



## CHAPTER 3

# Gx Interface Support

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## Introduction

Generally speaking, Gx interface may be used for two purposes:

1. Setting subscriber tunables (for example package id) and setting subscriber Radius VSA attributes, which are used by the Gy interface.

Subscriber parameters may be updated either by SCE or by PCRF triggering. SCE-initiated updates are mostly generated by login events, which result in sending CCR Initial/Update messages to the PCRF. PCRF can initiate an update by sending a RAR message to the SCE.

2. New subscriber integration method, where PCRF is responsible for coupling IP to the subscriber name in the SCE.

Gx subscriber integration is used by setting Gx as anonymous-group manager (similar to SM pull mode).

## Number of Subscriber IP Addresses Supported

The SCE supports a single IP address per subscriber when the Gx interface is used.

## Gx Subscriber Properties and AVPs

The PCRF provides the SCE with the properties related SCA BB and the RADIUS VSAs properties.

The properties related SCA BB provided by the PCRF to the SCE are:

- Package-id
- Real-time monitor
- Up virtual link
- Down virtual link

These properties are provided in the VSAs described in [Table 3-1](#).

## Vendor-Specific AVPs

Table 3-1 describes the vendor-specific Diameter AVPs defined for the Gx reference point. The Vendor-ID header of all AVPs defined in this section is set to “Cisco”.

**Table 3-1 Vendor-specific AVPs**

AVP Name	AVP Code	Value Type	AVP Flag Rules					
			Must	May	Must Not	Should Not	May Encr	Acc type
Cisco-SCA BB-Package-Install	1000	Uint32	V	P		M	Y	All
Cisco-SCA BB-Real-time-monitor-Install	1001	Uint32	V	P		M	Y	All
Cisco-SCA BB-Vlink-Upstream-Install	1002	Uint32	V	P		M	Y	All
Cisco-SCA BB-Vlink-Downstream-Install	1003	Uint32	V	P		M	Y	All



**Note**

The AVP header bit denoted as “M,” indicates whether support of the AVP is required. The AVP header bit denoted as “V,” indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see RFC 3588.

### Cisco-SCA BB-Package-Install

- AVP code—1000
- Value type—Uint32
- Used to activate the SCE package as instructed by the PCRF. Defines the policy that will be assigned to the subscriber.
- Can be used either to install or to update the package ID to a subscriber.

### Cisco-SCA BB-Real-time-monitor-Install AVP

- AVP code—1001
- Value type—Uint32
- Defines the SCE real-time monitor rule sent by the PCRF to the SCE. Activates and deactivates real-time monitoring for the subscriber.
  - Activate by sending a 1.
  - Deactivate by sending a 0.
  - Other values fail and are treated as error.

### Cisco-SCA BB-Vlink-Upstream-Install AVP

- AVP—1002
- Value type—Uint32
- Defines the virtual link upstream rule sent by the PCRF to the SCE. Defines the upstream virtual link that the subscriber is assigned to. The virtual link is used to manage a group of subscribers that share a resource.
- Can be used either to install or update the virtual link upstream to a subscriber.

**Cisco-SCA BB-Vlink-Downstream-Install AVP**

- AVP—1003
- Value type—Uint32
- Defines the virtual link downstream rule sent by the PCRF to the SCE. Defines the downstream virtual link that the subscriber is assigned to. The virtual link is used to manage a group of subscribers sharing a resource.
- Can be used either to install or update virtual link downstream to a subscriber.

## Gx Reused AVPs

Table 3-2 lists the Diameter AVPs reused by the Gx reference point from the existing Diameter applications. Other AVPs from existing Diameter applications, except for the AVPs from the Diameter base protocol, do not need to be supported. The AVPs from the Diameter base protocol are not included in Table 3-2, but they are reused by the Gx reference point.

Where 3GPP Radius VSAs are reused, they are translated to Diameter AVPs, with the exception that the “M” flag is set and the “P” flag may be set.

**Table 3-2** Gx Reused Diameter AVPs

Attribute Name	Description	Acc. type
CC-Request-Number	Number of the request for mapping requests and answers.	All
CC-Request-Type	Type of the request (initial, update, termination).	All
Framed-IP-Address	IP version 4 (IPv4) address allocated to the user.	All
Subscription-ID	Subscriber Id as defined in the PCRF, USER_E164.	All

**Note**

See [Appendix B, “Supported VSAs”](#) for a complete list of supported VSAs.

## Gx Session

The Gx session is the basic Gx entity and it uniquely describes a subscriber and single IP mapping. The session is identified by a unique string (called session-id) and it is created both on the server and the SCE. Each Gx message must include the session-id AVP, which identifies the session that the message refers to.

## Session Creation

The Gx session creation is initiated by the SCE. Session creation includes the exchange of Credit Control Request (CCR) and Credit Control Answer (CCA) messages. The SCE sends an CCR Initial message to the PCRF; the PCRF answers with a CCA message.

In the CCR Initial, the SCE sends the subscriber IP and subscriber name (if no Gx integration is used). The PCRF replies with a CCA Initial message, which includes a subset of the subscriber parameters. After the SCE receives a successful CCA Initial message (including a result AVP with success), the session is successfully opened. If the PCRF CCA Initial message includes error codes, the session is not created, and the SCE will attempt to reopen it later.

## Session Life Time

During the life time of a Gx session, the following messages can be sent:

- CCR Update: Similar to CCR Initial, except that the session is already opened. The SCE asks the PCRF for updates on the parameters.
- RAR: Message sent from the PCRF to the SCE to update subscriber parameters. In this case, an external event causes the PCRF to update the subscriber parameters and send the updates to the SCE.

## Session Ends

A session may be ended in either of two ways:

- The SCE may terminate the session by sending a CCR Terminate message. The CCR Terminate message is triggered by logout of the subscriber, either explicit (for example, SM logout) or implicit (by aging).
- PCRF may terminate the session by sending an Abort Session Request (ASR) message. The ASR message is intended to be used in Gx subscriber integration mode where an external event (for example, user disconnecting the mobile modem Internet connection) triggers the PCRF to close the session. The ASR terminates the session in both modes (Gx subscriber integration and other external integration methods). However, in Gx integration, the ASR also triggers a logout of the subscriber from the SCE.

## Gx Session Life Cycle

The Gx session life cycle varies based on the whether or not subscriber integration is external (set as none) or internal. The following sections describe the Gx session life cycles.

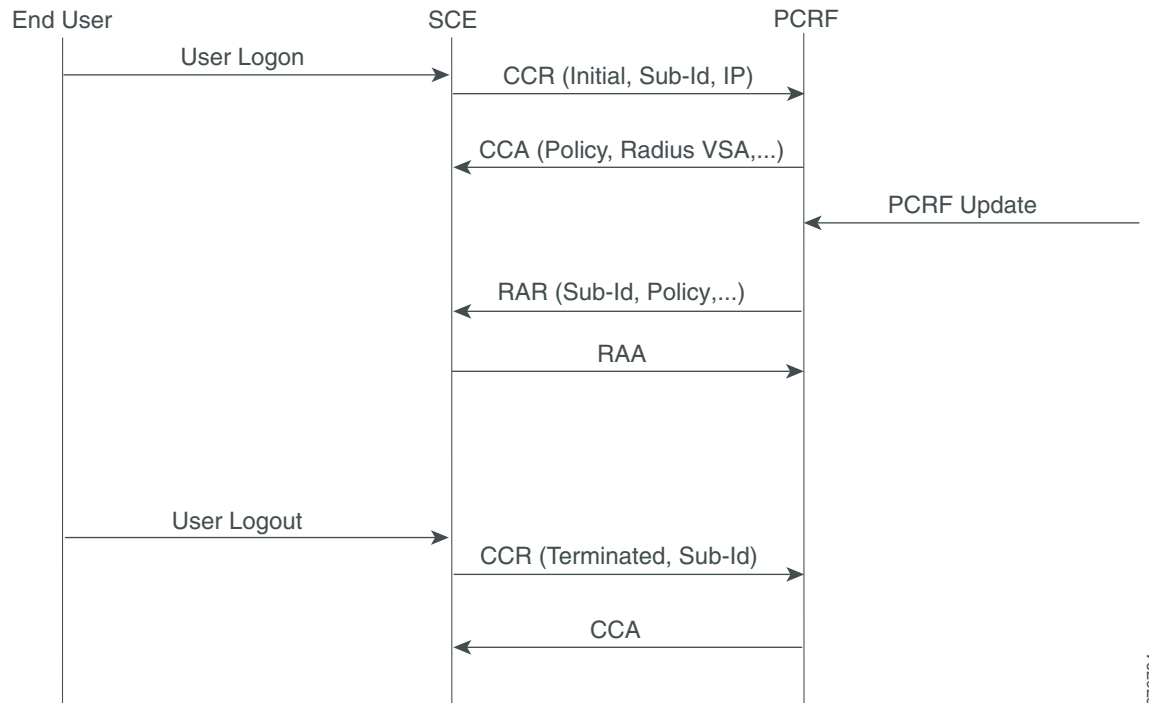
### Gx Subscriber Integration (None)

In an external subscriber integration method such as SM, the Gx session is created when the subscriber logs in. The subscriber is logged in to the SCE by the external API (for example, SM). When the login process is complete, the SCE tries to open a Gx session for the subscriber and IP tuple. After the session is created, (the PCRF responded with a successful CCA Initial), the subscriber parameters are extracted from the CCA message and updated. As described earlier, the PCRF may send a RAR message to the SCE during the life time of the session. CCR Updates may be sent to the PCRF as a result of the external API, such as SM sync.

The Gx session is terminated when the external API in use logs the subscriber out. The session can be terminated by sending an ASR message from the PCRF, although this does not trigger subscriber logout.

Figure 3-1 shows a typical flow of session messages. The flow starts when a subscriber is logged into the SCE, triggering a CCR and CCA message exchange. The session ends with user explicit logout, which terminates the session.

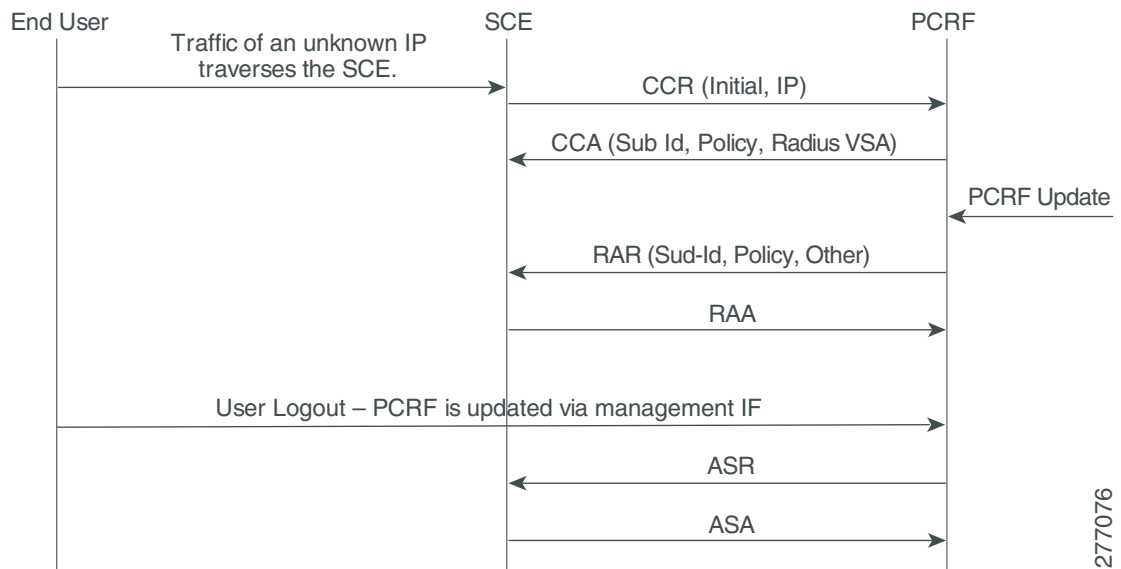
**Figure 3-1 Gx Subscriber Integration (None) Flow**



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## Gx Subscriber Integration

The Gx session life cycle is slightly different when Gx is the subscriber integration method. The SCE starts the Gx session upon identifying an anonymous IP that belongs to the Gx anonymous-group (similar to SM pull, where a pull notification is created). However, the SCE does not know the subscriber name, and therefore it is not sent as part of the CCR Initial message. The PCRF responds with a CCA Initial message that includes the subscriber name. The SCE logs in the subscriber and IP mapping to the SCE, together with the subscriber parameters. The Gx session may terminate in two ways, by aging, which generates subscriber logout, or by CCR Terminate, with the PCRF ending the session by sending ASR. In this scenario, the ASR also logs out the subscriber from the SCE because the Gx is the subscriber owner. See Figure 3-2.

**Figure 3-2 Gx Anonymous-Group Flow**

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Whether the session is terminated by aging or by CCR Terminate, the PCRF may send a RAR in order to update the subscriber parameters.

**Note**

Using Gx, the SCE supports a single IP mapping per subscriber.

## Configuring Gx Support

This section contains the information and instructions to configure and monitor the Gx support configuration.

### Gx Interface CLI Commands

Table 3-3 lists the CLI commands used to configure and monitor the Gx interface.

**Table 3-3 Gx Interface CLI Commands**

CLI Command	Command Description
[no] diameter Gx	Start and stop Gx.
show diameter Gx	Show Gx state and connected peers.
show diameter Gx counters	Show Gx messages statistics.
clear diameter Gx counters	Reset Gx statistics.
diameter Gx tx-timer <timeout-in-seconds>	Set the time out on messages. If the PCRF does not respond to a Gx message in the configured tx-timer seconds, the message is considered timed out. The message is dumped if it arrives after tx-timer expires.

Table 3-3 Gx Interface CLI Commands (continued)

CLI Command	Command Description
diameter Gx PCRF-connection-failure-grace-time <time>	Set the Gx failover grace period. Failover functions as follows: <ul style="list-style-type: none"> <li>• If a connection fails and is reestablished within the failover grace period, no failover action is taken.</li> <li>• If a connection fails and is not reestablished within the failover grace period, failover action is taken.</li> <li>• If a server fails, all its sessions remain open for the failover grace period. After the failover grace period expires, all the server sessions are closed and reopened on secondary server.</li> <li>• If a server fails on a system using session-sharing, no failover action is taken.</li> </ul>
diameter Gx fatal-grace-time <time>	Set the Gx detection timeout. If no connection to any server is detected for the configured length of time, all the diameter sessions are closed and a new connection must be established.

Example for displaying the Gx configuration:

```
SCE8000> show diameter gx
Gx Application Status           : Up
Gx Realm                       : scos.com
Gx tx-timer                    : 5
Gx PCRF-connection-failure-grace-time : 150
Gx fatal-grace-time            : 300
Connected
```

## High Availability for the Gx Interface

Two parameters define the High Availability (HA) behavior:

- Session shared—Defines whether the session needs to reopen upon failover. When a shared session is defined, it is assumed that each session is common to all the servers ( for example, through a common database).
- Stickiness—Defines whether the session needs to move back to the original server when it restarts.

A server is in failure mode if the underlying diameter connection fails and cannot recover for the configurable grace time. Fatal mode is when all the servers are in failure mode and no connections to PCRF exist .

### Session not Shared with Stickiness

When the primary server fails, all the sessions managed by that server are migrated to the next server in a controlled manner (limited by the maximum rate allowed).

If the subscriber is managed by the Gx session, the subscriber is logged out. On the next traffic generating event, the subscriber logs in on a different server. If the subscriber is managed by another method, only the Gx session is closed and the session reopens on the secondary server.

Eventually, all the subscribers relog and migrate to the secondary server. After the primary server is up, new sessions are forwarded to it. The migrated sessions on the secondary server continue on the secondary server until logout or failure.

In this scheme, a server failure causes a long convergence time.

In fatal mode, all Gx-managed subscribers are logged out and all other subscribers remain with their last configuration. When the connection resumes, the SCE reopens all the non-Gx-managed sessions and the Gx-managed sessions are triggered by traffic.

**Example:**

Servers A, B, and C with priority 100, 99, and 98, respectively.

1. After ten Gx sessions, all servers are up and all sessions are opened on server A. Servers B and C do not handle any sessions.
2. Servers A and B fail. The ten sessions are closed and are reopened on server C.
3. Server B is up. Server C continues to handle all its sessions, new sessions open on server B.
4. After nine more new Gx sessions, server A comes back up. Server A handles no sessions, server B handles nine sessions, and server C handles ten sessions.

## Session Shared with Stickiness

In this scheme, the servers share the session. When the primary server is down, all the existing sessions are handled by the secondary server. No relogin is required.

When the primary server is up again, all new sessions are handled by it, while old sessions that were moved to the secondary server remain on the secondary server until logout.

Fatal mode works in the same way as in a session not shared with stickiness.

**Example:**

Servers A, B, and C with priority 100, 99, and 98, respectively.

1. After 10 Gx sessions, all the servers are up and all sessions are opened on server A. Servers B and C do not handle any sessions.
2. Servers A and B fail. The 10 sessions are handled by server C without being closed (no action is taken). When a message needs to be sent, it is sent to server C, and remains with server C until the session is closed.
3. Server B is up. Again no action is taken, all the messages related to the new sessions are sent to server B. Any messages related to the sessions handled by server C (Step 2) remain with server C.
4. After nine more new Gx sessions, server A comes back up. If a message was generated in Step 2 or 3 for a session, it remains with server B or server C, respectively. All the other messages are sent to server A.

## Session Shared Without Stickiness

Same as the session shared with stickiness with the exception that when the primary server recovers, all the sessions are re-forwarded to it.

The fatal node works in the same way as in a session shared with stickiness.



**Example:**

Servers A, B, and C with priority 100, 99, and 98, respectively.

1. After 10 Gx sessions, all servers are up, and all the sessions are opened on server A. Servers B and C do not handle any sessions.
2. Servers A and B fail. The 10 sessions are handled by server C without being closed (no action is taken). When a message needs to be sent, it is sent to server C.
3. Server B is up. No action is taken, all the messages are sent to server B.
4. After nine more new Gx sessions, server A comes back up. No action is taken, all the messages are forwarded to server A.

## Load Balancing with Default High Availability

Load balancing is always done by round robin per available servers. Round robin is done per session and not per message, that is, all the messages for a specific session are sent to the same server.

When a server fails, it is removed from the round robin.

If a server is removed from the load balancing setup, sessions that are already initiated with that server will be closed. These sessions reopen on a new server and remain open with that server.

