ERICSSON

Diameter Configuration

OPERATION DIRECTIONS

62/1543-AXB 250 10/4-V3 Uen FB

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1 Introduction

This document describes configuration of the Diameter Base Protocol (DBP) in the EPG for GSM, WCDMA, LTE systems, trusted non-3GPP networks, and untrusted non-3GPP networks.

1.1 Scope

This document describes DBP configuration in the EPG, such as configuring Diameter properties, peers, and Diameter Application Systems (DASs).

For a description of DBP support in the EPG, refer to Diameter Base Protocol.

1.2 Target Groups

This document is intended for personnel configuring the EPG. The document assumes that the readers have a basic knowledge of data communication and telecommunication.

2 Diameter Configuration for the GGSN and PGW

The following sections describe Diameter configuration for the GGSN and PGW.

2.1 Set Up the GGSN and PGW for Diameter Communication

To connect the GGSN and PGW to a Diameter network, the Gom control plane logical interface must be configured for the PGW Session Controllers (PSCs). For information about configuring the Gom control plane logical interface, refer to EPG Board Configuration.

Additional logical interfaces for Gx+, Gy, Rf, and S6b interfaces can be associated with diameter peers, seeSection 2.3 on page 7. For information about configuring the Gx+, Gy, Rf, and S6b logical interfaces, refer to EPG Board Configuration.

Note: The Gom control plane logical interface must be configured before additional logical interfaces are configured.

2.2 Configure GGSN and PGW Diameter Properties

This section describes how to configure the GGSN and PGW properties in the Diameter network.

2.2.1 Configure the GGSN and PGW Diameter Hostname

The GGSN and PGW Diameter hostname is included in the Origin-Host AVP in Diameter-messages sent from EPG. For information on the format of this AVP, refer to Diameter Base Protocol. The configured Diameter hostname does not have to be the same as the GGSN and PGW node name.

To configure the GGSN and PGW Diameter hostname, include the following statement:

```
Ericsson(config)# epg pgw diameter
   host-name <host-name>
```

The hostname is configured as a string.

Note: The GGSN/PGW application must be stopped before reconfiguring the Diameter hostname and realm.

2.2.2 Configure the Number of Diameter Hosts

The EPG supports configuration of up to 64 hosts, with a maximum of 15 hosts configured for each active PSC.

Ericsson recommends configuring at least the same number of hosts as the number of active PSCs. Configuring fewer hosts than active PSCs may increase the CPU load. The impact size depends on the node configurations. For more information about the impact of the number of hosts, contact Ericsson support.

For information on how IP addresses for Diameter interfaces are allocated when number of hosts is configured, refer to EPG Board Configuration.

For information about the implication of configuring the number of hosts, refer to Diameter Base Protocol.

2.2.2.1 Configuring the Number of Hosts during Downtime or Increasing the Number of Hosts during Runtime

To configure the number of Diameter hosts when the PGW is stopped or to increase the number of Diameter hosts during runtime, use the following command:

```
Ericsson(config)# epg pgw diameter
   number-of-hosts <number>
```

If the configured Diameter hostname is `epg.com` and the number of configured hosts is 2, the two hostnames are `d0-epg.com`, and `d1-epg.com`.

The EPG adds additional Diameter hosts in sequential order. For example, if two hosts were already configured (d0 and d1) and `number-of-hosts` is configured to five, the three additional Diameter hosts are d2, d3, and d4. Additional Diameter hosts become active 30 seconds after entering the command.

2.2.2.2 Decrease the Number of Diameter Hosts during Runtime

Consider the following before decreasing the number of Diameter hosts:

— Diameter hosts can only be blocked and removed if the `number-of-hosts` parameter has been configured.

— At least one unblocked Diameter host must be available after the end of the procedure.

— The EPG does not select blocked Diameter hosts when creating new IP-CAN sessions.

Figure 1 shows the procedure for decreasing the number of Diameter hosts during runtime.

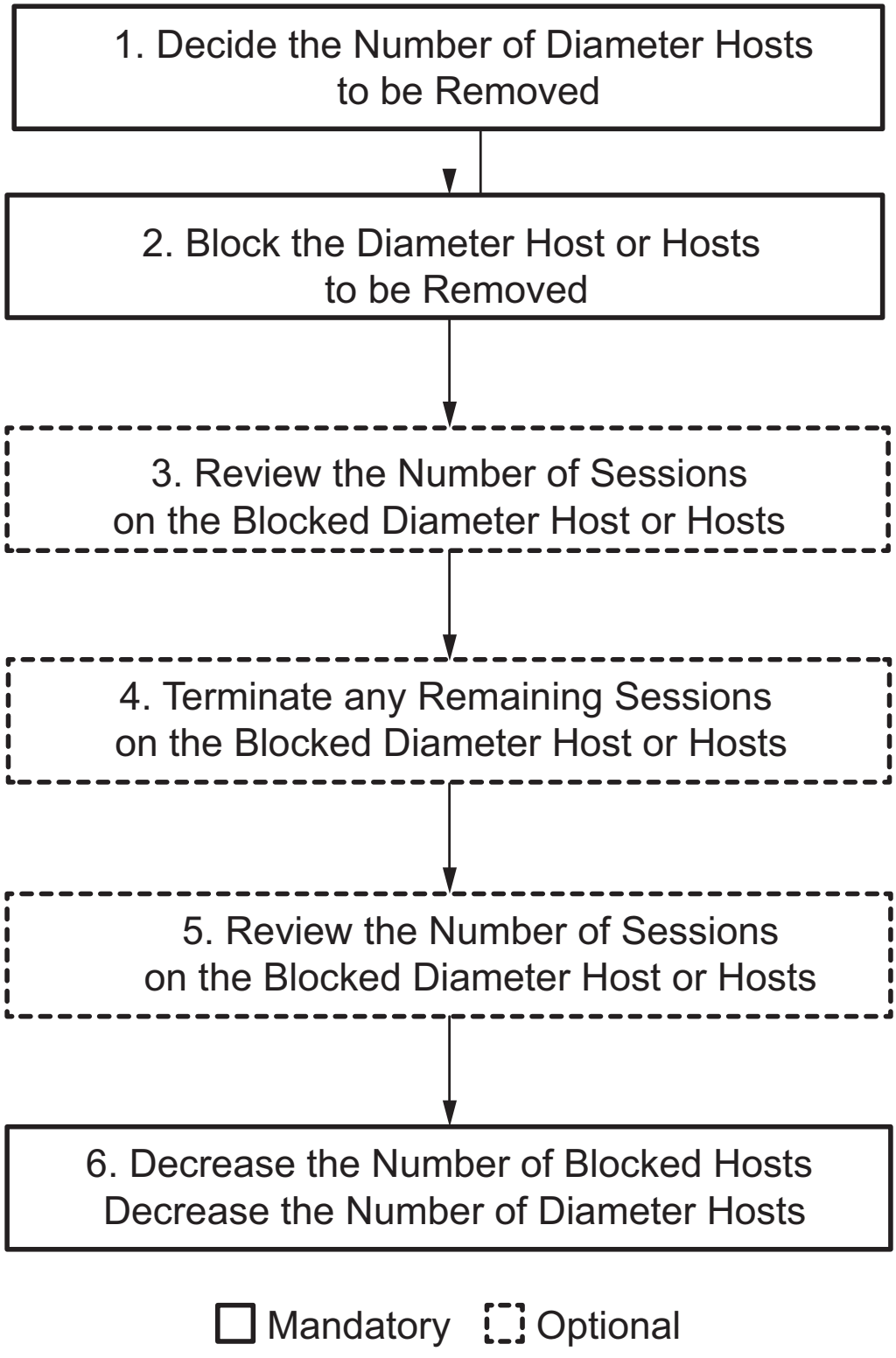

Figure 1 Decreasing the Number of Diameter Hosts during Runtime Procedure

To decrease the number of Diameter hosts during runtime, do the following:

1. Decide the number of Diameter hosts to be removed.

2. Prevent the PGW from establishing new connections to the Diameter hosts, by using the following command:

   ```
   Ericsson(config)# epg pgw diameter block-number-of-hosts <0-63>
   Ericsson(config)# commit
   ```

   The number entered in `block-number-of-hosts` should correspond to the number of Diameter hosts to be removed, see Step 1.

   The EPG blocks Diameter hosts in reverse sequential order, starting with the host that has the highest prefix value. For example, if five hosts are configured (d0, d1, d2, d3, and d4) and `block-number-of-hosts` is configured to 3, the PGW is prevented from establishing new connections to hosts d2, d3, and d4.

3. Optionally, review the number of IP-CAN sessions on the blocked Diameter hosts to assess the impact of a forced session termination, by using the following command:

   ```
   [local]Ericsson#epg pgw statistics-origin-host origin-host-name
   <host-name>
   ```

   Note: The EPG removes a Diameter host from the output of this command when the number of PDN connections for the Diameter host reaches zero.

4. Optionally, terminate any remaining IP-CAN sessions on a blocked Diameter host, by using the following command:

   Attention!

   Waiting for sessions to disconnect normally reduces the impact caused by a forced session termination.

   This command has a major impact on CPU usage. To reduce the impact on the CPU, wait until the number of IP-CAN sessions on the blocked Diameter host is less than 60,000 before issuing the command. Do not reuse the command until the EPG has reestablished the IP-CAN sessions from the terminated Diameter host to the unblocked Diameter hosts.
   For more information on session reestablishment, refer to Policy Control.

   ```
   [local]Ericsson#epg pgw control-plane session terminate
   -sessions diameter-host-option diameter-destination-host
   diameter-host-name <host-name> application-type all
   delete-option default-only
   ```

The **defaultOnly** parameter is optional. If this parameter is configured, the EPG does not terminate UE sessions that have established dedicated bearers. This prevents the EPG from forcibly terminating potential VoLTE calls.

5. Optionally, review the number of IP-CAN sessions on the blocked Diameter hosts to confirm that there are no remaining sessions, by using the command inStep 3.

6. Decrease the number of blocked hosts and number of Diameter hosts, by including the following commands:

Attention!

The EPG can only remove Diameter hosts that have no remaining IP-CAN sessions.

```
Ericsson(config)# epg pgw diameter block-number-of-hosts <0-63>
Ericsson(config)# epg pgw diameter number-of-hosts <number>
Ericsson(config)# commit
```

Scenario 1: Remove all of the blocked hosts.

Configure `block-number-of-hosts` to `0`.

The `number` entered in the `number-of-hosts` parameter must equal the existing number of hosts, minus the number of blocked hosts configured at Step 2. For example, if five hosts were configured and then three hosts were blocked, the updated `number-of-hosts` is 5−3=2.

Scenario 2: Remove some of the blocked hosts.

The `block-number-of-hosts` parameter must be reduced by the same amount as the `number-of-hosts` parameter.

For example, if six hosts were originally configured, and three hosts (d3, d4, d5) were blocked in Step 2 and the `number-of-hosts` is decreased from 6 to 5, the `block-number-of-hosts` parameter must also be decreased by 1. So `block-number-of-hosts` is 3−1=2.

The EPG unblocks and removes Diameter hosts in reverse sequential order, starting with the blocked host that has the highest prefix value.

In this scenario, Diameter host d5 is unblocked and removed, and Diameter hosts d3 and d4 remain blocked. The PGW is prevented from establishing new connections to the blocked Diameter hosts. To remove the remaining blocked hosts, see scenario 1.

2.2.3 Configure the GGSN and PGW Diameter Realm Name

The GGSN and PGW realm name is used together with the hostname to identify the GGSN and PGW in a Diameter network.

To configure the GGSN and PGW realm name, include the following statement:

```
Ericsson(config)# epg pgw diameter
   realm <realm-name>
```

The supported format of the realm name is a string, and the supported maximum length of the realm name is 255 characters. If the realm name includes spaces, it must be enclosed in double quotation marks (for example, `"realm abc"`).

2.2.4 Configure the DSCP Marking on Diameter Interfaces

To configure the class used for DSCP marking on the Diameter interfaces, include the following statement:

```
Ericsson(config)# epg pgw diameter
   dscp (af11 | af12 | af13 | af21 | af22 | af23 | af31 | af32 | af33 | af41
```

The default class for DSCP marking is **be**.

For more information about DSCP, refer to Quality of Service on the GGSN and PGW.

2.3 Configure GGSN and PGW Diameter Peers

The EPG supports configuration of up to 64 Diameter peers for the GGSN and PGW. The configured peer identifier (ID) is used to reference the peer from a DAS.

To configure GGSN and PGW Diameter peers, include the following statement:

```
Ericsson(config)# epg pgw diameter peer <peer-id>
   logical-interface <interface-name>
   address <address>
   port <port>
   transport-protocol (sctp | tcp)
```

If a logical interface is configured, it can be associated with a GGSN and PGW Diameter peer using the `logical-interface` parameter. If no `logical-interface` is configured, the Gom control plane logical interface is associated with the diameter peer by default. For information about configuring a logical interface, refer to EPG Board Configuration.

Adding, removing, or modifying only the `logical-interface` parameter in runtime results in a connection re-establishment with the Diameter peer. The Disconnect-Peer-Request (DPR) message is not sent to the Diameter peer in this scenario.

Modifying the `address`, `port`, or `transport-protocol` parameters in runtime results in a connection re-establishment with the Diameter peer and a DPR message is sent to the Diameter peer.

When `transport-protocol` is configured to `tcp`, the address used must not overlap with any address using the same routing context. When `transportProtocol` is configured to `sctp`, the address used must not overlap with addresses using SCTP on any routing context.

The default value for `transport-protocol` is `tcp`. If `transport-protocol` is configured to `sctp`, up to 16 peer addresses can be configured to support multihoming of the Diameter peer.

Note: If SCTP is configured as the transport protocol, configure the SCTP parameters to match the Diameter peers is recommended. For configuring SCTP parameters, see Section 2.3.3 on page 9.

The following restrictions apply to the configured properties of Diameter peers:

— The peer id is configured as a string.

— The peer address must be a valid IPv4 address.

— The port is configured as an unsigned integer.

— The transport protocol must be either `sctp` or `tcp`.

2.3.1 Configure the GGSN and PGW Peer Time-out

The GGSN or PGW uses the peer time-out to monitor the direct connection towards the adjacent peer. The peer time-out must be greater than the DAS time-out valid for the connection with the Diameter server.

To configure the GGSN and PGW peer time-out, include the following statement:

```
Ericsson(config)# epg pgw diameter peer <peer-id> watchdog
   timeout <seconds>
```

The peer time-out is configured as an unsigned integer, and the supported configuration range of the peer time-out is 3–300 seconds. The default value of the peer timeout is 30 seconds.

Note: After an ICR switchover, the EPG ignores the `timeout` configuration and tries to re-establish the Diameter connection every second until the EPG receives a successful Capabilities-Exchange-Answer (CEA) message. Up to 10 fast re-establishment requests are made after which the `timeout` configuration takes effect. The EPG uses this method to speed up the Diameter connection reestablishment to the Diameter peers.

2.3.2 Associate a Peer with a GGSN and PGW Diameter Hostname

Diameter host IDs are used to associate a peer with a Diameter hostname.

Note: The host ID must be predefined in the Diameter host table, see Section 2.5 on page 23.

To associate a peer with a GGSN and PGW Diameter hostname, include the following statement:

```
Ericsson(config)# epg pgw diameter peer <peer-id>
   host <host-id>
```

Modifications to the Diameter host ID configuration take effect at the next capability exchange between the GGSN or PGW and the peer in question.

Note: If a Diameter host ID is assigned to a peer that has an active transport connection, the GGSN or PGW immediately initiates a new capability exchange procedure with the peer.

2.3.3 Change GGSN and PGW SCTP Protocol Settings

SCTP protocol settings have the following configurable parameters:

Table 1 SCTP Protocol Settings - Parameters and Default Values

Parameter	Description	Data Type (Supported Range)	Default Value
`additional-logical-interface`	Secondary Gom control plane logical interface for SCTP communication The context of the primary and secondary logical interfaces must be same. The additional logical interface must not contain any IP address which is overlapping with any other logical interface's IP address that uses SCTP.	Name of a Gom control plane logical interface, for example `gom-c-if-2`	-

Parameter	Description	Data Type (Supported Range)	Default Value
disable-cross-paths	If disable-cross-paths is enabled, the EPG uses its secondary logical interface address as the origin for packets sent to the secondary address of the remote peer.	The parameter is enabled or disabled	Disabled
association-max-retrans	Maximum number of retransmission attempts on association	Unsigned integer	10
hb-interval	Heartbeat interval in milliseconds	Unsigned integer (0-4,294,967,295)	30,000
max-init-retransmits	Maximum number of initial retransmission attempts on path	Unsigned integer	8
path-max-retrans	Maximum number of retransmission attempts on path	Unsigned integer	5
rto-initial	Initial retransmission time-out in milliseconds	Unsigned integer (0-4,294,967,295)	3,000
rto-max	Maximum retransmission time-out in milliseconds	Unsigned integer (0-4,294,967,295)	60,000
rto-min	Minimum retransmission time-out in milliseconds	Unsigned integer (0-4,294,967,295)	1,000

Parameter	Description	Data Type (Supported Range)	Default Value
sack-timeout	Maximum time to wait before sending a SACK upon receiving a DATA chunk, in milliseconds	Unsigned integer (0-500)	200
path-mtu	Maximum Transmission Unit used for the path in bytes. This setting disables the Path MTU Discovery	Unsigned integer (512-65,535)	Use MTU on bound interface

To configure the parameters of SCTP protocol settings, include the following statement:

```
Ericsson(config)# epg pgw diameter peer <peer-id> sctp
   additional-logical-interface <interface-name>
   disable-cross-paths
   association-max-retrans <value>
   hb-interval <value>
   max-init-retransmits <value>
   path-max-retrans <value>
   rto-initial <value>
   rto-max <value>
   rto-min <value>
   sack-timeout <value>
   path-mtu <value>
```

Adding, removing, or modifying the `additional-logical-interface` parameter in runtime results in a connection re-establishment with the Diameter peer. The DPR message is not sent to the Diameter peer in this scenario.

Note: When deleting a configured SCTP protocol setting other than `additional-logical-interface` for a Diameter peer, the connection is unaffected.

To change the parameter values back to the default ones for an SCTP protocol setting on an active connection, it is required to configure the default values.

The `disable-cross-paths` parameter is only supported between the secondary logical interface of the EPG and the secondary interface of the remote peer.

Note: The EPG only supports configuring `disable-cross-paths` if the `number-of-hosts` is also configured. For more information, refer to Diameter Base Protocol.

2.4 Configure GGSN and PGW Diameter Application Systems

The configured DASs are identified by a GGSN or PGW local identifier, the `dasId`. Up to 32 DASs can be configured.

The GGSN and PGW uses the combination of the local DAS identifier, the Diameter application identifier, and the destination realm when addressing a DAS over the Diameter network.

This section describes the following parameters configurable per GGSN and PGW DAS:

- Access type
- Diameter application identifier
- Destination realm
- Allowed dynamic realm
- OCS
- Diameter peers
- Failure handling
- Maximum request rate
- Size of request window
- Request time-out
- Supported vendor IDs
- Ignore origin-state-ID

2.4.1 Configure the GGSN and PGW Access Type

The default access type is agent configuration.

To configure the GGSN and PGW access type, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   access-type (direct | agent)
```

2.4.2 Configure the GGSN and PGW Diameter Application Identifier

The following vendor-specific applications are supported:

— Ro

— 3GPP Gy

— Gx

— S6b

— Rf

The application identifier can also be specified as vendor-id:application-id. Both vendor-id and application-id numbers are assigned by the Internet Assigned Numbers Authority (IANA).

The Ro and PCC applications communicate over the Diameter protocol (IETF RFC 6733) and are used for credit control and policy control in the SACC solution. The Rf and S6b applications also communicate over the Diameter protocol.

Do!

Block bearer creation before configuring the Diameter application identifier for a DAS referenced by a profile pointed out by a user category.

For detailed instructions for performing configuration that requires blocking bearer creation, refer to Deleting and Modifying APNs.

To configure the GGSN and PGW Diameter application identifier for a DAS, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   application-id (ro | gy-3gpp | pcc | s6b | rf |
<application-identifier>)
```

— If `application-id ro` is included, the DAS is configured to use 3GPP Gy or Ericsson Gy. For information on selecting the service specification, refer to Credit Control Configuration.

— If `application-id gy-3gpp` is included, the DAS is configured to use 3GPP Gy.

— If `application-id pcc` is included, the DAS is configured to use Gx+ PCC, releases 7 and later, depending on supported features negotiation.

For detailed information on supported features negotiation, refer to Gx+ Interface Description.

— If `application-id rf` is included, the DAS uses the Rf Release configured for `service-context-id`. For more information, refer to Offline Charging Configuration.

— If `application-id s6b` is included, the DAS is configured to use 3GPP S6b release 11.

— If `application-id 10415:16777999` is included, the DAS is configured to use S6bAuth.

— If `application-id <application-id>` is included, the DAS uses the value configured in format `application-id` or `vendor-id:application-id`.

2.4.3 Configure the GGSN and PGW Destination Realm

A realm name is a string up to 255 characters long.

Do!

Block bearer creation before configuring the destination realm for a DAS referenced by a dynamic Gx profile, credit control profile, or S6b profile pointed out by a user category.

For detailed instructions for performing configuration that requires blocking bearer creation, refer to Deleting and Modifying APNs.

Configure the GGSN and PGW destination realm, by including the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   destination-realm <realm-name>
```

2.4.4 Configure the GGSN and PGW Allowed Dynamic Realm

This section describes how to configure allowed dynamic realm in a Diameter Application System (DAS).

With this configuration, if the diameter server realm in a received diameter response message is different from the configured destination realm, the received diameter server realm replaces the configured diameter server realm and is used for this Diameter session.

Note: The diameter response messages only apply for the `CCA Initial` , `CCA Update`, `AAA`, `ACA-Start` and `ACA-Update` messages.

Configure the GGSN and PGW allowed dynamic realm, by including the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion system <das-id>
      allow-dynamic-realm
```

2.4.5 Configure the GGSN and PGW Origin Realm

This section describes how to configure multiple Diameter origin realms in a Diameter Application System (DAS) for traffic segregation. With this configuration, the GGSN and PGW support multiple Diameter origin realms for the following interfaces:

— Gx+

— Gy+

— Rf

— S6b

— S6bAuth

To configure the GGSN and PGW Diameter origin realm, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   origin-realm <realm-name>
```

If no specific value of `origin-realm` is configured, the value on the Diameter level is applied. For more information on configuring the GGSN and PGW Diameter realm name, see Section 2.2.3 on page 6.

Note:

— If the DAS is for Rf interface on the PGW, the realm name can be modified in runtime. After the modification, the PGW resends the new realm name in the CER message to the peers.

— If the DAS is for Gx+, Gy+, S6b, or S6b Auth interface, the realm name is not allowed to be modified when there are active contexts using the corresponding DAS. The realm name can be modified after the session termination and APN block.

2.4.6 Configure the GGSN and PGW Diameter Routing Message Priority

The GGSN and PGW support the Diameter Routing Message Priority (DRMP) mechanism based on user session priority. To configure the message priority to apply to the messages being sent for a user session based on the user session priority, include the following statement:

```
Ericsson(config)# epg pgw session-priority arp-priori
ty-level <arp-value> diameter
   routing-message-priority <drmp-value>
```

Note: The DRMP mechanism is only supported for the Gx+ interface.

To enable the DRMP mechanism for a DAS, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   routing-message-priority
```

2.4.7 Configure DAS Selection for Ro or Gy Diameter Application System

The PCRF can select which Gy DAS to use for credit control of a user session by including the `Primary-Event-Charging-Function-Name` (PECFN) AVP in the `CCA Initial` message. If the PECFN AVP value matches the DAS selector configured in a Gy DAS, the EPG selects that DAS for the user session.

To configure the DAS selector, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   online-charging-system <das-selector>
```

The DAS selector must be unique among the DASs.

The DAS selector cannot contain the colon (:), semicolon (;), equal sign (=), or question mark (?) characters.

2.4.7.1 Configure the Use of the PECFN AVP as Destination Host

By default, the `Destination-Host` AVP in the `CCR Initial` message is omitted when a PECFN AVP in the `CCA-I` message from a PCRF was used to select a Ro or Gy DAS. To configure the GGSN and PGW to use the PECFN AVP value as `Destination-Host` AVP value in the `CCR-I` message, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   use-pecfn-as-destination-host
```

2.4.8 Configure Diameter Peers Associated with a Diameter Application System

All adjacent Diameter peers providing direct or agent access to a DAS must be associated with that DAS. Any number of the available Diameter peers can be configured for sending messages to a DAS, each with a priority from 0 through 255, where 255 is the highest priority.

Note: The adjacent peers used for sending messages to a DAS must be configured Diameter peers, see Section 2.3 on page 7.

To configure a Diameter peer for sending messages to a DAS, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-application
-system <das-id> peer <peer-id>
   priority <value>
```

The GGSN or PGW initiates a new capability exchange procedure with a peer if any of the following conditions are met:

— A peer is added to a new DAS configuration where the `application-id` of the new DAS differs from the `application-id` of any other DAS the peer previously or still belongs to.

— A peer is removed from one DAS configuration and it is not referenced in another DAS configuration with the same `application-id`.

2.4.9 Configure GGSN and PGW Diameter Path Supervision

This section describes how to configure path supervision for a DAS.

For detailed information on Diameter path supervision, refer to Diameter Base Protocol.

For information on resetting Diameter path tracking and showing current Diameter path status, refer to Action Commands for the GGSN and PGW.

Note: When any Diameter path supervision parameters are changed, the GGSN or PGW initiates a new capability exchange procedure with the peers in the DAS.

2.4.9.1 Configure Failure Threshold

The failure threshold determines the value the failure counter for a Diameter path must reach for the Diameter path to be considered unreliable.

Configuring the failure threshold is mandatory if path supervision is enabled. The value range is 1–4,294,967,295.

To configure the GGSN and PGW failure threshold, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-application
-system <das-id> diameter-path
   failure-threshold <value>
```

The configured value of failure threshold is applied by each Diameter application per PSC instance.

2.4.9.2 Configure Failure Timer

The failure timer determines the time a Diameter path is considered unreliable for after the failure counter reaches the value set in the failure threshold.

Configuring the failure timer is mandatory if path supervision is enabled. The value range is 1–86,400.

To configure the GGSN and PGW failure timer, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-application
-system <das-id> diameter-path
   failure-timer <seconds>
```

2.4.9.3 Configure Recovery Threshold

The recovery threshold is the percentage the failure counter's value is reduced to after the failure timer has passed.

Configuring the recovery threshold is mandatory if path supervision is enabled. The value range is 0–100 percent.

To configure the GGSN and PGW recovery threshold, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-application
-system <das-id> diameter-path
   recovery-threshold <percent>
```

2.4.9.4 Configure Result Codes Indicating Failure

Result codes indicating failure determine which received result codes increment the failure counter for a Diameter path.

Configuring result codes or ranges of result codes which are to indicate a failed request is optional. By default, only timed out requests are considered failed. Up to 64 result codes can be configured.

To configure the GGSN and PGW result codes, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-application
-system <das-id> diameter-path
   result-codes [<result-codes>]
```

2.4.10 Configuring the GGSN and PGW Traffic Shaping

The following sections describe configuration of the traffic shaping function.

Note: Optimal settings for traffic shaping parameters depend on factors such as external node characteristics and network dimensioning. The expected rate of messages entering the traffic shaper and capacity of the external diameter networks must be considered when setting the request rate and request window.

If the maximum number of request window is reached, the Diameter requests cannot be sent out even if maximum rate is not reach yet.

2.4.10.1 Configure Maximum Request Rate Per DAS

The range is from 0 to 5,000 requests per second. This parameter is not configured by default, that is, no limit is set.

To configure the GGSN and PGW maximum request rate, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   requests-per-second <request-rate>
```

2.4.10.2 Configure Maximum Request Rate Per Diameter Peer

The maximum request rate per Diameter peer controls the messages sent from the PGW to a specified Diameter peer in Direct Access Mode.

Note: The GGSN or PGW only includes the maximum request rate per Diameter Peer in `CCR-Initial` and `CCR-Update` messages sent over the Gx+ interface.

The GGSN or PGW supports combining the configurations for maximum request rate per DAS and maximum request rate per Diameter Peer. The GGSN or PGW applies the value specified in Maximum Request Rate Per DAS, if both parameters are configured.

The range is from 0 to 5,000 requests per second. By default, the maximum request rate per Diameter peer is not set.

To configure the GGSN and PGW maximum request rate per message type, include the following statement:

```
Ericsson(config)# epg pgw diameter peer <peer-id>
```

```
   message-type (ccr-initial | ccr-update)
      requests-per-second <request-rate>
```

2.4.10.3 Configure the GGSN and PGW Request Window

The request window controls the maximum number of unanswered requests that the GGSN or PGW is allowed to have outstanding towards the DAS. If the maximum number is reached, no new requests are sent until the number of outstanding requests have dropped to within the request window. The default value is 2,000 and the range is from 10 to 32,000.

To configure the GGSN and PGW request window, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   request-window-size <window-size>
```

2.4.10.4 Configure the GGSN and PGW Round Trip Timer

The minimum Round Trip Timer (RTT) is used to reserve the minimum time for the Diameter Server to handle the Diameter requests. The configurable value range is from 0.1 to 59.9.

To configure the GGSN and PGW RTT, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   minimum-rtt <time-value>
```

The granularity of the configuration is 0.1 seconds. The configured value for this timer must be at least 0.1 seconds less than the value of the Diameter requests timeout.

Note: `requests-per-second` must be configured before configuring this timer.

The configuration can be changed in runtime. The changed value is applied immediately to all new requests. The previous value is applied to existing Diameter requests.

2.4.11 Configure the GGSN and PGW Request Time-out

The request time-out is the number of seconds the GGSN and PGW waits for an answer from a DAS before the request is considered to be failed. The time includes time spent in the GGSN and PGW send queue. The default is 3 seconds, the granularity is 0.1 seconds, and the range is from 0.1 to 60 seconds.

To configure the GGSN and PGW request time-out, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   timeout <timeout-value>
```

Note: The EPG applies an additional delay of 0.05 seconds to the configured time-out value, because of the internal time-out mechanism.

Minimizing the request time-out value speeds up diameter request failure handling procedures and reduces the risk of exceeding the request window configured for the traffic shaping.

2.4.12 Configure Message Retry for the GGSN and PGW

The following sections describe how to configure the GGSN and PGW to retry one or more alternative paths if an alternative path is available.

2.4.12.1 Configure Message Retry by Request Timer

To configure the GGSN and PGW to retry one alternative path for a particular message if the `timeout` value expires, include the following statement:

```
Ericsson(config)# epg pgw diamter diameter-application-system
<das-id>
   message-type (ccr-initial | ccr-update | ccr-termination | acr-start | ac
      retry
```

2.4.12.2 Configure Message Retry by Result Code

Result codes can be configured as single result codes, or by configuring a range of result codes.

Note: The following result codes are ignored if configured:

- (2001) DIAMETER SUCCESS
- (3006) DIAMETER REDIRECT INDICATION

To configure the GGSN and PGW to retry an alternative path for a result code or a consecutive range of result codes separated by '-' for a particular type of message, include the following statement:

```
Ericsson(config)# epg pgw diamter diameter-applicat
ion-system <das-id>
   message-type (ccr-initial | ccr-update | ccr-termination | acr-start | ac
      retry
         result-code (<result-code> | <result-code>-<result-code>)
```

2.4.12.3 Configure the Number of Alternative Paths to Retry

By default, if retry is enabled, the GGSN and PGW retries one alternative path. To configure the number of alternative paths to retry, up to a maximum of four, include the following statement:

```
Ericsson(config)# epg pgw diamter diameter-applicat
ion-system <das-id>
   message-type (ccr-initial | ccr-update | ccr-termination | acr-start | acr-i
      retry
         max-number-of-retry <retry-value>
```

2.4.13 Configure Peer Selection

The GGSN or PGW can be configured to select Diameter peers with different methods, using the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   distribution (load-balance | round-robin | weight-based)
```

By default, the EPG uses the `load-balance` method to select Diameter peers. The configuration can be changed in runtime. The changed value is applied immediately to all new Diameter sessions.

For more information, refer to Diameter Base Protocol.

2.4.13.1 Configure Peer Weights for Weight-Based Peer Selection

To configure the weight value when the GGSN or PGW is configured to use `weight-based` distribution method, use the following command:

```
Ericsson(config)# epg pgw diameter diameter-application
-system <das-id> peer <peer-id>
   weight <weight-value>
```

The configuration can be changed in runtime. The weight value range is `0`–`10`. If a Diameter peer is assigned a value `0`, the node is not selected for new Diameter sessions.

The default weight value for a Diameter peer is `1`.

2.4.14 Configure the GGSN and PGW to Ignore the Origin-State-Id AVP

The GGSN and PGW can be configured to ignore the `origin-state-Id` AVP received from a Diameter agent or Diameter server. If the GGSN and PGW ignore the `origin-state-Id` AVP, the GGSN and PGW do not consider the Diameter agent or sever to have restarted. As a result, the GGSN and PGW do not generate the `Diameter Host Restarted` alert for the Diameter agent, or trigger the expected failure handling procedure on the Diameter application for the Diameter server.

Note: Gx interface does not support this configuration in EPG 2.5.

To configure the GGSN and PGW to ignore the `origin-state-Id` AVP, do the following:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion system <das-id>
   ignore-origin-state-id
```

For information on the`Origin-State-Id` AVP, refer to Diameter Base Protocol.

For information on the Gy failure handling procedure, refer to Credit Control.

For information on the `Diameter Host Restarted` alert, refer to Diameter Host Restarted.

2.5 Configure the GGSN and PGW Diameter Host Table

The Diameter host table contains associations between Diameter hostnames and internal GGSN and PGW Diameter host IDs. The Diameter host ID is used solely to facilitate GGSN and PGW configuration, for example, it can be used to specify the hostname of a Diameter peer. Configuring the Diameter host table is optional.

Note: The hostname must be an FQDN, as specified in IETF RFC 6733.

To configure the GGSN and PGW Diameter host table, include the following statement:

```
Ericsson(config)# epg pgw diameter host <host-id>
   host-name <name>
```

New entries can be added to the Diameter host table in runtime. It is also possible to modify a Diameter hostname in runtime. If the associated Diameter host ID is assigned to a peer that has an active transport connection, the GGSN or PGW immediately initiates a new capability exchange procedure.

An entry can be deleted from the table if the Diameter host ID is not used in the configuration of a peer.

2.6 Configure GGSN and PGW Diameter Applications

For information on configuring the Diameter applications, refer to the following:

— Policy control (Gx+): Policy Control Configuration

— Credit control (Gy+): Credit Control Configuration and Charging Methods Configuration

— Rf charging (Rf): Offline Charging Configuration

2.7 Configure Supported Vendor Ids in the GGSN and PGW

The GGSN or PGW can be configured to include a list of `Supported-Vendor-Id` AVPs in the CER message. To configure a list of `Supported-Vendor-Id` AVPs, include the following statement:

```
Ericsson(config)# epg pgw diameter diameter-applica
tion-system <das-id>
   supported-vendor-id (3gpp | 3gpp2 | ericsson | <vendor-id>)
```

`supported-vendor-id` is configured as a string; for known vendors, `supported-vendor-id` can be configured as a numeric string, or set to any of the following predefined values:

— 3gpp

— 3gpp2

— ericsson

For unknown or other vendors, `supported-vendor-id` is set to a numeric string.

Note: The GGSN and PGW only supports configuration of one value for `supported-vendor-id` for a vendor; either as a vendor name, or as a numeric vendor identifier. For example, if Ericsson is the vendor, `supported-vendor-id` can be configured either as `ericsson` or as `193`, not both.

If no `supported-vendor-id` is configured in the DAS, the GGSN or PGW includes the following predefined `Supported-Vendor-Id` AVPs in the CER message as the legacy behavior:

— Gx+: 3gpp, ericsson

— 3GPP Gy: 3gpp, 3gpp2

— Ro: 3gpp, ericsson, 3gpp2

— Rf: 3gpp, 3gpp2

— S6b: 3gpp

— S6bAuth: 3gpp, 12591

Note: The Supported-Vendor-Id list that is sent or received in the CER and CEA messages does not affect other vendor-specific AVPs in the Diameter application. For example, `3GPP2-BSID` AVP is sent independent of whether `Supported-Vendor-Id` AVP with 3gpp2 is sent or received.

The maximum number of `supported-vendor-id`s that can be configured is 64.

3 Diameter Configuration for the SGW

The following sections describe Diameter configuration for the SGW.

3.1 Set Up the SGW for Diameter Communication

To connect the SGW to a Diameter network, an Rf logical interface must be configured for the SGW Session Controller (SSC) running the control plane application.

To configure an Rf logical interface, include the following statement:

```
Ericsson(config)# epg node logical-interface <interface-name>
   address <ipv4-address>
   ipv6-address <ipv6-address>
   routing-instance <instance-name>
```

In the SGW, a logical interface can be added or deleted in runtime. The logical interface cannot be deleted if any Diameter peer is associated with it. The logical interface cannot be modified.

For information about how to associate a logical interface with a Diameter peer, see Section 3.3 on page 26.

3.2 Configure SGW Diameter Properties

This section describes how to configure the SGW properties in the Diameter network.

3.2.1 Configure the SGW Diameter Hostname

The SGW Diameter hostname is included in the Origin-Host AVP in Diameter-messages sent from EPG. For information on the format of this AVP, refer to Diameter Base Protocol. The configured Diameter hostname does not have to be the same as the SGW node name.

Note: If the hostname is not configured as an FQDN, a major communication failure occurs and the connections to the Diameter peers are lost

To configure the SGW Diameter hostname, include the following statement:

```
Ericsson(config)# epg node diameter
   local-host-name <host-name>
```

The SGW hostname can be modified in runtime. Modification of the hostname disconnects all diameter peers. The EPG reconnects to these peers using the modified hostname.

3.2.2 Configure the SGW Diameter Realm Name

The SGW realm name is used together with the hostname to identify an SGW in a Diameter network. The realm name is included in Diameter messages and is a string up to 255 characters long. If the realm name includes spaces, it must be enclosed in double quotation marks (“ ”).

To configure the SGW realm name, include the following statement:

```
Ericsson(config)# epg node diameter
   local-realm <realm-name>
```

The SGW realm name can be modified in runtime. Modification of realm name disconnects all diameter peers. The SGW then reconnects to these peers using the modified realm name.

3.3 Configure SGW Diameter Peers

The Diameter peers next to the SGW must also be configured. Up to 32 Diameter peers can be configured for the SGW. The configured peer ID is used to reference the peer from a DAS.

To configure SGW Diameter peers, include the following statement:

```
Ericsson(config)# epg node diameter remote-diamet
er-peer <peer-name>
   logical-interface <interface-name>
   address <ip-address>
   port <value>
```

An SGW Diameter peer can be added or deleted in runtime. To delete an SGW Diameter peer, all DAS peer statements for all DASs that reference the peer must also be deleted. A DAS that references the Diameter peer prevents the deletion of the Diameter peer. An SGW Diameter peer name cannot be modified.

If a logical interface is configured, the logical interface must be associated with a SGW Diameter peer using the `logical-interface` parameter. There is no default logical interface.

The `address` and `port` parameters can be configured for each configured Diameter peer. The default port value is 3868.

The `logical-interface`, `address`, or `port` parameter defined for an SGW Diameter peer can be modified in runtime. Modification of any of these disconnects the Diameter peer. The EPG then reconnects to the Diameter peer using the modified logical interface, address, or port.

3.3.1 Configure the SGW Peer Time-out

The peer time-out monitors the direct connection between the SGW and the adjacent peer. The peer time-out must be greater than the DAS time-out valid for the connection with the Diameter server. The default peer time-out is 30 seconds. The configurable interval is 3–300 seconds.

To configure the SGW peer time-out, include the following statement:

```
Ericsson(config)# epg node diameter remote-diamet
er-peer <peer-name>
   watchdog <timeout-value>
```

The SGW peer time-out can be modified in runtime. The modified value is applied at the next restart for the peer. Modification does not affect running timers.

3.4 Configure SGW Diameter Application Systems

The configured DASs are identified by an SGW local identifier, configured through `diameter-application-system`. Up to 32 DASs can be configured.

An SGW DAS can be added or deleted in runtime. Deleting a DAS disconnects all referenced diameter peers. An SGW DAS ID cannot be modified.

This section describes the following parameters configurable per SGW DAS:

— Diameter application identifier

— Destination realm

— Diameter peers

It is not possible to configure the DSCP value for a DAS. The DSCP value is hard-coded as `CS4`. For more information about DSCP values, refer to Quality of Service on the SGW and Quality of Service Configuration.

3.4.1 Configure the SGW Diameter Application Identifier

The SGW uses the Diameter application identifier and realm name when addressing a DAS over the Diameter network. The following vendor-specific application is supported:

— Rf

The application identifier can also be specified as `vendor-id:application-id`. Both `vendor-id` and `application-id` numbers are assigned by the Internet Assigned Numbers Authority (IANA).

To configure the SGW Diameter application identifier for a DAS, include the following statement:

```
Ericsson(config)# epg node diameter diameter-applic
ation-system <das-id>
   application-id rf
```

— If `application-id rf` is included, the DAS uses the Rf release configured for `service-context-id`. For more information, refer to Offline Charging Configuration.

An SGW DASs application identifier can be modified. Modification of the application identifier disconnects all diameter peers for the DAS. The EPG reconnects to these peers using the modified application identifier.

3.4.2 Configure the SGW Destination Realm

Diameter messages are addressed using the realm and the application identity of the DAS. A realm name is a string up to 255 characters long.

To configure the SGW destination realm, include the following statement:

```
Ericsson(config)# epg node diameter diameter-applic
ation-system <das-id>
   destination-realm <realm-name>
```

The destination realm for an SGW DAS can be modified. Modification of the destination realm disconnects all diameter peers for the DAS. The SGW then reconnects to these peers using the modified destination realm.

3.4.3 Configure SGW Diameter Peers

If the DAS is not next to the SGW, the SGW sends the requests to the DAS through an adjacent peer in the Diameter network. Any number of the available Diameter peers can be configured for sending messages to a DAS, each with a priority from `0` through 255, where `0` is the highest priority.

Note: The adjacent peers used for sending messages to a DAS must be configured Diameter peers, see Section 2.3 on page 7.

To configure a Diameter peer for sending messages to a DAS, include the following statement:

```
Ericsson(config)# epg node diameter diameter-application
-system <das-id> peer <peer-name>
   priority <value>
```

SGW peers can be added or deleted from a DAS in runtime. Deleting a peer disconnects the peer. If the peer is used in a different DAS, the connection is re-established using the application identifier of the other DAS. An SGW peer can be modified, but not the `peer-name` of the peer.

The priority for an SGW peer can be modified in runtime. The modified priority is used the next time a request message is sent.

Reference List

Standards

[1] Diameter Base Protocol, IETF RFC 6733