Policy Builder Configuration

Plug-in Configuration

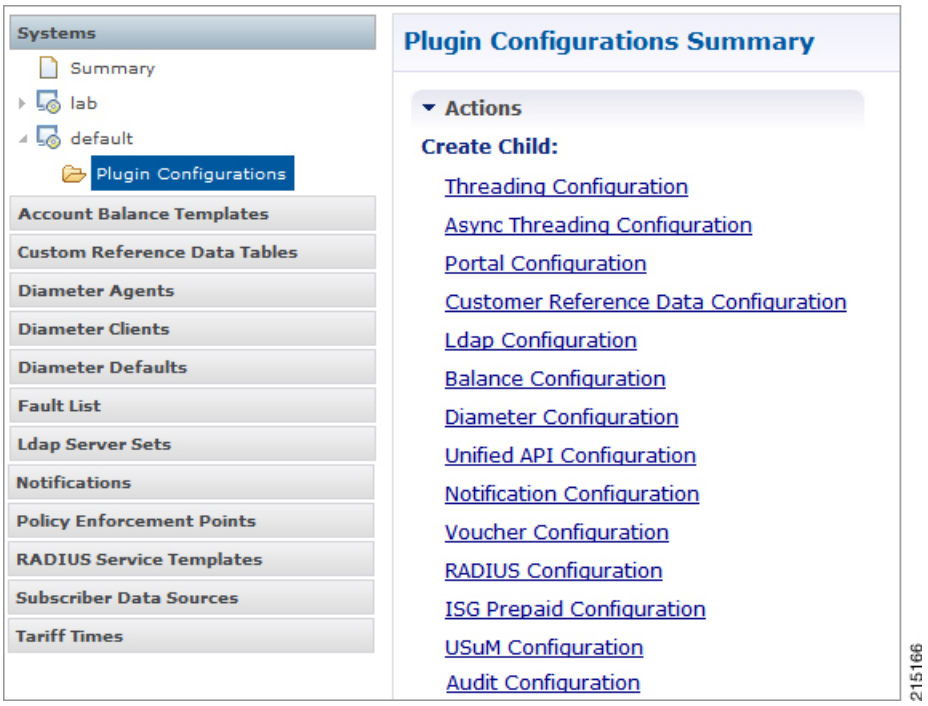
Cisco Policy Builder provides core plug-ins for customizing and optimizing your installation.

- Configurations set at the system level are system-wide except as noted in the bullet items below.
- Configurations set at the cluster level apply to that cluster and the instances in it. A value set here overrides the same value set at the system level.
- Configurations set at the instance level apply to the instance only and override the same value set at the cluster or system level.

Select the **Create Child** action in a **Plug-in Configuration** node in the **Systems** tree to define them. You can change any of the variables from the default, or choose not to use a plug-in, as necessary.

When you create a system from the example, the following configuration stubs appear at the cluster and instance level:

Figure 1: Create Child Action



Threading Configuration

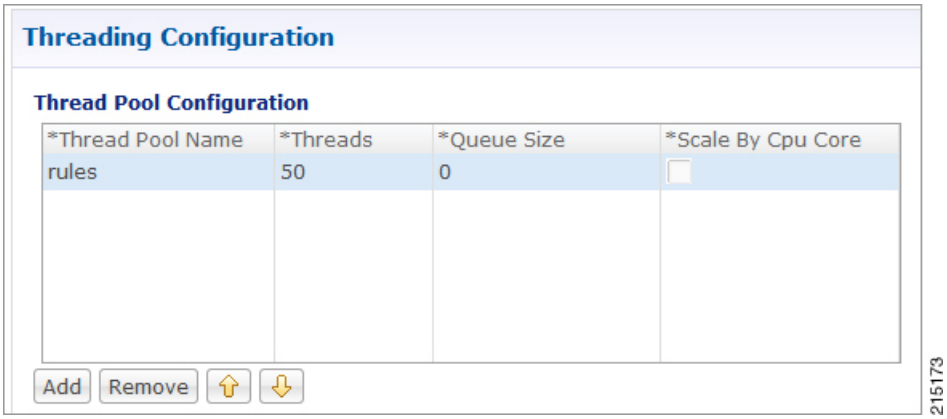
A threading configuration utility is provided for advanced users.

Click **Threading Configuration** in the right pane to add the threading configuration to the system. If you are planning to run the system with higher TPS, then you need to configure Threading Configuration. For further information, contact your Cisco Technical Representative.

The Threading Plug-in having thread pools controls the total number of threads in CPS vDRA that are executing at any given time. Each of these thread pools have a queue associated with it.

A configuration example is shown below:

Figure 2: Thread Pool Configuration



The following parameters can be configured under Threading Configuration:

Table 1: Threading Configuration Parameters

Parameter	Description
Thread Pool Name	Name of the thread pool. For more information on the thread pool names and recommended values that can be configured, refer to *Threading Configuration* section in the *CPS vDRA Advanced Tuning Guide*.
Threads	Number of threads to set in the thread pool.
Queue Size	Size of the queue before they are rejected.
Scale By Cpu Core	Select this check box to scale the maximum number of threads by the processor cores.

Async Threading Configuration

Click **Async Threading Configuration** in the right pane to add the configuration in the system.

Use the default values for the Async Threading Plug-in. The Async configuration controls the number of asynchronous threads.

Note Currently, CPS vDRA does not have any asynchronous threads. However, you must add "Async Threading Configuration" and keep this table empty.

The following parameters can be configured under Async Threading Configuration.

Table 2: Async Threading Configuration

Parameter	Description
Default Processing Threads	The number of threads that are allocated to process actions based on priority.
Default Action Priority	The priority assigned to an action if it is not specified in the Action Configurations table.
Default Action Threads	The number of threads assigned to process the action if it is not specified in the Action Configurations table.
Default Action Queue Size	The number of actions that can be queued up for an action if it is not specified in the Action Configurations table.

Parameter	Description
Default Action Drop	**DropOldestWhenFull**: The oldest queued action is dropped from the queue when a new action is added to a full queue. Otherwise, the new action to add is ignored. **DropWhenFull**: A handler for rejected tasks that silently discards the rejected task. No execution for rejected tasks. **DoNotDrop**: A handler for rejected tasks that runs the rejected task directly in the calling thread of the execute method, unless the executor has been shut down, in which case the task is discarded. Default value is **DropOldestWhenFull**.
Action Configurations Table	
Action Name	The name of the action. This must match the implementation class name.
Action Priority	The priority of the action. Used by the default processing threads to determine which action to execute first.
Action Threads	The number of threads dedicated to processing this specific action.
Action Queue Size	The number of actions that can be queued up.
Action Drop Oldest When Full	For the specified action only: When checked, the oldest queued action is dropped from the queue when a new action is added to a full queue. Otherwise, the new action to add is ignored.

Custom Reference Data Configuration

Configure your system, cluster, and instance for the first time to use Custom Reference Data Table plug-in. Then you can create as many tables as needed.

Important When you add new fields in CRD, manually update the new fields with appropriate values for all the existing entries in CRD. Otherwise DRA doesn't show any values for these new fields for existing entries and this can cause routing failures.

Click **Custom Reference Data Configuration** from right pane to add the configuration in the system.

- HA example:
  - Primary Database Host/IP Address: sessionmgr01
  - Secondary Database Host/IP Address: sessionmgr02
  - Database Port: 27717

The following parameters can be configured under Custom Reference Data Configuration.

Table 3: Custom Reference Data Configuration Parameters

Parameter	Description
Primary Database Host/IP Address	IP address or a host name of the sessionmgr database. For example, sessionmgr01.
Secondary Database Host/IP Address	(Optional) This field is the IP address or a host name of a secondary, backup, or failover sessionmgr database. For example, sessionmgr02.
Database Port	Port number of the sessionmgr. **Note** Make sure that the value for this field is same as filled in for both the Primary Database Host/IP Address and Secondary Database Host/IP Address fields. Default value is 27717.
Db Read Preference	Describes how sessionmgr clients route read operations to members of a replica set. Select one of the following options from drop-down list: • Primary: All operations read from the current replica set primary member. • PrimaryPreferred: In most situations, operations read from the primary database host. However, if this host is unavailable, operations read from the secondary databse host. • Secondary: All operations read from the secondary members of the replica set. • SecondaryPreferred: In most situations, operations read from secondary members. However, if a secondary database host is unavailable, operations read from the primary database host. Default value is Primary. For more information, see http://docs.mongodb.org/manual/core/read-preference/.
Connection Per Host	Number of connections that are allowed for each database host. Default value is 100. Connection Per Host is a performance tuning parameter and can be changed in case of a performance issue according to the call model and hardware.

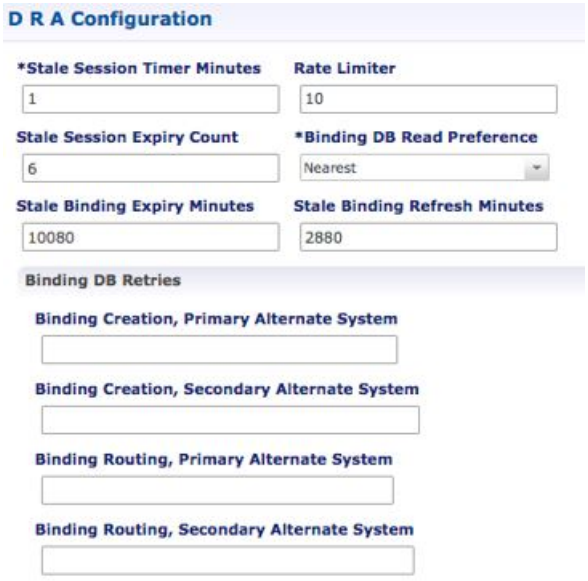
Parameter	Description
Avp Persists	Use this table to configure certain AVPs that you want to store in the session database. AVPs that are not configured as part of this table, are not persisted. • Name: Enter the name for the AVP value. • Avp Name: The name of the CRD/policy derived AVP. To retrieve the stored AVPs from the session, use the Customer Reference Data Debug AVPs. This retriever is used to send the stored AVPs in any diameter message, and available in the **PolicyState/Session data to Custom AVP Mapping** under Custom AVP Profiles. **Restriction** When you configure the AVP Persists table in the Policy Builder, for each AVP, configure both the AVP name and name. If no values are added for these fields, then the particular AVP is not added to the Gx session. This scenario leads to unavailability of the specific AVP and hence, no custom AVP are sent.

For more information on Custom Reference Data API Usage, see the *CPS Operations Guide* for this release.

DRA Configuration

Click **DRA Configuration** from the right pane in Policy Builder to add the configuration in the system.

Figure 3: DRA Configuration



The following parameters can be configured under DRA Configuration:

Table 4: DRA Configuration Parameters

Parameter	Description
Stale Session Timer Minutes	Indicates the time after which the audit RAR should be generated (in the subsequent audit RAR process cycle that runs every minute in CPS vDRA) for sessions that are stale. Default: 180 minutes (recommended value) Minimum: 10 minutes Maximum: 10080 minutes **Note** Once session becomes stale and crosses configured Stale Session Timer Minutes, vDRA generates audit RAR for that session. If there is no audit RAR or the result code in RAA is other than 5002/2001, stale session expiry count gets decremented by one and the same is updated in session database. vDRA performs this operation until stale session expiry count reaches zero. Once stale session expiry count reaches zero, session is deleted.
Rate Limiter	Indicates the number of audit RARs per second that should be sent out by CPS vDRA. Rate Limter value is per worker value. Total number of audit RAR processed is calculated as Rate Limiter value * number of workers. **Note** • If primary database is Mongo Shard DB, then rate limiter value should be set as follows: The value to be set in the Rate Limit would be = 1000 • If primary database is Application Shard DB, then rate limiter value should be set as follows: The value to be set in the Rate Limit would be = 1000/No. of workers Minimum: 1 Maximum: 1000 (maximum number of RAR messages per second from vDRA to PCEF) For information on recommended value, refer to *Audit Rate Limiter* section in the *CPS vDRA Advanced Tuning Guide*.

Parameter	Description
Stale Session Expiry Count	Specifies the number of retries vDRA should do for a stale session if there is no response of audit RAR or if there is Result-Code in RAA (for audit RAR) other than 5002 or 2001. Default: 6 Minimum: 0 (Session deleted without sending RAR) Maximum: 10 For information on recommended value, refer to *Audit Rate Limiter* section in the *CPS vDRA Advanced Tuning Guide*.
Binding DB Read Preference	Used to select the mode when reading from Binding DB. Use "nearest" mode for better performance of traffic that needs only read operation on Binding DB. Default: Nearest For information on recommended value, refer to *Audit Rate Limiter* section in the *CPS vDRA Advanced Tuning Guide*.
Stale Binding Expiry Minutes	Duration after which a binding record is validated against a session record to see if the binding should be deleted because it is stale The timer is initialized when the session is created. The records are deleted when binding expiry time is reached and no active session is found. Otherwise, the timer is updated so the binding record can be audited after another Stale Binding Expiry Minutes. Default: 10080 minutes (168 hours or one week) (recommended value) Minimum: 10 minutes Maximum: 43200 minutes (28 days) For more information about binding DB audits and stale records, see Binding DB Audit, on page 12.
Stale Binding Refresh Minutes	Duration for which the expiry time of the binding database records is refreshed. Default: 2880 minutes (48 hours or 2 days - recommended value). Minimum: 10 minutes Maximum: 10080 minutes (one week) **Note** Stale Binding Refresh Minutes should be greater than Stale Session Timer Minutes. **Important** **Stale Binding Refresh Minutes** parameter has been deprecated from CPS 19.5.0 and later releases. It is recommended to not set this value as zero.

Parameter	Description
Binding Creation, Primary Alternative System	Name of vDRA system to retry Gx CCR-i When vDRA tries to route a Gx CCR-i request, but is unable to reach the database, the configured values of first the primary, then the secondary systems are used to route the Gx CCR-i to a different vDRA to try the database. The retry is stopped if that vDRA also cannot reach the database. **Note** The primary system and the current vDRA system must share a common session database.
Binding Creation, Secondary Alternative System	Name of secondary vDRA system to retry Gx CCR-i **Note** The secondary system and the current vDRA must share a common session database.
Binding Routing, Primary Alternative System	Name of vDRA system to retry Rx AAR When vDRA tries to route a Rx AAR request, but is unable to reach the database, the configured values of first the primary, then the secondary systems are used to route the Rx AAR to a different vDRA to try the database. The retry is stopped if that vDRA also cannot reach the database.
Binding Routing, Secondary Alternative System	Name of secondary vDRA system to retry Rx AAR
Settings	Refer to Settings.
Rate Limits	Refer to Rate Limits.
DRA Feature	Refer to DRA Feature.
DRA Inbound Endpoints	Refer to DRA Inbound Endpoints, on page 19.
DRA Outbound Endpoints	Refer to DRA Outbound Endpoints, on page 21.
Relay Endpoints	Refer to Relay Endpoints, on page 27.

Settings

Click **Settings** check box to open the configuration pane.

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

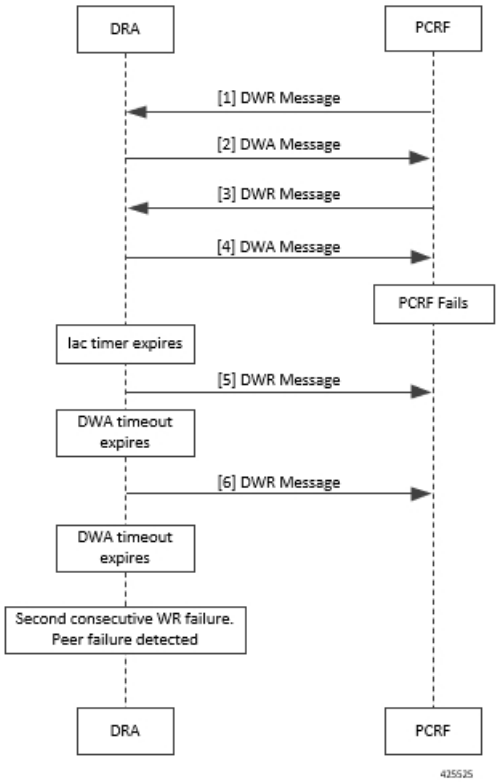
Table 5: DRA Configuration - Settings Parameters

Parameter	Description
Stop Timeout Ms	Determines how long the stack waits for all resources to stop. The delay is in milliseconds. Default: 10000 ms (recommended value) Minimum: 1000 ms Maximum: 60000 ms (one minute)
Cea Timeout Ms	Determines how long it takes for CER/CEA exchanges to timeout if there is no response. The delay is in milliseconds. Default: 10000 ms (recommended value) Minimum: 1000 ms Maximum: 60000 ms (one minute)
Iac Timeout Ms	Determines how long the stack waits before initiating a DWR message exchange on a peer connection from which no Diameter messages have been received. The timeout value is in milliseconds. Default: 5000 ms (recommended value) Minimum: 1000 ms Maximum: 30000 ms (30 seconds)
Dwa Timeout Ms	Determines how long the stack waits for a DWA message in response to a DWR message. If no Diameter message (DWA or other message) is received on the peer connection during the first timeout period, the stack counts a failure, sends another DWR message, and restarts the Dwa timer. If no Diameter messages are received during the second timeout period, the stack counts a second failure. After two consecutive failures, the stack considers the peer connection as failed, and closes the connection. The delay is in milliseconds. Default: 10000 ms (recommended value) Minimum: 1000 ms Maximum: 60000 ms (one minute)

Parameter	Description
Dpa Timeout Ms	Determines how long it takes for a DPR/DPA exchange to timeout if there is no response. The delay is in milliseconds. Default: 5000 ms (recommended value) Minimum: 1000 ms Maximum: 30000 ms (30 seconds)
Rec Timeout Ms	Determines how long it takes for the reconnection procedure to timeout. The delay is in milliseconds. Default: 10000 ms (recommended value) Minimum: 1000 ms Maximum: 60000 ms (one minute)
Drain Timeout Ms	Indicates the time that a peer connection remains open for responses to be sent to peers even if DPR is sent or received by vDRA. If a DPR is sent or received by vDRA, vDRA does not route requests to the disconnecting peer connection via any routing (Dest-Host, SRK, Binding, Table-Driven). However, responses and in-flight requests sent to the corresponding peers till the duration of Drain Timeout. This allows vDRA to gracefully shut down when any remote peer sends a DPR so as to minimize the diameter message loss. Default: 2000 ms Maximum: Must be less than Dpa timeout Ms **Note** When vDRA initiates DPR and the remote end PCRF/PGW disconnects TCP connection immediately after sending DPA, response for the in-flight requests are dropped before reaching the configured drain timeout value.
Response Timeout Ms	Response timeout in milliseconds. Default: 1700 ms

The following figure illustrates the timers in peer detection:

Figure 4: vDRA Peer Detection Failure



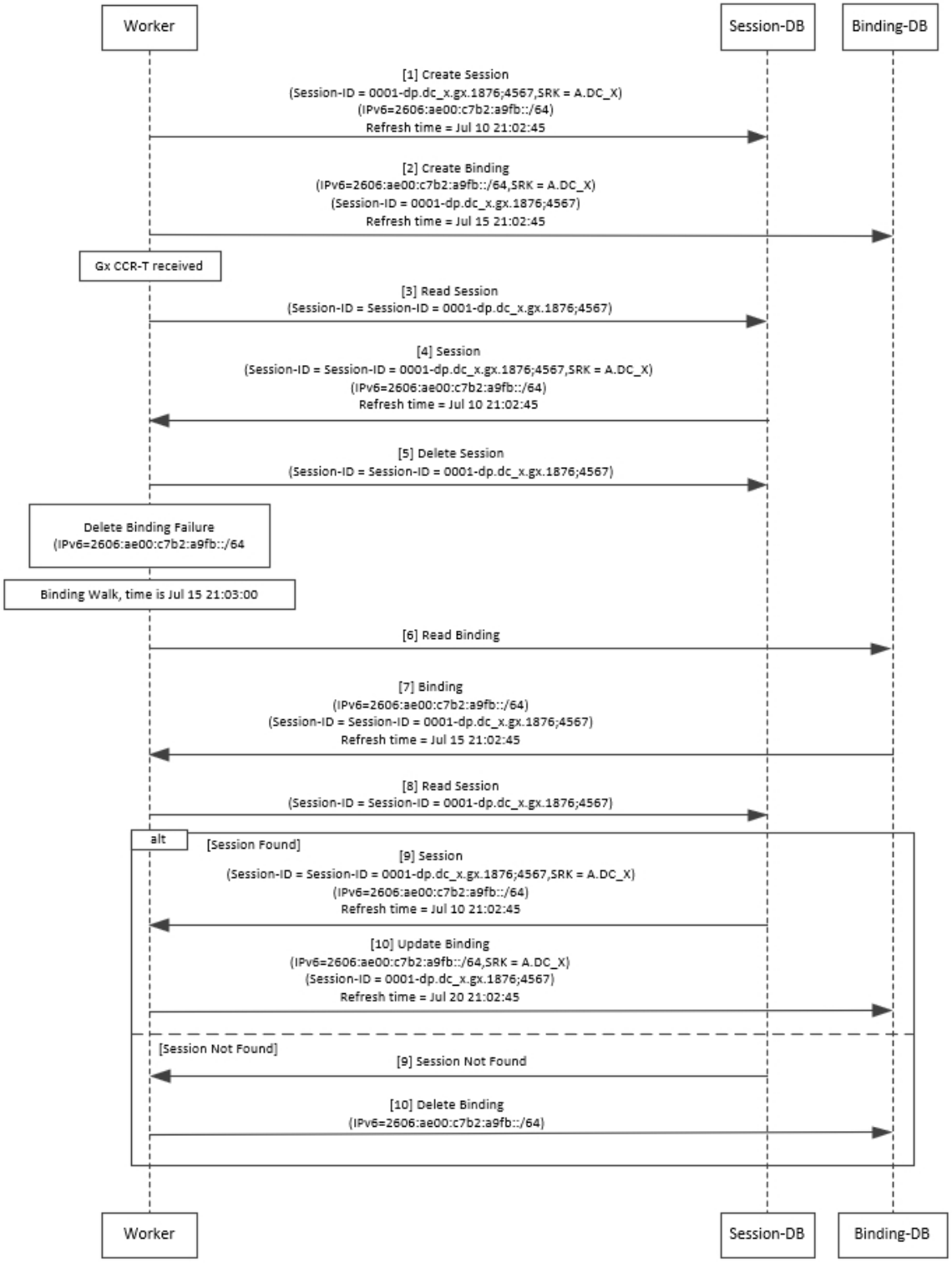
Binding DB Audit

The Binding DB Audit automatically deletes stale records from the binding DBs. When a Gx session record is created, binding records for the session binding keys are also created. When each binding record is created, the binding record expiry time is initialized to the sum of the session creation time and the Stale Binding Expiry Minutes (that you can configure in Policy Builder).

A binding record is deleted when the corresponding session record is deleted. A binding may become stale if it cannot be deleted when its associated session record is deleted (this occurs typically due to database communication failures). The binding records are audited using a binding audit background process. If the audit process finds a binding record with an expiry time in the past, the binding record is checked for staleness by checking the session database for the corresponding session record. If an active session record is found, the binding record expiry time is updated with sum of current time and the Stale Binding Expiry Minutes. If an active session is not found, the binding is considered stale and is deleted. Note that the binding audit process does not perform any Diameter signaling with the GW before deletion.

The following figures illustrate the working of binding DB:

Figure 5: DRA Binding Audit, Stale Binding Cleanup



Note There is a housekeeping thread to process stale sessions/bindings which does the following tasks in sequential order:

1. Process Stale Session Expiration: Generate Audit RAR OR delete the session if stale session expiry count has reached 0.
2. Process expiration of binding: Remove the bindings for which there is no corresponding session.

The stale session expiry task is scheduled to run every minute. This means that the stale session expiry processing is not guaranteed to happen exactly at the configured stale session expiry minutes interval. The stale session expiry processing can happen at any time within the configured stale session expiry minutes to configured stale session expiry minutes + 1 min interval.

However, if the previous task execution of the above mentioned three points takes longer time to complete due to large number of stale sessions/stale bindings, the stale session expiry would run post the previous task completion which can lead to a longer delay than expected 1 minute.

Rate Limits

Rate limit per process instance on Policy Director (lb) VM can be managed using this configuration.

Default is unchecked, that is, no rate limits for Diameter traffic (recommended setting).

If enabled, the following parameters can be configured under **Rate Limits**:

Table 6: DRA Configuration - Rate Limits

Parameter	Description
Rate Limit per Instance on Policy Director	Allowable TPS on a single instance of policy server (QNS) process running on the Policy Director. Minimum: 1 Maximum: 5000 **Note** Contact your Cisco representative for usecase-specific recommended values.
Result-Code in Response	Indicates the error code that must be used while rejecting requests, due to rate limits being reached. Default: 3004
Error Message in Response	Select the check box to drop the rate-limited messages without sending error response. If the check box is not selected, then the rate limited message are dropped with error response as configured.

Parameter	Description
Drop Requests Without Error Response	Select the check box to drop rate limited messages without sending error response. If the check box is unchecked, then the rate limited messages are dropped with error response as configured. To accommodate configuration to either drop the request or send an error response, a column *Discard Behavior* can be added under Peer Rate Limit Profile. The column may have one of the two possible values: • Send Error Response • Drop Message Default: Unchecked (recommended setting) For more information, refer to Peer Rate Limit. **Important** If both Rate Limit Error Code and Rate Limit Error String are provided along with Rate Limit Action as "Drop Message", the Rate Limit Action will take precedence and the other two fields will be ignored.

Here is the list of the available combinations for rate limiting:

Table 7: Rate Limiting Combinations

Rate Limiting Type	With Error Code	With Error Code and Error Message	Without Error Code (Drop)
Instance Level	Yes	Yes	Yes
Peer Level Egress	Yes	Yes	Yes
Peer Level Egress with Message Level	Yes	Yes	Yes
Egress Message Level (No Peer Level RL)	Yes	Yes	Yes
Peer Level Ingress	Yes	Yes	Yes
Peer Level Ingress with Message Level	Yes	Yes	Yes
Ingress Message Level (No Peer Level RL)	Yes	Yes	Yes

DRA Feature

Click **DRA Feature** check box to open the configuration pane.

The following parameters can be configured under **DRA Feature**:

Table 8: DRA Features

Parameter	Description
Gx Session Tear Down On5065	By default, **Gx Session Tear Down On5065** flag is enabled (recommended setting). When the PCRF responds with a Experimental Result Code of 5065 in AAAnswer on Rx Interface, DRA deletes its internal binding and session created for the transaction.A RAR with appropriate Session-Release-Cause AVP will also be sent to the PCEF. **Important** When using this flag, there will always be a database query to fetch Gx session id. So this means that the database transactions will linearly increase with AAR traffic on Rx Interface.
Update Time Stamp On Success R A A	When this check box is selected, session timestamp will be updated on receipt of success RAA (Result-Code: 2001) from PCEF. [1] Default is checked (recommended setting). **Important** When using this flag, there will always be a database query to fetch Gx session id. So this means that the database transactions will linearly increase with AAR traffic on Rx Interface.
Update Time Stamp On Success C C R U	When this check box is selected, session timestamp will be updated on receipt of success CCR-U (Result-Code: 2001) from PCEF. [2] Default is unchecked (recommended setting). **Important** When using this flag, there will always be a database query to fetch Gx session id. So this means that the database transactions will linearly increase with AAR traffic on Rx Interface.
Enable Proxy Bit Validation	Enables P bit validation. vDRA validates the P bit in the Diameter request and, if set, the message maybe proxied, relayed, or redirected. If this option is disabled, the P bit in the request is not checked and the request is not considered proxiable. Default: Enabled.

Parameter	Description
Enable Mediation	Enable advanced mediation capabilities in both egress and ingress direction. This feature allows you to configure vDRA to change the value of the Result-Code in Diameter Answer, use mediation to hide topology, prepend label to Destination Host AVP, etc.
Enable Doic	Enable or disable abatement action for Diameter requests towards PCRF, HSS, AAA, and OCS servers based on reporting of overloaded conditions using the architecture described in RFC 7683 Diameter Overload Indication Conveyance (DOIC). DOIC can be enabled/disabled at peer group level in Peer Group SRK Mapping table. If the destination peer is congested or overloaded, you can choose to either forward, divert, or drop messages.
Enable PCRF Session Query	Enables or disables the PCRF session query. If you enable this, Policy DRA then supports a fallback routing for Rx AARs for VoLTE using the PCRF session query. This ensures that VoLTE calls can complete in the event that IPv6 binding is not found in the binding database. For an Rx AAR with an IPv6 binding query, vDRA provides the ability to route the Rx AAR based on an API query to the PCRF to determine if it has a session for the IPv6. The queries can be made in parallel to a configured set of query points on PCRFs. The Framed-IPv6 AVP from the Rx must be provided in the request to the PCRF. PCRF returns an SRK to be used for routing, similar to existing binding lookups.
Create IPv6 Bindings based on PCRF Session Query	Enables creation of IPv6 binding record in the database based on PCRF session query. When PCRF session query result (success) is received and if IPv6 record is not present in the database, vDRA creates an IPv6 binding record based on the response from the PCRF. If any CCR-I is received for the same IPv6 record, then it overwrites the IPv6 binding record. For any CCR-T, vDRA deletes the IPv6 binding record from database. **Note** Ensure you also enable PCRF Session Query for this feature to work. The Stale Binding Expiry and Refresh Minutes are used to clear these binding records from the database. For more information, see Binding DB Audit, on page 12.

Parameter	Description
Enable Best Effort Binding	When selected allows the operator to enable the best effort binding creation configuration on a per APN basis. The configuration is enabled on a per APN basis and controls any or all of the following bindings (for best effort): • IPv6 • IPv4 • MSISDN/APN • IMSI/APN • Session Default is unchecked. Best effort bindings are those bindings for which DRA does not wait for DB write operations to be completed. DRA forwards the CCR without waiting for DB write and there is an asynchronous write call for best effort bindings. If there is no matching APN found in the best effort binding table from CCR-I, DRA takes the legacy behavior and treats all bindings as mandatory. The bindings to be created is primarily decided by binding creation profile and then DRA examines the best effort table to find the best effort and mandatory bindings. The session can be marked as best effort and in such cases session is not created if session Db is down but the CCR is forwarded.
Slf Max Bulk Provisioning TPS	Rate at which subscribers are provisioned in the SLF database. SLF bulk provisioning generates high number of database write operations in a short duration of time. To spread out the operations over a period of time and mitigate the performance issue, configure the TPS. The rate limit adds delay between transactions and thereby limits the number of transactions executed per second. For more information about SLF bulk provisioning, see the *CPS vDRA Operations Guide*.
A A R Priority Processing	In vDRA 19.4.0 and later release, this parameter has been deprecated and no longer supported. By default, when application-based client sharding is used, AAR processing is prioritized on workers.

[1] The time stamp is updated on generation of Stale RAR. Also, if a success RAR/RAA(2001) comes after generation of Stale RAR, then the Stale RAR counter is reset.

[2] The time stamp is updated on generation of Stale RAR. Also, if a success CCR(U)/CAA(2001) comes after generation of Stale RAR, then the Stale RAR counter is reset.

DRA Inbound Endpoints

The following parameters can be configured under **DRA Inbound Endpoints**:

Note To handle loads of 15 K TPS or more, create multiple TCP connections with PCRF and apply the same configuration to all DRA Directors.

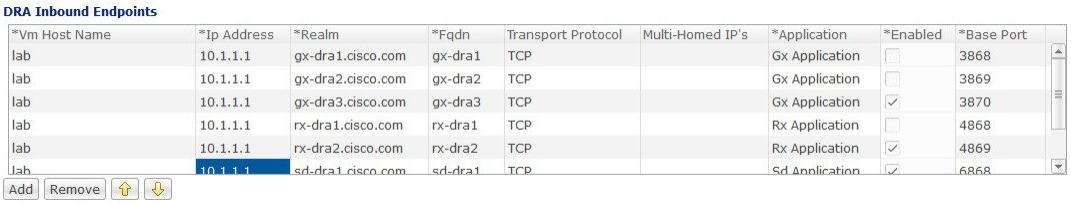
Table 9: DRA Configuration - DRA Inbound Endpoints Parameters

Parameter	Description
Vm Host Name	Host Name of the VM that hosts this CPS vDRA endpoint.
Ip Address	Address on which this CPS vDRA endpoint should bind to.
Realm	Realm of the CPS vDRA endpoint.
Fqdn	Fully Qualified Domain Name of the CPS vDRA end point.
Transport Protocol	Allows you to select either 'TLS', TCP' or 'SCTP' for the selected DRA endpoint. Default value is TCP. If the DRA/relay endpoint is to be configured for SCTP, the Transport Protocol should be selected as SCTP for those endpoints. **TLS**: Enables the connection as TLS from inbound . The supported TLS version is 1.2 and only for Rx application it is supported.

Parameter	Description
Multi-Homed IPs	This is a comma separated list of IP addresses that CPS vDRA will use to start the diameter stack with multi-homing enabled for SCTP transport. Diameter stack with TCP transport will still use the existing 'Local Bind Ip' field to specify any specific IP address for TCP stack. CPS vDRA will use 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. **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. **Note** Both IPv4 and IPv6 are supported in vDRA endpoint configuration. For IPv6, you can enter either short or long format. The configuration for multi-homing is validated by netstat command on lb01: `netstat -apn | grep 3898`
Application	Refers to 3GPP Application ID of the interface. You can select multiple applications on a peer connection. For example, S6a and SLg on a single IPv4/SCTP Multi-homed peer connection.
Enabled	Check to enable the endpoint.
Base Port	Refers to the port on which the CPS vDRA listens for incoming connections.

An example configuration is shown below:

Figure 6: DRA Inbound Endpoints - Example Configuration



DRA Outbound Endpoints

The following parameters can be configured under **DRA Outbound Endpoints**:

Table 10: DRA Configuration - DRA Outbound Endpoints Parameters

Parameter	Description
Vm Host Name	Host Name of the VM that hosts this CPS vDRA endpoint.
Ip Address	Address on which this CPS vDRA endpoint should bind to.
Realm	Realm of the CPS vDRA endpoint.
Fqdn	Fully Qualified Domain Name of the CPS vDRA end point.
Transport Protocol	Allows you to select either 'TCP' or 'SCTP' for the selected CPS vDRA endpoint. Default value is TCP. If the DRA/relay endpoint is to be configured for SCTP, the Transport Protocol should be selected as SCTP for those endpoints.

Parameter	Description
Multi-Homed IPs	This is a comma separated list of IP addresses that CPS vDRA will use to start the diameter stack with multi-homing enabled for SCTP transport. Diameter stack with TCP transport will still use the existing 'Local Bind Ip' field to specify any specific IP address for TCP stack. CPS vDRA will use 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. **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. **Note** Both IPv4 and IPv6 are supported in vDRA endpoint configuration. For IPv6, you can enter either short or long format. The configuration for multi-homing is validated by netstat command on lb01: `netstat -apn | grep 3898`
Application	Refers to 3GPP Application ID of the interface.
Enabled	Check to enable the endpoint.
Peer Realm	Diameter server realm.
Peer Host	Diameter server host. By default, the connection is initiated on the standard diameter port (3868). If a different port needs to be used than the peer name must be defined using the host:port format.

An example configuration is shown below:

Figure 7: DRA Outbound Endpoints - Example Configuration

DRA Outbound Endpoints

*Vm Host Name	*Ip Address	*Realm	*Fqdn	Transport Protocol	Multi-Homed IP's	*Application	*Enabled	*Peer Realm	*Peer Host
lab	10.1.1.1	gx-dra1.cisco.com	gx-dra9	TCP		Gx Application	✓	pcrf2-gx2.cisco.com	gx-pcrf
lab	10.1.1.1	rx-dra1.cisco.com	rx-dra9	TCP		Rx Application	✓	rx-pcrf.cisco.com	rx-pcrf:4868

Add Remove

Enable TLS and MTLS for Diameter Encryption

RFC 6733 Protocol Model

According to the RFC 6733 protocol model, you can configure the security details to initialize the TLS or MTLS connection.

Figure 8: Security Handshake for TLS Connection

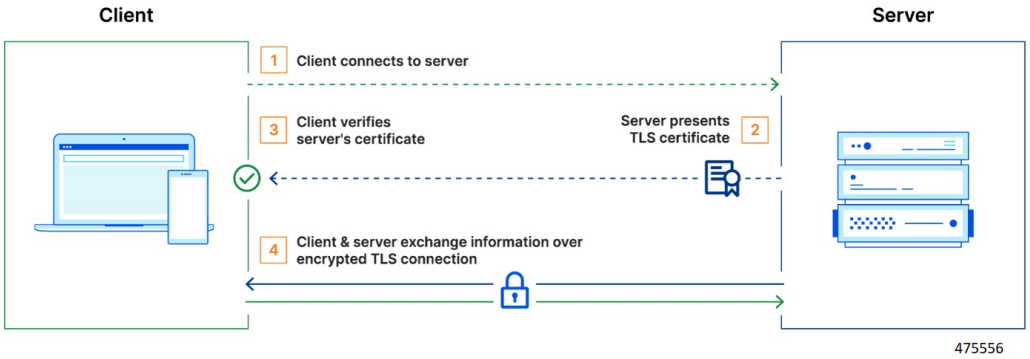
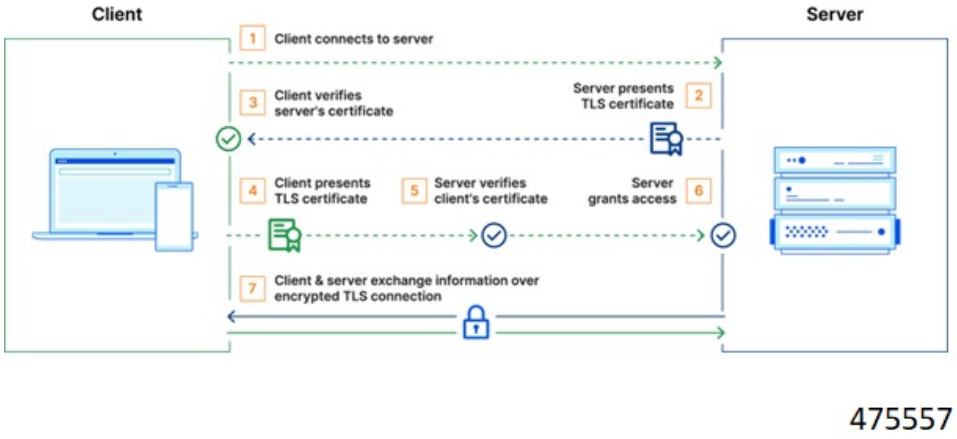


Figure 9: Security Handshake for MTLS Connection



The sequence for the data transmission is as follows:

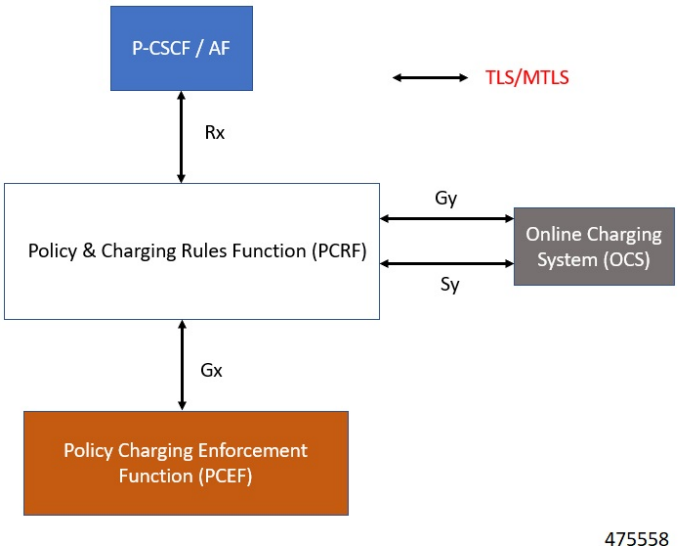
- Establishes TCP Connection
- Establishes TLS or MTLS connection over TCP.
- Exchanges CER/CEA message between the peers over TLS or MTLS.

- Exchanges application data over TLS or MTLS.

Feature Description

The vDRA supports a Transport Layer Security (TLS) and MTLS (Mutual Transport Layer Security) secure channels for diameter peer connection. The following architecture describes TLS and MTLS in DRA.

Figure 10: TLS/MTLS in DRA



Enabling TLS Protocol in the Policy Builder

Use the Policy Builder to enable the TLS protocol.

1. Log in to the Policy builder.
2. In the **DRA Inbound Endpoint**, from the **Transport Protocol** drop-down list, choose **TLS** to enable a connection as TLS from inbound. The supported version of TLS is 1.2 and it supports the Gx, Rx, Gy and Sy application.

   You can publish the configuration after providing necessary stack details.

Enabling MTLS in Policy Builder

The MTLS is configurable in the Policy Builder GUI.

1. Log in to the Policy builder.
2. In the **DRA Inbound Endpoint**, from the **Transport Protocol** drop-down list, choose **MTLS** to enable a connection as MTLS from inbound. The supported version of MTLS is 1.2 and it supports the Gx, Rx, Gy and Sy application.

An example configuration is shown below:

Figure 11: DRA Inbound Endpoints - Example Configuration

Importing Certificate through CLI

Prerequistes: Ensure that a cps.pem file is present in `/data/keystore` in the orchestrator container before executing the CLI.

Follow the steps to import certificates through CLI:

1. Copy the certificates files to the master VM under `/data/orchestrator/pemKey` to import the *tls* certificate.
2. Load the certificates to the Diameter application using the following CLI command

   `dra-tls cert import` *`certificate file private file`*

   a. Input certificate and private files for the CLI command.

   b. Enter the keystore password to encrypt the certificate file. Backend script converts files into JKS with encryption and copies to the diameter-endpoint containers.

Note

- Ensure to enter a Password with minimum of six characters, Alphanumeric, and special characters.
- Renegotiation of TLS Handshake for an established connection with the new certificate from the server side [Diameter] without any call failures are not supported.

Example 1:

dra-tls cert import certificate.pem private.pem

admin@orchestrator[pn-master-0]# ***dra-tls cert import tls-cert.pem private.pem***

*enter the Keystore Password for this private.pem cert:*********

Importing keystore /data/pemKey/certificate-tls.p12 to /data/pemKey/diameter-endpoint-tls.jks...

Example 2

admin@orchestrator[pn-master-0]# ***dra-tls cert import CA-cert.pem CA-key.pem***

*enter the Keystore Password for this private.pem cert:********

Importing keystore /data/pemKey/certificate-tls.p12 to /data/pemKey/diameter-endpoint-tls.jks...

Warning:

The JKS keystore uses a proprietary format. It is recommended to migrate to PKCS12 which is an industry standard format using "keytool -importkeystore -srckeystore /data/pemKey/diameter-endpoint-tls.jks -destkeystore /data/pemKey/diameter-endpoint-tls.jks -deststoretype pkcs12".

Import Successfully Completed for 192.1.XX.XX.

Importing Certificate to 192.1.XX.XX.

Import Successfully Completed for 192.1.XX.XX.

Importing Certificate to 192.1.XX.XX.

Import Successfully Completed for 192.1.XX.XX.

Importing Certificate to mongo-admin-a:27017 Database.

Certificate Imported Successfully.

Note

- The copy of the generated jks file will be maintained in Mongo Admin DB for high availability during VMDK upgrade.
- You can use the complex password that includes alpha numeric and special characters for generating JKS via CLI command [Supported Special Characters è ***! @ # $ % . , ^ & ' * "***].

Creating TLS Certificate Before Expiration and Raising Alerts

vDRA supports the following function:

- Installation of a new certificate on the Directors before expiration of a TLS certificate

Note After installation, the same certificate must be installed on the client.

- After replacing a new certificate, the client initiates reestablishment of connections within the maintenance window to avoid call failures.
- Monitoring the certificate validity will be every one hour, from the time of application restart.
- Alert notification prior to the certificate expiration date based on the following alert notification metrics.

Table 11: Alert Notification

Expiration in Days	Alert Level
60 days	Minor
40 days	Major

Expiration in Days	Alert Level
14 days	Critical

For more information, see the *Application Notifications* table and *Alert Rules* section in the *CPS vDRA SNMP and Alarms Guide*.

Inservice Certificate Management

Ensure to follow the procedure to install a new TLS certificate on the Director before the TLS certificate expiration:

- Place the new certificate in the following path `/data/orchestrator/pemKey/`.
- After placing a new updated certificate on the Master VM, use the same CLI command to replace the existing certificate.

  The existing connection from the older certificate remains connected and there should not be any call failure.
- To get the new certificate in place, terminate the existing connection and the new connection must be negotiated by the client.

Relay Endpoints

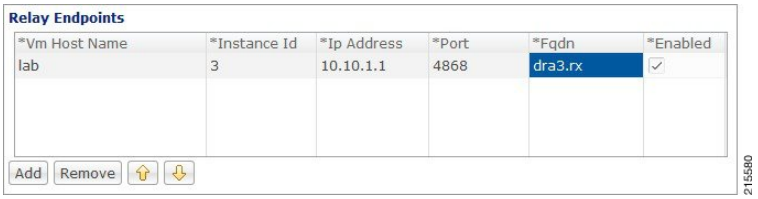
The following parameters can be configured under **Relay Endpoints**:

Table 12: DRA Configuration - Relay Endpoints Parameters

Parameter	Description
Vm Host Name	Host Name of the VM that hosts this Relay endpoint.
Instance Id	Instance Identifier is the ID of the current Instance.
Ip Address	Address on which this DRA endpoint should bind to. **Note** The relay endpoints must be configured on physical IPs and not on virtual IPs.
Port	Port is the listening port for this instance.
Fqdn	Fully Qualified Domain Name of the DRA end point.
Enabled	Check to enable endpoint.

An example configuration is shown below:

Figure 12: Relay Endpoints - Example Configuration



Policy Routing for Real IPs with Relay Endpoints

vDRA relay links consist of a control plane and a data plane.

The control plane uses virtual IPs and the data plane uses real IPs.

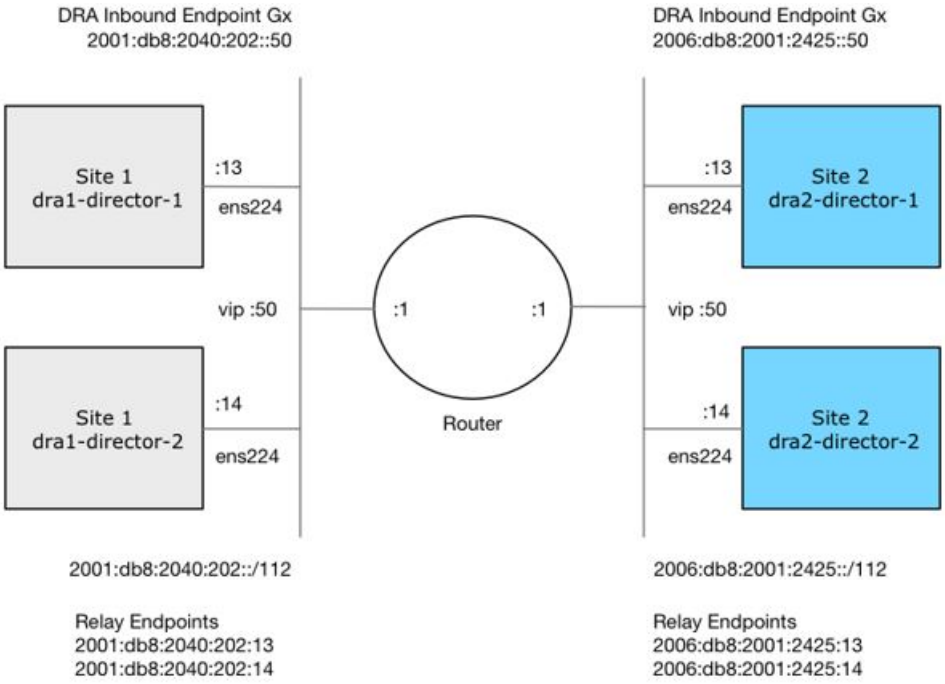
If the control and data plane use the same links, and those links are configured with VIPs, by default, the data plane uses the VIP as its source address for outgoing connections. The data plane uses the VIP as the source address only if the VIP is active on the data plane's outgoing interface.

To avoid this situation, policy routing is used to force the data plane to use the real IP address of the outgoing interface instead of the VIP.

Example of a vDRA Relay Endpoints

In the following example network, only the DRA director VMs and their relay links are displayed. In a real scenario, many more links may exist on the DRA director VMs.

Figure 13: Example of Relay Endpoints



Policy Routing

Linux policy routing includes rules and routing tables. The rules identify traffic and point to a user-defined routing table. The routing table contains customized routes.

To prevent the Relay Link's data plane from using the VIP as a source address, a rule is created to identify the real IP in the destination address and identify the desired routing table.

Configure Policy Routing

The following configuration procedure is performed on Site 1 dra1-director-1. Repeat the procedure for all other dra-directors and modify the IP addresses accordingly.

Perform the following steps on each dra-director VM to configure policy routing:

1. Create a custom routing table
2. Create an IP rule for each remote relay endpoint's real IP address
3. Add a route to the custom routing table that specifies the real IP source address

Set up Custom Routing Table

Set up the custom routing table as shown in the following example:

```
echo "200 dra.relay" | sudo tee --append /etc/iproute2/rt_tables
```

Define IP Rules

The following rules match the packets destined to the real IPs of interface ens224 on dra2-director1 and dra2-director2:

```
ip -6 rule add to 2006:db8:2001:2425::13 table dra.relay
ip -6 rule add to 2006:db8:2001:2425::14 table dra.relay
```

Define the Route

The following example of the route uses the router's interface as the next hop and specifies ens224's real IP address as the source address for outgoing packets.

```
ip route add 2006:db8:2001:2425::/112 via
2001:db8:2040:202::1 src 2001:db8:2040:202::13 table dra.relay
```

Validate the Routing

Use the following example commands to validate the route selection for remote relay real IP and VIP addresses.

```
ip -6 route show table dra.relay
ip -6 route get 2006:db8:2001:2425::13
ip -6 route get 2006:db8:2001:2425::14
ip -6 route get 2006:db8:2001:2425::50
```

Persistent Configuration

In order for the Policy Routing configuration to survive a reboot, add the configuration commands to `/etc/network/interfaces` under interface ens224 as shown below:

```
auto ens224
iface ens224 inet static
address 192.169.22.13
netmask 255.255.255.0
iface ens224 inet6 static
```

```
address 2001:db8:2040:202::13
netmask 112
up ip route add 2006:db8:2001:2425::/112 via 2001:db8:2040:202::1
up ip -6 rule add to 2006:db8:2001:2425::13 table dra.relay
up ip -6 rule add to 2006:db8:2001:2425::14 table dra.relay
up ip route add 2006:db8:2001:2425::/112 via 2001:db8:2040:202::1 src 2001:
db8:2040:202::13 table dra.relay
down ip route del 2006:db8:2001:2425::/112 via 2001:db8:2040:202::1
down ip -6 rule del to 2006:db8:2001:2425::13 table dra.relay
down ip -6 rule del to 2006:db8:2001:2425::14 table dra.relay
down ip route del 2006:db8:2001:2425::/112 via 2001:db8:2040:202::1 src
2001:db8:2040:202::13 table dra.relay
```

Configure Policy Routing with Deployer/Installer

Configure the VM artifacts and the cloud config to set up policy routing using the deployer.

VM Artifacts

Add Policy Route configuration to the DRA director VM's interfaces.esxi file as shown in the following example:

```
cps@installer:/data/deployer/envs/dra-vnf/vms/dra-director
/dra-director-1$ cat interfaces.esxi
auto lo
iface lo inet loopback

auto ens160
iface ens160 inet static
address 10.81.70.191
netmask 255.255.255.0
gateway 10.81.70.1

auto ens192
iface ens192 inet static
address 192.169.21.13
netmask 255.255.255.0

auto ens224
iface ens224 inet static
address 192.169.22.13
netmask 255.255.255.0
iface ens224 inet6 static
address 2001:db8:2040:202::13
netmask 112
up ip route add 2006:db8:2001:2425::/112 via 2001:db8:2040:202::1
up ip -6 rule add to 2006:db8:2001:2425::13 table dra.relay
up ip -6 rule add to 2006:db8:2001:2425::14 table dra.relay
up ip route add 2006:db8:2001:2425::/112 via 2001:db8:2040:202::1 src
2001:db8:2040:202::13 table dra.relay
down ip route del 2006:db8:2001:2425::/112 via 2001:db8:2040:202::1
down ip -6 rule del to 2006:db8:2001:2425::13 table dra.relay
down ip -6 rule del to 2006:db8:2001:2425::14 table dra.relay
down ip route del 2006:db8:2001:2425::/112 via 2001:db8:2040:202::1 src
2001:db8:2040:202::13 table dra.relay

auto ens256
iface ens256 inet static
address 192.169.23.13
netmask 255.255.255.0
cps@installer:/data/deployer/envs/dra-vnf/vms/dra-director/dra-director-1$
```

Cloud Config

Create the dra.relay routing table on the dra-directors by adding the following bootcmd: to user_data.yml and storing the file at `/data/deployer/envs/dra-vnf/vms/dra-director/user_data.yml`. The sed command prevents adding a routing table every time the VM boots.

```
bootcmd:
 - "sed -i -e '/^200 *dra.relay/d' /etc/iproute2/rt_tables"
 - "sh -c \"echo '200     dra.relay' >> /etc/iproute2/rt_tables\""
```

Example of user_data.yml:

```
#cloud-config
debug: True
output: {all: '| tee -a /var/log/cloud-init-output.log'}

users:
  - name: cps
    sudo: ['ALL=(ALL) NOPASSWD:ALL']
    groups: docker
    ssh-authorized-keys:
      - ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABAQDzjJjndIvUiBta4VSIbd2gJmlMWcQ8wtejgAbi
XtoFZdtMdo9G0ZDEOtxHNNDPwWujMiYAkZhZWX/zON9raavU8lgD9+YcRopWUtujIC71YjtoxIjWIBBbrtqt
PlUXMUXQsi91RQbUtslENP+tSatS3awoQupyBMMSutyBady/7Wq0UTwFsnYs5Jfs8jIQuMfVQ9uJ4mNn7wJ0
N+Iaf27rE0t3oiY5DRN6j07WhauM6lCnZ1JDlzqmTnTHQkgJ3uKmQa5x73tJ1OW89Whf+R+dfslVn/yUwK/
vf4extHTn32Dtsxkjz7kQeEDgCe/y7owimaEFcCIfEWEaj/50jegN cps@root-public-key

resize_rootfs: true

write_files:
  - path: /root/swarm.json
    content: |
     {
        "role": "{{ ROLE }}",
        "identifier": "{{ IDENTIFIER }}",
        "master": "{{ MASTER_IP }}",
        "network": "{{ INTERNAL_NETWORK }}",
        {% if WEAVE_PASSWORD is defined %}"weavePw": "{{ WEAVE_PASSWORD }}",
        {% endif %}
        "zing": "{{ RUN_ZING | default(1) }}",
        "cluster_id": "{{ CLUSTER_ID }}",
        "system_id": "{{ SYSTEM_ID }}"
     }
    owner: root:root
    permissions: '0644'
  - path: /home/cps/.bash_aliases
    encoding: text/plain
    content: |
      # A convenient shortcut to get to the Orchestrator CLI
      alias cli="ssh -p 2024 admin@localhost"
      alias pem="wget --quiet http://171.70.34.121/microservices/latest/cps.pem ;
      chmod 400
cps.pem ; echo 'Retrieved \"cps.pem\" key file'"
    owner: cps:cps
    permissions: '0644'
  - path: /etc/pam.d/common-password
    content: |
     #
     # /etc/pam.d/common-password - password-related modules common to all services
     #
     # This file is included from other service-specific PAM config files,
     # and should contain a list of modules that define the services to be
     # used to change user passwords.  The default is pam_unix.

     # Explanation of pam_unix options:
```

```
    #
    # The "sha512" option enables salted SHA512 passwords.  Without this option,
    # the default is Unix crypt.  Prior releases used the option "md5".
    #
    # The "obscure" option replaces the old `OBSCURE_CHECKS_ENAB' option in
    # login.defs.
    #
    # See the pam_unix manpage for other options.

    # As of pam 1.0.1-6, this file is managed by pam-auth-update by default.
    # To take advantage of this, it is recommended that you configure any
    # local modules either before or after the default block, and use
    # pam-auth-update to manage selection of other modules.  See
    # pam-auth-update(8) for details.

    # here are the per-package modules (the "Primary" block)
    password   requisite                       pam_pwquality.so retry=3 minlen=8
    minclass=2
    password   [success=2 default=ignore]      pam_unix.so obscure use_authtok
    try_first_pass sha512 remember=5
    password   sufficient                      pam_sss.so use_authtok
    # here's the fallback if no module succeeds
    password   requisite                       pam_deny.so
    # prime the stack with a positive return value if there isn't one already;
    # this avoids us returning an error just because nothing sets a success code
    # since the modules above will each just jump around
    password   required                        pam_permit.so
    # and here are more per-package modules (the "Additional" block)
    # end of pam-auth-update config
   owner: root:root
   permissions: '0644'
runcmd:
 - [vmware-toolbox-cmd, timesync, enable ]
bootcmd:
 - "sed -i -e '/^200 *dra.relay/d' /etc/iproute2/rt_tables"
 - "sh -c \"echo '200     dra.relay' >> /etc/iproute2/rt_tables\""
```

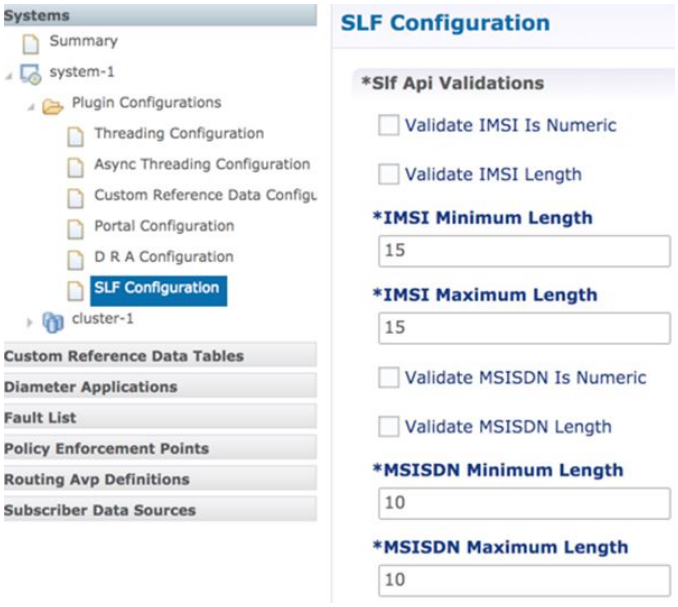
SLF Configuration

You can specify whether the IMSI and MSISDN values are validated in SLF API.

By default, SLF validation is disabled.

To set up SLF validation, create SLF Configuration from the Plugin Configuration in Policy Builder.

Figure 14: SLF Configuration



The following table describes the SLF API validations that you can configure:

Table 13: SLF Configuration

Field	Description
Validate IMSI is Numeric	If checked: IMSI received in the SLF API request must be numeric If unchecked: IMSI numeric validation is not performed on the IMSI received in the SLF API request
Validate IMSI Length	If checked: IMSI length is validated based on the specified IMSI Minimum Length (inclusive) and IMSI Maximum Length (inclusive) If unchecked: IMSI length validation is not performed on the IMSI received in the SLF API request
Validate MSISDN is Numeric	If checked: MSISDN received in the SLF API request must be numeric If unchecked: MSISDN numeric validation is not performed on the MSISDN received in the SLF API request

Field	Description
Validate MSISDN Length	If checked: MSISDN length is validated based on the specified MSISDN Minimum Length (inclusive) and MSISDN Maximum Length (inclusive) If unchecked: MSISDN length validation is not performed on the MSISDN received in the SLF API request

Ingress and Egress API Rate limit Configuration

Feature Description

The vDRA uses PCRF session query to query SRK from PCRF to route the request and then recreates the binding entry. There is no rate limit for a PCRF session query triggered from vDRA. Similarly, Ingress APIs (Binding/Session/SLF/CRD/SVN/Topology/Grafana/Promethus) does not have an overload protection mechanism.

In the CPS 22.1.0 and later releases, vDRA supports a configurable option to rate-limit the incoming traffic and outgoing traffic on the API interface at director level. This rate limiting process protects the system when acting as a client or server. Also, to prevent any back pressure and working on stale messages, vDRA supports configurable queue size and length message SLAs.

Egress API Rate Limiting

vDRA supports PCRF Session Query API rate limits at director level because applying rate limit at worker level can cause uneven distribution of rate limit across Workers.

For example, possibilities of same workers receiving all Rx AAR messages that need PCRF session query, and vDRA can apply rate limit only for that worker. This causes Rx AAR to for that worker even though remaining workers are under rate limit. To avoid this issue, vDRA supports rate limit configurations at the director level.

Note By default, rate limit is not configured for egress API.

The functions of egress rate limiting are:

- The Director triggers PCRF session query based on the configured rate limit. For example, ff configured rate limit is 50, then director allows only first 50 Rx AAR requests per second to trigger PCRF session query and remaining requests are dropped. vDRA sends Rx AAA for dropped PCRF Session query with error message as “PCRF Session Query Throttled”. vDRA maintains internal error code as “027”.
- If PCRF session query gets triggered due to “No Binding Found” error and PCRF session query got rate limited, then vDRA returns an error message:

```
“4006:027 – PCRF Session Query Throttled”
```

- If PCRF session query gets triggered due to “Binding DB Error” error and PCRF session query got rate limited, then vDRA returns error message:

```
"4007:027 – PCRF Session Query Throttled"
```

Ingress API Rate limiting

Following are the categories of Ingress APIs for which you can set rate limits:

- Binding API
- SLF API
- Topology API (Peer/Relay connections)
- OAM API(CRD/PB/CustRefData/Grafana/Promethues/SVN)

The functions of ingress Rate Limiting are:

- Ingress API is rate limited in HAProxy service.
- In vDRA, haproxy-common running in **master/control-0/control-1/directors** is used for load balancing of Policy Builder, Grafana, UI, CC, a so on. The haproxy-common receives request from client and forwards the request to vDRA backend servers.
- Ingress requests reaching haproxy-common is tracked in stick-table with server destination IP as key.
- In frontend, stick-table entries get compared with configured rate limit for respective ingress API. If the stick-table entries are greater than configured rate limit, then HAProxy sends HTTP deny status to the client. Otherwise, vDRA processes the request and send success status to client.
- vDRA returns error code 429 as deny status to the client for all the failed requests due to rate limit.
- Set the rate limit. For example:
  - If you want to set rate limit as 100 and the clients are configured to send requests only to haproxy-common running in master, then set rate limit as 100.
  - If the clients are configured to send requests to haproxy-common running master/control-0, then rate limit should be set as 50. So that two HAProxy running in master/control-0 provides 100 TPS.
  - In DRA, to make sure that DRA reaches the configured rate limit, additional 25 per cent is added to configured rate limit. This is mainly to get approximate rate limit in DRA. For example, If a rate limit is set as 500, then DRA internally adds extra 25 per cent to the configured rate limit 500 and the rate limit is set at 625. Thus, DRA allows requests 500–625.

Sample HAProxy configuration to rate limit ingress API:

```
frontend https_all_servers
       description Unified API,CC,PB,Grafana,CRD-API,PB-API,Promethues
       bind :443

      #ACL for Unified Binding IMSI-APN API
      acl binding_api_imsi_apn path_beg  /dra/api/bindings/imsiApn
/dra/api/deleteBinding/imsiApn
      http-request deny deny_status 429 if binding_api_imsi_apn {
dst,table_http_req_rate(binding_api_imsi_apn_servers) gt 625 }
      use_backend binding_api_imsi_apn_servers if binding_api_imsi_apn

       backend binding_api_imsi_apn_servers
       mode http
       balance source
```

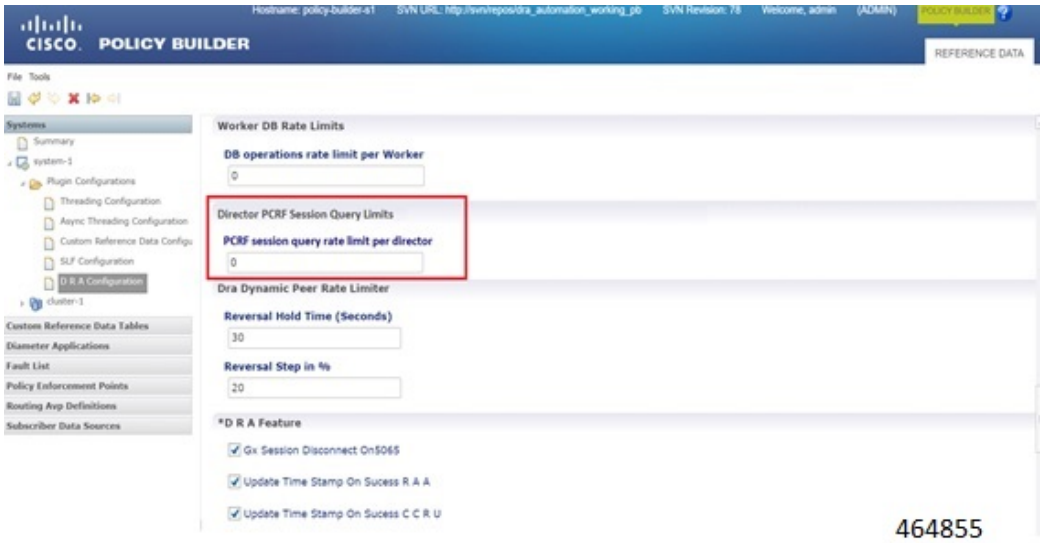
```
        option httpclose
        option abortonclose
        stick-table type ip size 1m expire 1s store http_req_rate(1s)
        http-request track-sc1 dst table binding_api_imsi_apn_servers
        server haproxy-api-s101 haproxy-api-s101:80 check inter 10s resolvers dns
resolve-prefer ipv4

        acl authoriseReadonlyUsers http_auth_group(cps_user_list) qns-ro
        acl authoriseAdminUsers http_auth_group(cps_user_list) qns
       http-request auth realm CiscoApiAuth if !authoriseReadonlyUsers !authoriseAdminUsers

        http-request deny if !METH_GET authoriseReadonlyUsers
```

Configuring Egress API Rate Limit in the Policy Builder

You can configure egress API rate limit for PCRF Session Query per director in the DRA Configuration.

- In the **Policy Builder**, click **DRA Configuration** from the left pane to add the configuration in the system.

Figure 15: Director PCRF Session Query Limits



- Configure the following parameters under DRA Configuration:

Table 14: DRA Configuration Parameters

Parameter	Description
DB operations rate limit per Worker	Specifies that the rate limit is per worker for DB operations. **Default**: By default, the rate limit is in disabled state.
PCRF session query rate limit per director	Specifies that the rate limit is for PCRF session query at Director level. Make sure to select the Director PCRF Session Query Limits" in the Policy Builder to view "PCRF session query limits per director" field. **Default**: By default the rate limit is in disabled state.

Parameter	Description
Reversal Hold Time (Seconds)	Specifies the reversal hold time in seconds.
Reversal Step in %	Specifies the reverstal step in percentage.
Gx Session Disconnect on5065	By default, **Gx Session Disconnect On5065** flag is enabled (recommended setting). When the PCRF responds with a Experimental Result Code of 5065 in AAAnswer on Rx Interface, DRA deletes its internal binding and session created for the transaction.A RAR with appropriate Session-Release-Cause AVP will also be sent to the PCEF. **Important** When using this flag, there is always a database query to fetch Gx session id. This results in linear increase in database transactions with AAR traffic on Rx interface.
Update Time Stamp On Success R A A	When this check box is selected, session timestamp will be updated on receipt of success RAA (Result-Code: 2001) from PCEF. [3] Default is checked (recommended setting). **Important** When using this flag, there is always a database query to fetch Gx session id. This results in linear increase in database transactions with AAR traffic on Rx interface.
Update Time Stamp On Success C C R U	When this check box is selected, session timestamp will be updated on receipt of success CCR-U (Result-Code: 2001) from PCEF. [4] Default is unchecked (recommended setting). **Important** When using this flag, there is always a database query to fetch Gx session id. This results in linear increase in database transactions with AAR traffic on Rx interface.

[3] The time stamp is updated on generation of Stale RAR. Also, if a success RAR/RAA(2001) comes after generation of Stale RAR, then the Stale RAR counter is reset.
[4] The time stamp is updated on generation of Stale RAR. Also, if a success CCR(U)/CAA(2001) comes after generation of Stale RAR, then the Stale RAR counter is reset.

Configuring Ingress API Rate Limit

You can configure Ingress API rate limits to set the environment variables and use them for checking ingress or egress API rate limit in the *haproxy.cfg.tmpl* file. The CLI updates are applied only in haproxy-common containers because haproxy-common is used for load balancing of Policy Builder, Grafana, UI, API, CC, and so on.

After CLI updates the rate limit in haproxy config file in haproxy-common containers, haproxy is restarted automatically to apply new rate limits.

Note Since these CLIs internally applies the rate limit and restart haproxy, you need not manually restart haproxy-common in Master/Control/diameter containers after configuring new rate limits.

You can set common rate limit for all binding API using the CLI **dra set-ratelimit binding-api** *rate limit value*. vDRA provides options to override common rate limits for imsi, imsi-apn, msisdn, msisdn-apn, and ipv6 binding api by specifying binding type in CLI as follows:

dra set-ratelimit binding-api-imsi | binding-api-imsi-apn | binding-api-msisdn
| binding-api-msisdn-apn | binding-api-ipv6]*value*

By default, DRA does not apply any rate limit for ingress APIs.

Use the following CLI commnads to select different ingress API types to set, remove or show rate limits.

- dra set-ratelimit binding-api <rate limit value>
- dra set-ratelimit binding-api-imsi <rate limit value>
- dra set-ratelimit binding-api-imsi-apn <rate limit value>
- dra set-ratelimit binding-api-msisdn <rate limit value>
- dra set-ratelimit binding-api-msisdn-apn <rate limit value>
- dra set-ratelimit binding-api-ipv6 <rate limit value>
- dra set-ratelimit session-api <rate limit value>
- dra set-ratelimit slf-api <rate limit value>
- dra set-ratelimit topology-api <rate limit value>
- dra set-ratelimit oam-api <rate limit value>
- dra remove-ratelimit binding-api
- dra remove-ratelimit binding-api-imsi
- dra remove-ratelimit binding-api-imsi-apn
- dra remove-ratelimit binding-api-msisdn
- dra remove-ratelimit binding-api-msisdn-apn
- dra remove-ratelimit binding-api-ipv6
- dra remove-ratelimit session-api
- dra remove-ratelimit slf-api
- dra remove-ratelimit topology-api
- dra remove-ratelimit oam-api
- dra show-ratelimit
- dra show-ratelimit binding-api

- dra show-ratelimit binding-api-imsi
- dra show-ratelimit binding-api-imsi-apn
- dra show-ratelimit binding-api-msisdn
- dra show-ratelimit binding-api-msisdn-apn
- dra show-ratelimit binding-api-ipv6
- dra show-ratelimit slf-api
- dra show-ratelimit session-api
- dra show-ratelimit topology-api
- dra show-ratelimit oam-api

For more information, see the *CLI Commands* section in the *CPS vDRA Operations Guide*.

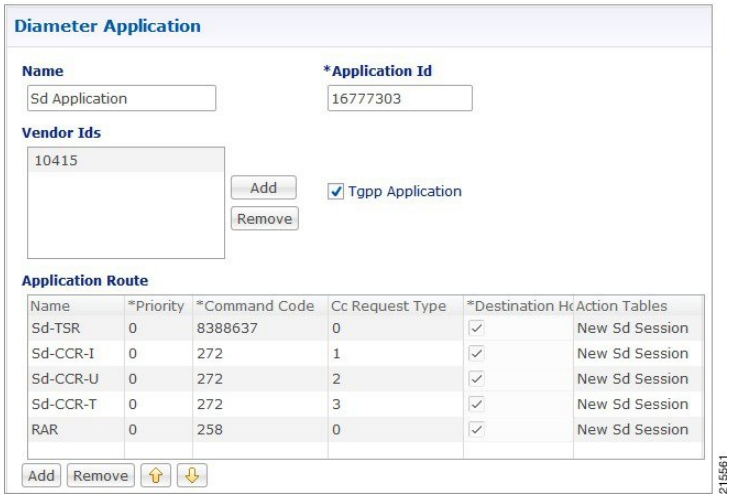
Diameter Application

Sd Application

For Sd, an Application Routing table is used to map specific diameter command codes and CC-Request-Types to a table, typically, an Sd New Session table for routing Sd TSRs to a peer route. The Sd New Session CD table will choose a peer route based on the Destination-Realm. The peer route will then point to a Peer-Group which contains multiple peer connections to a TDF and the DRA will load balance among the TDF peer connections in the Peer Group.

An example configuration is shown below:

Figure 16: Diameter Application - Sd Application Example



The following parameters are configured under Sd Application:

Table 15: Sd Application Parameters

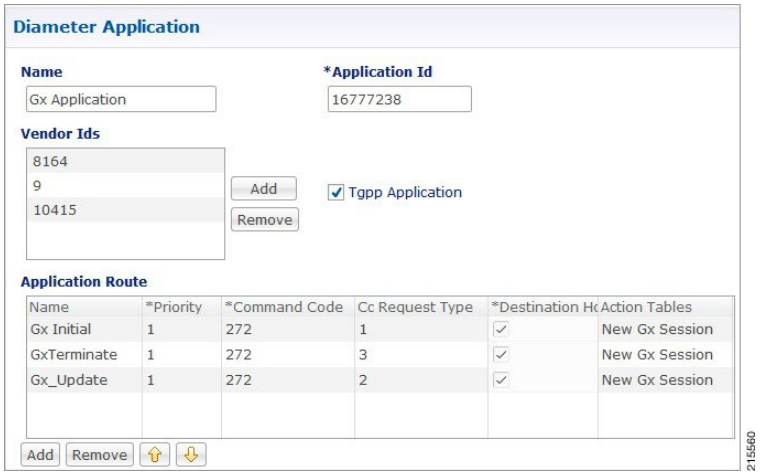
Parameter	Description
Name	Name of the Sd application.
Application Id	16777303, 3GPP specified Application Identifier for Sd interface.
Vendor Ids	Vendor Identifiers that are required to be supported on Sd interface.
Tgpp Application check box	If this check box is selected, indicates this is a 3GPP defined application interface.
Application Route table	
Name	Identifier of the route.
Priority	Indicates the priority of the route.
Command Code	Indicates value of command code AVP within the message.
Cc Request Type	Indicates if the Credit Control Request type is Initial(1)/Update(2) or Terminate(3).
Destination Host Null	If this check box is selected, indicates if Destination Host will be null in messages received for this application.
Action Tables	Identifies the request routing table for this interface and message.

Gx Application

For Gx, an Application Routing table is used to map specific diameter command codes and CC-Request-Types to a table. When “Destination Host Null” is checked, it means Destination-Host AVP is null. It will then check for table driven routing.

An example configuration is shown below:

Figure 17: Diameter Application - Gx Application Example



C-DRA attempts to do Dest-Host routing before doing table driven routing. If the Dest-Host AVP is absent, empty, or equal to the CDRA FQDN, then we skip Dest-Host routing altogether and proceed to Table-Driven routing.

The following parameters are configured under Gx Application:

Table 16: Gx Application Parameters

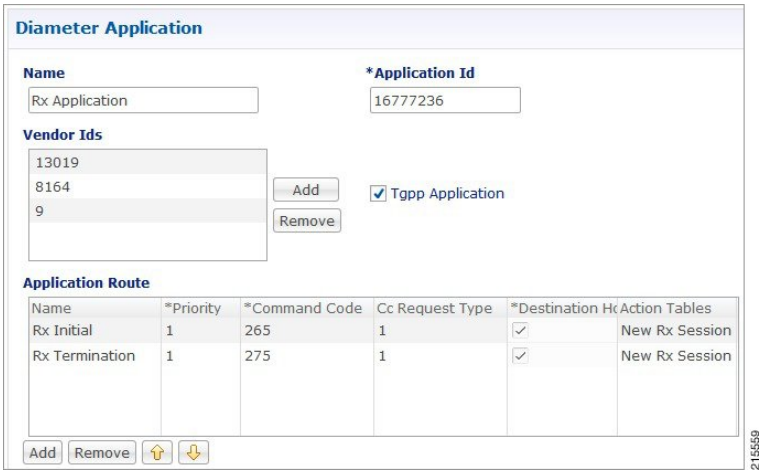
Parameter	Description
Name	Name of the Gx application.
Application Id	16777238, 3GPP specified Application Identifier for Gx interface.
Vendor Ids	Vendor Identifiers that are required to be supported on Gx interface.
Tgpp Application check box	If this check box is selected, indicates this is a 3GPP defined application interface.
Application Route table	
Name	Identifier of the route.
Priority	Indicates the priority of the route.
Command Code	Indicates value of command code AVP within the message.
Cc Request Type	Indicates if the Credit Control Request type is Initial(1)/Update(2) or Terminate(3).
Destination Host Null	If this check box is selected, indicates the message will contain a Destination-Host.

Parameter	Description
Action Tables	Identifies the request routing table for this interface and message.

Rx Application

Identifies the request routing table for this interface and message.

Figure 18: Diameter Application - Rx Application Example



The following parameters are configured under Rx Application:

Table 17: Rx Application Parameters

Parameter	Description
Name	Name of the Rx application.
Application Id	16777236, 3GPP specified Application Identifier for Rx interface.
Vendor Ids	Vendor Identifiers that are required to be supported on Rx interface.
Tgpp Application check box	If this check box is selected, indicates this is a 3GPP defined application interface.
Application Route table	
Name	Identifier of the route.
Priority	Indicates the priority of the route.
Command Code	Indicates value of command code AVP within the message.
Cc Request Type	Not supported for Rx interface.

Parameter	Description
Destination Host Null	If this check box is selected, indicates if Destination Host will be null in messages received for this application.
Action Tables	Identifies the request routing table for this interface and message.

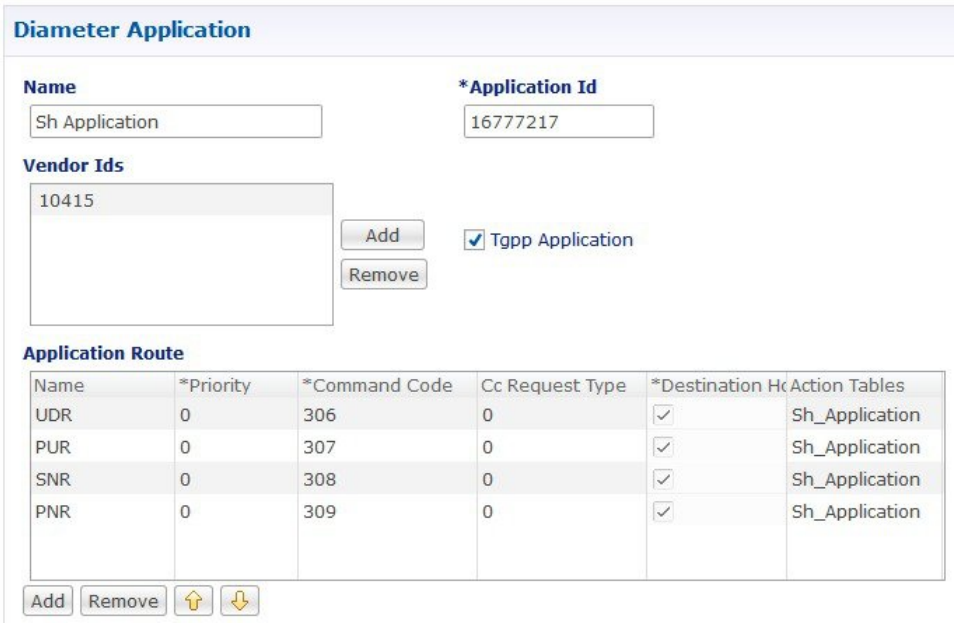
Sh Application

Sh interface is used for communication between AS and HSS for Call data query/Push subscriber profile and subscriber notification procedures.

Note In certain scenarios, the customer might use the Sh interface between PCRF and HSS also.

An example configuration is shown below:

Figure 19: Diameter Application - Sh Application Example



The following parameters are configured under Sh Application:

Table 18: Sh Application Parameters

Parameter	Description
Name	Name of the Sh application.

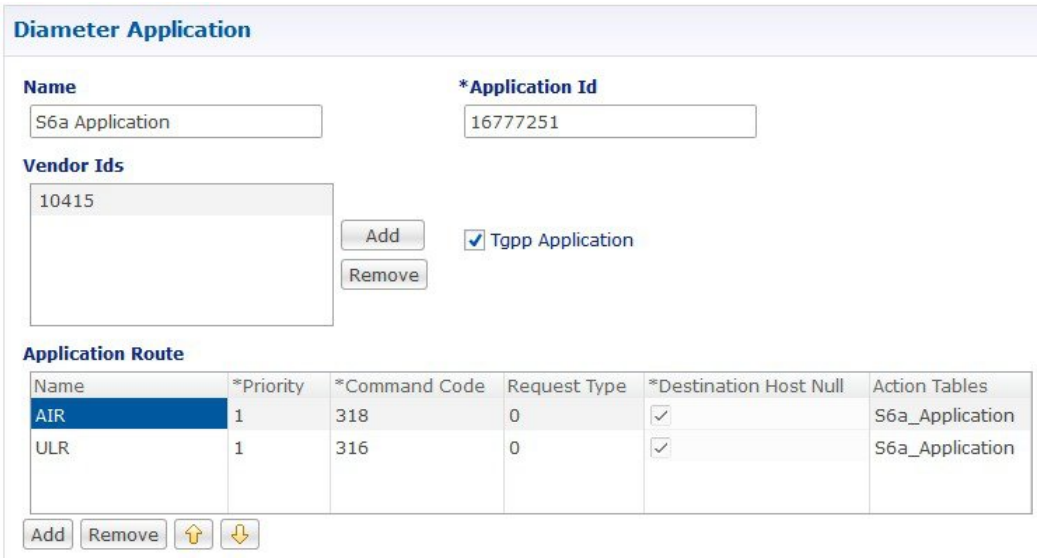
Parameter	Description
Application Id	16777217, 3GPP specified Application Identifier for Sh interface.
Vendor Ids	Vendor Identifiers that are required to be supported on Sh interface.
Tgpp Application check box	If this check box is selected, indicates this is a 3GPP defined application interface.
Application Route table	
Name	Identifier of the route.
Priority	Indicates the priority of the route.
Command Code	Indicates value of command code AVP within the message.
Cc Request Type	CC-Request-Type is not applicable for Sh interface.
Destination Host Null	If this check box is selected, indicates the message will contain a Destination-Host.
Action Tables	Identifies the request routing table for this interface and message.

S6a Application

DRA supports S6a interface with the implementation of Subscriber Location Function(SLF) feature. S6a is an interface which supports the mobility management and subscriber data management procedures between MME and HSS in an LTE EPC network.

An example configuration is shown below:

Figure 20: Diameter Application - S6a Application Example



The following parameters are configured under S6a Application:

Table 19: S6a Application Parameters

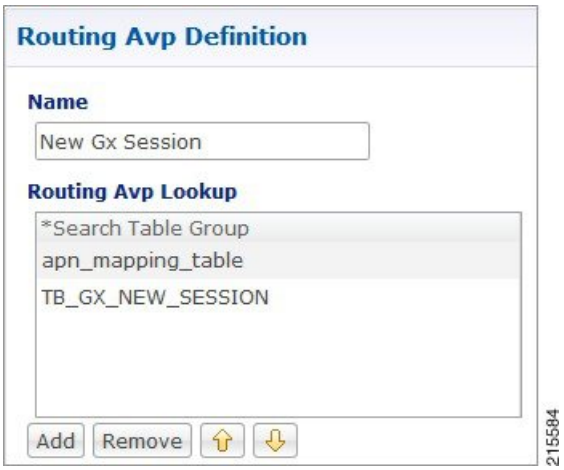
Parameter	Description
Name	Name of the S6a application.
Application Id	16777251, 3GPP specified Application Identifier for S6a interface.
Vendor Ids	Vendor Identifiers that are required to be supported on S6a interface.
Tgpp Application check box	If this check box is selected, indicates this is a 3GPP defined application interface.
Application Route table	
Name	Identifier of the route.
Priority	Indicates the priority of the route.
Command Code	Indicates value of command code AVP within the message.
Cc Request Type	CC-Request-Type is not applicable for S6a interface.
Destination Host Null	If this check box is selected, indicates the message will contain a Destination-Host.
Action Tables	Identifies the request routing table for this interface and message.

Routing AVP Definition

Gx Session

An example configuration is shown below:

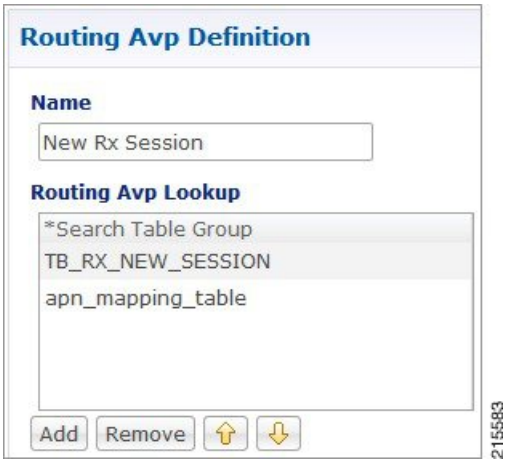
Figure 21: Routing AVP Definition - Gx Session



Rx Session

An example configuration is shown below:

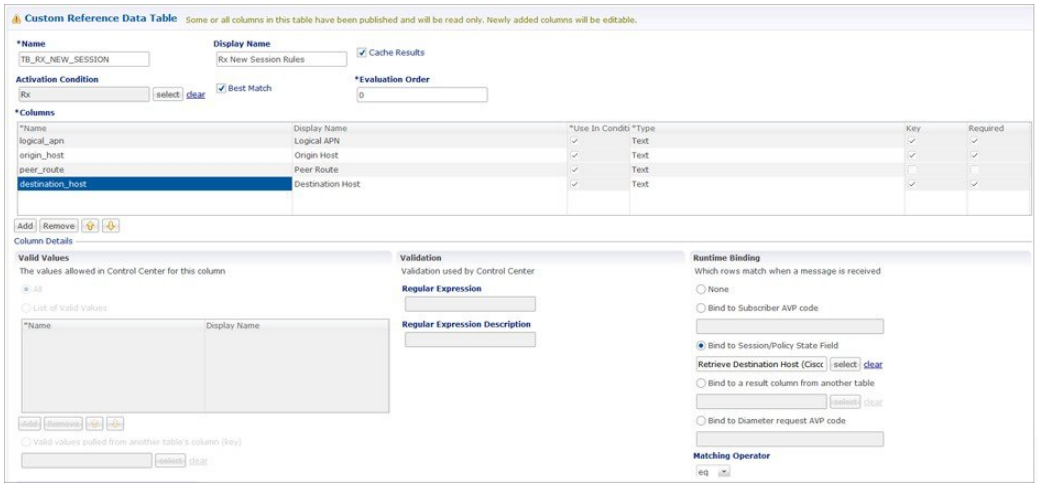
Figure 22: Routing AVP Definition - Rx Session



Rx New Session Rules - CRD Table

An example configuration is shown below:

Figure 23: Rx New Session Rules - CRD Table

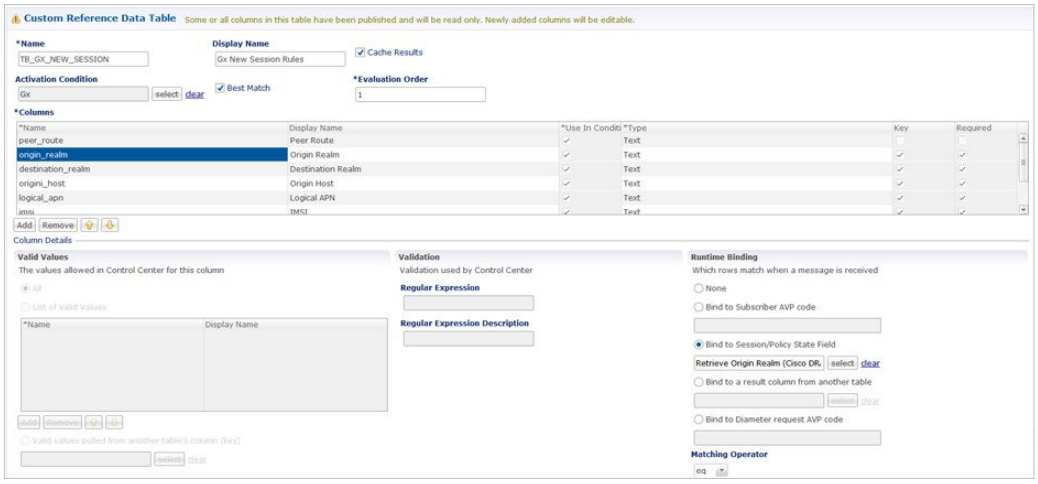


Gx New Session Rules - CRD Table

For Gx, an Application Routing table is used to map specific diameter command codes and CC-Request-Types to a table, typically, for routing Gx CCR-Is. The Gx CCR-I should be routed based on a logical APN and the Origin-Host attribute. Regular expression matching of logical APNs and Origin-Hosts can also be configured. The implementation should be flexible to allow CRDs to be configured for routing of other attributes such as Destination-Realm and Origin-Realm.

An example configuration is shown below:

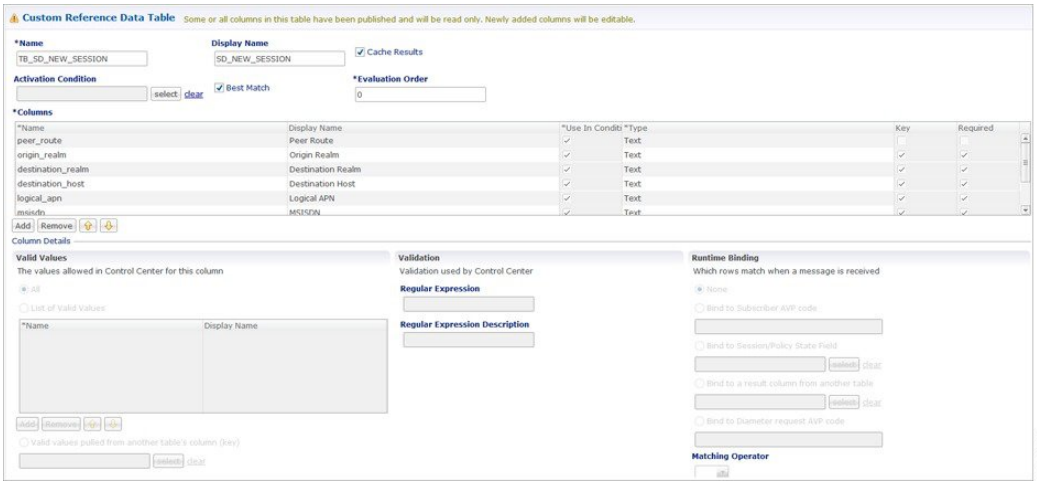
Figure 24: Gx New Session Rules - CRD Table



Sd New Session Rules - CRD Table

An example configuration is shown below:

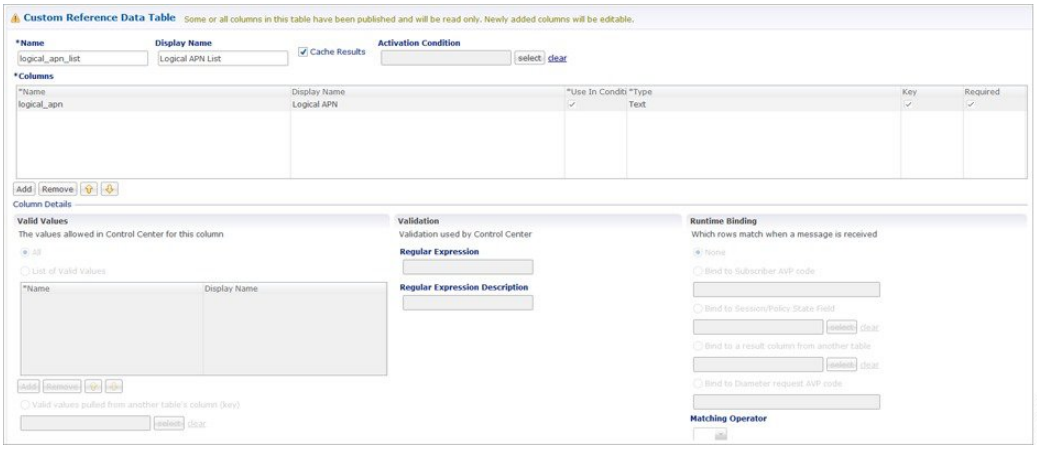
Figure 25: Sd New Session Rules - CRD Table



Logical APN List - CRD Table

An example configuration is shown below:

Figure 26: Logical APN List - CRD Table



Dynamic AVP Retriever for Routing

DRA supports routing messages based on the following AVPs from request message:

- Destination-Host
- Destination-Realm
- Origin-Host
- Origin-Realm
- APN (from Called-Station-ID)

- IMSI (from Subscription-ID)
- MSISDN (from Subscription-ID)

Regular-expression matching and combinations of AVPs is supported. This requirement is not applicable across all messages on different interfaces. The following table shows applicability of the AVP's at a message and interface level.

Table 20: Regular-expression Matching and Combinations of AVPs

Interface	Message	Origin Host	Origin Realm	Destination Host	Destination Realm	APN (Called-Station-ID)	IMSI	MSISDN
Gx	CCR-I	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	CCR-U	No	No	No	No	No	No	No
	RAR	No	No	Yes	No	No	No	No
Sd	TSR	Yes	Yes	Yes	Yes	No	No	No
	CCR-I	Yes	Yes	Yes	Yes	No	No	No
	CCR-U/T	No	No	Yes	No	No	No	No
	RAR	No	No	Yes	No	No	No	No
Rx	RAR	No	No	Yes	No	No	No	No

Dynamic AVP Retrievers are used mostly used in Custom Reference Data where data has to be fetched from messages at runtime.

Configure Dynamic AVP Retriever

The following sample configuration shows how to retrieve the AVP and bind it to a Key Column in the CRD.

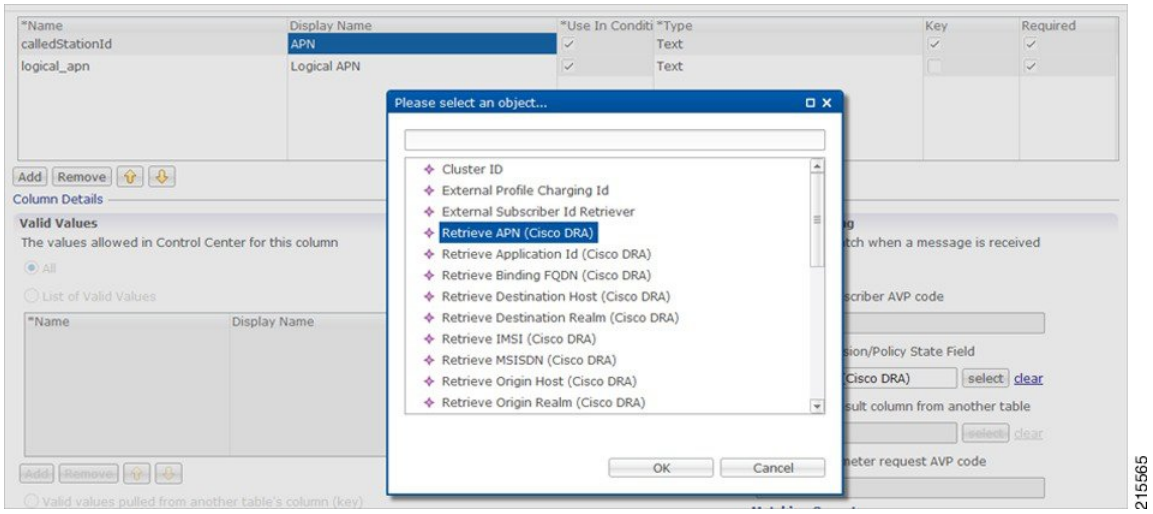
Procedure

Step 1 Select the column name from the **Columns** table and click **select** near **Bind to Session/Policy State Field** to open the **Please select an object...** dialog box.

Note
You can use **Bind to Session/Policy State Field** only for those columns in the **Columns** table where **Key** column has been selected.

Step 2 Select the required object from the dialog box and click **OK**.

Figure 27: Adding AVPs



Step 3 Repeat these steps to add additional AVPs.

Custom Reference Data Tables

Search Table Groups

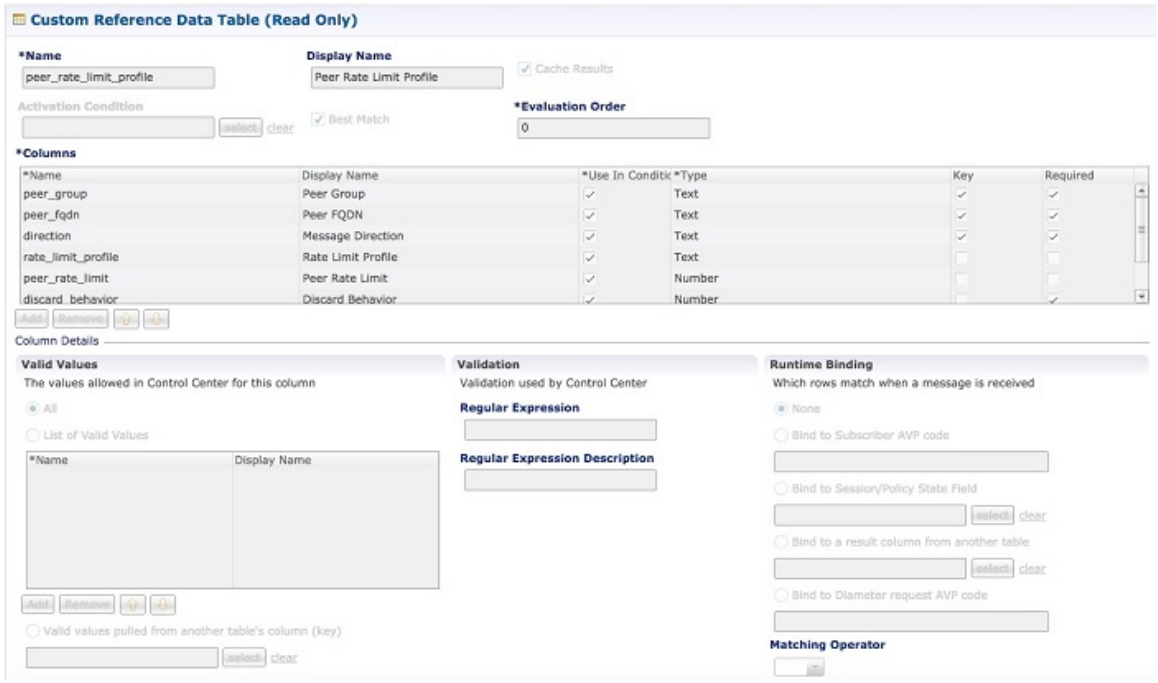
Peer Rate Limit Profile

This is a Search Table Group whose key columns are Peer Group, Peer FQDN or Origin Host in the message and Message Direction.

Using this search table group, the user can configure a maximum rate for each of the configured and defined diameter peers. It also allows the user to configure a maximum rate for each server process.

The peer rate limit is shown below:

Figure 28: Peer Rate Limit - STG



- Peer Group: This is the group of peers classified together using Peer Group and Peer Group Peer values initiating the message.
- Peer FQDN: The origin host of the peer. A specific diameter peer with its Fully Qualified Domain Name can be specified in this field or use wildcards specified by * in this field for any peer or matching peers like hss*.
- Direction: Message direction (Ingress and Egress).
  - Ingress: Any diameter messages received by CPS vDRA from diameter peer. The routing decision by CPS vDRA will be taken after the ingress side rate limiting has been applied.
  - Egress: Any diameter messages forwarded/routed by CPS vDRA to diameter peer. The egress side rate limiting will be applied after the routing decision has been taken by CPS vDRA.
- Peer Rate Limit: This field is to specify the threshold in TPS above which the diameter messages are discarded. This can be left empty if none of the messages are to be dropped or only message level rate limit is to be applied.
- Rate Limit Profile: Profile Name applicable for this Peer Group and Peer, if specified. This profile maps to Rate Limiting at message level. This field enables the rate limit at per message/command code level. See Message Rate Limit Profile for more details.
- Rate Limit Result Code: The result code sent by CPS vDRA for response message towards diameter peer when Discard Behavior is configured as Send Error Answer. In case Discard Behavior is configured as Drop Message, this field is ignored.
- Error String: The string specified in this field is populated by CPS vDRA in AVP Error Message for response message towards diameter peer when Discard Behavior is configured as Send Error Answer.

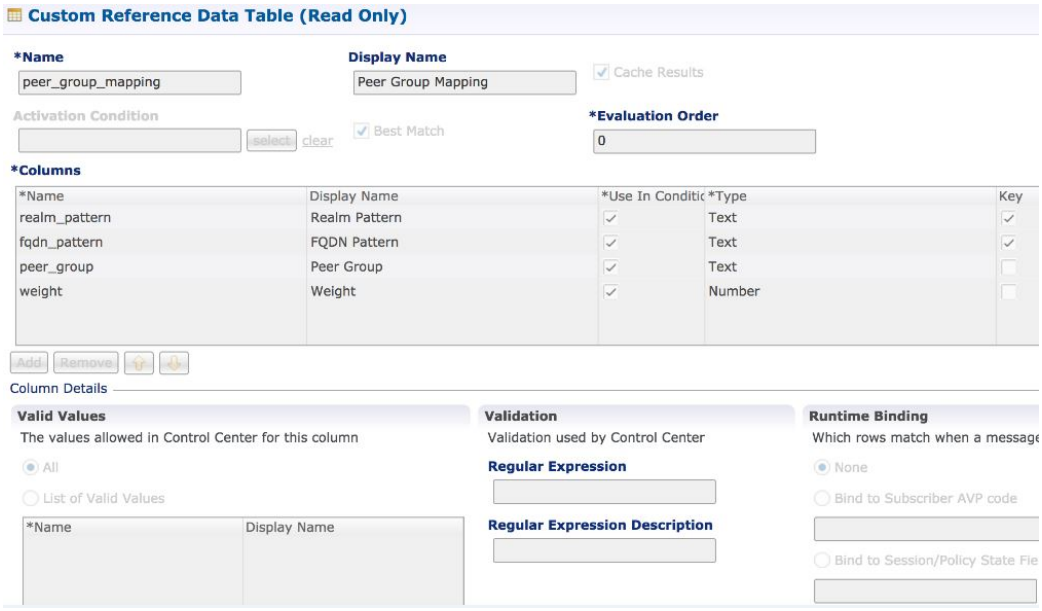
In case Discard Behavior is configured as Drop Message, this field is ignored. This is an optional field when Discard Behavior is configured as Send Error Answer.

Note If both Rate Limit Error Code and Rate Limit Error String are provided along with Rate Limit Action as "Drop Message", the Rate Limit Action takes precedence and the other two fields will be ignored.

For more information, see Peer Rate Limit Profile.

Peer Group Mapping

Figure 29: Peer Group Mapping - STG

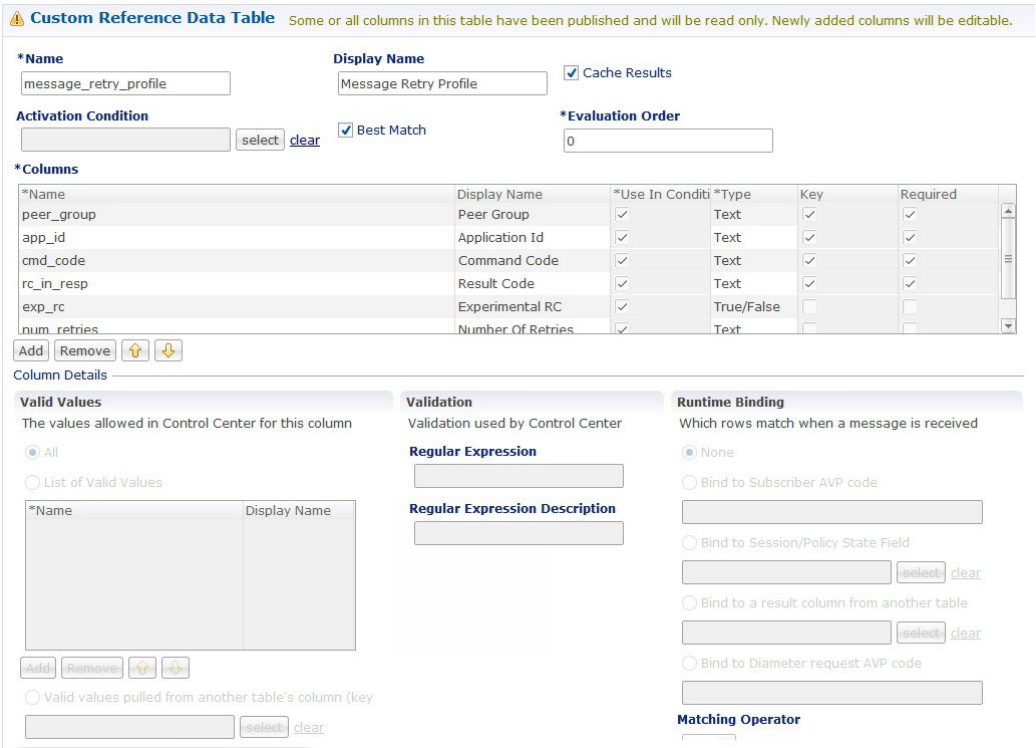


For more information, see Peer Group Mapping.

Message Retry Profile

Message retry profile has been added.

Figure 30: Message Retry Profile - STG



- Peer Group: Peer group for which the retry has to be happen.
- Application Id: Application Id of the diameter applications.
- Command Code: Command Code of the message.
- Result Code: Result code received from PCRF for timeout. The value is 7000.
- Experimental RC: Indicates whether result code is experimental or not. This is for future purpose and value in this has no effect on the message retry functionality.
- Number of Retries: Number of retries for the message.

For more information, see Message Retry Profile.

Message Mediation Profile

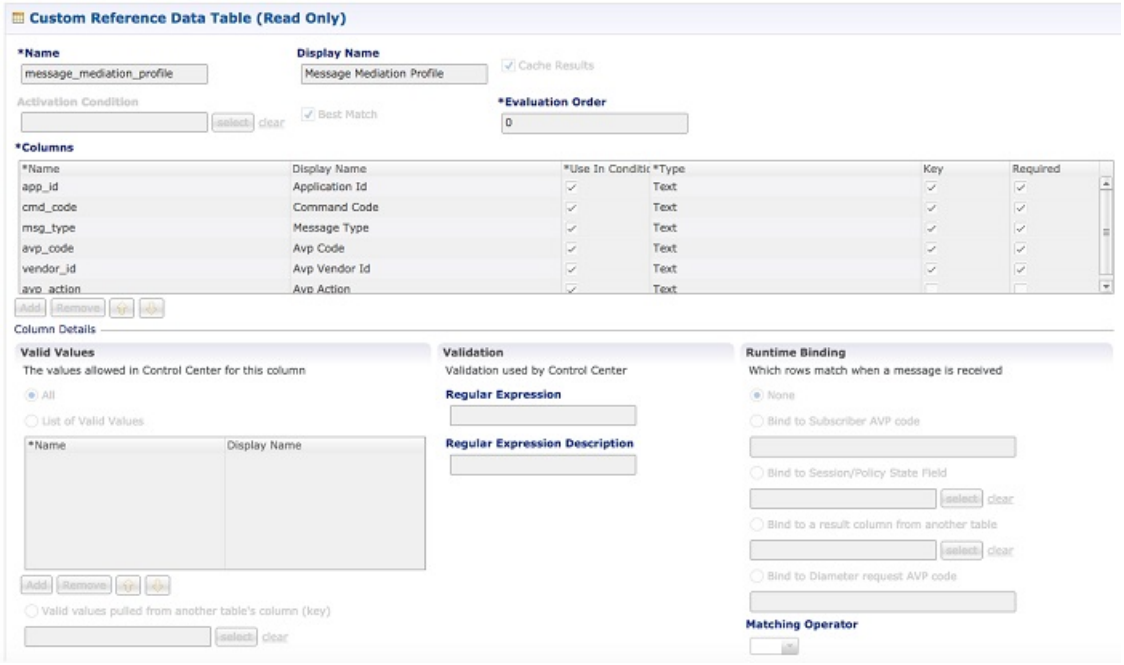
The message mediation profile is used to provide support for mediation of AVPs in Diameter request and answer.

- For Diameter requests, only remove is supported.
- For Diameter answers, the following actions are supported:
  - "remove" meaning remove all matching AVPs in the request.
  - "copy" meaning copy from the request if no AVPs are present in the answer.
    - If the AVP is present in answer, no action is performed.

- "overwrite" meaning first remove and then copy from the request.
  - Check if the AVP is present in answer, if so remove and add from request.
  - If AVP is not present in answer, copy from request.

A new **Message Mediation Profile** STG has been added:

Figure 31: Message Mediation Profile - STG



- Application Id: Application ID of the Diameter applications.
- Command Code: Command code of the message.
- Message Type : Request/Answer for which the rule has to be applied.
- Avp Code : AVP code of the Diameter message.
- Vendor Id : AVP vendor ID.
- Avp Action : Provides options for copy/remove/overwrite.

Note Application ID, Command Code, AVP Code and Vendor Id are used as key, so no duplicate rows could be defined for this combination and the same AVP action. For example, you cannot define both "remove" and "Copy from request" for the same set of Application ID, Command Code, AVP Code and Vendor Id.

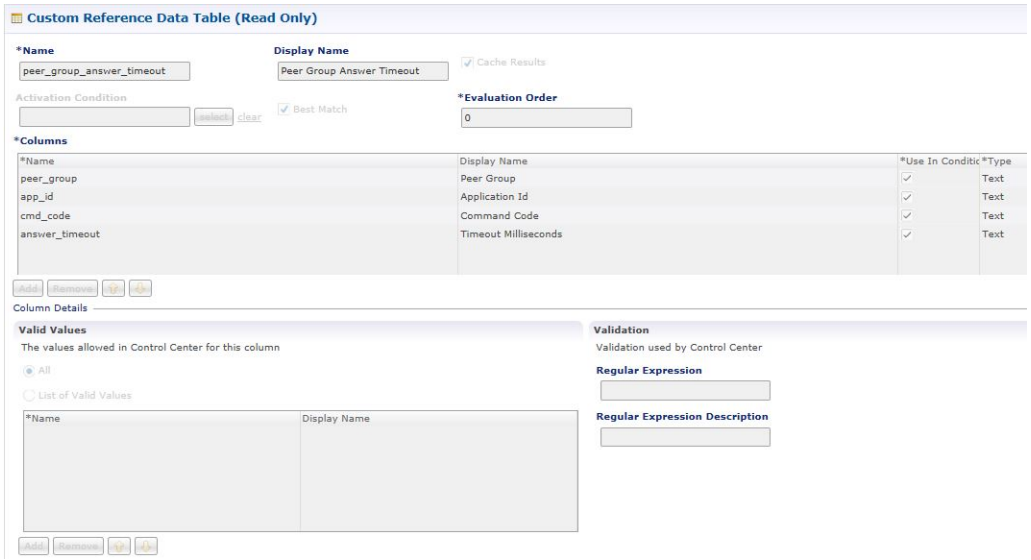
Best Match check box needs to be checked if you want to use the wildcard feature.

For more information, see Message Mediation Profile in Custom Reference Data Tables chapter.

Peer Group Answer Timeout

New search table Peer Group Answer Timeout has been added.

Figure 32: Peer Group Answer Timeout - STG



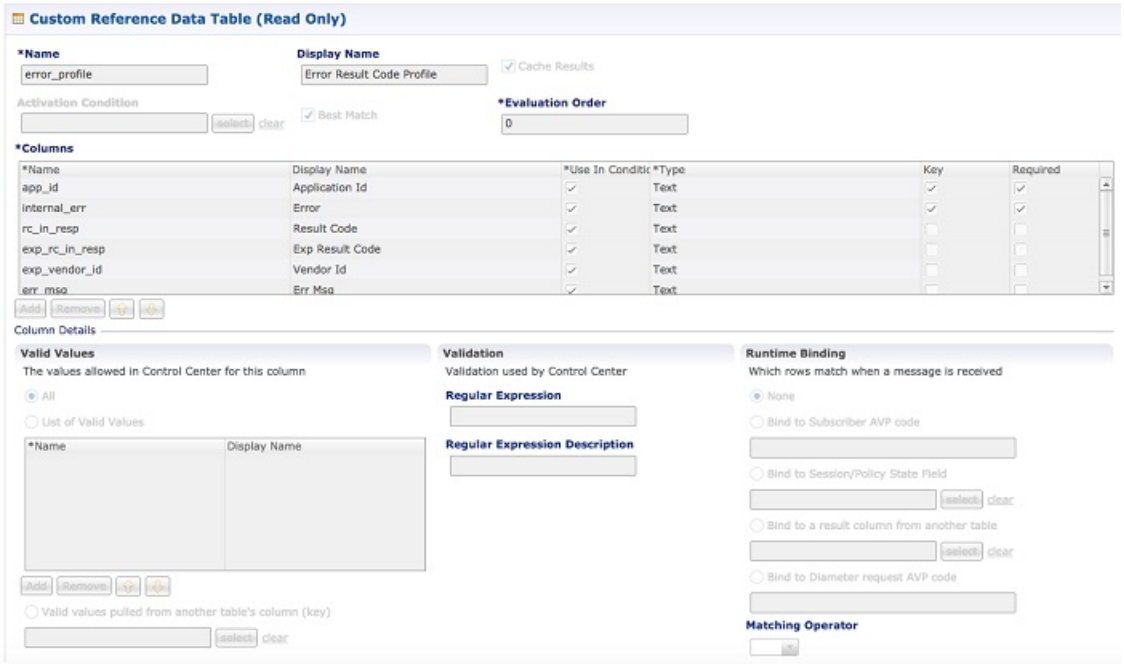
- Application Id: Application Id of the diameter applications.
- Peer Group: Peer group for which the timeout is applied.
- Command code (to enable different timeouts for different Diameter commands)
- Timeout: Timeout in milliseconds.

For more information, see Peer Group Answer Timeout.

Error Result Code Profile

Error result code profile can be used to map errors to Result-Code value and an error message string for the Error-Message AVP. It also provides support for configurable error result codes.

Figure 33: Error Result Code Profile - STG



Valid values is the place where all the valid error values can be configured in STG so that they are visible in CRD drop-down.

- ApplicationId: Application ID for which the mapping of Result-Code has to be done.
- Error: Internal error list.
- ResultCode: Result Code to be sent in answer.
- ExpResultCode: Experimental result code to be sent in answer. Vendor-Id will be sent in Answer only for Experimental result-Code.
- ErrMsg: Error message AVP sent in answer.

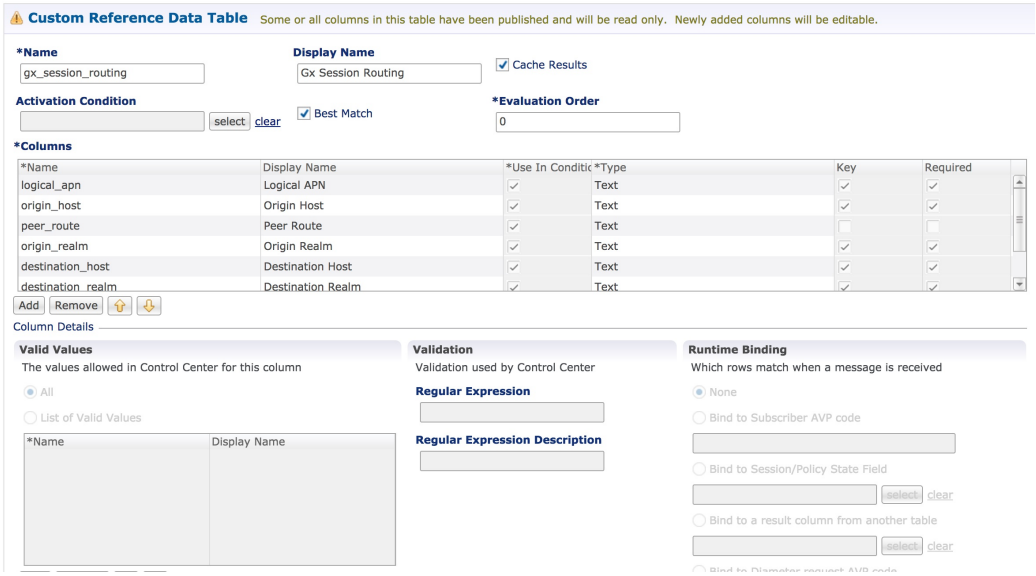
Note Experiment result code will be sent when Result-Code is not configured. If both Result-Code and experimental Result-Code are present, Result-Code would take precedence.

For more information, see Error Result Code Profile.

Gx Session Routing

Gx Session Routing table is required for "table driven routing". Here an example for Gx New Session Rules is provided. If table driven routing is required for Rx or Sd, user needs to create similar tables for Sd and Rx as well.

Figure 34: Gx Session Routing



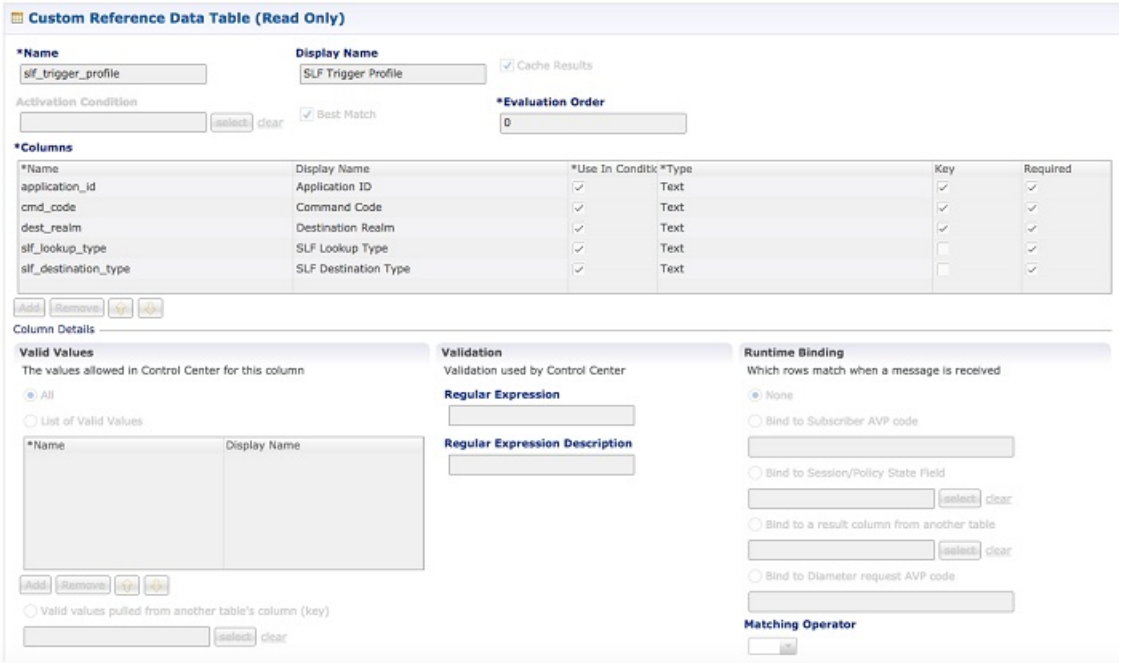
For more information, see Gx New Session Rules.

SLF Trigger Profile

This table is used to derive SLF destination type and SLF lookup type. Keys used for this table are: Application Id, cmd_code, and dest_realm. Output of this table are slf_lookup_type and slf_destination_type.

An example configuration is given.

Figure 35: SLF Trigger Profile - STG

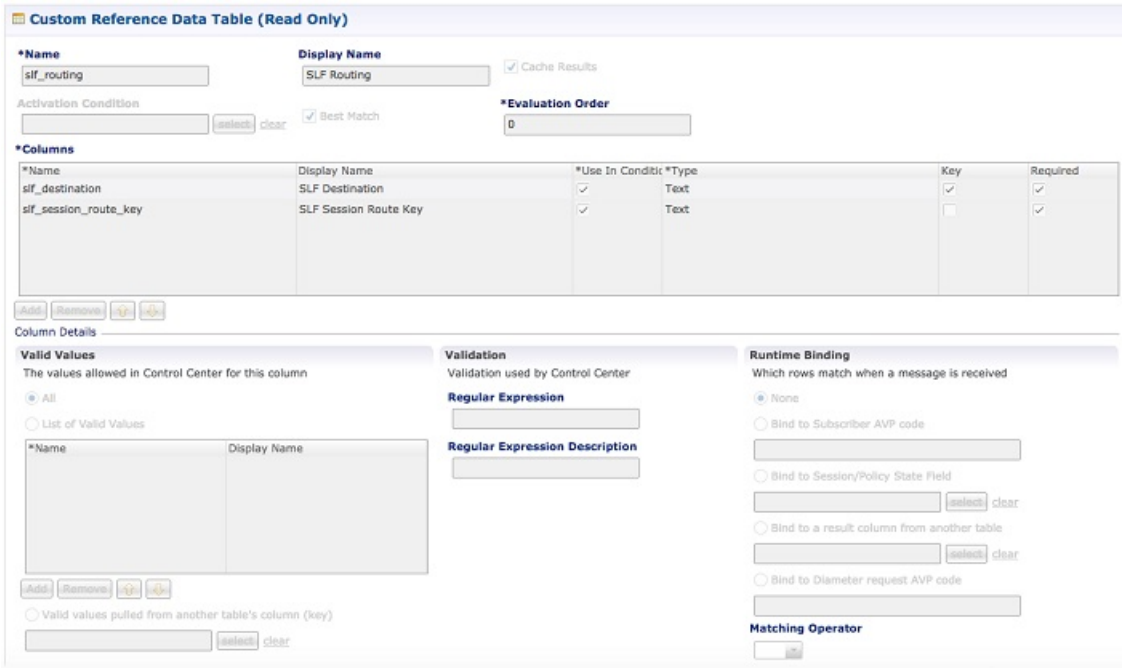


For more information, see SLF Trigger Profile.

SLF Routing

This table is used to derive SLF session route key from SLF Destination. An example configuration is given.

Figure 36: SLF Routing - STG



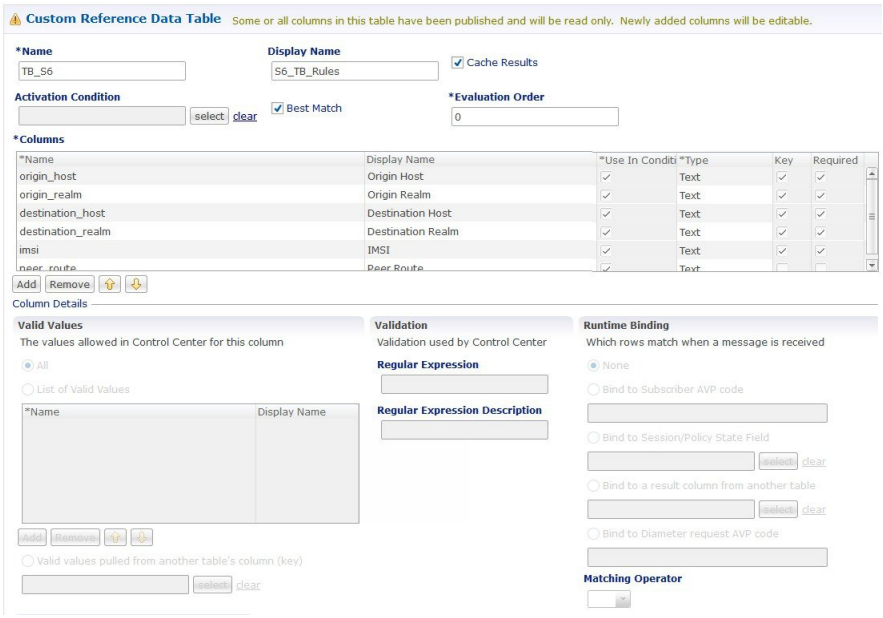
For more information, see SLF Routing.

S6/Sh Table Driven Rules

This table is used for the table driven routing of S6/Sh messages. Fields origin_host, origin_realm, dest_realm, dest_host, msisdn, imsi are used as keys to derive the peer_route.

An example configuration is given.

Figure 37: S6 Table Driven Rules - STG



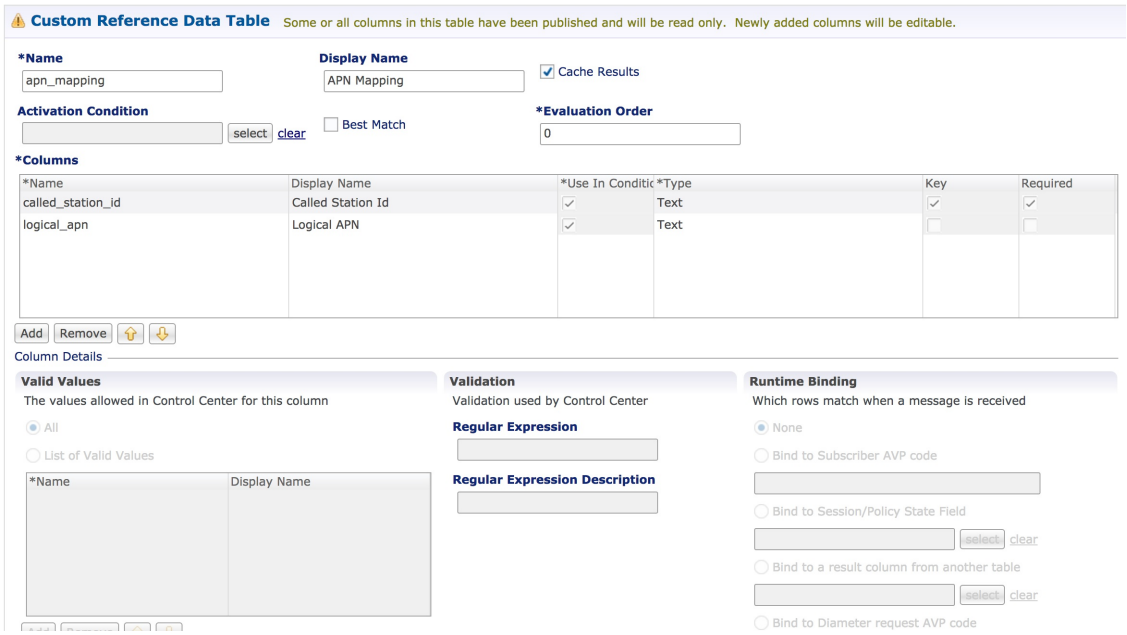
For more information, see S6/Sh Table Driven Rules.

Custom Reference Data Tables

APN Mapping

This table provides information related to APN Mapping. The read-only APN Mapping are shown below:

Figure 38: APN Mapping - CRD Table



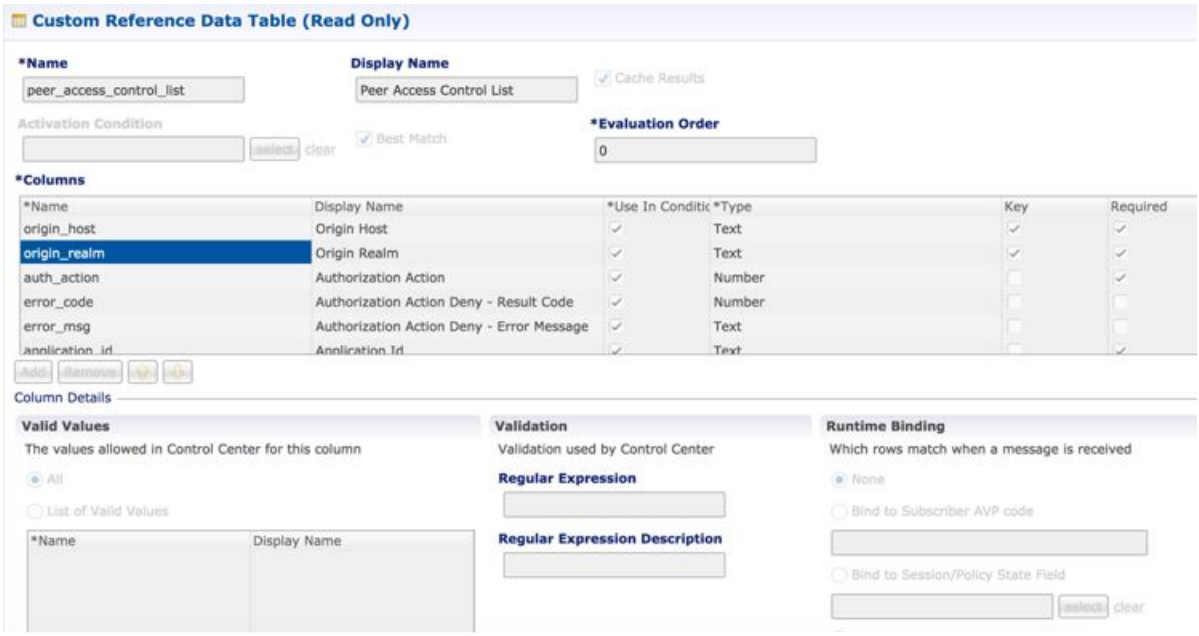
- Called-Station-Id: This is the AVP from which APN is derived. This also is the key column for this table. It is bound to the session or Policy State field as shown in the snapshot.
- Logical_APN: This is the mapped logical name that is used for referencing and processing the message within the system.

Note For sample data configuration, refer the *CPS Control Center Interface Guide for Full Privilege Administrators* for this release.

Peer Access Control List

You can use the Peer Access Control List to specify the list of peers (by realm, FQDN, and applications) that can establish peer connections to vDRA so that unknown peers are not permitted to create Diameter peer connections.

Figure 39: Peer Access Control List



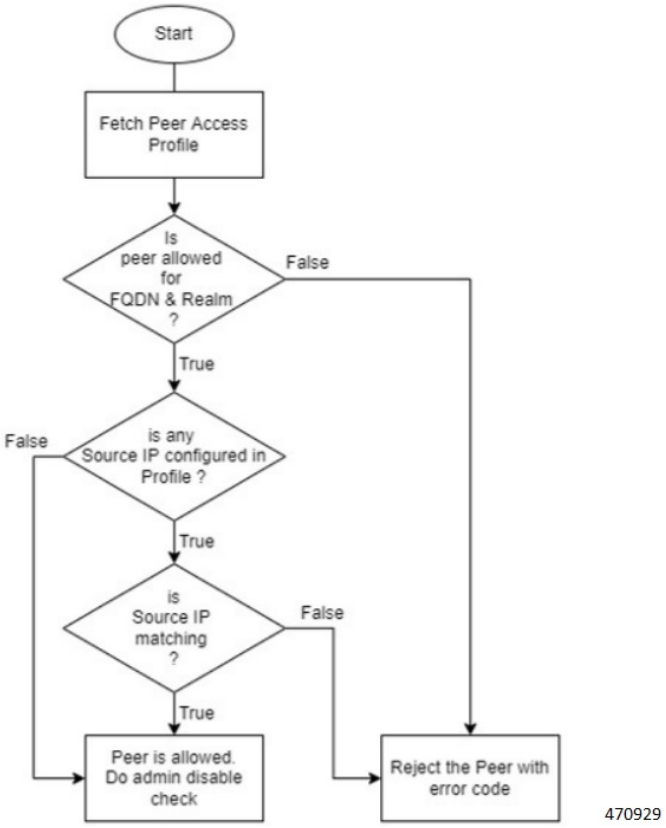
Source-IP Validation

In vDRA, you can allow or deny a peer based on the Source-IP validation. The Source-IP validation is an optional check, which an administrator can decide to configure Source-IP with peer FQDN/Realm or not. Source-IP uses Custom Reference Data (CRD) to persist the configuration. Hence the configuration is limited to a site. To block a peer from connecting to multiple sites, ensure to disable peer on each site.

Call Flow

The following section describes the call flow for Source-IP validation.

Figure 40: Source-IP Validation Call Flow For Connection Handling



The following procedure describes the Source-IP Validation for Connection Handling.

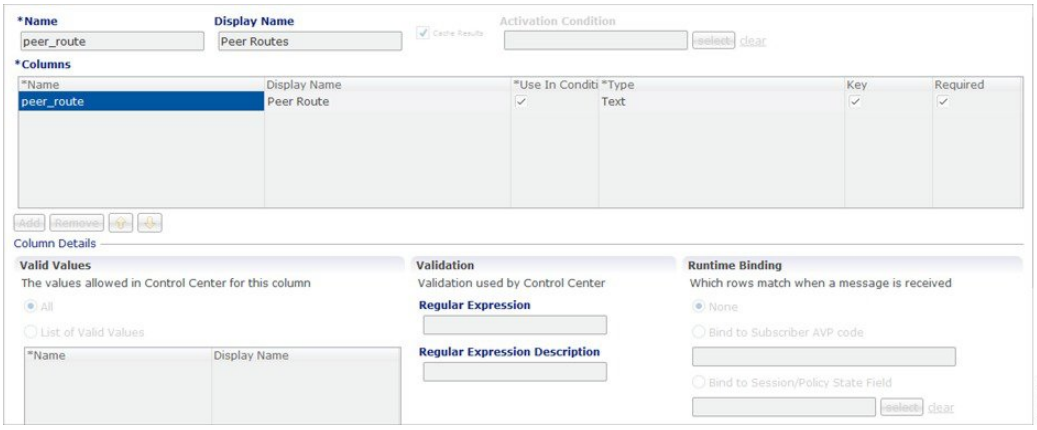
1. Diameter peer initiates a connection by sending a Capability Exchange Request (CER),
2. vDRA applies peer access control policy for the connection.
3. From the CER Request, vDRA fetches the Origin Host, Realm, and Source-IP that is Host-IP-Address AVP of CER.
4. vDRA fetches the Peer Access Profile detail from CRD and validates against the parameters collected from the request.
5. After the access control policy permits peer connection, vDRA responds with a Capability Exchange Answer (CEA), and a successful connection is established.

For more information about configuration, see the *Peer Control List* section in the *Custom Reference Data Configuration* chapter.

Peer Routes

This tables provides the information related to Peer Routes available in the system. The read-only peer routes are shown below:

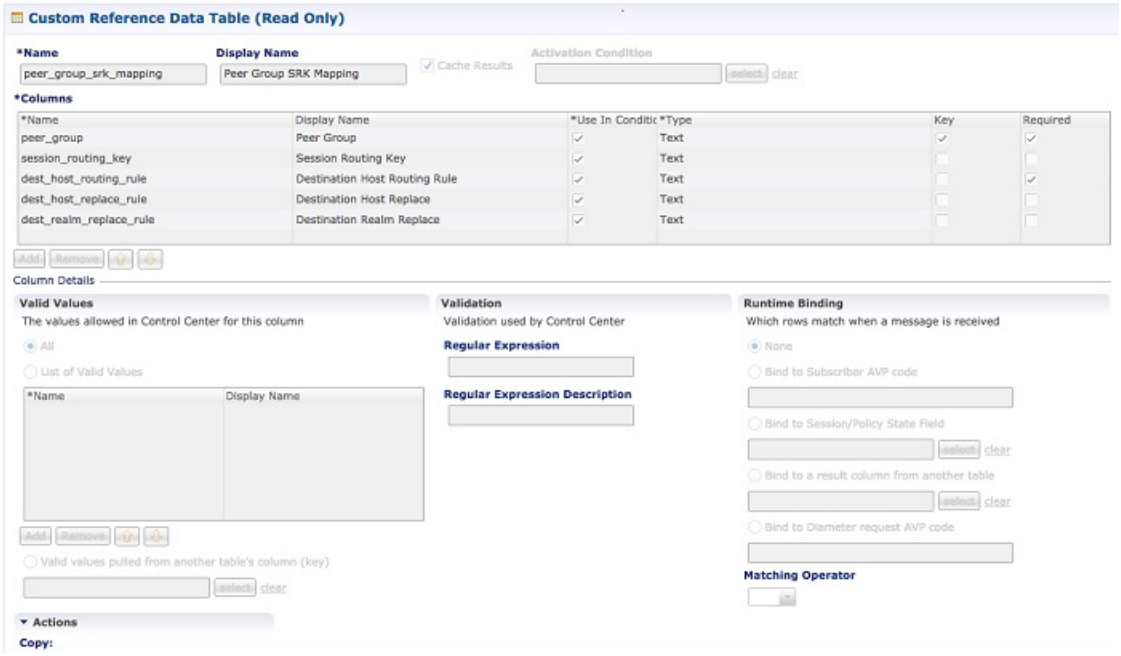
Figure 41: Peer Routes - CRD Table



Peer Group SRK Mapping

This table provides the information related to Peer Groups in the system. The read-only peer groups are shown below:

Figure 42: Peer Group - CRD Table

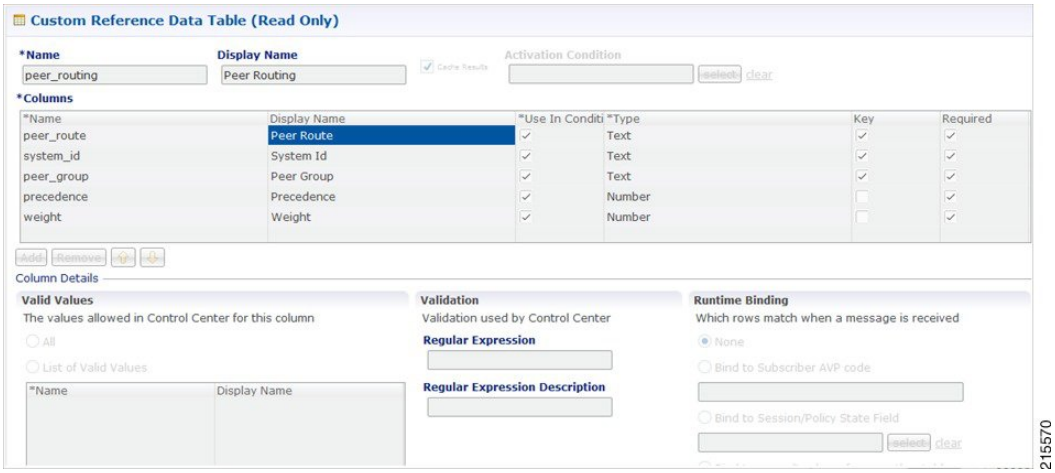


- Peer Group: Name of the peer group.
- Session Routing Key: Routing token for this Peer Group.
- Destination Host Routing Rule: Defines Routing behavior of this group.

Peer Routing

This table provides the information related to peer routing in the system. The read-only peer routings are shown below:

Figure 43: Peer Routing - CRD Table



- Peer Route: Identifier of this Peer Route.
- System ID: System Identifier for this VM.
- Peer Group: Identifier of the Peer group on this peer Route.
- Precedence: of the peer group on this Peer Route.
- Weight: Weight of the peer group on this Peer Route.

PCRF Session Query Peers

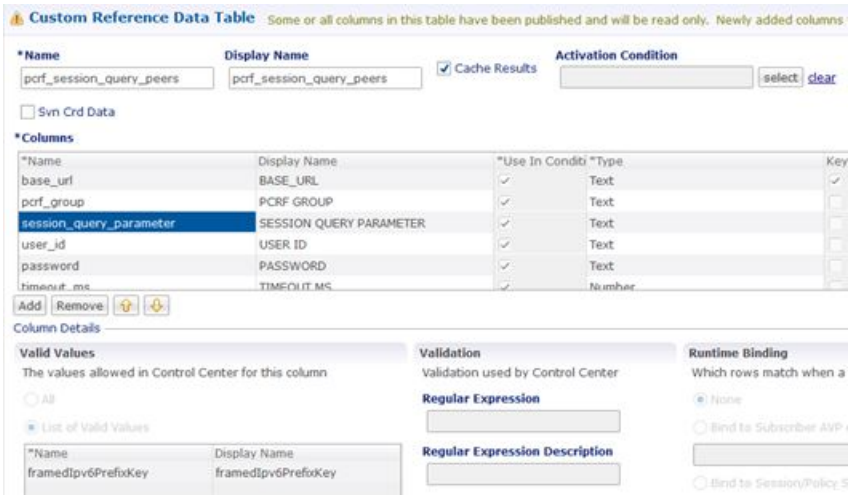
Use this CRD to configure the REST API parameters for Rx AAR fallback routing.

Policy DRA supports a fallback routing for Rx AARs for VoLTE using the PCRF session query.

For an Rx AAR with an IPv6 binding query, vDRA provides the ability to route the Rx AAR based on an API query to the PCRF to determine if it has a session for the IPv6. The queries can be made in parallel to a configured set of query points on PCRFs.

Note Ensure you have enabled PCRF Session Query in the DRA plugin configuration to use this feature.

Figure 44: PCRF Session Query Peers CRD



This CRD contains the following fields:

- base_url: The HTTP URL for the PCRF REST API, supports both HTTP and HTTPS. This does not contain the Rest API endpoint name.
- pcrf_group: The PCRFs can be configured in logical groups by defining the common pcrf_group. vDRA triggers the REST API request one after another for multiple PCRFs configured with same group name. This is to support PCRF with primary and secondary API endpoints. (Optional)
- session_query_parameter: PCRF session query parameter. Currently, only one value is supported: framedIpv6PrefixKey
- user_id: User ID for REST API request if PCRF requires any basic authentication. (Optional)
- password: Password for REST API request if PCRF requires any basic authentication. (Optional)
- timeout_ms: REST API equest timeout value. Default: 250ms. (Optional)

You can also configure a session route key for the PCRF response. When vDRA makes REST API requests to multiple PCRFs for session query using the Framed-IPv6-Prefix received in the Rx AAR message, the PCRF that has the corresponding Gx session sends a session route key in the response. vDRA then uses this key to look up the peer group and route the Rx AAR message to the correct PCRF. To configure a session route key in the response, see the Unified API Plugin Configuration in *CPS Mobile Configuration Guide*.

Additionally, diameter load balancing ensures that when a PCRF is connected to two directors and the PCEF traffic passes on one director, the traffic is then equally distributed to both directors.

vDRA can also load balance session query REST requests across multiple PCRF API endpoints. Previously, all REST queries were sent to the primary endpoint and only if the primary query fails, then the request is sent to secondary. Now, the requests are load balanced across the different PCRF endpoints within a peer group. If the session query results indicate that the PCRF does not have the corresponding Gx session for the IPv6 prefix, then vDRA does not send the query to the other PCRF configured in the same group. Similarly, for all other failures, vDRA sends the session query request to a different PCRF REST API in the same group. It is recommended that a group may contain a maximum of four PCRF REST API endpoints. If there is no group name, the PCRF API endpoint is considered as a standalone PCRF.

IPv6 Ranges System ID Mapping

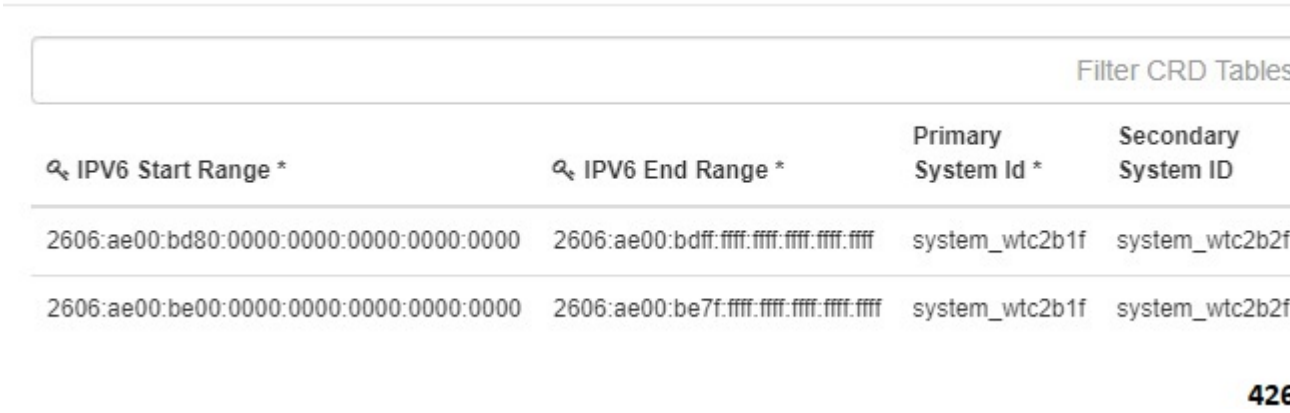
Use this CRD to specify a range of IPv6 addresses and the relay vDRA system ID.

This CRD is used to relay Rx AAR messages to other vDRA clusters based on the IPv6 range defined in the CRD.

When an Rx-AAR reaches vDRA, the AAR is checked for an IPv6 prefix. If there is an IPv6 prefix, then this CRD is checked for IPv6 ranges and to find the related primary and secondary vDRA system ID.

If the primary or secondary system is the current vDRA system-ID, then AAR message is processed locally. If the primary/secondary system ID is not the current vDRA, then current vDRA checks the relay links between current system and primary system. If the relay link is up, the the AAR is relayed to the primary system; else vDRA checks link to the secondary system.

Figure 45: IPv6 Ranges System ID Mapping CRD



Use the following table to specify a range of IPv6 addresses, the primary, and secondary vDRA system IDs.

Table 21: IPv6 Ranges System ID Mapping Fields

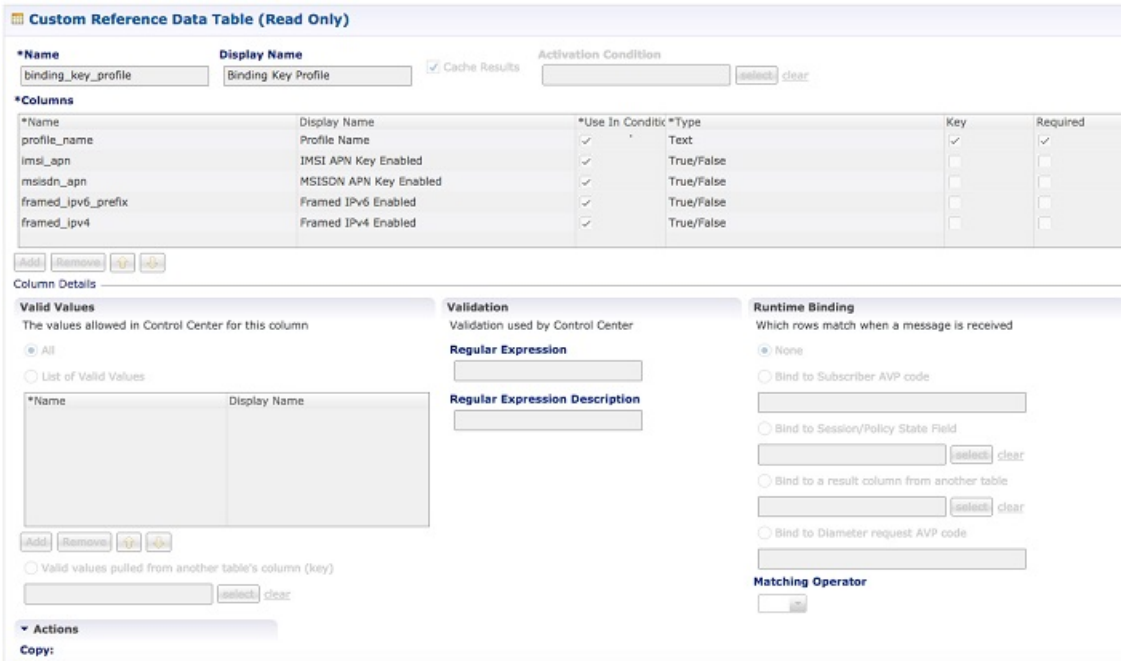
Fields	Description
IPV6 Start Range	Starting IP of IPv6 range in long format.
Note The starting and ending IPv6 range can be of 64/128 bits. The 128-bit not is supported for actual zone range configuration and below. The 128 bit format is supported for 64 bit framedIP range.	
IPV6 End Range	Ending IP of IPv6 range in long format.
Primary system ID	Mandatory field. Indicates the System ID of vDRA in a vDRA cluster to which the request can be relayed.
Secondary system ID	Secondary vDRA to which the request can be relayed if the primary is not present.

Note The ranges are expected to be mutually exclusive and unique. Verify the values when provisioning the same.

Binding Key Profile

This table provides the information related to binding key profile in the system. The read-only keys are shown below:

Figure 46: Binding Key Profile - CRD Table



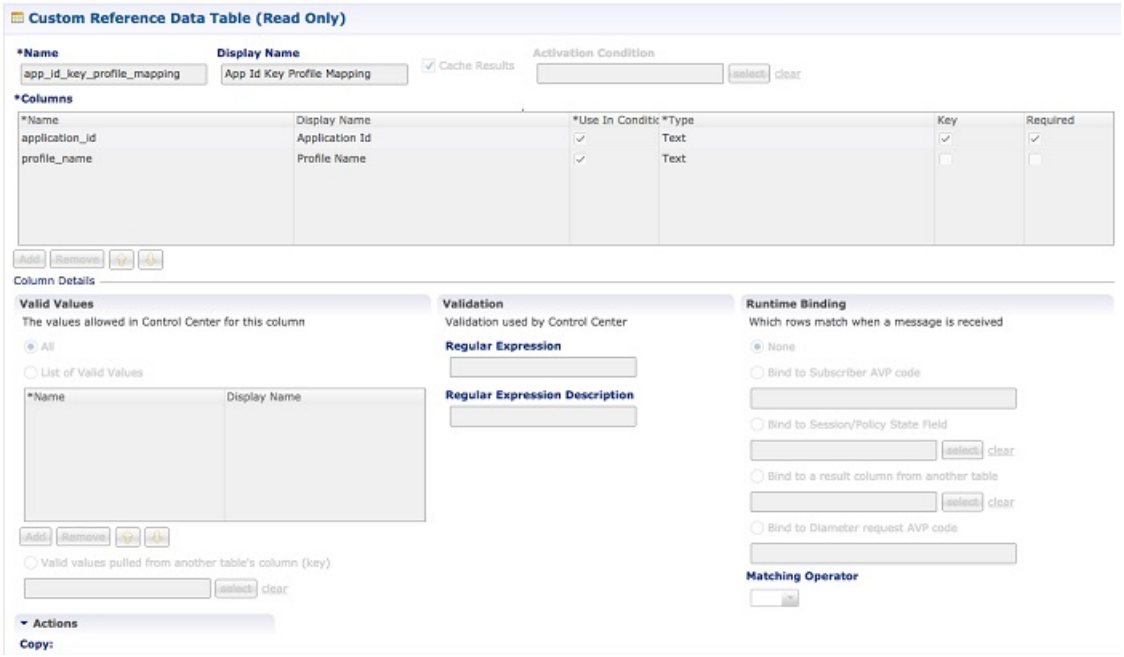
- Profile Name: This is the name given to the Bind profile that is associated with keys that are either enabled and/or disabled.
- MSI APN Key Enabled: Enabling this field would mean that bindings will be stored in IMSI APN collections in bindings database.
- MSISDN APN Key Enabled: Enabling this field would mean that bindings will be stored in MSISDN APN collections in bindings database.
- Framed IPv6 Enabled: Enabling this would mean binding data would be stored in “ipv6bindings” collection.
- Framed IPv4 Enabled: Enabling this would mean binding data getting stored in “ipv4bindings” collection.

Refer to Binding Key Profile for configuration in Control Center.

AppId Key Profile Mapping

This table stores the mapping between Application Identifiers and Bind Key Profile Names. The Application Identifiers are pre-provisioned for two Application Identifiers as Gx and Rx. Similarly, the BindingKeyProfile is also tied to the Profile Name column of the “BindingKeyType_Profile” table:

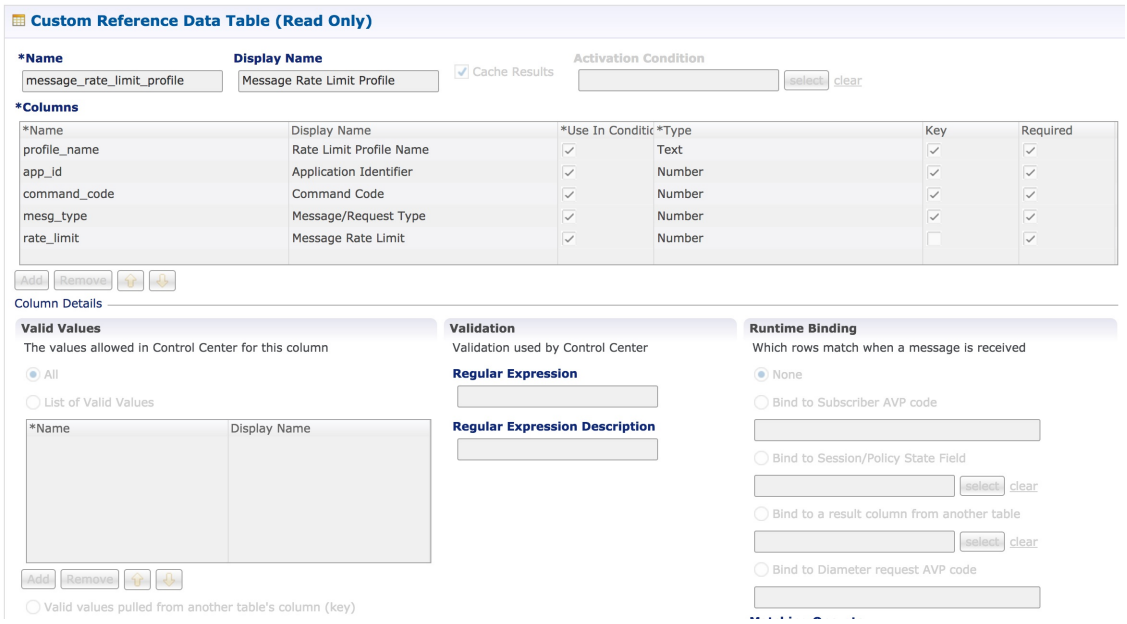
Figure 47: AppId Key Profile Mapping- CRD Table



Message Rate Limit Profile

This table gives a provision to configure Message Rate Limits at a profile level.

Figure 48: Message Rate Limit Profile - CRD Table



- Profile Name: Unique Identifier for a profile.
- Application ID: Application Identifier for this row. 3GPP App Ids only are allowed here.

- Command Code: Command Code of the message that is applicable on the said interface specified by Application Id above.
- Message Type: Initial/Update/Terminate or None for messages that do not have them. The message request type should be same as specified for the command code in Policy Builder under Diameter Application.
- Rate Limit: This field is to specify the threshold in TPS above which the diameter messages are discarded. This value should be more than the Peer Rate Limit in order for message level rate limit to be applied.
- Profile Name: Unique Identifier for a profile.

Refer to Message Rate Limit Profile for configuration in Control Center.

Reserved IMSI

You can configure the Reserved IMSI CRD table to validate a parsed IMSI for SLF routing against a configured list of reserved MCC ranges.

The CRD has two main columns : MCC Start range and MCC End Range. The MCC consists of the first three digits of an IMSI.

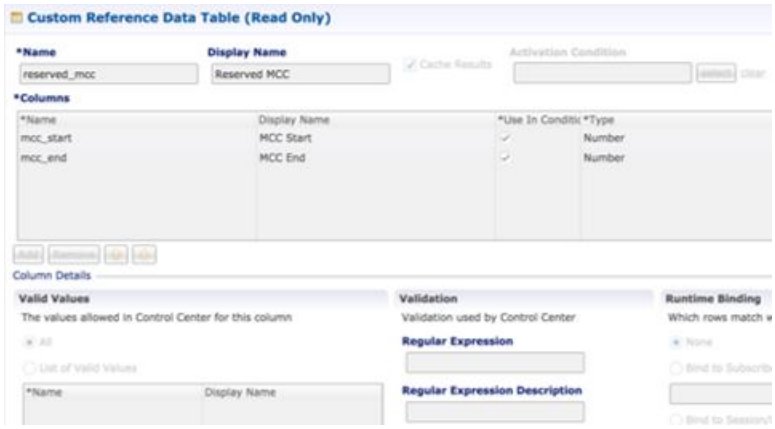
If the IMSI matches a reserved IMSI, the value is ignored for SLF routing.

You can provide support up to ten distinct (non-overlapping) MCC ranges as Reserved IMSIs.

The DRA/SLF ignores AVPs that contain such IMSIs, and continues searching other AVPs in the Diameter request, for a valid address to be used for address resolution.

The following image shows a sample Reserved IMSI configuration:

Figure 49: Reserved IMSI

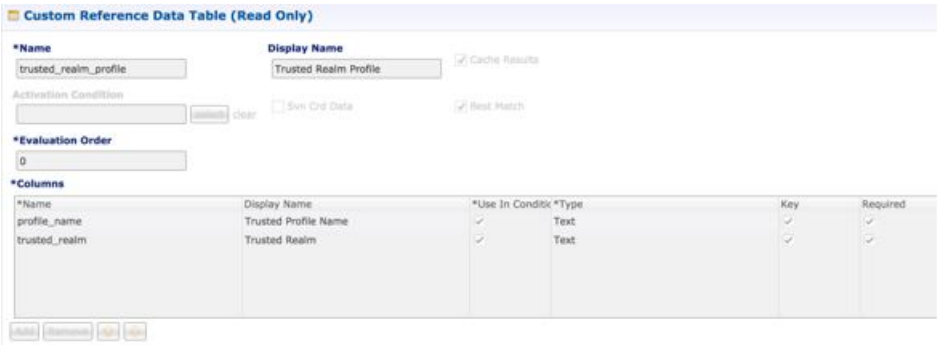


Trusted Realm Profile

Trusted Realm Profile is used for topology hiding. The CRD includes the following columns:

- Trusted Profile Name: Profile Name having a trusted realm mapped to it.
- Trusted Realm: Realm for which Topology Hiding is not required.

Figure 50: Trusted Realm Profile



Protected Realm Trusted Profile Mapping

Protected Realm Trusted Profile Mapping is used for topology hiding. The CRD includes the following columns:

- Protected Realm: Realm that is protected (topology hiding is required).
- Profile Name: Profile having realms that are trusted for this protected realm and that do not require topology hiding.

Figure 51: Protected Realm Trusted Profile Mapping

MME Alias Map

MME Alias Map is used for topology hiding. The CRD includes the following columns:

- MME FQDN: FQDN of MME that requires topology hiding.
- Alias1: Mandatory. An alias identity used for the protected host that belongs to an MME in the network.
- Alias 2: Optional. Alternate Alias that can be used for Topology Hiding for the given MME FQDN.
- Alias 3: Optional. Alternate Alias that can be used for Topology Hiding for the given MME FQDN.

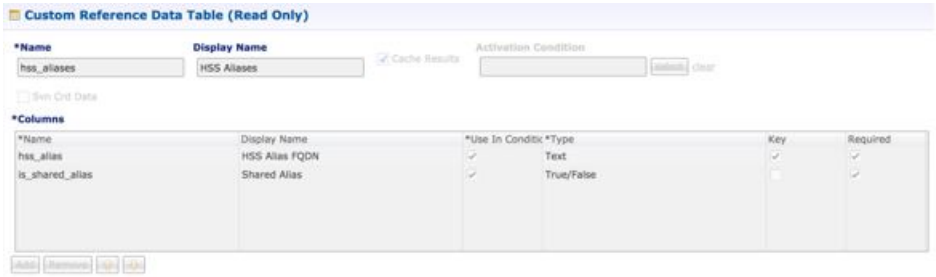
Figure 52: MME Alias Map

HSS Aliases

HSS Aliases is used for topology hiding. The CRD includes the following columns:

- HSS Alias FQDN: Alias FQDN used to replace a protected HSS FQDN.
- Shared Alias: Boolean variable used to indicate whether the Alias FQDN is shared across multiple HSS servers or not.

Figure 53: HSS Aliases

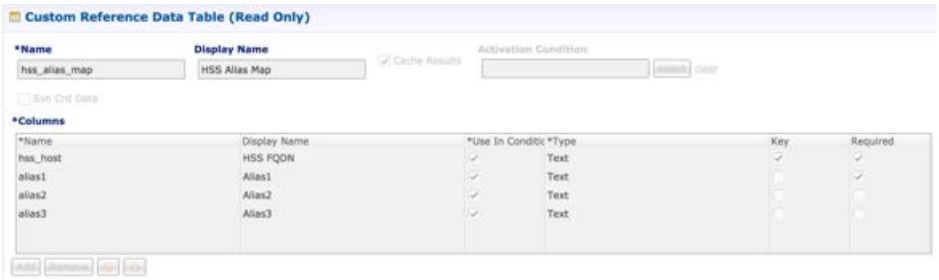


HSS Alias Map

HSS Alias Map is used for topology hiding. The CRD includes the following columns:

- HSS FQDN: FQDN of HSS peer.
- Alias1: Required field which is derived from HSS Alias CRD.
- Alias2: Optional. Alias for the HSS FQDN.
- Alias3: Optional. Alias for the HSS FQDN.

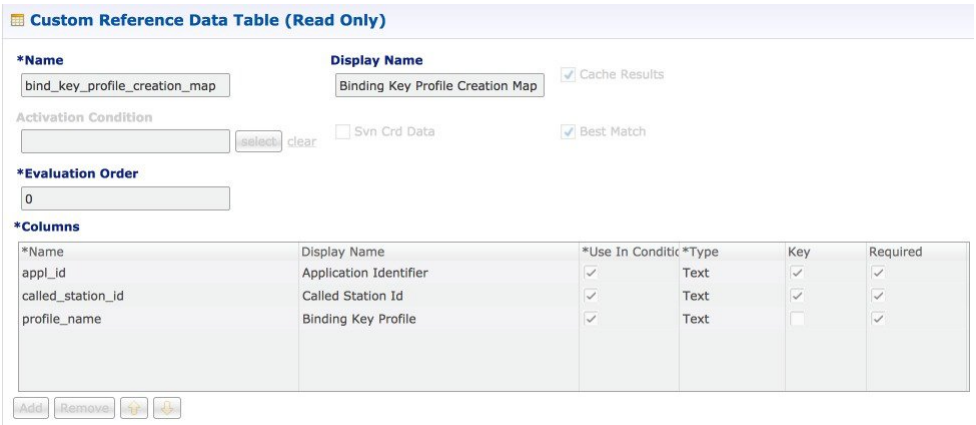
Figure 54: HSS Alias Map



Binding Key Profile Creation Map

This table provides the information related to binding key type profile creation map in the system. The read-only keys are shown below:

Figure 55: Binding Key Profile Creation Map - CRD Table



Note If there is no profile configured for any Application ID and Called Station ID pair, then a default profile is automatically selected. This profile has only Framed-IPv4-Enabled as false/disabled, while all other keys are true/enabled.

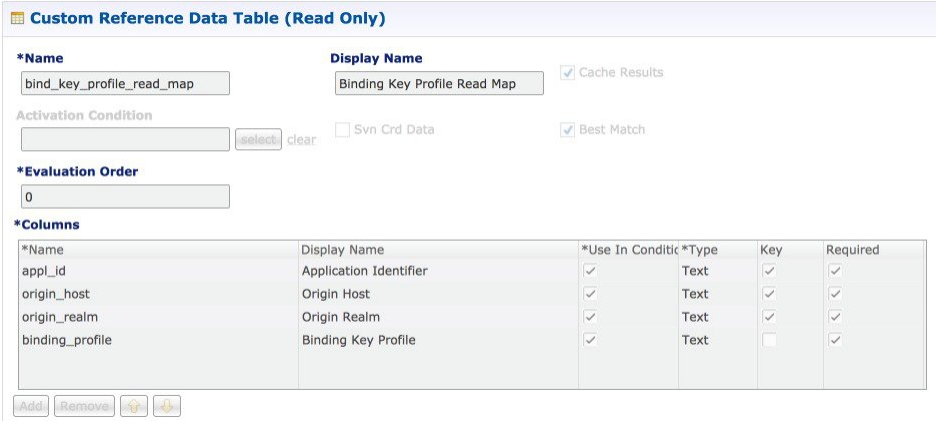
- Application Identifier: Application ID of the message.
- Called Station Id: Called-Station-Id AVP value from the Diameter message.
- Binding Key Profile: Profile name from binding key profile.

Refer to Binding Key Profile Creation Map for configuration in CPS Central.

Binding Key Profile Read Map

This table provides the information related to binding key type profile read map in the system. The read-only keys are shown below:

Figure 56: Binding Key Profile Read Map - CRD Table



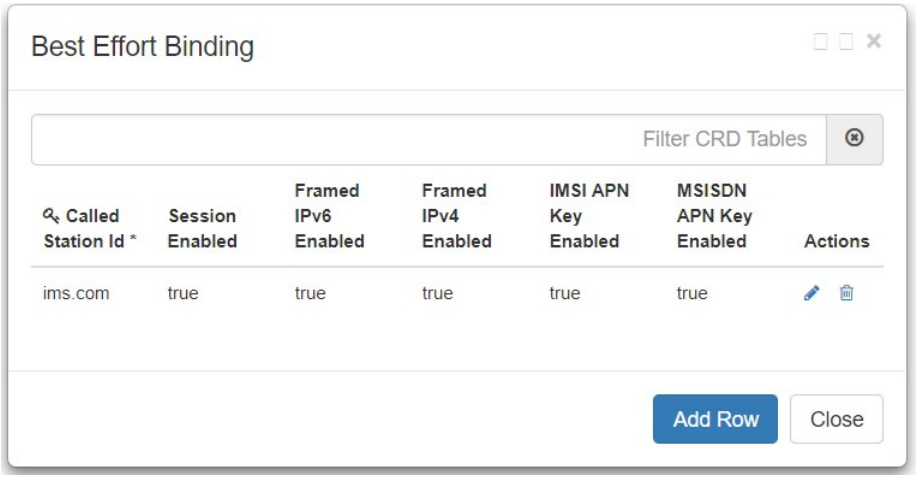
- Application ID: Application ID from the message.
- Origin Host: Origin host from the message.
- Origin Realm: Origin realm from the message.
- Binding Key Profile: Profile name from binding key profile.

Refer to Binding Key Profile Read Map for configuration in CPS Central.

Best Effort Binding

This table enables you to configure best effort binding on APN basis. The Caller Station Id column accepts regular expressions.

Figure 57: Best Effort Binding - CRD Table



Peer Admin Disabled List

Peer Admin Disabled List table is used by PAS to dynamically add/remove peer FQDN to administratively disable/enable peers. To administratively disable a peer, its FQDN should be added to “Peer Admin Disabled

List" table. To enable the peer, FQDN should be removed from the table. This table could also be updated by external systems using CRD API. The configuration changes take effect once CRD table is updated.

CRD table only supports exact matches (equality) of origin FQDN and realms. Pattern based rules are not supported. Since each peer is required to use unique origin-host FQDN, CRD table is designed to just include FQDN to identify a peer.

The CRD is used to persist the configuration. So, the configuration is limited to a site (scope of CRD). To block a peer from connecting to multiple sites, the peer must be disabled on each site.

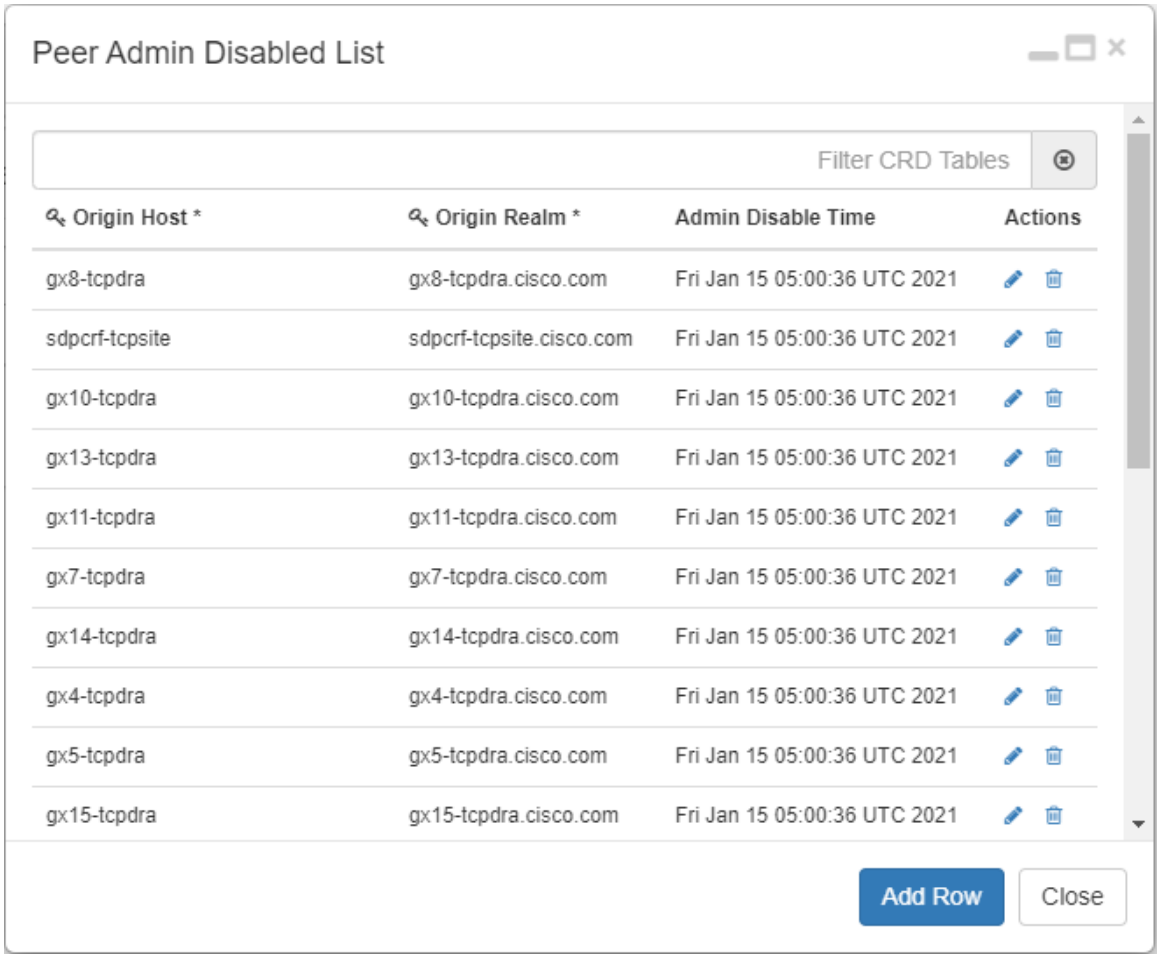
Note Peer Admin Disabled List is applied only for inbound diameter connections. Outbound diameter connections from PAS could be disabled by disabling the corresponding outbound endpoint.

When restoring CRD from backup, Peer Admin Disabled List should be excluded from import so that current configurations are not lost. The table should be included only if the intent is to reset the configuration.

When you add an entry for active peer in **Peer Admin Disabled List** CRD table, it takes effect only after the peer is disconnected and the peer attempts to reconnect. You can use **Active Peer Endpoints** GUI under **DRA Peer Monitoring** to disconnect the peer connection. For more information, refer to *View Filtered Data* section in the *CPS vDRA Administration Guide*.

If you need active peer connections to be administratively disabled, it is recommended to disable the peers using the **DRA Peer Monitoring** GUI only. For more information, refer to *CPS vDRA Administration Guide*.

Figure 58: Peer Admin Disabled List



The CRD table contains the following fields:

- Origin Host: Origin FQDN of peer to be administratively disabled.
- Origin Realm: Origin realm of the peer.
- Admin Disable Time: Time at which disable rule was created. This is read-only field.
- Actions: Edit or delete the current configuration.

The following APIs can be used to administratively disable and enable multiple peers. The APIs support bulk updates when multiple peers are selected in GUI.

- Disable APIs:
  - **API to create multiple rows in CRD:** `/custrefdata/peer_admin_disabled_list/_createRows`
  - **API to disconnect multiple endpoints:** `/dra/api/localActivePeerEndpoints/disconnect`
- Enable API:
  - **API to delete multiple rows in CRD:** `/custrefdata/peer_admin_disabled_list/_deleteRows`

For more information on APIs, refer to *API Endpoints And Examples* section in the *CPS vDRA Operations Guide*.

Attention Peer down alert (DIAMETER_PEER_DOWN) is suppressed for admin disabled peers. There is no change in handling of peer up or peer down state changes and corresponding alerts for admin enabled peers.

SVN Repository Changes

Note This feature has not been validated for all customer deployment scenarios. Please contact your Sales Account team for support.

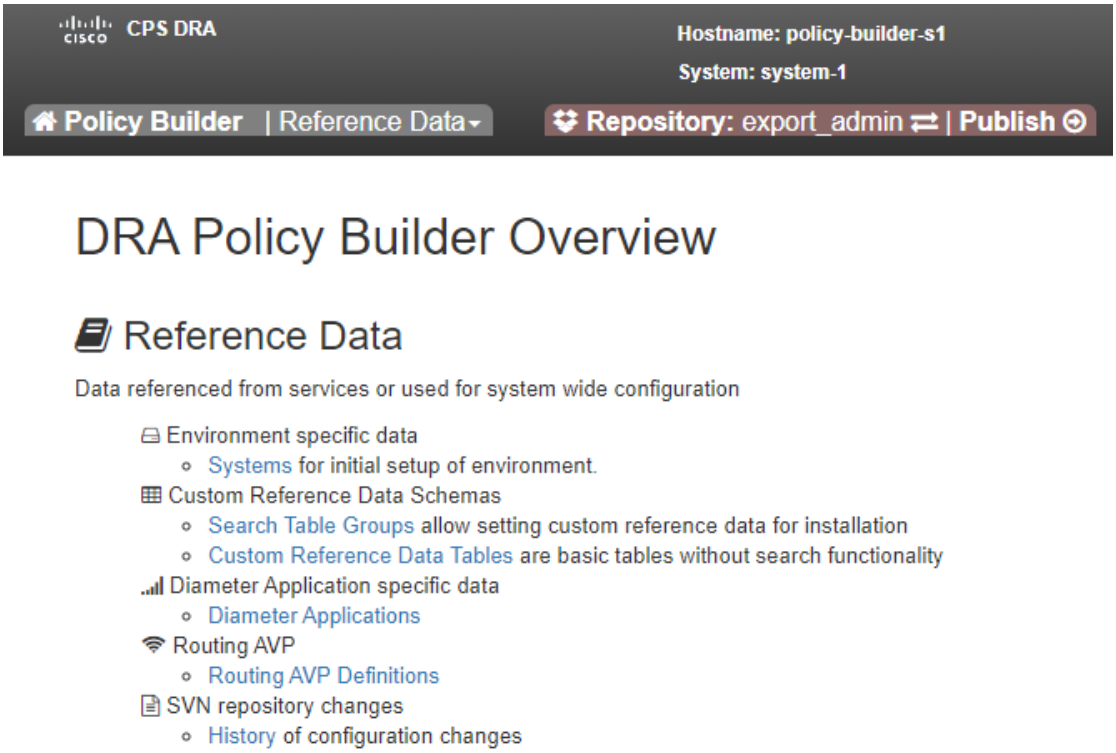
Viewing Summary of SVN Repository Changes in the Policy Builder

The CPS DRA provides GUI support to view history of Policy Builder configuration changes.

Perform the following steps to view the summary of publish changes:

1. In CPS DRA, choose **Policy Builder** > **Policy Builder** > **SVN repository changes** , click the **History of configuration changes** link to open the **History of configuration changes** window.

Figure 59: SVN Repository Changes



2. From the **Choose repository to view history** drop-down list box, choose a repository, and then click **Submit**. The following parameters are displayed for all the published commit changes published.

Figure 60: History of Configuration Changes

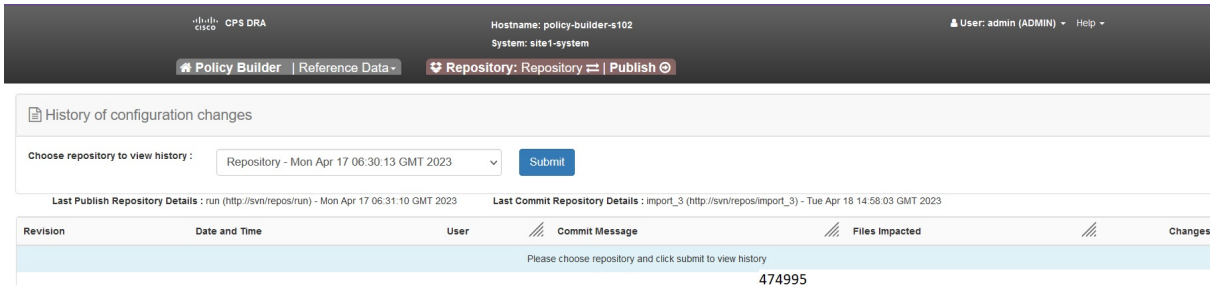


Table 22: History of Configuration Changes Parameters

Field	Description
Revision	Revision number of the SVN commit.
Date and Time	Shows the date and time of the last changes made.
User	Name of the user who made changes.
Commit Message	Commit message entered by user into GUI while publishing summary of changes.
Files Impacted	Shows impacted files during SVN commit changes.
Changes	Click the icon to view differences between two adjacent revisions. To download and save changes, click the Download icon at the top-right corner of the window.

Note DRA Central GUI retrieves the SVN log and SVN differences by using an underlying SVN containers. If SVN container is down then GUI will have issues.

View Last Published and Commit Repository Details

In the Policy Builder, you can view the last published and commit repository details using the API and SVN commands. It displays the following details:

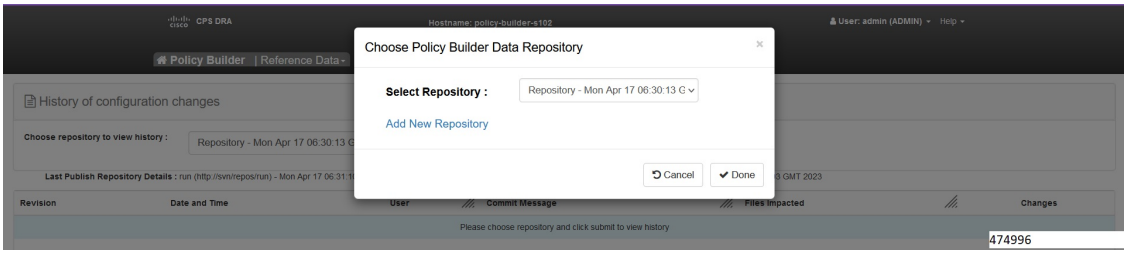
- Last committed repository and published repository in the history page.
- List of repositories sorted based on the last commit order in the DRA central.

API and SVN Commands

1. The following API displays the last published and commit repository details in the GUI page:

```
https://<Master/VIP-IP> / api/repository/actions/svn/repo/
```

Figure 61: Dropdown Repository List



2. The following SVN commands helps to view the list of repositories based on the last commit.

```
svn list --xml http://svn/repos/ | grep name
<name>caliperpb</name>
<name>configuration</name>
<name>golden-crd</name>
<name>run</name>
<name>siteB_config</name>
```

Note The SVN commands are executed in the SVN containers.

Limitation

DRA Central GUI retrieves the SVN last publish and SVN commit repositories by using an underlying SVN containers. If SVN container is down then GUI will have issues.