. Default value is disabled.



- Note**
- The End To End SLA value must always be greater than the existing QNS-SLA configured in the `qns.conf` file.
 - All the Policy Director (LB) and Policy Server (QNS) VMs need to be in time sync to ensure that the functionality of this feature works as expected.

Next Hop Routing

This feature provides support for inter-working with a DRA that is not configured in topology hiding mode. This is required because while the DRA advertises its own origin host and realm values when the diameter connection is established all the diameter application messages feature the actual host's origin host and realm (i.e. PCEF TDF AF). PCRF needs a way to figure out which particular DRA connection should use in order to deliver a message to the desired host.

While selecting the peer that is used to deliver the request (with or without using the Next Hop Routes table) load balancing across the peers having the same rating is done. Load balancing starts from the peers having highest rating and covers all the peers in a round robin manner. If none is UP load balancing is tried with the peers having the second highest rating and again covers all the peers in a round robin manner and so on.



- Note** Next Hop Routes table is used only for PCRF initiated requests. The response messages for any incoming request is always delivered on the same connection where the request was received or not delivered at all. This is in order to avoid asymmetric routes.

The DRA should explicitly advertise support for a Diameter application other than Relay. The Relay application having Application Identifier 0xffffffff is not supported.

The following parameters can be configured under Next Hop Routing table:

Table 8: Next Hop Routing Parameters

Parameter	Description
Next Hop Realm	DRA realm name as received in Origin-Realm AVP in CER or CEA message. Note All the next hop realms (Next Hop Realm) should match the Origin-Realm AVP value in the incoming CER/CEA message.
Next Hop Hosts	DRA hosts name list as received in Origin-Host AVP in CER or CEA message. Note All the next hop host names (Next Hop Hosts) should match the Origin-Host AVP value value in the incoming CER/CEA message.
Application Id	Diameter application id advertised as being supported by the DRA. It contains information that identifies the particular service that the service session belongs to.
Destination Realms Pattern	Actual destination realm name pattern as received in Origin-Realm AVP in AAR message. The pattern needs to follow the standard Java regular expression syntax described here .
Destination Host Pattern	Actual destination host name pattern as received in Origin-Host AVP in AAR message. The pattern needs to follow standard Java pattern conventions. The pattern needs to follow the standard Java regular expression syntax described here .

While populating the Next Hop Routes table, we recommend that you create only one entry for each Next Hop Realm value - Application Id value pair while all the DRA host names are provided as a list under Next Hop Hosts field. This is not a requirement though.



Note The order in which the DRA hosts are provisioned in the Next Hop Hosts field for any given next hop route is not relevant. The DRA host having the highest rating (priority) value is used. In case multiple hosts have the same rating one is randomly selected. Refer to [Diameter Stack Configuration, on page 35](#) for more details about host rating. Outbound realm rating of next hop is not considered except for SY_PRIME.

CPS supports grouping of realms and application identifiers using wildcarding and assigns it to a group of next hop peers. CPS routes outgoing messages by selecting the peer with highest priority.

An example configuration for Grouping and Wildcarding in the Next Hop Routing table is shown below:

Figure 1: Grouping and Wildcarding in the Next Hop Routing Table

Diameter Configuration

Default Gx Stale Session Timer Minutes
 Use V9 Event Trigger Mapping

Rel8 Usage Monitoring Supported

Stale Session Configuration

Inbound Message Overload Handling

Next Hop Routing

***Next Hop Routes**

*Next Hop Realm	*Next Hop Hosts	*Application Id	*Destination Realms	*Destination Hosts P
nyc*.pcef	pcef.dra, pcef1.dra	16777236	pcef.cisco.com	pcef-gx
ab*.pcef	pcef.dra	16777238	ggsn.starentnetwork	seagull-local
nyc*.ocs	ocs.dra	16777302	sy-cisco.com	seagullserver, seagu

Destination Realm and Destination Hosts are used to map with the Peer configuration as defined in the Diameter Stack. The figure given below shows the mapping of the message containing the Realm from a peer to a protocol or interface. For more information on peer configuration refer to [Diameter Stack Configuration](#), on page 35.

Figure 2: Rating

Inbound Peers

Local Host Name	Instance Number	*Rating	Port Range	*Response Timeout	*Name Pattern
Test1	0	1		3000	segull-local
Test2	0	1		3000	pcef-gx
Test3	0	1		3000	pcef-dra

Realms

Peer Type	*Processing Protocol	Rating	Stats Alias	*Name Pattern
	RF_TGPP	0		rf.cisco.com
	GX_TGPP	0		pcef.cisco.com
	RF_TGPP	0		pcef.cisco.com

Outbound Peers

***Local End Points**

*Local Host Name	Instance Number	*Advertised Diameter F Q D N	*Listening Port	Local Bind Ip	*Transport Protocol	Multi Homing Hosts
Test	0	qns-c-server-1	3868		TCP	

215435

Message Timeout and Retry Configuration

Message Timeout and Retry Configuration table can be configured under Diameter Configuration plug-in in Policy Builder.

This table allows for the configuration of different message timeout value and retry behavior using the combination of Application Id, Command Code and (experimental) result code parameters.



Note Sh Interface (Auth-Application-Id 16777217) message retry information can be configured using:

- Message Timeout and Retry Configuration table
- Setting Up Additional Profile Data

Only one of the two retry configuration options should be used for Sh Interface.

The following parameters can be configured in the Message Timeouts and Retry Configuration table.

Table 9: Message Timeout and Retry Configuration Parameters

Parameter	Description
Application Id	The Diameter Application ID (Auth-Application-Id) on the message which is to be retired. Default: 0
Command Code	The Diameter command code of the message which is to be retried. Default: 0
Result Code	This is the result code received in the diameter response for which the user wants to retry. The values configured should be a valid diameter result code value or an experimental result code value. For example, 3002 (DIAMETER_UNABLE_TO_DELIVER) received in RAA. Permanent failure result codes 5xxx and successful result codes 2xxx should not be configured (where, x denotes a valid number). However, if configured, CPS retries for it. Note For retry on timeout, the result code should be configured as 7000. Default: 0
Is Experimental	If this check-box is selected, it means that the value configured in the Result Code column is an Experimental-Result-Code value. This is necessary because there are few values which are the same for both experimental-result-code and result-code. Default: Not selected
Action	The action for the CPS platform to take after the Diameter Response is received. The options are Retry or None. <ul style="list-style-type: none">• Retry - CPS retries the request message identified by the value in the command code column depending on the retry count configured in Retry Count column.• None - No retry. Default: None
Action Timer (Ms)	The amount of time in milliseconds for CPS to wait before doing a retry. It is the wait time between retries. CPS doesn't retry immediately and drops all the stress on the system ¹ . Default: 0

Parameter	Description
Retry Count	<p>The number of times to retry when the action is “Retry”.</p> <p>Note This retry count does not include the initial attempt made by CPS.</p> <p>Default: 1</p>
Retry on Alternate Node	<p>Configures CPS to retry on any alternate peer configured in Policy Builder.</p> <p>Default: Not selected</p>
Backoff Algorithm	<p>The back-off algorithm used while determining the actual delay between retry attempts. Currently, only one option (CONSTANT_INTERVAL) is supported.</p> <ul style="list-style-type: none"> • LINEAR_INTERVAL: Causes the configured retry interval to increase linearity with each attempt using the formula $\text{retry interval} = \text{Action Timer (Ms)} \times \text{current retry attempt number}$. <p>For example, Action=Retry, Action Timer (Ms)=200, Retry Count=3, Backoff Algorithm=LINEAR_INTERVAL will trigger the first retry after $200 \times 1 = 200$ ms, the second retry after $200 \times 2 = 400$ ms, the third retry after $200 \times 3 = 600$ms</p> <ul style="list-style-type: none"> • CONSTANT_INTERVAL: Causes the configured retry interval to be used (without any change) for delay for all retry attempts (other options like exponential back-off where retry interval increases exponentially are currently not supported/implemented). <p>Default: CONSTANT_INTERVAL</p>

¹ If the timeout and retry count is not configured then the default values (`diameter.default.timeout.ms` and `diameter.default.retry.count`) defined in `/etc/broadhop/qns.conf` are used.

The `diameter.default.timeout.ms` and `diameter.default.retry.count` parameters configured in `qns.conf` file are taken into consideration only in case of timeout (result code = 7000) and do not impact the behavior in any other case (result code other than 7000).

If no values are defined in the `qns.conf` file, then the default values of `diameter.default.timeout.ms=3000` and `diameter.default.retry.count=1` are used. If Result Code = 7000 is defined in the Message and Retry Configuration table in Policy Builder, then this configuration takes precedence over `qns.conf` file parameters.

Result Code Based Action Configuration

CPS can be configured to take specific action over Gx and Sy based on response received on Sy/Sd interfaces. CPS can be configured to continue (default) terminate or re-initiate the session.

Figure 3: Result Code Based Action

*Application Id	*Command Code	Realm	*Request Type	Result Code	Is Experimental	*Action	*Action Over
16777302	8388635		1	5002	<input type="checkbox"/>	Reinitiate	Reauthorize
16777302	8388635		0	5004	<input type="checkbox"/>	Terminate	None
16777302	8388635		0	5005	<input type="checkbox"/>	Terminate	None
16777302	8388635		0	5012	<input type="checkbox"/>	Terminate	None
16777302	8388635		0	5030	<input type="checkbox"/>	Terminate	None

The following parameters can be configured in the Result Code Based Action Configuration table.

Table 10: Result Code Based Action Configuration

Parameter	Description
Application Id	The diameter interface in numeric format (Auth-Application-Id) on which the message is received. For example Sy (16777302) and Sd (16777303). Currently only Sd and Sy interfaces are supported. Default: 0
Command Code	The diameter message type. For example SLR (8388635) in case of Sy and RAR (258) in case of Sd. Default: 0
Realm	New key added as Sy client realm. If the realm value is not specified, then the realm key is not be considered (CPS only performs action on key applicationid:commadcode:realm:requestType:resultcode).
Request Type	The request type of the message for Sy interface. For example INITIAL_REQUEST (0) INTERMEDIATE_REQUEST (1). For Sd Request Type is not valid. Default: 0
Result Code	The result-code received in the response for which the action over Gx and/or Sy/Sd is to be taken. Default: 0
Is Experimental	If this check-box is selected, it means that the value configured in the Result Code column is an Experimental-Result-Code value. This is necessary because there are few values which are the same for both experimental-result-code and result-code. Default: Not selected

Parameter	Description
Action	

Parameter	Description
	<p>The action to be taken over the Sy/Sd interface when the response is received. Possible actions are Continue/Terminate/Reinitiate.</p> <ul style="list-style-type: none"> • Continue (default) In case of Continue CPS just continues with the session and does not clear the session from the DB. • Terminate (for Sd) In case of Terminate CPS removes the session from database after triggering a Session Removal RAR over Sd interface. Terminate (for Sy) In case of Terminate CPS removes the session from database after triggering a Session Removal STR over Sy interface. • Reinitiate (for Sd) In case of Reinitiate CPS first triggers a Session Removal RAR over Sd interface. Once we receive Sd RAR response (any result-code) CPS removes the old session and triggers creation of a new session by sending out a TSR towards TDF. Reinitiate (for Sy) In case of Reinitiate CPS first triggers a Session Removal STR over Sy interface. Once we receive Sy STR response (any result-code) CPS removes the old session and triggers creation of a new session by sending out SLR towards OCS. • Re-Initiate Action Timer (Ms): The amount of time in milliseconds for CPS to wait before performing a retry. It is the wait time between retries. Note This configuration works in accordance with the Next Evaluation Timer. Hence, there will be a minute delay in Message generation. Default: 0 • Re-Initiate Retry Count: The number of times to retry when the action is ?Retry?. Note The retry count does not include the initial attempt made by CPS. Default: 0 • Backoff Algorithm: The backoff algorithm is used for determining the actual delay between retry attempts. Currently, only one option (CONSTANT_INTERVAL) is supported. • LINEAR_INTERVAL: Causes the configured retry interval to increase linearity with each attempt using the formula retry interval = Action Timer (Ms) x current retry attempt number For example, Action=Retry, Action Timer (Ms)=200, Retry Count=3, Backoff Algorithm=LINEAR_INTERVAL will trigger the first retry after 200 x 1 = 200 ms, the second retry after 200x2 = 400 ms, the third retry after 200x3 = 600ms. • CONSTANT_INTERVAL: Causes the configured retry interval to be used (without any change) for delay for all retry attempts. Note Other options such as exponential back-off where retry interval increases exponentially are currently not supported.

Parameter	Description
	Default: CONSTANT_INTERVAL
Action Over Gx	<p>The action to be taken over the Gx interface when the response is received. Possible actions are None/Terminate/Reauthorize.</p> <p>Currently Action over Gx is not supported for Sd RAR.</p> <ul style="list-style-type: none"> • None (default): No action would be taken on Gx interface. • Terminate: In case of Terminate CPS would terminate the Gx session by sending a RAR with Session Release Cause. Also CPS would be sending STR which would then clear the corresponding Sy device session. If the action over Gx is TERMINATE the action over Sy does not matter as the Sy session would be terminated. • Reauthorize: In case of Reauthorize CPS would mark the Sy session as waiting for action over Gx and would mark corresponding Gx session as needing action over Gx as Re-Auth. <p>The Gx Network Device Manager would then perform the ReAuthorization by sending RAR over Gx interface. On receiving RAA the action over Sy interface would then be performed. If the Gx session is stale and we receive DIAMETER_UNKNOWN_SESSION_ID the Sy session would then be automatically terminated irrespective of the action configured on Sy interface.</p> <p>Note The actions TERMINATE and REAUTHORIZE over Gx does not work with SLA-Initial if the SLR is sent synchronously. In case the SLR is triggered synchronously and the action over Gx is configured as TERMINATE/REAUTH the CPS would log an error message and would continue the session. The synchronous/asynchronous sending of SLR can be configured in the SpendingLimitReport service configuration.</p>

Message Buffering Configuration

When Gx features for OneGxRulePerFlow is enabled then the gateway triggers simultaneous Gx-CCR-U's for APPLICATION-START within a short time span. This causes a burst of CCR-U message on CPS. Because of the burst, CPS fails to process all the CCR-U message due to "cache out of date" errors and sends DIAMETER_UNABLE_TO_DELIVER errors to gateway. So in order to support the processing of all the CCR-U messages, Message Buffering Configuration can be used.

Message Buffering Configuration can be configured under **Diameter Configuration** plug-in in Policy Builder.

The following parameters can be configured under **Message Buffering Configuration**:

Table 11: Message Buffering Configuration Parameters

Parameter	Description
Buffer Timeout In Milliseconds	The time in milliseconds to hold the diameter messages in the buffer after the buffering has been triggered for a particular session ID. Default value is 15 ms.
Max Buffered Messages Per session	Maximum number of messages that are held in the message buffer for a particular session ID. Default value is 64.
Disable Early Processing	Disable the early processing of buffered message before the configured buffer-timeout (15 ms). If the message buffering has started then CPS triggers an early timeout (after 5 ms) and check the buffer status. If the buffer has single message or contains messages without any holes (in correct sequence) then it sends the first message to Policy Server (qns) node for processing. Default value is unchecked.
Allow Gaps In Buffer	Do not drop the messages from the message buffer when a hole/gap is detected while processing the buffered messages (i.e. after ordering the buffered message it detects that certain messages are missing). Default value is unchecked.
Message Buffering Table	This table is used to specify the criteria for buffering the messages. CPS buffers only those messages that have a matching entry in this table. For more information on parameters, refer to Table 12: Message Buffering Table Parameters, on page 23 .

Table 12: Message Buffering Table Parameters

Parameter	Description
Application Id	Application ID of the interface whose message are to be buffered. For example, 16777238 for Gx messages.
Command Code	Command code of the diameter message for the above application ID. For example, 272 for CCR messages.
Origin Realm Pattern	Origin-realm from the diameter request message to check for message buffering. It supports pattern matching as per the JAVA regular expression. This is an optional field and if not configured then CPS applies the configuration to any realm for the matching application ID and Command Code.

Parameter	Description
Origin Host Pattern	<p>Origin-host from the diameter request message to check for message buffering. This is an optional field and if not configured then CPS applies the configuration to any host for the matching application ID and Command Code.</p> <p>Note In case of multiple entries for same application ID and command code combination, CPS matches the origin-realm and origin-host from the message with the realm and host patterns defined in the table and use the row that matches first.</p>
Buffer Start Avp Code	<p>Diameter AVP code for the AVP that would trigger the start for buffering the messages. For example, 1006 is the diameter AVP code for Event-Trigger AVP.</p> <p>Note Allowed parameters are of string type so that child AVP path can also be used.</p> <p>For example, To give Charging-Rule-Report > Rule-Failure-Code, you have to mention '1018.1031' (where, 1018 is an AVP Code for 'Charging-Rule-Report' and 1031 is an AVP Code for 'Rule-Failure-Code').</p> <p>All rows having same 'Application Id' and 'Command Code' should have same Order AVP Code and Order AVP Type.</p> <p>CPS goes through all the rows one by one and verifies whether configured AVP exist in the incoming message and buffers the message accordingly.</p>
Buffer Start Avp Type	A drop-down list to select the data-type of the AVP to trigger buffering of message. This is required for correctly extracting the AVP value.
Buffer Start Avp Value	The possible values for the diameter AVP for starting the buffering of message. List supported to configure multiple values.
Order Avp Code	The diameter AVP code for the AVP whose value can be used for sequencing/ordering the buffered message while sending them to Policy Server (qns) node for processing.
Order Avp Type	<p>A drop-down list to select the type of the Order AVP for extracting its value.</p> <p>CPS currently supports only numeric values for ordering the buffered messages.</p>

Memory Impact

- The memory usage of diameter endpoint process (qns process on lb) may be increased when it starts buffering messages for multiple sessions.

Configuration and Restrictions

- Buffered messages are lost if the diameter-endpoint (qns process) on LB node goes down.
- All the CCR-U messages in the burst are processed sequentially, that is, only after a CCA-U is sent out for a CCR-U message then the next CCR-U message is taken up for processing.
- CPS initiated messages (for example, Gx RAR) are not considered for buffering and are sent out as they are triggered. Also, if terminate message (for example, Gx CCR-T) is received in between a message burst then CPS drops all further messages from the buffer after processing the terminate message.
- As the buffered messages are processed sequentially the response time (towards PCEF) increases. For example, for a burst of 64 simultaneous CCR-U messages, CCA-U for the last message (that is, CCR-U message with highest sequence number) is after a duration of $64 \times 20 + 15$ ms (approx. 1300 ms).
- The response time (towards PCEF) for normal messages (not received in a burst but matches the message buffering criteria) has an impact of at least 5 ms (the early processing time). For example, if CCR-U processing takes 20 ms then for a single user plane CCR-U message, the minimum response time is 25 ms.
- If CPS receives negative response from Policy Server (qns) node while processing a buffered message then CPS stops processing the message buffer for that session and drops all further buffered messages.
- While processing a buffered message if Policy Director (lb) node does not get a response from Policy Server (qns) node within the configured time (SLA) then it drops all the remaining messages from the message buffer of that session. The SLA time is calculated from the time the message was sent from Policy Director (lb) to Policy Server (qns) node and the time that the message spends while waiting for processing in the message buffer.
- CPS checks only for 3GPP vendor ID while matching the diameter AVP code defined for Buffer start AVP and Order AVP. If vendor ID is not available in the received AVP then it is assumed to be of default 3GPP vendor ID.
- While processing the buffered messages, if another burst of CCR-U messages is received then CPS appends those messages to the existing buffer. In doing so if the buffer size reaches the Max Buffered Messages per session then CPS drops those messages.
- CPS maintains the order only for buffered messages. Order is not checked for messages across multiple message bursts for same session.

PolicyDRA Health Check

PolicyDRA Health Check is used to initiate a dummy AAR message that results in querying the binding database allowing the PCRF to take corrective action based on the response.

PolicyDRA Health Check is configured under **Diameter Configuration** plug-in in Policy Builder. Select **PolicyDRA Health Check** and **Binding Db** configuration to enable the feature.

The following parameters can be configured under **PolicyDRA Health Check**:

Table 13: PolicyDRA Health Check Configuration Parameters

Parameter	Description
Binding Db	<p>When selected, it enables the feature.</p> <p>When unselected, the feature is disabled.</p> <ul style="list-style-type: none"> Health Check Time Interval: Time interval in seconds when periodic AAR is sent. <p>Note The Health Check Time Interval and Revalidation Time under RevalidationTime service configuration should not be configured with the same value.</p> <p>For more information on Revalidation Time, refer to <i>RevalidationTime</i> in <i>Service Configuration Objects</i> chapter.</p> <ul style="list-style-type: none"> Session Release T P S: Per Policy Server (QNS) Gx RAR (with session release cause) TPS when binding database is down. <p>Default value is 0.</p>
Alarm Config	<p>When selected, it enables the generation of alarms or traps.</p> <p>When unselected, the alarms are not generated.</p> <ul style="list-style-type: none"> Primary Ip Address: Primary database IP address where the alarm information is stored. <p>Whenever PolicyDRA binding database down is detected i.e., when AAA comes with error result code, CPS generates a trap/notification/alarm. The generation time of this alarm is stored in the database configured. After the Alarm Clearance Interval, the trap/notification/alarm is cleared by CPS. In between this duration, CPS does not generate trap/notification/alarm on detection of binding database failure. Only one trap/notification/alarm is generated by CPS.</p> <ul style="list-style-type: none"> Secondary Ip Address: Secondary database IP address where the alarm information is stored. Port: Port number of the database. <p>Default value is 0.</p> <ul style="list-style-type: none"> Alarm Clearance Interval: Timer interval in seconds after which the alarm is cleared. Policy Dra Resultcode: AAA result-codes for which alarms are generated. Severity: Severity of the alarm. <p>Default value is Critical.</p>
Enable Proxy	<p>When checked, it makes sure P-Bit is set and Destination-Host AVP is not set for the outgoing AAR messages for PAS Health check.</p> <p>Default value is unchecked.</p>



Note To improve the performance when PolicyDRA Health Check is enabled, you must configure 'RxClientSessionKey' key as the Lookaside Key Prefix so that memcache is used and full database scan is avoided. This is highly recommended for higher capacity systems.

Diameter Messages Action on Threshold in LB

When **Diameter Messages Action on Threshold in LB** check box is enabled and **Diameter Message Count Threshold for PD** is configured with value greater than 0, the Policy Director processes keep track of messages being handled at process level and when number of messages being tracked crosses the configured **Diameter Message Count Threshold for PD**, the messages are dropped or responded with DiameterBusy.

Diameter Messages Action on Threshold in LB configuration is optional. When this configuration is not used, all the messages are sent from LB (Policy Director) to Policy Engines.

- The following parameters can be configured under **Diameter Messages Action on Threshold**:

Table 14: Diameter Messages Action on Threshold

Parameter	Description
Diameter Interface	Diameter Interface in Diameter message selected from drop-down list.
Command Code	Command code in Diameter message. When Command Code is set to 0, it applies to all Command Codes of the Application ID configured in the row.
Request Type	CCR Request type. Default value is 0. When Request Type is set to 0, it applies all the CCR Request types, namely Initial(1), Update(2) and Terminate(3). For non-CCR messages default 0 is must be set.
Action	What action to take when the Diameter message is received at LB (Policy Director) when outstanding Diameter messages have reached the Message Count Threshold . Possible Values: MESSAGE_DROP and DIAMETER_TOO_BUSY Default value is MESSAGE_DROP.

- **Diameter Message Count Threshold for PD**: This value defines the maximum number of a Diameter Inbound/Outbound messages per PD (Policy Director) process from the table **Diameter Messages Action on Threshold in LB**. Default value is 0.
- **Max TPS per PD**: Defines maximum TPS supported per PD process. Default value is 0.
- **Default Discard Behavior**: Describes the action to be taken when a Diameter request message is received in LB and rate limiter acquire fails. Possible values include **MESSAGE_DROP** and **DIAMETER_TOO_BUSY**. Default value is **MESSAGE_DROP**.



Note If **DIAMETER_TOO_BUSY** is selected from the drop-down list, at very high TPS, it can lead to higher CPU consumption on Policy Director (LB) VM. This can lead to performance degradation. Cisco recommends using **MESSAGE_DROP**.

Session Id Handling Configuration

Session Id Handling Configuration provides an option to parse part of the Diameter session ID attributes and store them in session AVP.

The following table describes parameters that can be configured under **Session Id Handling Configuration**.

Table 15: Session Id Handling Configuration

Parameter	Description
Diameter Interface	Diameter Interface DM for which the Session ID handling is required.
Input Regex	Provide an inverse regex to derive the new AVP. Example: Consider the Session ID is pcef01.dstest01.2b4.gx;375030;1285311481;BB2001@MCC2001. To get the Gw_Version BB2001@MCC2001, write an inverse regex ".*;*;.*;" which returns BB2001@MCC2001 as value.
Output Policy AVP Name	Policy derived AVP name to be stored.
Save to Session	Save the policy derived AVP to session.
Origin Realm	Origin-realm from the diameter request message to parse the session ID.
Origin Host	Origin-host from the diameter request message to parse the session ID.

Gx Offline Stale Session Cleanup



Important This feature is only enabled for deployments with arbitervip running on pcrfclient VMs.

Stale session builds up due to network issues, timeout at PAS and so on. As a result CPS starts rejecting new sessions due to capacity or session license limit. The offline Stale Session cleanup helps to remove the stale sessions having duplicate IMSI and AON combination.

Execute the following command in the pcrfclient where the application is running to stop the application:

```
monit stop stale-session-cleaner-helper
```

Execute the following command in the pcrfclient where the application is not running to restart the application:

```
monit restart stale-session-cleaner-helper
```

The following table lists parameters in the

/etc/broadhop/stale-session-cleaner/stale-session-cleaner.conf file:

Table 16: Gx Offline Stale Session Cleanup Configuration Parameters

Parameter	Description
-Dadmin.primary.host	VM name which hosts the primary member of the PCRF Admin replica-set. Any sessionmgr VM names. Default value is localhost. Example: sessionmgr01
-Dadmin.secondary.host	VM name that hosts a secondary member of the PCRF Admin replica-set. If the primary Admin member fails, the Stale Session Cleaner tries to connect to this secondary member. Any sessionmgr VM names. Default value is localhost. Example: sessionmgr02
-Dadmin.port	Port of the PCRF Admin replica-set. Possible values can be Integers. Default value is 27017. Example: 27721
-Dmemcache.host	The Host on which memcache is running on. Strings in the following format: <host>:<port> Default value is localhost.
-Dmemcache.port	The Port number of memcache. Possible values are Integers. Default value is 11211.
-Dtps.per.shards	Maximum number of executions per second per shard. Possible values are Integers. Default value is 200.
-Dmongo.query.batch.size	Number of records in the results for each query to the Session replica-set. Possible values are Integers. Default value is 1000.

Parameter	Description
-Dfactor.count.audit.log	<p>If the number of deleted sessions reaches a multiple of this parameter's value, it performs audit log.</p> <p>For example, if the parameter value is 100, then the deleted count is printed in the logs on 100 deletions, 200 deletions, 300 deletions, and so on.</p> <p>Possible values are Integers.</p> <p>Default value is 10000.</p>
-Dsession.count.threshold	<p>Specify the minimum count of session at which the utility triggers stale session cleanup.</p> <p>Possible values are Integers.</p> <p>Default value is 15000000.</p>
-Dsession.threshold.timer	<p>The frequency in minutes where utility monitors session threshold breach to start deletion of stale session.</p> <p>Possible values are Integers.</p> <p>Default value is 5.</p>
-Dsession.cache.update.timer	<p>The frequency in minutes where utility updates the latest session ID in the local cache. This parameter should be in the multiple of "session.threshold.timer."</p> <p>Possible values are Integers.</p> <p>Default value is 30.</p>
-Dnumber.of.shards	<p>Total number of shards for the Session replica-sets.</p> <p>Possible values are Integers.</p> <p>Default value is 80.</p>
-Dlogback.configurationFile	<p>The path to the log configuration file.</p> <p>Any directory path with a logback file for the application.</p> <p>Default value is /etc/broadhop/logback-stale-session-cleaner.xml.</p>

Cleaning Stale Session



Important

This feature is only enabled for deployments with arbitervip running on pcrfclient VMs.

The services for the application are running on pcrfclient from first deployment, but the application does not start unless the arbitervip is present on the pcrfclient VM. The default value for admin database is 127.0.0.1. Application only starts to delete stale sessions when admin database is correctly configured.

Stale session build up due to network issues when CPS is processing bulk traffic. Stale sessions are observed when there is an increase in incoming request and timeouts are observed. Session replica-sets are piled-up with the sessions and once the session capacity limit is breached, CPS start rejecting new session requests.

The existence of stale sessions in session replica sets results in storage of duplicate sessions, i.e. multiple sessions from a subscriber UE to the same APN. This feature is to identify the duplicate sessions (match with same IMSI + APN) in regular intervals and keep the latest session and remove the older duplicate sessions to make sure that there is no additional overhead in call processing.



Note Enabling/disabling this feature does not have any impact on existing stale session functionality.

This utility cleans the stale sessions without sending RARs to the gateway. This utility does not deletes corresponding records from SK database.

The following table lists parameters in the `/etc/broadhop/stale-session-cleaner/stale-session-cleaner.conf` file:

Table 17: Stale Session Cleanup Configuration Parameters

Parameter	Description
-Dadmin.primary.host	VM name which hosts the primary member of the PCRF admin replica-set. Any sessionmgr VM names. Default value is localhost. Example: <code>-Dadmin.primary.host=sessionmgr01</code> Possible Values: Primary Admin database name
-Dadmin.secondary.host	VM name that hosts a secondary member of the PCRF admin replica-set. If connecting to primary admin member fails, the Stale Session Cleaner tries to connect to this secondary member. Any sessionmgr VM names. Default value is localhost. Example: <code>-Dadmin.secondary.host=sessionmgr02</code> Possible Values: Secondary Admin database name
-Dadmin.port	Port of the PCRF admin replica-set. Default value is 27017. Example: <code>-Dadmin.port=27721</code> Possible Values: Integers (port number)

Parameter	Description
-Dmemcache.host	<p>The hostnames on which memcache is running on.</p> <p>Comma separated memcached server hostnames. Utility distributes memcached keys among the specified servers based on consistent hashing.</p> <p>Note If any of the specified instances is down, then utility cannot save memcache keys related to those instances and stale sessions corresponding to those keys are not cleaned.</p> <p>Default value is pcrclient01,pcrfclient02.</p> <p>Example: <code>-Dmemcache.host=pcrclient01,pcrfclient02</code></p> <p>Possible Values: Strings in the following format: <hostName1>, <hostName2></p>
-Dmemcache.port	<p>The port number of memcache.</p> <p>Default value is 11211.</p> <p>Example: <code>-Dmemcache.port=11211</code></p> <p>Possible Values: Integers</p>
-Dtps.per.shards	<p>The number of parallel tasks for scanning and cleaning the sessions.</p> <p>Note If the session creation TPS per shard (can be determined by max possible Gx CCR-I TPS / no. of shards) is higher than value configured, then utility does not process the older sessions.</p> <p>Default value is 200.</p> <p>Example: <code>-Dtps.per.shards=200</code></p> <p>Possible Values: Integers</p>
-Dmongo.query.batch.size	<p>The number of records to return in each batch of the response from the MongoDB instance.</p> <p>Default value is 1000.</p> <p>Example: <code>-Dmongo.query.batch.size=1000</code></p> <p>Possible Values: Integers</p>

Parameter	Description
-Dfactor.count.audit.log	<p>It prints the logs if the number of deleted sessions reaches a multiple of this parameter's value.</p> <p>For example, if the parameter value is 100, then the deleted count is printed in the logs on 100 deletions, 200 deletions, 300 deletions, and so on.</p> <p>Default value is 10000.</p> <p>Example: <code>-Dfactor.count.audit.log=10000</code></p> <p>Possible Values: Integers</p>
-Dsession.count.threshold	<p>Session clean up is kicked in after total active session count is greater than <code>session.count.threshold</code> value.</p> <p>Default value is 15000000.</p> <p>Example: <code>-Dsession.count.threshold=15000000</code></p> <p>Possible Values: Value must always be greater than total active sessions</p>
-Dsession.threshold.timer	<p>The frequency in minutes where utility monitors session threshold breach to start deletion of stale session.</p> <p>Default value is 5.</p> <p>Example: <code>-Dsession.threshold.timer=5</code></p> <p>Possible Values: Integers</p>
-Dsession.cache.update.timer	<p>The frequency in minutes where utility updates the latest session ID in the local cache. This parameter should be in the multiple of <code>session.threshold.timer</code> value.</p> <p>Default value is 30.</p> <p>Example: <code>-Dsession.cache.update.timer=30</code></p> <p>Possible Values: Integers</p>
-Dnumber.of.shards	<p>Total number of shards for the session replica-sets.</p> <p>Default value is 80.</p> <p>Example: <code>-Dnumber.of.shards=80</code></p> <p>Possible Values: Integers</p>

Parameter	Description
-Dlogback.configurationFile	<p>The path to the log configuration file.</p> <p>Default value is /etc/broadhop/logback-stale-session-cleaner.xml.</p> <p>Example: -Dlogback.configurationFile= /etc/broadhop/logback-stale-session-cleaner.xml</p> <p>Possible Values: Any directory path with a logback file for the application.</p>
-DdbPassword	<p>Configure the database password if MongoDB Authentication is enabled.</p> <p>Example: -DdbPassword=encryptedDbPassword</p> <p>Make sure to restart the Stale session utility after mongo db password change procedure.</p> <p>For more information on MongoDB Authentication, see:</p> <ul style="list-style-type: none"> • <i>MongoDB Authentication section in the CPS Installation Guide for VMware</i> • <i>MongoDB Authentication Process section in the CPS Installation Guide for OpenStack</i>

Memory and Performance Impact

- Logs require a maximum of 1.5 GB (stale-session-audit.log) and 1 GB (stale-session-cleaner.log) disk space.
- The utility JVM process requires 4 GB of additional memory over base perfcient VM requirement to run.
- You must configure a minimum and maximum value of -Xms4g and -Xmx8g for JVM memory in /etc/broadhop/stale-session-cleaner/jvm.conf file.
- Minimum four additional cores are required for the perfcient VM. This number of additional CPU cores depends on the number of shards and TPS per shard.
For example, in a CPS setup, if there are 88 shards and each shard handles 200 TPS, so a total of 17600 TPS is being processed. Then, it is recommended to add 4 cores.
- Enabling the utility requires additional 15% of CPU usage on each sessionmgr VM.
- The utility requires requires additional 2 GB memory space and 10% of one CPU (perfcient) core for memcache.
- Memcache server memory allocation depends on the number of unique keys that are saved in memcache with 200 bytes needed for each such entry. When multiple memcache instances are specified then data is distributed among those and memory requirement for each instances must be calculated based on expected number of records that are saved in that instance. The default and minimum required memory

allocation for each memcache instance is 2 GB. Memory needed by memcache instance is in addition to the memory required for VMs.

Configuration and Restrictions



Note

- It is recommended to set the value for `session.count.threshold` to be greater than total number of active sessions.
- Log rotation for `/var/log/broadhop/stale-session-audit.log` or `/var/log/broadhop/stale-session-cleaner.log` is controlled by logback, whereas the service logs are controlled by logrotate. It is similar to qns log and service-qns logs.

Starting and Stopping the Service

- Execute the following command in the `pcrfclient` where the application is running (and `arbitervip` is present) to stop the application:

```
monit stop stale-session-cleaner-helper
```

- Execute the following command in the `pcrfclient` where the application (and `arbitervip` is present) is not running to restart the application:

```
monit restart stale-session-cleaner-helper
```

Diameter Stack Configuration

This section allows for the creation of the stacks that handle the diameter traffic. Depending on your particular requirements one or more stacks can be created.

At System Level

In order to define a Diameter stack at system level you need to perform the following steps:

1. Login into Policy Builder.
2. Select **Reference Data** tab.
3. From the left pane, select **Systems**.
4. Select and expand your *system name*.
5. Select and expand **Plugin Configurations**.
6. Select **Diameter Configuration**.
7. From the right pane, click **Diameter Stack** under **Create Child**.

At Cluster Level

In order to define a Diameter stack at cluster level you need to perform the following steps:

1. Login into Policy Builder.
2. Select **Reference Data** tab.
3. From the left pane, select **Systems**.
4. Select and expand your *system name*.
5. Select and expand your *cluster name*.
6. Select and expand **Plugin Configurations**.
7. Select **Diameter Configuration**.
8. From the right pane, click **Diameter Stack** under **Create Child**.

The following parameters can be configured under Diameter Stack:

Table 18: Diameter Stack Parameters

Parameter	Description
Name	Local stack name. This is only used within the Policy Builder GUI to identify the diameter stack.
Realm	Local realm for the diameter stack. This value is going to set as Origin-Realm AVP value in all the diameter messages originated from this stack. For example, volte.pcrf.cisco.com
Accept Undefined Peer	This allows for any incoming diameter peer connection request to be accepted by the stack provided the peer realm is provisioned under inbound realms. For more details on Inbound Peers check Inbound Peers, on page 40 . Default value is checked. Note If this is unchecked, then the Inbound Peers and Outbound Peers table must be defined. Note that using this option opens a security hole into the system. Therefore, Cisco does not recommend using this option (uncheck the flag) in production environments.
Local End Points	This configures other stack parameters.
Local Host Name	The host local name where this stack is going to be created. Note If Local Host Name value does not map to a valid IP the stack binds to localhost (127.0.0.1).
Instance Number	Indicates the Instance number of the Policy Server process on Policy Director for which this entry applies. On a Policy Director each Policy Server process is assigned an Instance Number.

Parameter	Description
Advertised Diameter FQDN	<p>This value is going to be set as Origin-Host AVP value in all the diameter messages originated from this stack.</p> <p>The Advertised Diameter FQDN value needs to map to a valid IP address because that IP address is going to be set as Host-IP-Address AVP value in CER/CEA. As per RFC 3588 Host-IP-Address is a mandatory AVP in CER/CEA.</p>
Listening Port	The port the stack is listening to on the host identified by Local Host Name attribute. Default value is 3868.
Local Bind Ip	Allows the stack to bind to a different IP than the one that Local Host Name value maps to. When provisioned Local Bind Ip value overrides the Local Host Name value.
Transport Protocol	Allows you to select either 'TCP' or 'SCTP' for the selected diameter endpoint. Default value is TCP.
Multi Homing Hosts	<p>This is a comma separated list of IP addresses that CPS uses to start the diameter stack with multi-homing enabled for SCTP transport. Diameter stack with TCP transport still uses the existing 'Local Bind Ip' field to specify any specific IP address for TCP stack.</p> <p>CPS uses the 'Local Bind Ip' to bring up SCTP stack and use it along with the 'Multi Homing Hosts' to start the SCTP transport with multi-homing support.</p> <p>Note While using SCTP multi-homing functionality review the Linux network and gateway configurations for supporting multiple networks on different subnets. CPS supports Centos 6 release and reverse path filtering kernel parameter (rp_filter) values can be set for allowing packets from different subnets on Policy Director VMs. The default behavior in Centos 6 is to discard the packets in such scenarios.</p>

Settings

You can provision different timers that are available at the diameter stack level.

Figure 4: Settings

The following parameters can be configured under Settings:

Table 19: Settings Parameters

Parameter	Description
User Uri As Fqdn	Sets the Origin-Host AVP value in CER/CEA to the user URI value instead of FQDN value. Default value is not set.
Stop Timeout Ms	Sets the timeout duration for a stack to wait till all the resources stop. The delay is in milliseconds. Default value is 10000.
Cea Timeout Ms	Sets the CER or CEA exchange timeout duration in case of no response. The delay is in milliseconds. Default value is 10000.
Iac Timeout Ms	Sets the timeout duration for a waiting stack before retrying the communication with a peer that has stopped answering DWR messages. The delay is in milliseconds. Default value is 5000.

Parameter	Description
Dwa Timeout Ms	Sets the DWR or DWA exchange timeout duration in case of no response. The delay is in milliseconds. Default value is 10000.
Dpa Timeout Ms	Sets the DPR or DPA exchange timeout duration in case of no response. The delay is in milliseconds. Default value is 5000.
Rec Timeout Ms	Sets the timeout duration for reconnection procedure. The delay is in milliseconds. Default value is 10000.

Auto Provision Avp Parser

This section allows for provisioning of the necessary information needed to parse the Cisco vendor specific SN-Transparent-Data AVP value.

Figure 5: Auto Provision Avp Parser

The following parameters can be configured under Auto Provision Avp Parser:

Table 20: Auto Provision Avp Parser

Parameter	Description
AVP Name	The AVP name whose value needs to be parsed using the field separator and value separator. For example “abcd=xyz##lmno=pqrst”
Field Separator	String value used as a token to split pairs of attribute and values. In the above example # is the field separator.
Value Separator	String value used as a token to split pairs of attribute and values. In the above example = is the value separator.

Inbound Peers

This section allows for the provisioning of the diameter peers that are allowed to initiate connections towards PCRF. The PCRF does not initiate diameter connections with these peers.

Peer name and peer realm are independently checked against the two tables.

The following parameters can be configured under Inbound Peers:

Table 21: Inbound Peers Parameters

Parameter	Description
Peers	Defines which peer names are allowed to initiate connections towards PCRF.
Local Host Name	Identifies the local host name of the Policy Director (load balancer) that identifies and allows an incoming connection from the Peer.
Instance Number	Indicates the assigned number of the Policy Server (QNS) process that initiates a connection with the Outbound Peer. Note Local Host Name and Instance Number should be specified if the intention is for only a single Policy Server (QNS) process on Policy Builder (load balancer) to allow/initiate a connection with the said peer else Instance number can be kept as “0”. In which case all the Policy Server (QNS) processes on Policy Director (load balancer) shall attempt/allow connection with the peer. Default value is 0.
Rating	Priority assigned to this peer for delivering a PCRF initiated request. The higher the rating value the higher is the priority assigned to the peer. Default value is 1.
Port Range	Should be specified only when the underlying transport connection is SCTP and not required when the same is TCP.
Response Timeout	Cisco recommends not to use this parameter.
Name Pattern	Origin-Host AVP value in CER needs to validate against this pattern in order for the connection to be established. If that does not happen the CER is silently discarded and the TCP connection is reset by PCRF. Name pattern check does not happen if Accept Undefined Peer option described in Diameter Stack Configuration, on page 35 is checked. The Name Pattern needs to follow the standard Java regular expression syntax described here .

Table 22: Inbound Realms Parameters

Parameter	Description
Realms	Defines which peer realms are allowed to initiate connections towards PCRF.
Peer Type	Not used with inbound realms.
Processing Protocol	Mapping between the realm name and the specific PCRF logic that should be applied for the message. For more information on processing protocol refer to Table 6: Protocols, on page 11 . Note When a Diameter Stack with a diameter realm is imported with no protocol assigned, it takes the default value as GX_TGPP.
Rating	Priority assigned to this realm for delivering a PCRF initiated request. This is only used with SY_PRIME processing protocol. Default value is 0. Note The lower the rating value, the higher is the priority assigned to the realm. For example, a realm having Rating=10 is used after a realm having Rating=1.
Stats Alias	Whatever the statistics that gets generated for the respective realm gets the name that is configured in “Stats Alias” appended to those statistics. This is applicable for com.broadhop.message mbean statistics only.
Name Pattern	Origin-Realm AVP value in CER needs to validate against this pattern in order for the incoming message to be processed. If that does not happen the message is silently discarded and the TCP connection is reset by PCRF. The Name Pattern needs to follow the standard Java regular expression syntax described here .



Important In **Message Timeout and Retry Configuration**, diameter response timeout is defined using the combination of **Application Id** and **Command Code** parameters.

When PCRF is configured to work with a DRA the actual system's host name does not need to be provisioned in the Peers table for the message to be answered.

When PCRF is configured to work with a DRA the actual system's origin realm name does need to be provisioned in the Peers table for the message to be processed. If it is not provisioned then PCRF shall send an error response containing the Result-Code AVP with value DIAMETER_APPLICATION_UNSUPPORTED (3007).

Outbound Peers

This section allows for the provisioning of the diameter peers to which the PCRF initiates the diameter connections.

Peer name and peer realm are independently checked against the two tables.

The following parameters can be configured under Outbound Peers:

Table 23: Outbound Peers Parameters

Parameter	Description
Peers	Defines the peers to which CPS can initiate connections.
Local Host Name	Identifies the local host name of the Policy Director (load balancer) that initiates a connection with the said Peer.
Instance Number	Indicates the assigned number of the Policy Server (QNS) process that allows an incoming connection from the Peer. Default: 0
Rating	Priority assigned to this peer for delivering a PCRF initiated request. The higher the rating value the higher is the priority assigned to the peer. Default: 1
Port Range	Should be specified only when the underlying transport connection is SCTP and not required when the same is TCP. However in mixed mode where both SCTP and TCP co-exist then it is mandatory to provide port range values for both TCP and SCTP peers in order to avoid any conflicts on using local ports on same host.
Response Timeout	Cisco recommends not to use this parameter.
Name	Peer host name. Peer host name needs to be mapped to a valid IP address or the diameter connection is not initiated. By default the connection is initiated on the standard diameter port (3868). If a different port needs to be used than the peer name shall be defined using the host:port format. Default value is “default”. Note We recommend that the peer names (Name) should match the Origin-Host AVP value in the incoming CER/CEA message.
Transport Protocol	Allows you to select either 'TCP' or 'SCTP' for the selected diameter stack instance. Default value is TCP.

Parameter	Description
Multi Homing Hosts	<p>This is a comma separated IP addresses list that CPS uses to start the client connections towards external diameter peer. If either TCP/SCTP or both TCP and SCTP are configured in the Outbound Peers (Peers) table then client connections to the peers are initiated based on whether the PD instance is started as a 'SCTP' or 'TCP' stack. Mixed mode of client and stack running on both 'TCP' and 'SCTP' is not currently supported by diameter.</p> <p>Note While using SCTP multi-homing functionality review the Linux network and gateway configurations for supporting multiple networks on different subnets. CPS supports Centos 6 release and reverse path filtering kernel parameter (rp_filter) values can be set for allowing packets from different subnets on Policy Director (load balancer) VMs. The default behavior in Centos 6 is to discard the packets in such scenarios.</p>

Table 24: Outbound Realms Parameters

Parameter	Description
Realms	Defines the realms to which CPS can initiate connections.
Peer Type	This indicates which diameter server to use when there are multiple target servers for the same protocol. This is only used with SY_PRIME processing protocol.
Processing Protocol	Mapping between the realm name and the specific PCRF logic that should be applied for the message. For more information on processing protocol refer to Table 6: Protocols, on page 11 .
Rating	<p>Priority assigned to this realm for delivering a PCRF initiated request. This is only used with SY_PRIME processing protocol.</p> <p>Default value is 0.</p> <p>Note The lower the rating value, the higher is the priority assigned to the realm. For example, a realm having Rating=10 is used after a realm having Rating=1.</p> <p>Note This rating is used only for next hop based routing with SY_PRIME.</p>
Stats Alias	<p>Whatever the statistics that gets generated for the respective realm gets the name that is configured in "Stats Alias" appended to those statistics.</p> <p>This is applicable for com.broadhop.message mbean statistics only.</p>
Name	<p>Origin-Realm AVP value in CER needs to validate against this pattern in order for the incoming message to be processed. If that doesn't happen the message is silently discarded and the TCP connection is reset by PCRF.</p> <p>The Name Pattern needs to follow the standard Java regular expression syntax described here.</p>



Important In **Message Timeout and Retry Configuration**, diameter response timeout is defined using the combination of **Application Id** and **Command Code** parameters.



Note Outbound Realms table is not used when Next Hop Routing table is defined. For more information on next hop routing table, refer to [Next Hop Routing, on page 13](#).

When PCRF is configured to work with a DRA the actual system's host name does not need to be provisioned in the Peers table for the message to be answered.

When PCRF is configured to work with a DRA the actual system's origin realm name does need to be provisioned in the Peers table for the message to be processed. If it is not provisioned than PCRF shall send an error response containing the Result-Code AVP with value DIAMETER_APPLICATION_UNSUPPORTED (3007).

The following restrictions are applicable while configuring CPS for SCTP:

When using SCTP as a transport protocol, CPS selects the 'Multi Homing Hosts' values along with the 'local bind ip' defined in local endpoints. But for TCP transport protocol CPS ignores the 'Multi home hosts' value.

When using SCTP as a transport protocol, CPS selects the 'Multi Homing Hosts' values along with 'Outbound Peers' defined in 'Peers' table. But for TCP transport protocol CPS ignores the 'Multi Homing Hosts' value.

Configuring Port-Range for SCTP outbound peers is mandatory. We also recommend using non-overlapping port ranges across different PDs within same Policy Director (load balancer) node while configuring multiple PDs.

For example:

PD1 (qns-2 process in the Policy Director (load balancer) VM) 12000-12500

PD2 (qns-3 process in the Policy Director (load balancer) VM) 13000-13500

PD3 (qns-4 process in the Policy Director (load balancer) VM) 14000-14500

Diameter Agents

The Diameter Agent in CPS currently supports only the PROXY mode of operation (for more information, see RFC 6733 – Diameter Base Protocol at <https://tools.ietf.org/html/rfc6733>). In Proxy mode, all relevant messages that are received by the CPS node (based on the applied filter on which the message is to be proxied) are forwarded to the given agent.

Policy Builder currently supports proxy functionality for Gx, Gy, and Rx interfaces. Messages reaching CPS may be proxied to an alternate realm based on the "Application-ID" and/or the "Command-Code" within the incoming message. As part of the Diameter agent's configuration (described in [Diameter Agent Configuration, on page 45](#)), the specified realm translates to a destination realm, and a destination node is selected based on outbound peers and priority/rating.

The filter information on which the Application/message needs to be proxied by CPS is provided by configuring a Use Case Template containing the DiameterAgentInfo service configuration (described in [DiameterAgentInfo Service Configuration Object Setup, on page 45](#)) as part of the configured service.

Diameter Agent Configuration

A diameter agent is defined with a name and an associated realm, and is then used when configuring the DiameterAgentInfo service configuration object.

Procedure

- Step 1** Log in to Policy Builder.
- Step 2** Select the **Reference Data** tab.
- Step 3** In the left pane, select **Diameter Agents**.
- Step 4** In the **Summary** pane, click **Diameter Agent** under **Create Child**.
- Step 5** In the **Diameter Agent** pane, type the **Name** and the **Realm** for the agent.

Figure 6: Diameter Agent Configuration

The screenshot shows a web interface for configuring a Diameter Agent. On the left is a navigation pane with the following items: Systems, Account Balance Templates, Custom Reference Data Tables, Diameter Agents (selected), Summary, Agent 1, Diameter Applications, Diameter Clients, Diameter Defaults, and Fault List. The main area is titled 'Diameter Agent' and contains the following fields and actions:

- *Name**: A text input field containing 'Agent 1'.
- *Realm**: A text input field containing '@cisco.com'.
- Actions**: A section with a dropdown arrow and a 'Copy' label.
- Copy:** A button with the text 'Current Diameter Agent'.

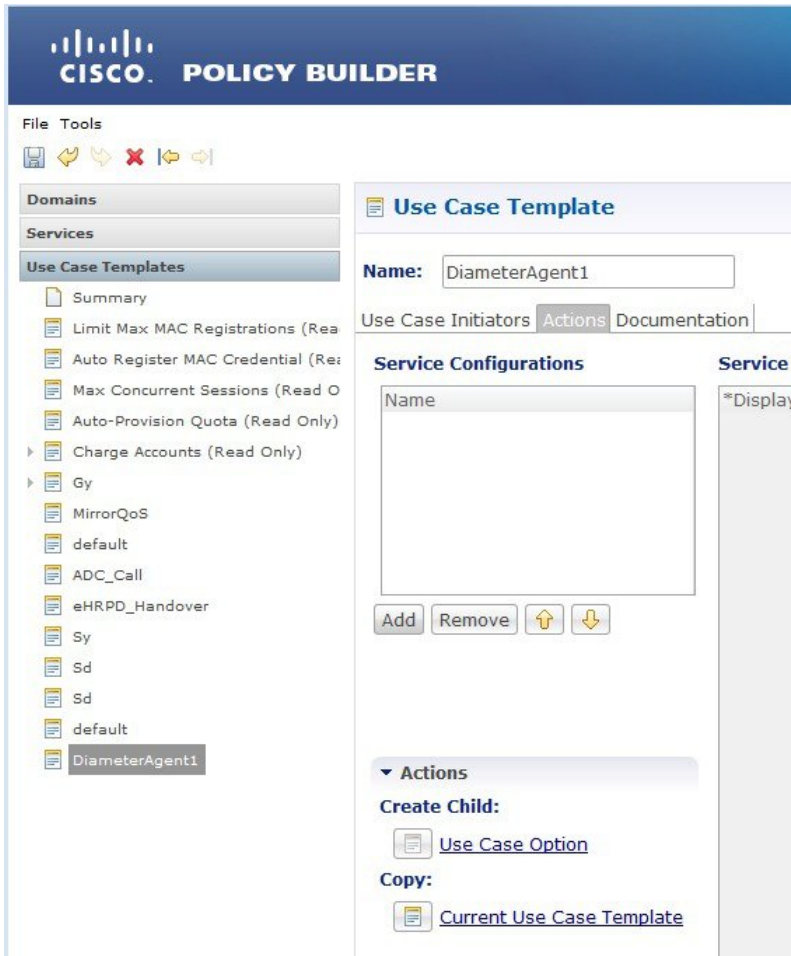
DiameterAgentInfo Service Configuration Object Setup

This section describes how to configure the DiameterAgentInfo service configuration object.

Procedure

- Step 1** In Policy Builder, select the **Services** tab.
- Step 2** In the left pane, select **Use Case Templates**.
- Step 3** Select **Summary** and from right side pane, click **Use Case Template** under **Create Child**.
- Step 4** In the **Name** field, type a name for the template.
- Step 5** select the **Actions** tab, and then click **Add** under **Service Configurations**.

Figure 7: Use Case Template Actions Tab



Step 6 In the **Select Service Configuration** dialog box, scroll down to the proxy section, select **DiameterAgentInfo**, and click **OK**.

Step 7 Configure the DiameterAgentInfo parameters as described in the following table:

Table 25: DiameterAgentInfo Parameters

Parameter	Description
Diameter Agent Name	Click in the Value column beside Diameter Agent Name , and type the name that you supplied when you configured the Diameter agent.
Diameter Agent Type	Proxy is the only agent type that has been implemented.

Parameter	Description
Proxy Protocol	<p>Select one of the following protocols from the drop-down list:</p> <ul style="list-style-type: none"> • GX_TGPP • GY_V8 • RX_TGPP <p>The other protocols in the list are not currently supported.</p>
Proxy Request A V Ps (List)	<p>In this section, you can define additional AVPs to add to the proxy request. The following parameters can be configured:</p> <p>Command Code –</p> <p>Request Type –</p> <p>Code – Type a code for the AVP.</p> <p>Value – Type a value for the AVP.</p> <p>Type – Select the AVP type from the drop-down list.</p> <p>Operation – Select the Operation from the drop-down list.</p> <p>Vendor – Select the AVP Vendor from the drop-down list.</p>
Proxy Response A V Ps (List)	<p>In this section, you can define additional AVPs to add to the proxy response. The following parameters can be configured:</p> <p>Command Code –</p> <p>Request Type –</p> <p>Code – Type a code for the AVP.</p> <p>Value – Type a value for the AVP.</p> <p>Type – Select the AVP type from the drop-down list.</p> <p>Operation – Select the Operation from the drop-down list.</p> <p>Vendor – Select the AVP Vendor from the drop-down list.</p>

Diameter Clients

The Diameter Clients section allows for the creation of different clients identified by their realm. The clients defined in this section can be further used while configuring a policy so that different clients get different service configuration objects.

In order to define a Diameter Client you need to perform the following steps:

1. Login into Policy Builder.
2. Select **Reference Data** tab.

3. From the left pane, select **Diameter Clients**.
4. Select **Summary**.
5. Create the specific client that corresponds to your interface. If there is no specific client for your interface select the generic Diameter Clients.
6. Provide values for at least the mandatory attributes.

Figure 8: Gx Client



Note The mandatory fields are marked with a “*” on the upper left corner of the field name label.

Once you have done that you can use the diameter client to filter the service objects that are going to be used in a policy.

More details about each client field and attribute will be provided in the following sections dedicated to each type of client.

In order to filter a Service Option based on the Diameter Client you need to perform the following steps:

1. Login into Policy Builder.
2. Select **Services** tab
3. From the left pane, select **Services**.
4. Expand Service Options tree.
5. Select and expand your service option.
6. Select the service option object.
7. Select the Value cell corresponding to the Diameter Client Display Name.
8. Click the “...” button.
9. Select the Diameter Client from the popup window.
10. Click **OK**.

For more details about how to define a service option refer to [Services](#).



Note If your service configuration object does not have a Diameter Client attribute it means it is not diameter related and it cannot be filtered out based on diameter client.

Currently, the following diameter client types are supported:

- Diameter Clients
- Gx Clients
- Rx Clients
- Gy Clients



Note The diameter client feature is mainly for use with inbound realms. No validation is done as to whether a realm is unique for a specific client type. If multiple clients are defined for the same realm the behavior may be unpredictable. The interface specific diameter clients are built on top of the generic Diameter Clients. They add specific behavior and this is why they should always be used in the context of the specific interface.

Diameter Clients

This generic diameter client object is supposed to be used for any interface that does not have a matching specific diameter client.

The following parameters can be configured under generic Diameter Client:

Table 26: Diameter Client Parameters

Parameter	Description
Name	The client name that is going to be used to reference this particular client in the service configuration object.
Realm Pattern	The pattern that peer realm name should match in order for this diameter client to be used. The pattern needs to follow the standard Java regular expression syntax described here . The first choice for Realm Pattern value should always be the exact peer realm name whenever possible.
Override Supported Features	Currently, not supported. Note This table is only supported for Gx and Rx client.

Parameter	Description
Copy Current Diameter Client	<p>This action creates a new diameter client that is an exact copy of the current diameter client. The only difference between the original and the copy is that “-Copy” is appended to the name of the copy.</p> <p>The Copy action works exactly the same for all types of diameter clients.</p>

Gx Clients

This specific diameter client object is supposed to be used only in relation with the Gx interface. It adds Gx specific features to the generic diameter client already described in [Diameter Clients, on page 49](#).

Basic Options

The following parameters can be configured for Basic Options under Gx Client:

Table 27: Gx Client Parameters - Basic Options

Parameter	Description
Add Subscriber Id	<p>Adds Subscription-Id grouped AVP in Gx CCA-i message with one of the following Subscription-Id-Type AVP value and Subscription-Id-Data AVP value depending on the selection. The values will be copied from the incoming Gx CCR-i message if available.</p> <ul style="list-style-type: none"> • NONE (default): No Subscription-Id grouped AVP in Gx CCA • IMSI: END_USER_IMSI (1) • MSISDN: END_USER_E164 (0) • NAI: END_USER_NAI (3)
Rx PCC Rule Flow Direction Behavior	<p>Controls how the Flow-Direction AVP value under Flow-Information grouped AVP is derived. This option is only used for Rx dedicated bearers.</p> <ul style="list-style-type: none"> • Derive Flow-Direction: Flow-Direction AVP is derived based on Flow-Description AVP value and Flow-Status AVP value. This option is used only in case the PCEF advertised support for Rel10 feature under Supported-Features AVP. For more information refer to Table 28: Flow-Direction AVP Values, on page 54. • 3GPP Gx Rel11 Compliant: Flow-Direction AVP is derived as per 3GPP TS 29.212 v11 • Exclude Flow-Direction (default): Flow-Direction AVP is not set.
Sending Delayed Message Wait Time Ms	<p>This parameter specifies the amount of time the Gx RAR is delayed after Gx CCA is sent when "Gx Triggered Session-Release-Cause in RAR" is enabled.</p> <p>Default value is 500 milliseconds.</p>

Parameter	Description
Max Num of Dynamic Rule Supported	This parameter specifies the maximum number of dynamic rules supported per Gx session. Default value is 100. Allowed value > 10
Max Number of PRA Identifiers Supported	This parameter indicates the maximum number of PRA identifiers CPS supports. When PresenceReportingAreaConfiguration service configuration is configured with number of PRA Identifiers more than the this value, the PRA Identifiers configured beyond this value are ignored. Default value is 8.
Emergency Called Station Ids	The list of APNs that are allowed to initiate IMS emergency calls as per procedures described in 3GPP TS 29.212.
Controls Session Lifecycle	Decides whether all the other sessions bound to the current Gx session get terminated upon Gx session termination. Default value is checked.
Load By Imsi	If checked, attempts to load the session by IMSI (Subscription-Id-Data AVP value under Subscription-Id grouped AVP where Subscription-Id-Type AVP value is END_USER_IMSI (1)). Default value is unchecked.
Load By Nai	If checked, attempts to load the session by NAI (Subscription-Id-Data AVP value under Subscription-Id grouped AVP where Subscription-Id-Type AVP value is END_USER_NAI (3)). Default value is unchecked.
Load By Msisdn	If checked, attempts to load the session by MSISDN (Subscription-Id-Data AVP value under Subscription-Id grouped AVP where Subscription-Id-Type AVP value is END_USER_E164 (0)). Default value is unchecked.
Imsi Based Nai	If checked, the subscriber is identified by PCRF using “IMSI based NAI”, where the identity is represented in NAI form as specified in RFC 4282 [5], and formatted as defined in 3GPP TS 23.003 [6], clause 19.3.2. The IMSI based NAI is sent within the Subscription-Id AVP with the Subscription-Id-Type set to END_USER_NAI at IP-CAN session establishment. Default value is unchecked.
Load By Framed Ip	If checked, attempts to load the session by IPv4 address (Framed-IP-Address AVP value). Default value is unchecked.

Parameter	Description
Load By Ip V6 Prefix	If checked, attempts to load the session by IPv6 address (Framed-IPv6-Prefix AVP value). Default value is unchecked.
Session Chained	If checked, it does not attempt to terminate the Gx session by sending a Gx RAR to PCEF. Default value is unchecked.
Remove Realm In User Id Mapping	If checked, removes the realm from the NAI (if present) before attempting to load the session by username. For more details on NAI see RFC 2486. Default value is unchecked.
Exclude Sponsor Identity Avp	If checked, it does not add the Sponsor-Identity AVP to the Charging-Rule-Definition grouped AVP. This option is used only in case the PCEF advertised support for SponsoredConnectivity feature under Supported-Features AVP. Default value is unchecked.
Load By Called Station Id	If checked, attempts to load the session by IMSI and APN. In order for this option to be effectively used 'Load By Imsi' option (described above) needs to be checked. Default value is unchecked.
Re-install Rule on Monitoring Key Change	If checked, attempts to reinstall a charging rule in case the only AVP value that changed for a PreConfiguredRule is the monitoring key value.
Limit with Requested QoS on modification failure	If checked, authorizes bound QoS between retained and calculated QoS after CPS has received QoS modification failure event from PCEF. Default value is checked.
Enforce Missing Avp Check	The default value of this new attribute is TRUE (checked); that is, CPS will perform missing Enforce Missing AVP Check, on page 55 validations and send DIAMETER_MISSING_AVP (5005) result in the answer message. However, if this attribute is FALSE (unchecked), CPS will not perform the missing AVP validation.

Parameter	Description
One Gx Rule Per Flow	<p>This parameter applies only to the dynamic charging rules over Gx that are generated by CPS due to the APPLICATION_START event trigger received over the Sd interface for ADC rules.</p> <p>If checked, CPS creates one dynamic charging rule over Gx per flow information received in the Application-Detection-Info AVP over the Sd interface. CPS also creates a unique TDF-Application-Identifier over Gx for each of these rules. So, each generated rule has a unique TDF-Application-Identifier and only one Flow-Information AVP.</p> <p>If unchecked, CPS generates only one rule per TDF-Application-Identifier received over the Sd interface. This one rule has all the Flow-Information AVPs. The TDF-Application-Identifier over Gx is same as over Sd.</p> <p>By default, the check box is unchecked.</p>
Selective Muting	<p>If checked, CPS selectively mutes the flow corresponding to a TDF-Application-Identifier on the dedicated bearer after it receives the first Application_Start event trigger on the dedicated bearer from PCEF.</p> <p>For default bearer, CPS selectively mutes the flow corresponding to a TDF-Application-Identifier after it receives the Application_Start event trigger on the default bearer from PCEF and maximum limit is reached on the dedicated bearer.</p> <p>Note Limit on number of flows on a given dedicated bearer is based on a unique combination of QCI and ARP Priority Level. This value is configurable in Policy Builder.</p> <p>After CPS receives Application_Stop event trigger from PCEF for a specific TDF-Application-Identifier (with TDF-App-Instance-ID=0), CPS removes that rule from the dedicated bearer and installs the rule on the default bearer and unmutes all the rules related to that Sd TDF-Application-Identifier on the default bearer.</p> <p>Note PCEF sends the TDF-App-Instance-ID as 0 only after all applications related to a TDF-Application-Identifier are stopped.</p>
Re-Install Predefined Rules on Rulebase Change	<p>Indicates whether all the existing predefined rules that are applicable for the session are re-installed if there is a Rule-Base change. Select this option if you want all the predefined rules (that are applicable to the session) to be re-installed if the Rule-Base changes due to any reason. If unchecked, whenever there is a Rule-Base change, CPS only notifies the changes (if any) in predefined rules to PCEF and does not re-install all the existing predefined rules.</p> <p>Note The rules that are not applicable are removed.</p> <p>This option does not apply to preconfigured or dynamic rules from Rx/Sd.</p> <p>Restriction Use this checkbox only in consultation with Cisco Technical Representative.</p>

Parameter	Description
Gx triggered Session-Release-Cause in RAR	<p>If checked (enabled), any Gx initiated session termination is responded to with a RAR immediately after CCR/CCA exchange with the PCEF. The RAR contains the Session-Release-Cause AVP.</p> <p>If unchecked (disabled), any Gx initiated session termination response from the PCRF in the CCA-U contains the Session-Release-Cause AVP. This is the default behavior.</p> <p>Note When the Gx RAR option is enabled, it is sent after the number of milliseconds specified under "Sending Delayed Message Wait Time Ms" field.</p>
Enhanced Logic for Preconfigure Rule Redirection Support	<p>If checked, Redirect-Support as disabled is only sent when enable was sent previously.</p> <p>By default, the check box is unchecked.</p>
Enhanced Gx-RAR Behavior	<p>If checked (enabled), the desired behavior is exhibited for call flows.</p> <p>By default, the check box is unchecked for backward compatibility.</p>
Save Session State	<p>If checked (enabled), Gx session state is restored following a failed Gx RAA (Result-Code AVP value not equal to DIAMETER_SUCCESS (2001)) to the state it was before the Gx RAR was sent. The behavior is same for both sync and async Gx RAR.</p> <p>By default, the check box is unchecked to for backward compatibility.</p>
Ignore IPME Rule On Handover	<p>Indicates whether to use IPME rules during handover or not.</p> <p>If checked, CPS does not consider the IPME rules during handover.</p> <p>If unchecked, CPS considers IPME rules during handover.</p> <p>By default, the check box is selected.</p>

Table 28: Flow-Direction AVP Values

Priority	Criteria	Flow-Direction AVP Values
1	Flow-Description AVP value contains "permit in"	UPLINK (2)
2	Flow-Description AVP value contains "permit out"	DOWNLINK (1)
3	FlowStatus AVP value is ENABLED (2)	BIDIRECTIONAL (3)
4	FlowStatus AVP value is ENABLED_UPLINK (0)	UPLINK (2)
5	FlowStatus AVP value is ENABLED_DOWNLINK (1)	DOWNLINK (1)

Enforce Missing AVP Check

The following is the list of AVPs for which CPS performs the missing AVP validation if **Enforce Missing Avp Check** check box is selected:

- Mandatory AVPs: Origin-Host, Destination-Realm, CC-Request-Type, CC-Request-Number
- Conditional AVPs for session establishment: Subscription-Id (Subscription-Id-Type, Subscription-Id-Data), IP-CAN-Type, RAT-Type, Framed-IP-Address OR Framed-IPv6-Prefix (one must be present), AN-GW-Address (If IP-CAN-TYPE = '3GPP-EPS' or '3GPP2')
- Conditional AVPs for session modification: These AVPs are required based on the event trigger type.
 - SGSN_CHANGE Event Trigger: 3GPP-SGSN-Address or 3GPP-SGSN-IPv6-Address
Applicable only to 3GPP-GPRS access types and 3GPP-EPS access types with access to the P-GW using Gn/Gp.
 - QOS_CHANGE Event Trigger: Bearer-Identifier, QoS-Information
When IP-CAN-Type is 3GPP-GPRS and if the PCRF performs bearer binding, the Bearer-Identifier AVP shall be provided to indicate the affected bearer. QoS-Information AVP is required to be provided in the same request with the new value.
 - RAT_CHANGE Event Trigger: RAT-Type
The new RAT type must be provided in the RAT-Type AVP.
 - PLMN_CHANGE Event Trigger: 3GPP-SGSN-MCC-MNC
 - IP_CAN_CHANGE Event Trigger: IP-CAN-Type
The RAT-Type AVP must also be provided when applicable to the specific IP-CAN Type (for example, 3GPP IP-CAN Type).
 - RAI_CHANGE Event Trigger: RAI
Applicable only to 3GPP-GPRS and 3GPP-EPS access types.
 - USER_LOCATION_CHANGE Event Trigger: 3GPP-User-Location-Info
Applicable only to 3GPP-GPRS and 3GPP-EPS access types.
 - USER_LOCATION_CHANGE Event Trigger: 3GPP2-BSID
Applicable only to 3GPP2 access types.
 - OUT_OF_CREDIT Event Trigger: Charging-Rule-Report, Final-Unit-Action
 - REALLOCATION_OF_CREDIT Event Trigger: Charging-Rule-Report
 - AN_GW_CHANGE Event Trigger: AN-GW-Address
 - UE_TIME_ZONE_CHANGE Event Trigger: 3GPP-MS-TimeZone
 - LOSS_OF_BEARER, RECOVERY_OF_BEARER, SUCCESSFUL_RESOURCE_ALLOCATION: Charging-Rule-Report
 - DEFAULT_EPS_BEARER_QOS_CHANGE: Default-EPS-Bearer-QoS
 - ECGI_CHANGE or TAI_CHANGE Event Trigger: 3GPP-User-Location-Info
 - ACCESS_NETWORK_INFO_REPORT Event Trigger:

3GPP-User-Location-Info, if Required-Access-Info = USER_LOCATION

3GPP-MS-Timezone, if Required-Access-Info = MS_TIMEZONE

- APPLICATION_START or APPLICATION_STOP Event Trigger over Gx:
TDF-Application-Identifier

Advanced Options

Default Flow Description

The **Default Flow Description** field helps in configuring the flow description AVP value corresponding to charging rule over Gx Message, when Media-Sub-Component AVP contains the Flow-Number AVP set to "0", and the rest of AVPs within the Media-Component-Description and Media-Sub-Component AVPs are not used.

By default, this field is disabled or unchecked. The corresponding Flow Description AVP value is set to charging rule **permit in ip from any * to any *** for inbound and **permit out ip from any * to any *** for outbound.

Select the **Default Flow Description** check box to configure the parameters.

Table 29: Default Flow Description Parameters

Parameter	Description
Is Inbound?	This is a check box field. This parameter denotes whether Flow Description configuration defined is for Inbound or Outbound call. Default value is checked.
Source IP	This parameter denotes the Source IP of the Flow-Description AVP received in the message. Default value is any.
Source Port	This parameter denotes the Source Port of the Flow-Description AVP received in the message. Default value is *.
Destination IP	This parameter denotes the Destination IP of the Flow-Description AVP received in the message. Default value is any.
Destination Port	This parameter denotes the Destination Port of the Flow-Description AVP received in the message. Default value is *.

Cisco Pending Transaction Retry

StarOS 16 introduces optional custom behavior for handling overlapping Gx transactions so that the potential race conditions that can occur on Gx interface are to be handled deterministically.

This feature introduces a new error indication to allow the transaction originator to determine if a re-attempt of the transaction is appropriate. The PCRF shall send an error response to the PCEF containing the Experimental-Result-Code AVP with Cisco specific value DIAMETER_PENDING_TRANSACTION (4198) if the PCRF expects a response to a pending request that it initiated. The PCRF shall also have the ability to retry the request message for which it received an error response containing the Experimental-Result-Code AVP with Cisco specific value DIAMETER_PENDING_TRANSACTION (4198).

Refer to the CISCO StarOS 16 and CISCO ASR5500 documentation for more details.

Default value (if enabled) is 1.

Figure 9: Cisco Pending Transaction Retry

Max Pending Transaction Retry Count does not include the initial request. For example, in the above case the system will send a initial message and if it fails, it will send the same message 1 more time (retry).



Note PCRF will cache and retry only one message per Gx session. If due to Rx IMS session interaction multiple Gx RAR messages are being evaluated while another Gx RAR message is already pending than PCRF will not reply on the Rx IMS session.

Sponsored Profile

The default monitoring key name format used to track the usage when the AF provides sponsored data connectivity to the subscriber is:

`_<Sponsor-Id>_ <Rx-Session-No>`

where:

- **<Sponsor-Id>**: Sponsor-Identity AVP value under the Sponsored-Connectivity-Data grouped AVP.
- **<Rx-Session-No>**: Counts how many Rx sessions have bound so far to the Gx session by the time the current Rx session is created. This is an attribute of the Rx session stored on PCRF side and it doesn't change during the Rx session lifetime. The value starts from zero and it increases with one for each new Rx session that binds.

This feature allows for customization of the monitoring key name. The monitoring key name matching the Sponsor-Identity AVP value and Application-Service-Provider-Identity AVP value will be used instead of the default one.

Figure 10: Sponsored Profile

Sponsor Id	A S P Id	Monitoring Key
SponsorA	ASPA	MKA
SponsorB	ASPB	MKB

Buttons: Add, Remove, ↑, ↓

This option is used only in case the PCEF advertised support for SponsoredConnectivity feature under Supported-Features AVP.

Rx Based QoS Upgrade of Default Bearer

- **Override Boost with Throttle for Similar Priority:** This provides an option to over-ride Throttle with Boost for same priority values received in Dynamic-PCC-Request-QoS.



Restriction

- This feature is applicable for QoS uplift on Default Bearer only.
- This feature overrides the earlier implementation of QoS uplift done in CPS 7.0.5 and earlier versions.
- **Atomic Update of QCI and ARP:** This check box has been added to support QCI and ARP atomicity. When checked, on receiving boost request, ARP gets modified only when QCI is modified.

Count of Flow Description in one Charging Rule

CPS now supports the ability to split Flow Information received from the Traffic Detection Function (TDF) in a CCR-Update across multiple Charging Rules and sent over the Gx interface.

This release provides the ability for CPS to distribute the TFTs across multiple CRNs. The distribution of TFTs keeps the Uplink and Downlink flows together in the same CRN. The number of TFTs per CRN is configurable. By default, CPS is configured to allow 8 TFTs per CRN.

Figure 11: Count of Flow

Count of Flow Descriptions in one Charging Rule

Count of TFT's in one Charging Rule

8

The following parameter can be configured:

Table 30: Count of Flow Descriptions in one Charging Rule Parameters

Parameter	Description
Count of TFT's in one Charging Rule	One TFT is equivalent to or denotes one Flow-Description AVP received in the message.

Max Number of Flow Descriptions on a bearer (per QCI)

Here, you can set the maximum number of flows that can be configured on the default and dedicated bearer (per QCI).

The following parameters can be configured:



Note These parameters apply only to the dynamic charging rules over Gx that are generated by CPS due to the APPLICATION_START event trigger received over the Sd interface for ADC rules.

Table 31: Max Number of Flow Descriptions on a bearer (per QCI) Parameters

Parameter	Description
Max Number of Flow Descriptions on a default bearer (per QCI)	This parameter defines the maximum number of flows that can be installed on a default bearer per QCI. So, on receiving the APPLICATION_START event trigger over the Sd interface, CPS installs the corresponding flows over the Gx interface and QCI maps to that of the default bearer. Essentially, this is the limit of flows per QCI that CPS can accept from TDF over the Sd interface. Once this limit is reached, CPS ignores any more flows received from TDF, that is, CPS does not install any rules for those flows. Default value is 64.
Max Number of Flow Descriptions on a dedicated bearer (per QCI)	On receiving the APPLICATION_START event trigger from PCEF, CPS removes the default bearer rule and installs the dedicated bearer rule for the received Gx TDF-Application-Identifier. So, QCI for the new rule maps to a dedicated bearer. This parameter defines the the maximum number of flows per QCI that can be installed on a dedicated bearer. Once this limit is reached, CPS ignores the APPLICATION_START event trigger received over the Gx interface and there is no rule or flow installed on the dedicated bearer. Default value is 16.

Charging Rule Retry Configuration

Upon failure of installation of any/all of the TFTs across one or both CRNs, a configurable retry timer is activated with a configurable number of retries for the TFTs marked as "INACTIVE". The number of retries and the timer interval between each retry is configurable.

Figure 12: Charging Rule Retry Configuration

The following parameters can be configured under Charging Rule Retry:

Table 32: Charging Rule Retry Parameters

Parameter	Description
Retry Interval	The delay between retry attempts. The default interval is 10 seconds. Also, by default, the value is capped at 15 secs (configurable). If value is less than 15 seconds, then the retries will be scheduled at second level granularity. If value is greater than 15 seconds, then granularity is of 1 minute (overdue retry events are checked every minute rather than each second).
Max Retry Attempts	The maximum times retry is attempted for a rule. Default value is 3 attempts.
Backoff Algorithm	The back-off algorithm used while determining the actual delay between retry attempts. Currently only one option is supported: Constant Interval: Causes the configured retry interval to be used (without any change) for delay for all retry attempts (other options like exponential back-off where retry interval increases exponentially are currently not supported/implemented).

Upon failure to install TFTs even after retry, all remaining flows are removed (if there were any successfully installed) followed by termination of the Sd Session. After a refresh, CPS attempts to re-establish the Sd-Session. CPS also marks the failed flows as INACTIVE.

Redirect Requests

CPS can reject incoming CCR-I messages with DIAMETER_REDIRECT_INDICATION (3006) error by acting as a redirect agent (RFC 3588). This decision to redirect a request is configured using an STG or CRD. CPS expects the STG or CRD to include a **Redirect Request Column** (of type **True** or **False**). There is no restriction on the condition that determines the redirect behavior.

The following parameters can be configured under Redirect Requests:

Table 33: Redirect Requests Parameters

Parameter	Description
Redirect Request Column	The result column (True/False) from the CRD used to determine if the session needs to be redirected. If result column specified here evaluates to True, session is redirected, else it continues as usual.
Redirect Host	The list of Redirect-Host AVP values to be included in the response. If there are more than one hosts listed, all the hosts are included in the response.
Redirect Max Cache Time (in seconds)	The Redirect-Max-Cache-Time AVP value (in seconds) to be included in the response.
Redirect Host Usage	<p>The Redirect-Host-Usage AVP value (in seconds) to be included in the response. Redirect-Host-Usage AVP supports the following values:</p> <ul style="list-style-type: none"> • DONT_CACHE: The host specified in the Redirect-Host AVP should not be cached. This is the default value. • ALL_SESSION: All messages within the same session, as defined by the same value of the Session-ID AVP may be sent to the host specified in the Redirect-Host AVP. That is, there is no need to consult the redirect agent for all the messages associated in the session. Identity received is stored until the session terminates. • ALL_REALM: All messages destined for the realm requested may be sent to the host specified in the Redirect-Host AVP. • REALM_AND_APPLICATION: All messages for the application requested to the realm specified may be sent to the host specified in the Redirect-Host AVP. • ALL_APPLICATION: All messages for the application requested may be sent to the host specified in the Redirect-Host AVP. • ALL_HOST: All messages that would be sent to the host that generated the Redirect-Host may be sent to the host specified in the Redirect- Host AVP. • ALL_USER: All messages for the user requested may be sent to the host specified in the Redirect-Host AVP.

Creating an STG to Redirect Requests

You must configure an STG to determine whether an incoming CCR-I needs to be rejected or not. The steps to configure the decision table are as follows:



Note The below procedure is a sample configuration based on APN and Billing plan.

Procedure

- Step 1** Log into Policy Builder.
- Step 2** Select the **Reference Data** tab.
- Step 3** Click **Custom Reference Data Tables** and select **Search Table Groups**.
- Step 4** Under **Actions**, click **Search Table Groups**.
- Step 5** Enter a name for the STG.
- Step 6** Under **Result Columns**, click **Add** and enter a **Name**, **Display Name**, and select the check box under **Use In Condition**.
- Step 7** Click **Custom Reference Data Table** under **Actions > Create Child**.
- Step 8** Enter a **Name** and **Display Name** for the CRD Table.
- Step 9** Under **Columns**, click **Add** and enter the following parameters as shown in the following figure:

Figure 13: Custom Reference Data Table Parameters

*Name	Display Name	*Use In Condit	*Type	Key	Required
apn	APN	<input checked="" type="checkbox"/>	Text	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
redirect_request	Redirect Request	<input checked="" type="checkbox"/>	True/False	<input type="checkbox"/>	<input type="checkbox"/>
billing_plan	Billing Plan	<input checked="" type="checkbox"/>	Text	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Add Remove Add Down Arrow

Column Details

Valid Values
The values allowed in Control Center for this column

All
 List of Valid Values

*Name	Display Name

Add Remove Up Arrow Down Arrow

Valid values pulled from another table's column (key)

Validation
Validation used by Control Center

Regular Expression

Regular Expression Description

Runtime Binding
Which rows match when a message is received

None
 Bind to Subscriber AVP code
 Bind to Session/Policy State Field

Gx APN

Bind to a result column from another table

Bind to Diameter request AVP code

Matching Operator
eq

For **apn**, make sure you select **Bind to Session/Policy State Field**, click select and select **Gx APN**. Similarly, for **billing_plan**, select **Bind to Subscriber AVP code** and enter the name or code for the AVP that represents the subscriber's billing plan (for example, **billingplan**).

- Step 10** Save the PB configuration.

Pending Transaction Retry

When a Gx session is established, the Supported-Features AVP value is checked for Pending Transactions bit in accordance with 3GPP TS 29.212. The AVP value is stored in the Gx session.

This feature is disabled by default. Select the Pending Transaction Retry check box to enable the feature.



Important On enabling this feature, make sure to disable the Cisco Pending Transaction Retry feature.

If the Pending Transaction Retry check box is unchecked (that is, disabled) in Policy Builder, the system defaults to 3GPP handling of race conditions or pending transactions.

The following parameters can be configured under Pending Transaction Retry:

Table 34: Pending Transaction Retry Parameters

Parameter	Description
Back Off Algorithm	<ul style="list-style-type: none"> • Constant_Interval: The configured retry Interval is used (without any change) for all retry attempts. • Linear_Interval: Retry interval is derived by multiplying the attempt number with the retry interval. This is applicable only when RAR messages are retried due to pending transactions. <p>Default value is Constant_Interval.</p>
RAR Retry Interval (MilliSeconds)	<p>Retry time interval (milliseconds) after which same RAR is retried after receipt of Pending Transactions (4144) Experimental Result code in RAA.</p> <p>Default value is 1000 milliseconds.</p>
Time (MilliSeconds) to hold CCR-U processing	<p>Time interval (milliseconds) during which CCR-U processing is withheld till pending RAA is received from PCEF.</p> <p>Default value is 1000 milliseconds.</p>
Time (MilliSeconds) to wait for CCR-U retry	<p>Time interval (milliseconds) during which CPS should wait for PCEF to initiate a CCR-U retry after sending a RAA with Pending Transactions (4144) Experimental Result code.</p> <p>Default value is 1000 milliseconds.</p>
Max No of additional RAR's to be stored	<p>Number of RARs generated during pending transactions situations that need to be held and retried in sequence. Additional maximum RARs that can be stored is three. If this value is more than three, Policy Builder displays configuration violation error message.</p> <p>Default value is 1. If set to 0, additional RAR's are discarded.</p>

Extract Avps

AVPs that are required for policy decisions are extracted from the diameter message. The AVPs are specified by their path within the diameter message. Additionally, nested AVPs (each level delimited with ".") can also be extracted with or without qualifiers.

Once extracted, the AVPs are then available for use in Initiator conditions or as key AVP in CRD tables for policy decisions. The AVPs are not stored with the session. Thus, if some policy is enabled because of a

received message, and if there is a subsequent trigger message that does not contain that AVP, the initiator conditions will fail and the policy is reverted.

If the AVP to be extracted appears multiple times, each of the instance will be extracted and made available as a policy AVP. Initiator conditions can be written for one or more of these instances. Each condition will check all the available instances for evaluation. Thus if there are multiple instances, multiple conditions (if configured) can be true for the same AVP but with different values.

The **Extract Avps** table lists the AVPs that must be extracted from the diameter message.

- **Name:** Enter a logical name for the extracted AVP. This name will be used in Initiator conditions and CRD tables to identify the extracted AVP. This is a mandatory parameter.
- **Avp Path:** Enter the complete AVP path. This is a mandatory parameter.
- **Command Code:** If Command Code is specified, CPS attempts to extract the AVPs from only that command (and skip the rest). This is an optional parameter.

For example:

- Name: Event-Trigger
- Avp Path: Event-Trigger
- Command Code: 272

For the above example, given a CCR with Event-Trigger AVPs, CPS extracts each Event-Trigger AVP instance and adds it to the current policy state.

Override Supported Features

CPS supports override of Supported-Features with configured value (instead of internally calculated value). The override Supported-Features value can be defined in a CRD table. If the value is configured, CPS compares (bitwise AND) the incoming PCEF advertised value with the configured value and uses the result as the negotiated value. This negotiated value is included in the response message.

If the Override functionality is not enabled or table evaluation provided under the Override Supported-Features does not return a result, CPS falls back to the internal Supported-Features calculation.



Note CPS does not validate the configured Feature-List value. If wrong value is configured, CPS still evaluates negotiated features based on this wrong value and can enable features which CPS does not actually support.

The following parameters can be configured:

Table 35: Override Supported Features Parameters

Parameter	Description
Search Table Group	The STG to lookup for determining the configured Supported-Features (for override).
Vendor Id	The Result column from the selected STG that corresponds to Vendor-Id AVP value.

Parameter	Description
Feature List Id	The Result column from the selected STG that corresponds to Feature-List-Id AVP value.
Feature List	The Result column from the selected STG that corresponds to Feature-List AVP value.



Note Multiple entries can be configured, which are evaluated in order.

Custom Dynamic Rule Name

For an Rx call a different Rx dedicated bearer is created for each Media-Sub-Component grouped AVP in the incoming Rx AAR message. This feature allows for customization of the Rx dedicated bearer name based on the AF-Application-Identifier AVP value and Media-Type AVP value received in Rx AAR message.

Figure 14: Custom Dynamic Rule Name

Af Application Id	Media Type	Partial Rule Name
urn:urn-7:3gpp-service.ims.icsi.mmtel	AUDIO	SIP_MEDIA_AUDIO
urn:urn-7:3gpp-service.ims.icsi.mmtel	VIDEO	SIP_MEDIA_VIDEO
urn:urn-7:3gpp-service.ims.icsi.mmtel	MESSAGE	SIP_MEDIA_MESSAGE
sos	AUDIO	E911

215411

The default Rx dedicated bearer name format is:

`_<Rx-Session-No>_<MCD-No>_<Flow-Number>_<partialRuleName>_<Media-Type>`

where:

- `<Rx-Session-No>`: Counts how many Rx sessions have bound so far to the Gx session by the time the current Rx session is created. This is an attribute of the Rx session stored on PCRF side and it doesn't change during the Rx session lifetime. The value starts from zero and it increases with one for each new Rx session that binds.
- `<MCD-No>`: Media-Component-Number AVP value under Media-Component-Description grouped AVP for the current Media-Sub-Component grouped AVP.
- `<Flow-Number>`: Flow-Number AVP value for the current Media-Sub-Component grouped AVP.
- `<partialRuleName>`: Partial Rule Name value matching the current Af Application Id and Media Type values for the current Media-Sub-Component grouped AVP or "AF" if no match.
- `<Media-Type>`: Media-Type AVP value for the current Media-Sub-Component grouped AVP.



Note Only the <partialRuleName> part can be customized.

Rx Clients

This specific diameter client object is supposed to be used only in relation with the Rx interface. It adds Rx specific features to the generic diameter client already described in [Diameter Clients, on page 47](#).

The parameters described in the following table can be configured for the Rx client:

Table 36: Rx Client Parameters

Parameters	Description
Session Binding Attribute	Allows the Rx sessions initiated by this client to bind to the Gx session by other attribute than the IP address as per 3GPP TS 29.214. For more information refer to Table 37: Session Binding Attribute Values, on page 72 .
Flow Description Source Ip Evaluation	<ul style="list-style-type: none"> • None: When selected, CPS does not take any action on source IP. • Replace with 'any': When selected, CPS replaces the flow description source IP with 'any'. • Replace with UE IP: When selected, CPS replaces flow description source IP with UE framed IP.
STA Hold Time Ms	<p>This parameter is used to define the timer by which the STA is held back. Once the timer expires even if the CCR-U is not received, STA is sent to the AF and the rxSession is removed.</p> <p>Default value is 4000 milliseconds.</p>

Parameters	Description
CCR-U Wait Time (in seconds)	<p>CCR-U Timer is the time to wait for CCR-U from PGW when the AF started a request and Specific-Action CUSTOM_DPCC_STATUS_REPORT was armed in AAR.</p> <p>CCR-U timer is started for every request (default bearer boost/spawning of dedicated bearer) from AF if the CCR-U is configured in Policy Builder and CUSTOM_DPCC_STATUS_REPORT(200) is armed in AAR request. There is a separate timer event for different Rx client.</p> <p>This timer is stopped by PCRF when CCR-U is received from P-GW. Also in case when P-GW does not respond to Gx-RAR then CCR-U timer is stopped on receiving internal Gx-RAA (result-code=7000) message.</p> <p>CCR-U timer is helpful in informing AF if the QoS requested through AF is updated on P-GW. In case of default bearer QoS boost/throttle request from AF, there is no notification sent by the P-GW to PCRF. In this case PCRF internally runs this CCR-U time which on expiry sends an update (through Rx_RAR having DPCC-Status AVP) to AF that QoS request is served.</p> <p>There is no default value for this timer. If you want to start CCR-U timer, then you need to configure through Policy Builder. The maximum value is 15 seconds.</p>
Sending Delayed Message Wait Time Ms	<p>This parameter is used to configure wait timer for sending delayed messages. Default value is 500 milliseconds.</p> <p>In case of multiple Media-Component-Descriptions being received in an AAR message by CPS, where one of them is rejected after evaluating for Rx Authorization, CPS sends a successful AAA for the accepted Media-Component-Descriptions and also creates a scheduled event for sending a delayed Rx RAR for rejected Media component.</p> <p>This Rx RAR is sent to AF based on Sending Delayed Message Wait Time configured.</p>
Emergency URN List	<p>The list of URNs that are used to indicate that a AF session relates to emergency traffic as per procedures described in 3GPP TS 29.214. For more information refer to Wildcard URN. See Emergency URN List, on page 72.</p>
Override AF App Id with URN for Emergency sessions	<p>When selected, CPS overrides the AF-Application-Identifier AVP value with the Service-URN AVP value for emergency calls. This option is provided in order to overcome the lack of AF-Application-Identifier AVP value in Rx AAR in case of IMS emergency calls.</p> <p>The default setting is unchecked.</p>

Parameters	Description
Validate Flow-Description AVP Value	<p>When selected, CPS validates the Flow-Description AVP values received as part of Media-Sub-Component based on restrictions provided in the 3GPP 29.214 Release 11 specification. If the Flow-Description value does not comply with the format specified then the AAR request is rejected with FILTER_RESTRICTIONS (5062) value in Experimental-Result-Code.</p> <p>When unchecked, CPS does not validate the Flow-Description AVP value and simply forwards it as is to PCEF as part of generated rules.</p> <p>The default setting is unchecked.</p>
29.213 standard QoS for preliminary service	<p>When checked, CPS supports the QoS handling for Preliminary Service Status. So, on receiving Service-Info-Status AVP as preliminary service information from AF, CPS generates the dynamic PCC rule and assign QCI and ARP values of the default bearer to these PCC rule to avoid signaling to the UE.</p> <p>When unchecked, CPS ignores the Service-Info-Status AVP value and derive the ARP and QCI values as per the QoS derivation algorithm defined in 3GPP TS 29.213 specification.</p> <p>The default setting is unchecked.</p>
NetLoc: Report ANI on rule failure	<p>When checked, CPS always sends the ANI to AF on receiving ANI event from the PCEF. So, in case of bearer release that is either in Rx_RAR (when few rules are impacted) or in Rx_STA when all the rules are impacted, PCRF adds the ANI (access network information) towards AF.</p> <p>When unchecked, CPS does not report ANI to the AF every time the ANI event is received from PCEF.</p> <p>In case of Rx session termination by PCRF that is, when PCRF sends Rx ASR to the AF; PCRF sends the ANI in the Rx STA message even if AF has not asserted the Required-Access-Info AVP for ANI in the Rx STR message.</p> <p>Note The checkbox can be used only when NetLoc feature has been negotiated over Gx and Rx and the AF has requested for ANI in the Rx AAR message.</p> <p>The default setting is unchecked.</p>
Hold STA if RAN-NAS-Cause enabled	<p>When RAN-NAS-Cause feature is enabled, CPS sends access network information and RAN-NAS-Release-Cause to AF in STA. So, when this check box is selected, CPS waits for this information from the PCEF and does not send STA till it receives the CCR-U from the PCEF.</p> <p>The default setting is checked (TRUE).</p> <p>Note The check box is only applicable when RAN-NAS-Cause feature has been negotiated over Gx and Rx.</p>

Parameters	Description
Auto Increment Precedence Avp	<p>When selected, CPS automatically increments the precedence AVP value by 1 for every Rx charging rule that is installed as part of any Rx session that is using this Rx client within the same Gx session. For example, Gx session (Gx1) has one Rx session (Rx1). When Rx1 is created, two charging rules are installed and they are assigned precedence values 1 and 2. A second Rx session (Rx2) starts for Gx1 and also installs two Rx charging rules. These rules are assigned precedence values 3 and 4.</p> <p>The precedence values are stored in the Gx session in the rxPrecedenceCounter attribute.</p> <p>Using this option overrides any other Rx charging rule precedence settings (for example, any that may have been configured for the RxSponsoredDataChargingParameters service option).</p> <p>Note When this option is enabled, existing VoLTE deployments may be impacted. After upgrading to CPS 11.0.0, make sure that the gateway's configuration is changed to consider precedence values.</p> <p>You can use the Precedence Start Value and Precedence End Value options to set lower and upper limits for the precedence AVP values. If you do not set these options, the starting precedence value is set to 1 and is incremented to 9223372036854775807.</p> <p>The default setting is unchecked.</p>
Remove Rule On Rule Deactivation	<p>When selected, CPS manages the expiration of Rule-Deactivation time triggers. On expiration of the installed Rule-Deactivation time, CPS initiates removal of the inactive dynamic rules and tear-down of the existing Rx session.</p> <p>The default setting is unchecked (false).</p>
Authorize Sponsor Data Connectivity	<p>When selected, CPS validates the sponsor ID received in AAR request. If the received sponsor ID is unauthorized, CPS returns UNAUTHORIZED_SPONSORED_DATA_CONNECTIVITY (5067) code in AAA.</p> <p>The default setting is unchecked (false).</p>
Enforce Unique AF-Charging-Identifier	<p>When selected, CPS enforces a unique AF-Charging-Identifier across all Rx sessions within a given subscriber or network session. During an Rx session establishment, if there is already an Rx session (within the subscriber or network session) containing the same AF-Charging-Identifier value, CPS rejects the new Rx session with DUPLICATED_AF_SESSION (5064) experimental result code.</p> <p>The default setting is unchecked.</p>

Parameters	Description
Prefer command level AF-Application-Identifier	<p>The AF-Application-Identifier AVP present in the AAR message indicates the particular service that the AF session belongs to. This AVP can be present at the command level and within the Media-Component-Description AVP.</p> <p>When selected, and if the AF-Application-Identifier is sent both at command level and within the Media-Component-Description AVP, the AF-Application-Identifier AVP value present at the command level is considered.</p> <p>The default setting is unchecked, that is, the AF-Application Identifier provided within the Media-Component-Description AVP is considered.</p>
Send timezone and location info	<p>When selected, CPS sends time zone and location information in Rx AAA, STA, and Rx RAR response messages provided that 3GPP-MS-TimeZone AVP and 3GPP-User-Location-Info AVP are already received in the CCR message.</p> <p>To receive the updated time zone and location information in the messages, CPS should arm the UE_TIME_ZONE_CHANGE event trigger and USER_LOCATION_CHANGE event trigger in the service option under Event-Trigger configuration.</p> <p>Note CPS does not report this information until it is received in a CCR message from PCEF.</p>
Trigger RAR when all rules fail (for SRVCC)	<p>When selected, CPS can trigger RAR instead of ASR when all rules fail with rule failure code PS_TO_CS_HANDOVER.</p> <p>The default setting is unchecked.</p>
Reject AAR with Invalid Service Info for missing Media-Type	<p>When selected, if Media-Type is found to be missing in any Media-Component-Descriptions in Rx_AAR, CPS rejects the Rx_AAR with Experimental-Result-Code=INVALID_SERVICE_INFORMATION (5061).</p> <p>The default setting is unchecked.</p>
Precedence Avp Lower And Upper	
Precedence Start Value	<p>When selected, CPS automatically increments the precedence AVP value by 1 for every Rx charging rule that is installed as part of any Rx session using this Rx Client, within the same Gx session. The precedence values are stored in the Gx session in the rxPrecedenceCounter attribute.</p> <p>This value is optional, but when used, must be greater than 0 and less than the Precedence End Value.</p>
Precedence End Value	<p>The upper limit of the precedence values for Rx charging rules that are installed. When this value is reached, the rxPrecedenceCounter is reset to the Precedence Start Value.</p> <p>This value is required when using the Precedence Start Value. It must be greater than the start value.</p>

Parameters	Description
Netloc Access Not Supported Configuration	See Netloc Access Not Supported Configuration , on page 73.
Session Binding Overriding	See Table 37: Session Binding Attribute Values , on page 72.
Rule Failure Mapping Table	<p>By default, the table is empty and unchecked (for backward compatibility) but if you want to override the default behavior, then you need to configure all the error codes received over Gx via CCR-U or RAA message for which Rx RAR needs to be sent.</p> <p>You can create two tables for mapping rule-failure-code to specific-action (for sending in Rx RAR) and rule-failure-code to abort-cause (for sending in Rx ASR).</p> <p>If you have checked Rule Failure Mapping Table checkbox and did not configure any mappings then neither default Specific Action nor Abort Cause is applied for any of the Failure Code.</p> <p>If you have not checked Rule Failure Mapping Table checkbox then default Specific Action and Abort Cause is applied.</p> <ul style="list-style-type: none"> For mapping rule-failure-code to specific-action: Table Name: Gx Rule Failure To Rx Specific Action Mapping For mapping rule-failure-code to abort-cause: Table Name: Gx Rule Failure To Rx Abort Cause Mapping <p>Note In order to successfully map the rule-failure-code to specific-action, the P-CSCF/AF must have the corresponding specific-action on CPS.</p>
Request Gx RAA for Event-Triggers	<p>By default, the table is empty and unchecked (for backward compatibility). This configuration is used to determine the Gx event triggers that CPS should subscribe in Gx RAR (dummy RAR) before it processes the media information that it has received in Rx AAR message.</p> <p>The event triggers are determined based on a CRD table (dummy RAR table) whose input columns are bound to Rx media details (for example, Media-Type, AF-Application-Id, and so on) and output columns specify the event-trigger numbers that are to be subscribed/enabled on PCEF.</p> <p>The evaluation of this CRD table per media (Media-Component-Description) is defined through Rx STG lookup binding configuration under Rx Profile. The Rx CRD AVP names to extract Event-Triggers list is used to specify the Rx CRD AVP names. These Rx CRD AVPs are created based on the output column mapping defined for the CRD table (dummy RAR table) under Rx STG lookup binding (AVP name defined under Output column AVP pairs).</p>
Extract Avps	See Extract Avps , on page 63.
Override Supported Features	See Override Supported Features , on page 64.

Table 37: Session Binding Attribute Values

Session Binding Attribute value	Description
IP Address (default)	Attempts to bind by <ul style="list-style-type: none"> • 1 Framed-IP-Address • 2 Framed-IPv6-Prefix
IMSI and APN	IMSI value and APN value from incoming request.
MSISDN and APN	MSISDN value and APN value from incoming request.
IMSI And IP Address	IMSI value, IP address value, and IPv6-Prefix value from incoming request. On receiving Rx session request, keys are generated for IMSI and IP Address or IMSI and IPv6-Prefix combination to load the session based on these keys.

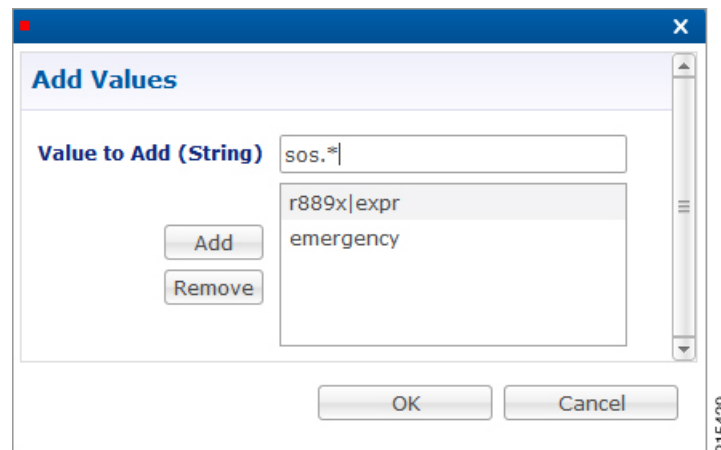
“IMSI and APN” and “MSISDN and APN” session binding attribute values are provided in order to support non 3GPP TS 29.214 compliant Rx clients.

Emergency URN List

CPS supports wildcard service URN. For example if `sos.*` is configured under Emergency URN List in Policy Builder and when Service-URN is received from AF with “`sos`” “`sos.fire`” “`sos.police`” and “`sos.ambulance`” and so on. indicating an emergency session CPS applies special policies that are configured for Emergency sessions.

1. Select the Rx Client name created.
2. Click **Add** near the **Emergency URN List** box. A new window **Add Values** is displayed.

Figure 15: Add Values



3. Type the name of the emergency URN that you want to add in the **Value to Add (String)** text box and click **Add**.
4. Click **OK**. In the example shown below, three URNs entries are added. To remove an URN from this list select the URN to be removed and click **Remove**.

Figure 16: Add/Remove URN

The screenshot shows the 'Rx Client' configuration interface. It includes the following fields and controls:

- *Name:** Text input field containing 'AF A'.
- *Realm Pattern:** Text input field containing 'af-a.cisco.com'.
- *Session Binding Attribute:** Dropdown menu with 'IP Address' selected.
- Emergency URN List:** A list box containing 'r889x|expr', 'emergency', and 'sos.*'. To the right are 'Add' and 'Remove' buttons.
- Override AF App Id with URN for Emergency sessions
- Validate Flow-Description AVP Value
- Actions:** A dropdown menu with 'Copy:' selected, and a link for 'Current Rx Client'.



Note As shown in the example, '*' has been used for wildcarding. CPS uses standard Java pattern characters for Emergency URNs. The pattern needs to follow the standard Java regular expression syntax described [here](#).

Netloc Access Not Supported Configuration

CPS supports to send NetLoc-Access-Support AVP in Rx AAA or STA message based on the current IP-CAN-Type or the values of Rat-Type AVP and AN-Trusted AVP. This is in accordance with the section 4.4.6.7 of the 3GPP 29.214.

To enable this, **Netloc Access Not Supported Configuration** has been added under **Rx Client**.

Figure 17: Netloc Access Not Supported Configuration

The screenshot shows the 'Netloc Access Not Supported Configuration' page. It features a checked checkbox at the top. Below are two lists with associated controls:

- List Of Ip Can Type:** A list box containing the value '6'. Below it are 'Add', 'Remove', 'Up Arrow', and 'Down Arrow' buttons.
- List Of Rat Type:** A table with two columns: 'Rat Type' and 'An Trusted'.

Rat Type	An Trusted
0	1
1	-1

 Below the table are 'Add', 'Remove', 'Up Arrow', and 'Down Arrow' buttons.

By default, this configuration is disabled. This means that PCRF will not check for NetLoc access support based on IP-CAN-Type or Rat-Type AVP and AN-Trusted AVP.

If this configuration is enabled but there are no entries in the two tables associated with it, then PCRF will not check for NetLoc access support based on IP-CAN-Type or Rat-Type AVP and AN-Trusted AVP.

The following table provides description related to the two tables under this configuration:

Table 38: Netloc Access Not Supported Configuration Tables

Table Name	Description
List Of Ip Can Type	<p>This is the list of IP-CAN-Type values for which NetLoc access is not supported. For valid values of the IP-CAN-Type, refer the 3GPP specification 29.212.</p> <p>This table only takes integer values as input.</p> <p>Default value is -1.</p> <p>An entry with value = -1 must not be used for validation of NetLoc access.</p>
List Of Rat Type	<p>This is the list of Rat-Type AVP & AN-Trusted AVP values for which NetLoc access is not supported. For valid values of the Rat-Type & AN-Trusted, refer the 3GPP specification 29.212.</p> <p>This table only takes integer values as input.</p> <p>Default value is -1.</p> <p><i>Rat Type</i> entry with value = -1 must not be used for validation of NetLoc access.</p> <p><i>An Trusted</i> entry with value = -1 means that the AN-Trusted value does not care for this entry.</p>

When the PCRF receives a request to report the access network information from the AF in an AAR command or in an STR command triggered by the AF, the PCRF tries to determine whether the access network supports the access network information reporting based on the currently used IP-CAN type or the values of RAT-Type AVP and AN-Trusted AVP.

PCRF first searches the list of configured IP-CAN-Type and if no match is found in the IP-CAN-Type list, then it searches the list of Rat-Type and AN-Trusted. If there is a match in any one list i.e. either the currently used IP-CAN-Type matches or current value of the Rat-Type and AN-Trusted matches, then the PCRF responds to AF with an AAA or STA command including the NetLoc-Access-Surpport AVP set to the value of 0 (NETLOC_ACCESS_NOT_SUPPORTED); otherwise, it immediately configures the PCEF to provide such access network information.

Gy Clients

This specific diameter client object is supposed to be used only in relation with the Gy interface. It adds Gy specific features to the generic diameter client already described in [Diameter Clients, on page 47](#).

The following parameters can be configured under Gy Client:

Table 39: Gy Client Parameters

Parameters	Description
Load By Realm And User Id	If checked attempts to load the session by realm (Origin-Realm AVP value) and User Id. Default value is unchecked.
Load By Apn And User Id	If checked attempts to load the session by APN (Called-Station-Id AVP value) and User Id. Default value is unchecked.
Gy As Primary	<p>This check box controls whether you want to run the Gy as primary (for example, for Gy only call model) or secondary (for example, Gx + Gy call model).</p> <p><code>gyAsPK</code> parameter in <code>qns.conf</code> file is also used to run Gy as primary or secondary. This flag is system wide parameter. In case you want to run Gy only call model and Gx + Gy call model both on the same system, the <code>qns.conf</code> parameter cannot be used.</p> <p>The new check box field added under Gy Client is backward compatible with <code>qns.conf</code> parameter settings. For example, if <code>-DgyAsPK=true</code> parameter is configured in <code>qns.conf</code> file, the check box is overwritten with the value configured in <code>qns.conf</code> file.</p> <p>To run both Gy only and Gx + Gy call model on same system:</p> <ul style="list-style-type: none"> • First delete the parameter (<code>-DgyAsPK=true</code>) if it is already configured in <code>qns.conf</code> file. • In Policy Builder, create separate Gy Clients for primary Gy and secondary Gy. • Next check the "Gy As Primary" check box in this Gy Client, if you want Gy as primary. • Uncheck the "Gy As Primary" check box in this Gy client, if you do not want Gy as primary.
Override Supported Features	Currently, not supported. Note This table is only supported for Gx and Rx client.

Both of the above mentioned flags help in binding the Gy session to correct Gx session when multiple Gx sessions exist for the same user.

In both cases User Id is:

User Id	AVP Value
IMSI	Subscription-Id-Data AVP value under Subscription-Id grouped AVP where Subscription-Id-Type AVP value is END_USER_IMSI (1)

User Id	AVP Value
MSISDN	Subscription-Id-Data AVP value under Subscription-Id grouped AVP where Subscription-Id-Type AVP value is END_USER_E164 (0)
NAI	Subscription-Id-Data AVP value under Subscription-Id grouped AVP where Subscription-Id-Type AVP value is END_USER_NAI (3)



Note When `gyAsPK` flag set to true in `qns.conf` file (`/etc/broadhop`), it loads the Gy session using the Gy session ID as the primary key. In CPS 12.1.0, CPS 13.1.0, and CPS 14.0.0 and higher releases, this parameter is enforced on all Gy messages. In other CPS releases, the parameter is ignored on CCR-I's, and the session is loaded by secondary keys specified in the Gy client. If there are no keys configured for the Gy client, CPS uses the default: IMSI and MSISDN from the Gy message. Default value is false.

Sy Clients

This specific diameter client object is supposed to be used to access the Sy Server.

The following parameters can be configured under Sy Client:

Table 40: Sy Client Parameters

Parameter	Description
Name	The client name that is going to be used to reference this particular client in the service configuration object.
Realm Pattern	The pattern that peer realm name should match in order for this diameter client to be used. The pattern needs to follow the standard Java regular expression syntax described here . The first choice for Realm Pattern value should always be the exact peer realm name whenever possible.
Counter Lookahead Interval	Dynamic calculation of policy counters events that are subjected to an update for the interval specified. If the look ahead interval is specified, CPS evaluates all policy counters and if a policy counter is about to expire before the interval, CPS sends the <code>policy-counter-stats</code> . Default value is 180 minutes.

Diameter Defaults

The Diameter Defaults section provides global default values for different modules of the system.

In order to define a Diameter Default you need to perform the following steps:

1. Login into Policy Builder.

2. Select **Reference Data** tab.
3. From the left pane select **Diameter Defaults**.
4. Select **Summary**.
5. Create the specific default object according to your needs.
6. Provide values for at least the mandatory fields.

**Note**

- The mandatory fields are marked with a “*” on the upper left corner of the field name label.
- There should be at most one object for each diameter default type or the results will be unpredictable. The Policy Builder GUI does not enforce this restriction though.

Custom AVP Profile

This feature allows the Service Provider to extend the Diameter dictionary with new vendor specific AVPs along with a source for that AVP and a destination where the AVP is going to be used.

The feature consists of two components:

- Custom Avp Table
- Avp Mappings

Custom Avp Table

This table allows for the definition of the custom AVP with all the standard attributes of an AVP.

The following parameters can be configured under Custom Avp Table:

Table 41: Custom Avp Table Parameters

Parameter	Description
AVP Name	Any string that is used to identify this custom AVP.
Avp Code	<p>AVP Code combined with Vendor Id field identifies the attribute uniquely.</p> <ul style="list-style-type: none"> • 1 - 255 Backward compatibility with Radius without setting the Vendor Id field. <p>Note RADIUS-based policy control is no longer supported in CPS 14.0.0 and later releases as 3GPP Gx Diameter interface has become the industry-standard policy control interface.</p> <ul style="list-style-type: none"> • 256 - above Used for Diameter and are allocated by IANA.

Parameter	Description
Vendor Id	<p>It indicates the Vendor Id of the AVP. The following are the supported Vendor Ids:</p> <ul style="list-style-type: none"> • base (0) • ciscoSystems (9) • Ericsson (193) • Tekelec (323) • TGPP2 (5535) • Openet (7898) • Starent (8164) • TGPP (10415) • ETSI (13019) • NSN (28458) • Nokia (34326) • Lucent (1751) • Verizon (12951) • Camiant (21274) • Huawei (2011)
Vendor Code	Vendor Id value as assigned by IANA. The Vendor Id bit known as the Vendor-Specific bit indicates whether the optional Vendor Code field is present in the AVP header. When set the AVP Code belongs to the specific vendor code address space.
Mandatory Bit	Indicates whether support of the AVP is required. If this Bit is checked then Diameter Client Server Proxy and Translation Agent must support the handling of this AVP.
Protected Bit	Indicates the need for encryption for end-to-end security. If this bit is checked indicates that AVP data is encrypted for end-to-end security.
Vendor Id Bit	Indicates whether the optional Vendor-ID field is present in the AVP header.

Parameter	Description
Data Type	Any valid basic AVP data format <ul style="list-style-type: none"> • Float32Avp • Float64Avp • Integer32Avp • Integer64Avp • OctetStringAvp • Unsigned32Avp • Unsigned64Avp • UTF8String

Avp Mappings

This table allows for the mapping between the source and the destination for the custom AVP (defined in the previous section). Multiple attributes can be used to identify both the source for the custom AVP value as well as the destination where the AVP is going to be used.

The following mappings are supported:

- Custom AVP to Custom AVP Mapping Maps a custom AVP to another custom AVP.
- 3gpp / spr AVP to 3gpp AVP Mapping Maps a 3GPP AVP or a SPR attribute to a 3GPP AVP.
- 3GPP / SPR AVP to Custom AVP Mapping Maps a 3GPP AVP or a SPR attribute to a custom AVP.

Custom AVP to Custom AVP Mapping

The following parameters can be configured under Custom AVP to Custom AVP Mapping:

Table 42: Custom AVP to Custom AVP Mapping Table Parameters

Parameter	Description
Source Avp	Name of AVP that has to be looked up for possible mapping.
Source App Id	The Application Interface Id (Gx) in numeric format (16777238) on which the Source AVP is received.
Source Cmd Code	The command code of the message on interface Source APPID that contains the Source AVP.
Source Cmd Type	The message indicated by Source Command Code is a request or response. Types: <ul style="list-style-type: none"> • Request • Response
Origin Host	This field contains the identification of the source point of the operation.

Parameter	Description
Origin Realm	This field contains the identification of the realm of the operation originator.
Target Avp	AVP Name that is actually mapped to Source AVP.
Target App Id	Target Application Identifier (Sy - 16777302 - for this release).
Target Cmd Code	The command code of the message that goes on Target APPID and have Target AVP.
Target Cmd Type	The message having Target Command Code request or a response. Types: <ul style="list-style-type: none"> • Request • Response
Destination Host	This field contains the identification of the destination point of the operation.
Destination Realm	This field contains the realm of the operation destination.

Response value for Source Cmd Type and Target Cmd Type is not currently supported.

3gpp / spr AVP to 3gpp AVP Mapping

The following parameters can be configured under 3gpp / spr AVP to 3gpp AVP Mapping:

Table 43: 3gpp / spr AVP to 3gpp AVP Mapping Table Parameters

Parameter	Description
Source Avp	Name of AVP that has to be looked up for possible mapping.
Is SPR AVP?	Check if the source is an SPR attribute. The Source AVP originates from a Source Command or from Subscriber profile in Subscriber Profile Repository. Default value is unchecked.
Source App Id	The Application Interface Id (Gx) in numeric format (16777238) on which the Source AVP is received.
Source Cmd Code	The command code of the message on interface Source APPID that contains the Source AVP.
Source Cmd Type	The message indicated by Source Command Code is a request or response. Types: <ul style="list-style-type: none"> • None • Request • Response
Origin Host	This field contains the identification of the source point of the operation.

Parameter	Description
Origin Realm	This field contains the identification of the realm of the operation originator.
Target Avp	AVP Name that is actually mapped to Source AVP.
Target App Id	Target Application Identifier (Sy - 16777302 - for this release).
Target Cmd Code	The command code of the message that goes on Target APPID and have Target AVP.
Target Cmd Type	The message having Target Command Code request or a response. Types: <ul style="list-style-type: none"> • Request • Response
Destination Host	This field contains the identification of the destination point of the operation.
Destination Realm	This field contains the realm of the operation destination.

Response value for Source Cmd Type and Target Cmd Type is not currently supported.

3GPP / SPR AVP to Custom AVP Mapping

The following parameters can be configured under 3GPP / SPR AVP to Custom AVP Mapping:

Table 44: 3GPP / SPR AVP to Custom AVP Mapping Table Parameters

Parameter	Description
Source Avp	Name of AVP that has to be looked up for possible mapping.
Is SPR AVP?	Check if the source is an SPR attribute. The Source AVP originates from a Source Command or from Subscriber profile in Subscriber Profile Repository. Default value is unchecked.
Source App Id	The Application Interface Id (Gx) in numeric format (16777238) on which the Source AVP is received.
Source Cmd Code	The command code of the message on interface Source APPID that contains the Source AVP.
Source Cmd Type	The message indicated by Source Command Code is a request or response. Types: <ul style="list-style-type: none"> • None • Request • Response
Origin Host	This field contains the identification of the source point of the operation.

Parameter	Description
Origin Realm	This field contains the identification of the realm of the operation originator.
Target Avp	AVP Name that is actually mapped to Source AVP.
Target App Id	Target Application Identifier (Sy - 16777302 - for this release).
Target Cmd Code	The command code of the message that goes on Target APPID and have Target AVP.
Target Cmd Type	The message having Target Command Code request or a response. Types: <ul style="list-style-type: none"> • Request • Response
Destination Host	This field contains the identification of the destination point of the operation.
Destination Realm	This field contains the realm of the operation destination.

Response value for Source Cmd Type and Target Cmd Type is not currently supported.

ToD Schedule

This feature allows for different PCC rules to be installed on a per time-of-day basis. Based on the defined schedules PCRF will look ahead one scheduled interval every time the policy is re-evaluated and will schedule for each PCC rule an activation time using the Rule-Activation-Time AVP and de-activation time using the Rule-Deactivation-Time AVP.

Figure 18: ToD Schedule

Name	*Start Time	*End Time
A	11:05	14:35
B	16:45	19:35

- Both Start Time and End Time need to be defined in hhmm 24hr format.
- UE time zone (3GPP-MS-TimeZone AVP) if available takes precedence over PCRF time-zone.
- ToD schedule should be complete for 24 hours.
- There should be no overlapping between the different schedule Switch Times.

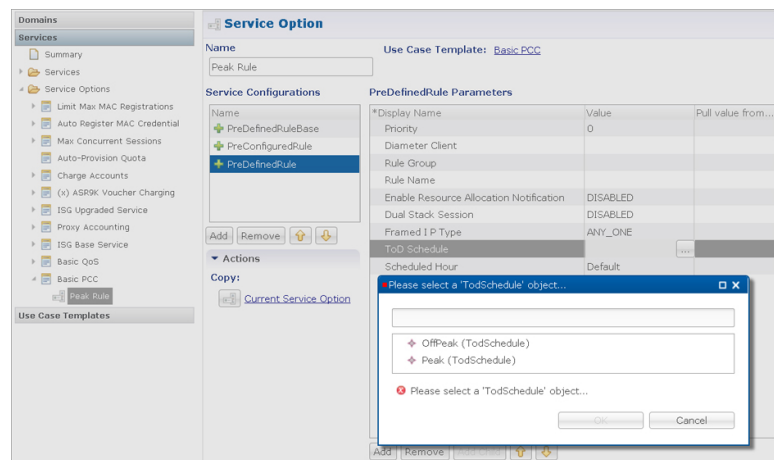
- First charging schedule should start at mid-night with start-time value as 0000 and last schedule should end on next mid-night with end-time value as 2359. Time entry with 2359 is rounded up to the next minute to complete the 24 hour schedule.

The ToD Schedule can be referenced only from a **PreDefinedRule**, **PreDefinedRuleBase** or a **PreConfiguredRule** service configuration object.

In order to use a ToD Schedule in a Service Option you need to perform the following steps

1. Login into Policy Builder.
2. Select **Services** tab.
3. From the left pane select **Services**.
4. Expand **Service Options** tree.
5. Select and expand your service option.
6. Select the service option object.
7. Select the **Value** cell corresponding to the ToD Schedule.
8. Push the “...” button.
9. Select the ToD Schedule from the popup window.
10. Click **OK**.

Figure 19: ToD Schedule - Service Option



For more details about how to define a service option refer to [Services](#).

Sd Push Rules

This section supports the Sd solicited reporting scenario when the TDF-Information grouped AVP is not sent from the PCEF to the PCRF in a Gx CCR-i. For more information on Sd solicited reporting refer to *3GPP TS 29.212*.

Figure 20: Sd Push Rules

The following parameters can be configured under **Sd Push Rules**:

Table 45: Sd Sync Mode

Parameters	Description
Sync TSR	Select to enable TSR in sync mode.
Time To Live in Cache (ms)	When Sd Sync mode is enabled, determines how long the Gx CCA-I response is stored in the session before retracting the stored response to be sent to PGW after Sd TSR/TSA exchange occurs between PCRF and TDF. This value is recommended to be higher than the PGW timeout.

Table 46: Sd Push Rules

Parameter Type	Message	Attribute	AVP
Input	Gx CCR-i	Gx Realm	Origin-Realm
		Gx Host Pattern	Origin-Host
Output	Sd TSR	TDF Realm	Destination-Realm
		TDF Host	Destination-Host

**Note**

- The first choice for Gx Host Pattern value should always be the exact peer realm name whenever possible.
- No Sd session is initiated if there's no match for the input columns in the Sd Push Rules table.

Gx Profile

This section provides default values to be used for Gx default bearer QoS parameters as well as some specific behavior related to default bearer QoS.

The following parameters can be configured under Gx Profile:

Table 47: Gx Profile Parameters

Parameter	Description
Push Pre Configured Rule Options	Controls whether the configured default bearer QoS will be installed on the default bearer or on the secondary bearers. <ul style="list-style-type: none"> • PushOnDefaultBearerQoS (default) • PushWithUpgradedDefaultBearerQoS
Logical Apn	Allows for a default APN name to be defined. This APN name is going to be further used as an input into the AF Application Id Validation feature described below. The APN value will be set based on the available data and the priorities described below. <ul style="list-style-type: none"> • 1 - A policy derived AVP having the same value as the Logical Apn • 2 - Called-Station-Id AVP from incoming Rx AAR • 3 - Called-Station-Id AVP from Gx session
Gx Client QoS Exclusion List	Gx client names that are allowed not to have a default bearer QoS installed. In case a default bearer QoS has not been configured in the policy and the Gx client name has not been added to this list an error response will be sent to the PCEF containing the Result-Code AVP value DIAMETER_ERROR_BEARER_NOT_AUTHORIZED (5143).
Grant Requested QoS	Controls whether the requested QoS should be granted or not as the default bearer QoS. Default value is unchecked.
Grant Requested Qos Over Global Qos	If this option is selected then the requested QoS should be granted even if the global QoS is provisioned. There are three type of QoS first is taken from service second is from default QoS and third one is from request. If this flag is checked then requested QoS will take priority over default QoS. Default value is unchecked.
Global Default Granted QoS	
Qci	The QoS class identifier identifies a set of IP-CAN specific QoS parameters that define QoS excluding the applicable bitrates and ARP. It is applicable both for uplink and downlink direction. The QCI values 0 10 – 255 are divided for usage as follows <ul style="list-style-type: none"> • 0 - Reserved • 10-127 - Reserved • 128-254 - Operator specific • 255 - Reserved
Max Req Bandwidth UL	It defines the maximum bit rate allowed for the uplink direction.
Max Req Bandwidth DL	It defines the maximum bit rate allowed for the downlink direction.

Parameter	Description
Guaranteed Bit Rate UL	It defines the guaranteed bit rate allowed for the uplink direction.
Guaranteed Bit Rate DL	It defines the guaranteed bit rate allowed for the downlink direction.
Apn Agg Max Bit Rate UL	It defines the total bandwidth usage for the uplink direction of non-GBR QCI at the APN.
Apn Agg Max Bit Rate DL	It defines the total bandwidth usage for the downlink direction of non-GBR QCI at the APN.
Enable Pending Policy Evaluation	When selected, pending policy calculation is enabled for one look ahead in advance. Default value is unchecked.

ARP

Select the Arp type from the drop-down list to open parameters for the corresponding selection. ARP is used to indicate the priority of allocation and retention.

The following parameters can be configured under **Arp**:

Table 48: ARP Parameters

Selection	Parameters	Description
Allocation Retention Priority	Priority Level	<p>The priority level is used to decide whether a bearer establishment or modification request can be accepted or needs to be rejected in case of resource limitations (typically used for admission control of GBR traffic). The AVP can also be used to decide which existing bearers to pre-empt during resource limitations. The priority level defines the relative importance of a resource request. Values 1 to 15 are defined with value 1 as the highest level of priority.</p> <ul style="list-style-type: none"> • Values 1 to 8 - assigned for services that are authorized to receive prioritized treatment within an operator domain. • Values 9 to 15 - Can be assigned to resources that are authorized by the home network and thus applicable when a UE is roaming.
	Preemption Capability	<p>If it is provided within the QoS-Information AVP the AVP defines whether a service data flow can get resources that were already assigned to another service data flow with a lower priority level. If it is provided within the Default-EPS-Bearer-QoS AVP the AVP defines whether the default bearer can get resources that were already assigned to another bearer with a lower priority level.</p> <ul style="list-style-type: none"> • 0 This value indicates that the service data flow or bearer is allowed to get resources that were already assigned to another service data flow or bearer with a lower priority level. • 1 This value indicates that the service data flow or bearer is not allowed to get resources that were already assigned to another service data flow or bearer with a lower priority level. This is the default value applicable if this AVP is not supplied.
	Preemption Vulnerability	<p>If it is provided within the QoS-Information AVP the AVP defines whether a service data flow can lose the resources assigned to it in order to admit a service data flow with higher priority level. If it is provided within the Default-EPS-Bearer-QoS AVP the AVP defines whether the default bearer can lose the resources assigned to it in order to admit a pre-emption capable bearer with a higher priority level.</p> <ul style="list-style-type: none"> • 0 This value indicates that the resources assigned to the service data flow or bearer can be pre-empted and allocated to a service data flow or bearer with a higher priority level. This is the default value applicable if this AVP is not supplied. • 1 This value indicates that the resources assigned to the service data flow or bearer shall not be pre-empted and allocated to a service data flow or bearer with a higher priority level.

Selection	Parameters	Description
Application QoS Policy	AF Application Identifier Pattern	It contains information that identifies the particular service that the AF service session belongs to. This information may be used by the PCRF to differentiate QoS for different application services. You can specify regular expressions for this parameter as needed.
	Media Type	Applicable Media-Type (session level or specific to Media-Component-Description). The list includes Audio Video Data Application Control Text Message and Other.
Reservation Priority QoS Policy	Reservation Priority	The Reservation Priority includes the priority value of the related priority service. The Reservation Priority is populated with a default value if the priority value is unknown.
Base MPS QoS/Base MPS QoS Gx	Qci	The QoS class identifier identifies a set of IP-CAN specific QoS parameters that define QoS excluding the applicable bit rates and ARP. It is applicable both for uplink and downlink direction. The QCI values 0 10 – 255 are divided for usage as follows: <ul style="list-style-type: none"> • 0 Reserved • 10-127 Reserved • 128-254 Operator specific • 255 Reserved
MPS QoS	MPS Id	The MPS Id contains the national variant for MPS service name indicating an MPS session.
	Media Type	Applicable Media-Type (session level or specific to Media-Component-Description). Select from drop-down list. The list includes Audio Video Data Application Control Text Message and Other.

Relaxed USAGE_REPORT Event-Trigger Handling

Use this checkbox to enable the functionality for supporting old event-trigger value (26) for the usage report. This configuration will be applicable only when CPS is configured to use R10 event-trigger values by unchecking the 'Use V9 Event Trigger Mapping' flag in [Diameter Configuration](#).

Peers using Event-Trigger value (26) for USAGE_REPORT

The following table contains the list of realm and host entries for which CPS will support old event-trigger value (26) for USAGE_REPORT.

The parameters can be configured under **Relaxed USAGE_REPORT Event-Trigger Handling**:

Table 49: Relaxed USAGE_REPORT Event-Trigger Handling Parameters

Parameter	Description
Realm Pattern	The pattern that peer realm name should match in order for this diameter client to be used. The pattern needs to follow the standard Java regular expression syntax described here .

Parameter	Description
Host Pattern	Host name pattern as received in Origin-Host AVP in AAR message. The pattern needs to follow standard Java pattern conventions. The pattern needs to follow the standard Java regular expression syntax described here .

QoS Retry on APN-AMBR_FAILURE_MODIFICATION

Use this check box to receive APN-AMBR_FAILURE_MODIFICATION events from PCEF.

The following parameters can be configured under **QoS retry on APN-AMBR_FAILURE_MODIFICATION**:

Table 50: QoS retry on APN-AMBR_FAILURE_MODIFICATION Parameters

Parameter	Description
Number Of Retry	Number of retries to push calculated QoS information.
QoS Retry Options	In the case GGSN sends APN-AMBR_FAILURE_MODIFICATION report to CPS, following are the retry options in which CPS sends the QoS information: <ul style="list-style-type: none"> • Immediate Retry: CPS calculates QoS based on the configured policy and sends it immediately in a CCA message. • Delayed Retry: CPS responds to CCA-U without any QoS information unless there is difference between the current derived QoS and previously sent QoS. CPS sends the QoS information in the next RAR or CCA-U message.
Action On QoS Retry Exhaust	CPS retries sending the QoS information "n" times, to avoid looping. After exhaustion of the retries, following are the options: <ul style="list-style-type: none"> • Continue Session: CPS does not send same QoS information in subsequent CCA-U message unless there is a difference between the current calculated QoS and previously sent QoS. • Terminate Session: CPS sends RAR with Release Cause value as UNSPECIFIED_REASON after the time configured in Time To Trigger Release RAR expires. On receiving CCR-T, CPS terminates the session.
Time To Trigger Release RAR In Minutes	CPS sends RAR with Release Cause value as UNSPECIFIED_REASON after the time configured in Time To Trigger Release RAR expires.
Time To Reset QoS Retry Counter In Minutes	Once CPS receives APN-AMBR_FAILURE_MODIFICATION, CPS sets next reset timer to value configured in Time to Reset QoS Retry Counter. If CPS does not receive APN-AMBR_FAILURE_MODIFICATION within this specified time, CPS resets the retry count to 0.

MPS Profile

This section provides default values to be used if MPS feature is needed to support eMPS priority. The MPS Profile provides MPS attributes required for priority service provisioning. The priority level value from Service configuration takes precedence over MPS Profile value.



Note There must be at least one Mps Profile defined under **Mps Profiles**.

Figure 21: MPS Profile

The following parameters can be configured under **Mps Profile**:

Table 51: MPS Profile Parameters

Parameter	Description
Ims Apn	List of IMS APNs for which the MPS feature is supported. This field can accommodate several Ims Apn that are used to match with the incoming service request for priority service. The values that are received by the Default Bearer QoS are looked up for a suitable Ims Apn match. If the APN value of a Gx session request matches IMS APN IMS signaling priority from EMPS service is used as priority level.
Mps QoS	For information on parameters under Mps QoS refer to ARP Parameters.

For additional information on 3GPP specifications refer to <http://www.3gpp.org/DynaReport/29212.htm>.

The above link is compliant with Release 11.

Rx Profile

This section provides default and specific values to be used by the different QoS parameter mapping functions at PCRF as per 3GPP TS 29.213. This section also provides a mechanism to authorize the Rx IMS sessions.

Basic Options

Table 52: Rx Profile - Basic Options

Parameter	Description
Prefer answer Codec-Data	Select Prefer answer Codec-Data checkbox if you want the default priority to be given to the answer codec (when both answer and offer are present within the AAR). By default, this option is unchecked (not selected).
Disable Always On EMPS Service	If the checkbox is selected, then the feature Always On EMPS Service gets disabled otherwise the feature works by default (when the checkbox is not selected).
Disable Downgrade of Normalised ARP and QCI	If this checkbox is selected, the Normalised ARP and QCI is not downgraded till all the Rx sessions terminate. By default, this option is not selected. If this checkbox is not selected, the Normalised ARP and QCI is downgraded when RxSession with Priority ARP terminates. For more information and ARP and QCI Normalization, refer to ARP and QCI Normalization, on page 95 .
Default QoS Policy	Provides the values to be used during the derivation of the Maximum Authorized Data Rates Authorized Guaranteed Data Rates Maximum Authorized QoS Class per IP flow or bidirectional combination of IP flows in the PCRF and for calculating the Maximum Authorized/Guaranteed Data Rates QCI and ARP in the PCRF whenever the “as set by the operator” phrase is used in the algorithm description. For description of different parameters under Default QoS Policy, refer to Table 47: Gx Profile Parameters, on page 85 .
Rx Sync Mode	For description of different parameters under Rx Sync Mode parameters, refer to Table 53: Rx Sync Mode Parameters, on page 92 .

Parameter	Description
MPS QoS Policy	<p>Provides a way to derive QoS attributes for MPS sessions based on some other AVP values.</p> <p>For description of different parameters under MPS QoS Policy, refer to Table 48: ARP Parameters, on page 87.</p> <p>Note A Media-Type having an empty label shall be used only to get the output values to be used for default bearer QoS.</p>
Codec QoS Policy	For more information, refer to Codec QoS Policy, on page 92
Reservation Priority QoS Policy	<p>Provides a way to derive Rx dedicated bearers QoS attributes based on Reservation-Priority AVP value as per 3GPP TS 29.213.</p> <p>For description of different parameters under Reservation Priority QoS Policy refer to Table 47: Gx Profile Parameters, on page 85 and Table 48: ARP Parameters, on page 87.</p>
AF Application Id Validation	For more information, refer to AF Application Id Validation, on page 94

Table 53: Rx Sync Mode Parameters

Parameters	Description
Sync AAR	Select to enable AAR in sync mode.
Sync STR	Select to enable STR in sync mode.
Time To Live in Cache Millis	When Rx Sync mode is enabled, determines how long the Rx AAR/STR response is stored in the session before retracting the stored response to be sent towards PCSCF after Gx RAR/RAA exchange occurs between PGW and PCRF. This value is recommended to be higher than the PCSCF timeout.

Codec QoS Policy

Provide a way to derive Rx dedicated bearers QoS attributes based on Codec-Data AVP value as per 3GPP TS 29.213.

For description of different parameters under Codec QoS Policy refer to [Table 47: Gx Profile Parameters, on page 85](#) and [Table 48: ARP Parameters, on page 87](#).

The additional parameters Codec Data Pattern and Codec Details Pattern contains codec related information known at the AF. This information is encoded as per 3GPP 29.214 specifications

The first line of the value of the Codec-Data AVP consists of either the word `uplink` or the word `downlink` (in ASCII) followed by a new-line character. The semantics of these words are the following:

- `uplink` indicates that the SDP was received from the UE and sent to the network.
- `downlink` indicates that the SDP was received from the network and sent to the UE.

The second line of the value of the Codec-Data AVP consists of either the word `offer`, the word `answer`, or the word `description`.

The rest of the value consists of the SDP line(s) in ASCII encoding separated by new-line characters, as specified in IETF RFC 4566. The first of these line(s) is an `m` line. The remaining lines are any available SDP `a` and `b` lines related to that `m` line.



Restriction

- You should not configure 'Codec QoS Policy' table with ambiguous entry. If multiple rows are configured which matches same 'Codec-Data' and 'Codec-Details' values then CPS will fetch first matched row.
- Codec-Data column value is mandatory in Policy Builder configuration while adding entry in the 'Codec QoS Policy' table.
- CPS considers the first Codec-Data AVP if AAR request has multiple 'Codec-Data' AVPs.
- By default, CPS uses the first Codec-Data AVP with `offer` or `answer` on the second line if the AAR request has multiple Codec-Data AVPs. If `Prefer Answer` is set to `true`, CPS uses the first Codec-Data AVP with `answer` on the second line, or the first Codec-Data AVP with `offer` if there is no Codec-Data AVP with `answer`.
- CPS considers only the first media format in the `m=` line.
- You should configure the 'Codec Data Pattern' and 'Codec Details Pattern' column values with wildcards as per the standard Java regular expression syntax described at the [link](#).
CPS supports leading middle and trailing wildcards. Multiple wildcards should be possible in a single string.
- Case sensitivity is supported for both 'Codec Data Pattern' and 'Codec Details Pattern' columns so you should provide the values accordingly.

If multiple Codec-Data AVPs are reported in multiple AAR messages for a single Rx session then CPS will consider the first Codec-Data AVP value received in first AAR message for selecting QoS policies.

The following sections provides few examples on how to configure the wildcards.

1. Codec Data value used as the search key in this table is the 4th group (of numbers) from the 3rd line of the Codec-Data AVP string value.

In the following example, only the value 116 is going to be used as a search key in the Codec QoS Policy table.

```
uplink
offer
m=audio 50000 RTP/AVP 116 107 97 115 111 110
a=rtpmap116 AMR-WB/16000
a=rtpmap107 AMR-WB/16000
a=rtpmap97 AMR/8000
a=rtpmap115 AMR/8000
a=rtpmap111 telephone-event/16000
a=rtpmap110 telephone-event/8000
a=curreqos local none
a=curreqos remote none
a=desqos mandatory local sendrecv
a=desqos optional remote sendrecv
a=sendrecv
a=ptime20
a=maxptime240
```

2. Only the first Codec-Data AVP value is used.
3. You can configure Codec Details Pattern and Codec Data Pattern columns with wildcards as per java regular expressions (for example, .* \$, and so on) so that CPS can compare the AVP values with this regex and fetch the appropriate QoS values.

Example:

Consider you want to configure “Codec Data Pattern 98” and “Codec Details Pattern AMR/8000”.

There are multiple combination you can configure. Some examples are given below :

With ExactMatch:

- Codec Data Pattern 98 Codec Details Pattern AMR/8000.
- Codec Data Pattern 98 Codec Details Pattern <No value specified>, that is, null

With wildcards

- Codec Data Pattern .*8 Codec Details Pattern AM.*
- Codec Data Pattern 9.* Codec Details Pattern .*80
- Codec Data Pattern 9.* Codec Details Pattern AM.*80
- Codec Data Pattern .* Codec Details Pattern ^AM.*80

AM.*80 indicates that String that has AM and any number characters and 80. It does not mean that string should start with AM and end with 80.

If you want to specify starting and ending characters explicitly then you should use '^' for starting (say ^77 value should start with 77) and '\$' for ending (say AM.*80\$ value should end with 80); you should configure the 'Codec Data Pattern' and 'Codec Details Pattern' column as per the standard Java regular expression syntax.

Suppose you configure multiple rows matching the same values; for example, as shown in the following figure, both rows can be matched with values “Codec-Data 98 and Codec-Details AMR/8000.” In this case, CPS will select the first matched row.

Figure 22: Codec QoS Policy

Codec QoS Policy							
QoS	Max Requested	Max Requested Bandwidth	Guaranteed Bitrate U L	Guaranteed Bitrate D L	Codec Data Pattern	Codec Details Pattern	
6	10001	10001	10001	10001	9.*	.*80	
8	10002	10002	10002	10002	.*8	AM.*	

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AF Application Id Validation

Provides a way to authorize the Rx IMS sessions. In case there's not a match between the AVP values below in the table the PCRF shall send an error response to the AF containing the Experimental-Result-Code AVP with value REQUESTED_SERVICE_NOT_AUTHORIZED (5063) as per 3GPP TS 29.214.

Interface	AVP Value
Gx	Refer to Logical APN attribute under Gx Profile , on page 84.

Interface	AVP Value
Rx	AF-Application-Identifier
	Media-Type

**Note**

- Called-Station-Id AVP value is retrieved from the Gx session the Rx session binds to.
- If the incoming Rx AAR message contains multiple flows having different AF-Application-Identifier AVP value or Media-Type AVP value and any of these flows is not authorized than the PCRF shall send an error response as described above.
- If no AF-Application-Identifier AVP is present in the incoming request the validation is skipped.

ARP and QCI Normalization

Apply Best/Normalized ARP across all PrioritySharing Rx sessions with same MediaType and AF-Application-Identifier. The ARP normalization is applied within multiple Media Sub Component within Media Component Description.

Elevate the Default bearer ARP to the best/normalized ARP across all QCI, Media Type and AF-Application-Identifiers.

There are two ways to enable the feature:

- Priority-Sharing-Indicator (PSI) AVP present in the Rx_AAR sent by P-CSCF/IMS "Priority-Sharing-Indicator".
 - 0 - enabled
 - 1 - disabled
- PSI feature is enabled/disabled for specific AF-Application-Identifier via Policy Builder and CRD Configuration.
 - Enable - set prioritySharing value as "0"
 - Disable - set prioritySharing value as "1"

Policy Builder and CRD Configuration: Rx STG lookup binding for AF-Application-Identifier AVP to PrioritySharing Enable/Disable.

Figure 23: Rx STG lookup binding

Rx STG lookup binding

Name

Stg Reference
 [clear](#)

List Of Input Column Avp Pairs

*Avp Name	Column
AF-Application-Identifier	AF_AppId

List Of Output Column Avp Pairs

*Avp Name	Column
PrioritySharing	PrioritySharing

Actions
Copy:
[Current Rx STG lookup binding](#)

Advanced Options

You can get access to these features by creating child objects to your Rx profile object.



Note There should be at least one object of each type for any Rx profile object or the results will be unpredictable. The Policy Builder GUI does not enforce this restriction though.

Sponsored Data Charging Parameters

The Sponsored Data Charging Parameters allows you to configure specific charging parameters for the Sponsored Data scenarios depending on some AVPs from the incoming Rx AAR. These parameters are going to be set under Charging-Rule-Definition grouped AVP.

The required charging parameters are as follows:

- Rating-Group
- Reporting-Level
- Online
- Offline
- Metering-Method

To map the above mentioned parameters the following keys are used:

- Sponsor-Id
- Application-Service-Provider-Identity
- Media Type

These keys are applicable for Sponsored Data Charging Parameters only.

The mapping configuration for the charging parameters is configured under **Policy Builder > Reference Data tab > Diameter Defaults > Rx Profile**.

Figure 24: Sponsor Data Charging

Sponsor Data Charging									
Service Identifier	Rating Group	Online	Offline	Metering Method	Reporting Level	Precedence	Sponsor Identity	App Service Provider Id	Media Type
81	1	DISABLE	ENABLE	VOLUME		101	Sponsor-A	App-Serv-Prov-Id-A	AUDIO
83	1	DISABLE	ENABLE	VOLUME		101	Sponsor-A	App-Serv-Prov-Id-B	AUDIO

Add Remove ↑ ↓

In the Sponsor Data Charging table, you can define the parameter values in all the columns including the values for the key parameters such as - Sponsor Identity App Service Provider Identity and Media Type.

Default Sponsor Data Charging

Defines the default values for the sponsor data charging parameters under Charging-Rule-Definition grouped AVP to be used in case there's no match in the Sponsor Data Charging. This configuration is optional. Default value is unchecked.

The following parameters can be configured under Sponsor Data Charging:

Table 54: Sponsor Data Charging Parameters

Parameter	Description
Service Identifier	The identity of the service or service component the service data flow in a PCC rule relates to.
Rating Group	The charging key for the PCC rule used for rating purposes.
Online	<p>It defines whether the online charging interface from the PCEF for the associated PCC rule is enabled. The default charging method provided by the CPS takes precedence over any pre-configured default charging method at the PCEF.</p> <ul style="list-style-type: none"> • Enable This value is used to indicate that the online charging interface for the associated PCC rule is enabled. • Disable This value is used to indicate that the online charging interface for the associated PCC rule is disabled.

Parameter	Description
Offline	<p>It defines whether the offline charging interface from the PCEF for the associated PCC rule is enabled. The default charging method provided by the CPS takes precedence over any pre-configured default charging method at the PCEF.</p> <ul style="list-style-type: none"> • Enable This value is used to indicate that the offline charging interface for the associated PCC rule is enabled. • Disable This value is used to indicate that the offline charging interface for the associated PCC rule is disabled.
Metering Method	<p>The Metering-Method AVP (AVP code 1007) is of type Enumerated and it defines what parameters shall be metered for offline charging. The PCEF may use the AVP for online charging in case of decentralized unit determination and having three values</p> <ul style="list-style-type: none"> • DURATION (0) This value shall be used to indicate that the duration of the service data flow shall be metered. • VOLUME (1) This value shall be used to indicate that volume of the service data flow traffic shall be metered. • DURATION_VOLUME (2) This value shall be used to indicate that the duration and the volume of the service data flow traffic shall be metered.
Reporting Level	<p>The Reporting-Level AVP is of type Enumerated and it defines on what level the PCEF reports the usage for the related PCC rule. There are three types of reporting levels</p> <ul style="list-style-type: none"> • SERVICE_IDENTIFIER_LEVEL (0) This value shall be used to indicate that the usage shall be reported on service id and rating group combination level and is applicable when the Service-Identifier and Rating-Group have been provisioned within the Charging-Rule-Definition AVP and Rating-Group AVP have been provisioned within the Charging-Rule-Definition AVP. Applicable for offline charging. • RATING_GROUP_LEVEL (1) This value shall be used to indicate that the usage shall be reported on rating group level and is applicable when the Rating-Group has been provisioned within the Charging-Rule-Definition AVP and Rating-Group AVP have been provisioned within the Charging-Rule-Definition AVP. Applicable for offline charging. • SPONSORED_CONNECTIVITY_LEVEL (2) This value shall be used to indicate that the usage shall be reported on sponsor identity and rating group combination level and is applicable when the Sponsor-Identity AVP, Application-Service-Provider-Identity AVP and Rating-Group AVP have been provisioned within the Charging-Rule-Definition AVP. Applicable for offline charging.
Precedence	<p>This determines the order in which the service data flow templates are applied at service data flow detection at the PCEF. A PCC rule with the Precedence AVP with lower value shall be applied before a PCC rule with the Precedence AVP with higher value.</p>

Parameter	Description
Sponsor Identity	Sponsor-Identity AVP value under the Sponsored-Connectivity-Data grouped AVP.
App Service Provider	App Service Provider Id is same as Sponsor-Identity. It is an AVP under the Sponsored-Connectivity-Data grouped AVP.
Media Type	Applicable Media-Type (session level or specific to Media-Component-Description). Select from drop-down list. The list includes Audio Video Data Application Control Text Message and Other.

Dynamic Rule Charging Parameter

The Dynamic Rule Charging Parameters allows you to configure different charging parameters for the Rx dedicated bearers. Charging parameters are defined for dynamic PCC rules so that the service provider can properly charge for the traffic. For each Media-Sub-Component grouped AVP under Media-Component-Description grouped AVP in an AAR request PCRF installs a dynamic charging rule. The charging parameters for these dynamic PCC rules are not included in the AAR message so they are pulled out from the configuration.

Figure 25: Charging Parameters

Charging Parameters

Service Identifier	Rating Group	Online	Offline	Metering Method	Reporting Level	Precedence	AF Application Identifier Pattern	Media Type
1	2	ENABLE	DISABLE	VOLUME	SERVICE_IDENTIFIER_LE 2000		AUDIO_RL0	AUDIO
2	1	ENABLE	DISABLE	DURATION	RATING_GROUP_LEVEL 3000		AUDIO_RL1	AUDIO
1	2	ENABLE	DISABLE	DURATION	SERVICE_IDENTIFIER_LE 1111		VIDEO_RL0	VIDEO
1	2	ENABLE	DISABLE	VOLUME	RATING_GROUP_LEVEL 2222		VIDEO_RL1	VIDEO
1	2	ENABLE	DISABLE	VOLUME	SERVICE_IDENTIFIER_LE 7777		TEXT_RL10	TEXT
1	2	ENABLE	DISABLE	DURATION	RATING_GROUP_LEVEL 5555		TEXT_RL1.*	AUDIO

Add Remove ↑ ↓

In the **Charging Parameters** table, you can define the parameter values in all the columns including the values for the key parameters such as - **AF Application Identifier Pattern** and **Media Type**.

The **AF Application Identifier Pattern** parameter contains information that identifies the particular service that the AF service session belongs to. This information may be used by the PCRF to differentiate QoS for different application services. You can specify regular expressions for this parameter as needed.

Default Charging Parameters

Defines the default values for the charging parameters under Charging-Rule-Definition grouped AVP to be used in case there's no match in the Charging Parameters table. This configuration is optional. Default value is unchecked.

For description of different parameters under Dynamic Rule Charging Parameters refer to [Table 54: Sponsor Data Charging Parameters, on page 97](#).



- Note**
- An empty value being selected in either of Online Offline or Metering Method drop-boxes means no value is defined for that attribute so it will not be added to the Charging-Rule-Definition grouped AVP. Default value for all these three attributes is empty.
 - The same parameters can be configured using an RxChargingParameterSTGConfiguration service configuration object.

Rx STG Lookup Binding

In the **Rx STG lookup binding** you can define the STG that is based on Rx media information (such as, media-type, af-application-id, and so on) and specify the mappings for binding the CRD columns to input and output AVPs.

CPS evaluates the CRD tables defined under **Rx STG lookup binding** using the media information available in the rx-sessions after the evaluation of all CRDs by the framework.

The following parameters can be configured under **Rx STG lookup binding**:

Table 55: Rx STG lookup binding Parameters

Parameter	Description
Name	The name of the Rx STG lookup binding.
Stg Reference	Reference to the Search Table Group containing the CRD tables that defines parameters for Rx specific media information.
List Of Input Column Avp Pairs	<p>Defines the mapping between the AVP Names and the key Columns defined in the selected STG. These AVPs are inputs while evaluating the CRD table in STG.</p> <ul style="list-style-type: none"> • Avp Name: Name of the diameter AVP (received in Media Component Description AVP of the AAR message) which is to be used as input for CRD table evaluation. For example, Media-Type, AF-Application-Identifier, and so on. • Column: Reference to the key column in STG corresponding to the specified AVP.
List Of Output Column Avp Pairs	<p>Defines the mapping between the AVP Names and the output columns defined in the STG selected. These mapping indicate how the output column's values are mapped to AVPs after the CRD is evaluated.</p> <ul style="list-style-type: none"> • Avp Name: The name/code of the Rx CRD AVP that is created for the output column. The Rx CRD AVP stores the information related to the media (media-type, mcd number, rx-session-id, and so on). There are multiple such AVPs with same code for the evaluated MCDs. • Column: Reference to the output column defined in the STG selected.

Evaluation of STGs defined in **Rx STG lookup binding** (evaluated for each media in the Rx session) creates multiple **Rx CRD result AVP** for each configured output column. Along with the code and CRD output value, this result AVP also stores the media component details such as, Media-Component-Number, Media-Type and Rx session-id. This information can be used for creating conditions (for example, An Rx CRD result Avp exists).

Rule Retry Profiles

CPS can be configured to selectively re-attempt to install rules that fail to install or activate. Upon receipt of a Charging-Rule-Report indicating the failure to install or activate one or more rules CPS will evaluate the failed rules and take further action.

CPS decides whether to reinstall a failed rule based on the Rule Retry Profile configured for the rule. The configuration of this Rule Retry behavior takes place in the Rule Retry Profile screen in Policy Builder.

- CPS will not re-attempt to install a failed rule unless the rule has a Rule Retry Profile associated with it. If no Rule Retry Profile is configured the rule status and failure code are updated immediately and no attempt to install the rules is made. This is the default behavior.
- If the Rule Retry Profile is configured but the reported rule failure code does not match any of the failure codes defined in the associated Rule Retry Profile the rule status and failure code are updated immediately and no attempt to install the rules is made regardless of the status of the other parameters.
- The rule status is not updated until the last retry fails.

Create a Rule Retry Profile

Procedure

- Step 1** Login to Policy Builder.
- Step 2** Go to **Reference Data > Rule Retry Profiles**.
- Step 3** From the right pane, click **Rule Retry Profile** under **Create Child** to open a Rule Retry Profile.

The following parameters can be configured for each Rule Retry Profile:

Table 56: Rule Retry Profile Parameters

Parameter	Description
Retry Interval	<p>The number of seconds to wait before retrying to install a rule. See also Backoff Algorithm parameter.</p> <p>Default: 10 seconds</p> <p>Note If the value is less than 15 seconds, then the retries are scheduled at second level granularity. If the value is greater than 15 seconds, then granularity is in minutes. For example, if the interval is configured as 30 seconds, the timer may expire within 30 sec + 1 min approximately.</p>

Parameter	Description
Max Retry Attempts	<p>The maximum number of retry attempts to make. When CPS reaches this maximum retry value without successfully installing the rule the rule status and failure code are updated immediately and no further attempts are made to install the rule.</p> <p>Note This value does not include the initial installation attempt that is reported as failed but only the subsequent attempts.</p> <p>Default: 3</p>
Backoff Algorithm	<p>The algorithm to be used for calculating the time between retries.</p> <p>CONSTANT_INTERVAL Each retry is scheduled after an interval equal to Retry Interval seconds since the last report.</p> <p>LINEAR_INTERVAL Each retry is scheduled after an interval equal to Retry Interval x Current Attempt Number seconds since the last report.</p> <p>Default: CONSTANT_INTERVAL</p>
Rule Failure Code	<p>Select the failure codes for which CPS retries as specified in 3GPP TS29.212 v11.10 Section 5.3.38 Rule-Failure-Code AVP.</p> <p>Click Add then select one or more failure codes from the drop down menu. Click Add to include them to the list. Click OK when you are done.</p> <p>If no Rule Failure Code is specified, then CPS retries regardless of the failure code reported.</p>
Name	<p>Enter a unique name for this Rule Retry Profile.</p> <p>This name is used to associate Rules to this Rule Retry Profile.</p>
Max Retry Interval	<p>Enter the maximum time in seconds between the first and the last retry.</p> <p>If set to zero, the PCRF does not enforce a time limit for sending the retry messages.</p> <p>Default: 0 (zero)</p>

Parameter	Description
Cisco Event Failure code	<p>When a Cisco-CC-Failure-Type AVP is received to report Gy failure, CPS matches the Cisco-CC-Failure-Type AVP value in the diameter message CCR-Update with the Cisco Event Failure Code for the rule. If the value matches, then CPS retries the rule. Cisco Event Failure Code supports all values of type Unsigned32 from PGW.</p> <p>The following are some examples values for the Cisco Event Failure code:</p> <ul style="list-style-type: none"> • 0 - CC_CONNECTION_FAILURE • 1 - CC_RESPONSE_TIMEOUT • 3* - 3xxx Protocol Error result-codes (For example, 3004 - DIAMETER_TOO_BUSY) • 4* - 4xxx Transient Failure result-codes (For example, 4002 - DIAMETER_OUT_OF_SPACE) • 5* - 5xxx Permanent Failure result-codes (For example, 5001 - DIAMETER_AVP_UNSUPPORTED) <p>For more information on codes, refer to RFC 3588.</p>
Enable Profiles Based On Failure Code	<p>This check box is used to configure profiles based on failure codes.</p> <p>By default, this checkbox is not selected.</p> <p>For more information, refer to Profile Based On Failure Code, on page 103.</p>

If there is still time to retry a rule installation ($\text{First Retry Time} + \text{Max Retry Interval} \leq \text{Current Time}$) then the rule status and failure code are not updated immediately such that no policy change based on rule failure status is triggered.

Profile Based On Failure Code

This table is used to override the attributes Retry Interval, Backoff Algorithm, Max retry Attempts, and Max Retry Interval of generic profile which is already available.

CPS uses the following columns to select a row from this table:

- Cisco Event Failure Code
- Rule Failure Code
- Sy Realm

**Note**

- Cisco Event Failure Code or Rule Failure Code column value is mandatory to select the row. If both has Null values, then CPS ignores that row.
- If Sy session exist, then only CPS considers Sy Realm column value. There is no need to add a value if you do not want to consider SyRealm.
- If there is no value configured for Retry Interval, Backoff Algorithm, Max retry Attempts, and Max Retry Interval columns for a selected row in the table then CPS sets those attributes with already existing field values present under generic **Rule Retry Profile**.

Sy Realm Value

This parameter is used to derive SyRealm from CRD. User has to select CRD output column so that SyRealm value is pulled from the CRD table. If there is no Sy realm value derived from this field, then CPS tries to get the realm information from local Sy session.

The CRD output column values takes precedence over local Sy session.

Associate a Rule Retry Profile with a Rule

Each type of Service Configuration Object Rule in CPS (PreDefinedRule PreDefinedRuleBase PreConfiguredRule) can be associated with the Rule Retry Profile created in the previous section.

Procedure

-
- Step 1** In Policy Builder select the **Services** tab.
 - Step 2** From the left pane select **Services**.
 - Step 3** Expand **Service Options** tree.
 - Step 4** Select and expand your service option.
 - Step 5** Select the service option object.
 - Step 6** In the Service Option screen select the Service Configuration object. A Rule Retry Profile can be referenced only from a **PreDefinedRule**, **PreDefinedRuleBase** or a **PreConfiguredRule** service configuration object.
 - Step 7** Select the **Value** cell corresponding to the **Retry Profile**.
 - Step 8** Click the “...” button.
 - Step 9** Select the Rule Retry Profile from the popup window then click **OK**.
 - Step 10** Click **OK**.

For more details about how to define a service option refer to Services chapter.
