



## CHAPTER 5

# Configuring Charging on the GGSN

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This chapter describes how to configure the charging function on a gateway GPRS support node (GGSN). If at minimum, one charging gateway is configured, by default, charging processing is enabled on the GGSN. There are several ways to customize communication with a charging gateway. Many of the default values for the charging options will provide a satisfactory configuration until you become more familiar with your network and decide to customize the charging interface.

For a complete description of the GGSN commands in this chapter, refer to the *Cisco GGSN Command Reference* for the Cisco GGSN release you are using. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

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## Configuring an Interface to the Charging Gateway

To establish access to an external charging gateway in the general packet radio service/Universal Mobile Telecommunication System (GPRS/UMTS) network, you must configure a interface on the GGSN to connect to the network of the charging gateway. In GPRS/UMTS, the interface between the GGSN and the charging gateway is referred to as the *Ga interface*. GGSN Release 4.0 and later supports both a 2.5G Ga interface and 3G Ga interface.

On the Cisco 7600 series router platform, this interface is logical one (on which IEEE 802.1Q-encapsulation has been configured) to the Layer 3 routed Ga VLAN configured on the supervisor engine.

For more information about the Ga VLAN on the supervisor engine, see “[Platform Prerequisites](#)” section on page 1-2.

For more information about configuring interfaces, see the *Cisco IOS Interface Configuration Guide* and the *Cisco IOS Interface Command Reference*.

### Configuring 802.1Q-Encapsulated Subinterfaces

To configure a subinterface that supports IEEE 802.1Q encapsulation to the Ga VLAN, use the following commands, beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# <b>interface</b> gigabitethernet <i>slot/port.subinterface-number</i>	Specifies the subinterface on which IEEE 802.1Q will be used.
Step 2	Router(config-if)# <b>encapsulation dot1q</b> <i>vlanid</i>	Defines the encapsulation format as IEEE 802.1Q (dot1q), and specifies the VLAN identifier.
Step 3	Router(config-if)# <b>ip address</b> <i>ip-address mask</i>	Sets a primary IP address for an interface.

## Verifying Interface Configuration to the Charging Gateway

To verify the interface to the charging gateway (CG) you can first verify your GGSN configuration and then verify that the interface is available.

- Step 1** To verify that you have properly configured a Ga interface on the supervisor engine, use the **show running-config** command. The following example is a portion of the output from the command showing the Fast Ethernet 8/22 physical interface configuration as the Ga interface to the SGSN. The configuration of the Fast Ethernet 8/22 physical interface is shown in bold.

```
Sup# show running-config
Building configuration...

Current configuration :12672 bytes
!
version 12.2
...
interface FastEthernet8/22
no ip address
switchport
switchport access vlan 302
!
interface Vlan101
description Vlan to GGSN for GA/GN
ip address 10.1.1.1 255.255.255.0
!
interface Vlan302
ip address 40.0.2.1 255.255.255.0
```

- Step 2** To verify that the physical interface and the Ga VLAN are available, use the **show interface** command on the supervisor engine. The following example shows that the Fast Ethernet 8/22 physical interface to the charging gateway is up as well as the Ga VLAN, VLAN 101:

```
Sup# show ip interface brief FastEthernet8/22
Interface          IP-Address      OK? Method Status      Protocol
FastEthernet8/22  unassigned     YES unset  up          up

Sup# show ip interface brief Vlan302
Interface          IP-Address      OK? Method Status      Protocol
Vlan302           40.0.2.1       YES TFTP   up          up

Sup#
```

- Step 3** To verify the Ga VLAN configuration and availability, use the **show vlan name** command on the supervisor engine. The following example shows the Gn VLAN Gn\_1:

```
Sup# show vlan name Ga_1

VLAN Name                Status    Ports
-----
302  Ga_1                    active    Gi4/1, Gi4/2, Gi4/3, Gi7/1
                                           Gi7/2, Gi7/3, Fa8/22, Fa8/26

VLAN Type  SAID      MTU   Parent  RingNo BridgeNo Stp   BrdgMode Trans1 Trans2
-----
302  enet    100302   1500   -       -       -       -       -       0       0

Remote SPAN VLAN
-----
Disabled

Primary Secondary Type          Ports
-----
```

- Step 4** On the GGSN, to verify that you have properly configured a Ga subinterface to the Ga VLAN, use the **show running-config** command. The following example is a portion of the output from the command which shows a Fast Ethernet 5/1 physical interface configuration as the Ga interface to the charging gateway:

```
GGSN# show running-config
Building configuration...

Current configuration :7390 bytes
!
! Last configuration change at 16:56:05 UTC Wed Jun 25 2003
! NVRAM config last updated at 23:40:27 UTC Fri Jun 13 2003
!
version 12.3
.....
interface GigabitEthernet0/0.2
 description Ga/Gn Interface
 encapsulation dot1Q 101
 ip address 10.1.1.72 255.255.255.0
 no cdp enable
!
.....
ip route 40.1.2.1 255.255.255.255 10.1.1.1
```

- Step 5** To verify that the subinterface is available, use the **show ip interface brief** command. The following example shows that the Gigabit Ethernet 0/0.2 subinterface to the Ga VLAN is in “up” status and the protocol is also “up”:

```
GGSN# show ip interface brief GigabitEthernet0/0.2
Interface          IP-Address      OK? Method Status          Protocol
GigabitEthernet0/0.2 10.1.1.72      YES NVRAM  up              up
```

## Configuring the Default Charging Gateway

You can configure a primary charging gateway that the GGSN uses, by default, to communicate charging information. Additionally, you can specify a secondary and tertiary charging gateway as backups. All charging gateways share the same global charging parameters.

To configure a default charging gateway for a GGSN, use the following command in global configuration mode:

Command	Purpose
Router(config)# <b>gprs default charging-gateway</b> { <i>ip-address</i>   <i>name</i> } [{ <i>ip-address</i>   <i>name</i> }] [{ <i>ip-address</i>   <i>name</i> }] [{ <i>ip-address</i>   <i>name</i> }]	<p>Specifies a primary charging gateway (and secondary and tertiary backups), where:</p> <ul style="list-style-type: none"> <li><i>ip-address</i>—Specifies the IP address of a charging gateway. The second (optional) <i>ip-address</i> argument specifies the IP address of a secondary charging gateway.</li> <li><i>name</i>—Specifies the host name of a charging gateway. The second (optional) <i>name</i> argument specifies the host name of a secondary charging gateway.</li> </ul>

## Configuring the GGSN to Switchover to the Highest Priority Charging Gateway

When priority switchover has been configured on the GGSN using the **gprs charging switchover priority** command, regardless of the state of the current active charging gateway, when a gateway of higher priority comes up, the GGSN will switch over and send G-CDRs to that charging gateway.

To configuring priority switchover on the GGSN, use the following command in global configuration mode:

Command	Purpose
<b>Step 1</b> Router(config)# <b>gprs charging switchover priority</b>	Configures the GGSN to switch over to the gateway of higher priority when that gateway becomes active.

## Changing the Default Charging Gateway

To change the default charging gateway of a GGSN, use the following commands, beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# <b>gprs default charging-gateway</b> 10.9.0.2	Specifies a primary charging gateway at IP address 10.9.0.2.
Step 2	Router(config)# <b>no gprs default charging-gateway</b> 10.9.0.2	Removes the primary charging gateway at IP address 10.9.0.2.
Step 3	Router(config)# <b>gprs default charging-gateway</b> 10.9.0.3	Specifies the new default primary charging gateway at IP address 10.9.0.3.

## Configuring the GGSN Memory Threshold

The GGSN memory protection feature prevents processor memory from being drained during periods of abnormal conditions (such as when all charging gateways are down and the GGSN is buffering CDRs into memory). By default, the memory threshold is 10% of the total memory available at the time GGSN services are enabled using the **gprs ggsn service** global configuration command. You can use the **gprs memory threshold** global configuration command to configure the threshold according to the router and memory size.

When the amount of memory remaining on the system reaches the defined threshold, the memory protection feature activates and the GGSN performs the following actions to keep the processor memory from falling below the threshold:

- Rejects new create PDP requests with the cause value “No Resource.”
- Drops any existing PDPs for which an update is received with the cause value “Management Intervention.”
- Drops any PDPs for which a volume trigger has occurred.



### Note

While the memory protection feature is active, byte counts will be maintained and reported after the GGSN recovers. However, because some change conditions are not handled, some counts will not reflect the accurate charging condition (for example, QoS and tariff conditions).

To configure the memory threshold that when reached, activates the memory protection feature on the GGSN, use the following global configuration command:

Command	Purpose
Router(config)# <b>gprs memory threshold</b> <i>threshold</i>	Configures the memory threshold on the GGSN. Valid range is 0 to 1024. The default is 10% of the total memory available at the time GGSN services are enabled.

# Configuring the Transport Protocol for the Charging Gateway

You can configure a GGSN to support either Transport Control Protocol (TCP) or User Datagram Protocol (UDP) as the transport path protocol for communication with the charging gateway.

The GGSN default configuration specifies UDP, which is a connectionless protocol that is considered an unreliable transport method but can yield greater performance.

## Configuring TCP as the Charging Gateway Path Protocol

TCP is a connection-based protocol that provides reliable transmission through packet acknowledgment. To specify TCP as the transport path protocol, use the following commands, beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# <b>gprs charging cg-path-requests 1</b>	Specifies the number of minutes that the GGSN waits before trying to establish the TCP path to the charging gateway when TCP is the specified path protocol. The default is 0 minutes, which disables the timer.
Step 2	Router(config)# <b>gprs charging path-protocol tcp</b>	Specifies that the TCP networking protocol is used by the GGSN to transmit and receive charging data.

## Configuring UDP as the Charging Gateway Path Protocol

The GGSN default configuration specifies UDP as the transport path protocol to the charging gateway. If you need to reconfigure the charging gateway for UDP transport, use the following command in global configuration mode:

Command	Purpose
Router(config)# <b>gprs charging path-protocol udp</b>	Specifies that the UDP networking protocol is used by the GGSN to transmit and receive charging data. The default value is UDP.

## Configuring the Charging Release

GGSN Release 4.0 and later support both 2.5G and 3G Ga interfaces and GPRS (R97/R98) and UMTS (R99) Quality of Service (QoS) profile formats. With GGSN Release 5.0 and later, the GGSN can be configured to comply with 3GPP TS 32.215 Release 4 or Release 5.

Depending on the CG and GGSN configuration, when specifying the 99 or 98 keyword, the following actions take place:

- If the GGSN is configured to present R97/R98 CDRs (**gprs charging release 98** is configure):
  - If the PDP context is R98, the GGSN presents an R97/R98 G-CDR.
  - If the PDP context is R99, the GGSN presents an R97/R98 G-CDR by converting the R99 QoS profile to an R97/R98 QoS profile.

- If the GGSN is configured to present R99 CDRs (**gprs charging release 99** is configure):
  - If the PDP context is R99, the GGSN presents an R99 G-CDR.
  - If the PDP context is R98, the GGSN presents an R99 CDR by converting the QoS profile.

To configure the charging release with which the GGSN complies when presenting G-CDRs, use the following command in global configuration mode:

Command	Purpose
Router(config)# <b>gprs charging release</b> {99   98   4   5}	<p>Configures the format presented by the GGSN in CDRs.</p> <ul style="list-style-type: none"> <li>• <b>99</b>—R97, R98, and R99 QoS profile formats are presented.</li> <li>• <b>98</b>—R97/R98 QoS profile formats are presented.</li> <li>• <b>4</b>—GGSN complies with 3GPP TS 32.215 Release 4.</li> <li>• <b>5</b>—GGSN complies with 3GPP TS 32.215 Release 5.</li> </ul> <p>The default value is 99.</p> <p><b>Note</b> When 99 is configured, the Charging Characteristics parameter is included in G-CDRs. When 4 or 5 is configured, the Charging Characteristics Selection Mode IE is included.</p>

## Configuring Charging for Roamers

A GGSN can be configured to generate G-CDRs for roaming mobile subscribers.

When the charging for roamers feature is enabled on the GGSN, when the GGSN receives a PDP context request, it first checks to see if both the GGSN and serving GPRS support node (SGSN) public land mobile network (PLMN) IDs are present and match (via the Routing Area Identity [RAI] field information element [IE]).

If not both are not present and match, the GGSN matches the IE containing the SGSN Signaling Address field against a list of PLMN IP address ranges that have been defined using the **gprs plmn ip address** command with the **sgsn** keyword option specified.



### Note

To use the RAI IE in Create PDP Context requests to detect roamers, a valid home PLMN must be configured on the GGSN using the **gprs mcc mn** global configuration command. When a valid home PLMN is configured, or valid trusted PLMNs, a CDR will not be generated if the RAI matches the configured home (or trusted) PLMN. A CDR will be created for all PDPs with RAIs that do not match a home or trusted PLMN.



### Note

If the RAI field is not present in a Create PDP Context, and an address range has not been configured using the **gprs plmn ip address** command with the **sgsn** keyword option specified, the PDP will be classified as “unknown” and treated as a roamer.

If the GGSN determines that the SGSN that sent the Create PDP Context request is not located within the same PLMN as it is, the GGSN generates a call detail record (CDR). If the GGSN determines that the SGSN is located in the same PLMN, it will not generate a CDR until it receives notification that the SGSN has changed location to another PLMN.

To enable charging for roamers on the GGSN using the **gprs charging roamers command**, you should first define a set of IP address ranges for a PLMN, using the **gprs plmn ip address** command.

**Note**

It is important that you configure the **gprs plmn ip address** and **gprs charging roamers** commands in their proper order. After you configure the IP address range for a PLMN, use the **gprs charging roamers** command to enable the charging for roamers feature on the GGSN. You can change the IP address range by reissuing the **gprs plmn ip address** command.

To verify your configuration, use the **show gprs charging parameters** command to see if the charging for roamers feature is enabled. To verify your PLMN IP address ranges, use the **show gprs plmn ip address** command.

## Configuring PLMN IP Address Ranges

Depending on how the PLMN IP address ranges have been defined using the **gprs plmn ip address start\_ip end\_ip [sgsn]** command, the charging for roamers feature operates as follows:

- If no PLMN IP address ranges are configured using the **gprs plmn ip address start\_ip end\_ip [sgsn]** command, the GGSN generates CDRs for all initiated PDP contexts regardless of whether the GGSN and SGSN are located within the same PLMN.
- If a list of PLMN IP address ranges has been configured using the **gprs plmn ip address start\_ip end\_ip [sgsn]** command, and one or more of those ranges has been defined using the **sgsn** key word, the GGSN uses those ranges defined with the **sgsn** keyword to determine whether an SGSN is located within the same PLMN.

With this configuration, the following scenarios outline how the charging for roamers feature will function:

- MS1 is subscribed to PLMN1 and attaches to an SGSN in PLMN2. From PLMN2, MS1 initiates a PDP context with the GGSN in PLMN1. In this case, MS1 is a roamer and the GGSN generates a CDR because it determines that the SGSN is located in a different PLMN.
- MS1 is subscribed to PLMN1 and attaches to an SGSN in PLMN2. From PLMN2, MS1 initiates a PDP context with the GGSN in PLMN2. In this case, MS1 is not a roamer because the SGSN and GGSN are in the same PLMN. The GGSN does not create a G-CDR.

To configure PLMN IP address ranges, use the following command in global configuration mode:

Command	Purpose
Router(config)# <b>gprs plmn ip address start_ip end_ip [sgsn]</b>	Specifies the IP address range of a PLMN. Optionally, specifies that only the PLMN IP address ranges defined with the <b>sgsn</b> keyword specified be used to determine if an SGSN is located in a PLMN other than the GGSN.



## Enabling Charging for Roamers

To enable the charging for roamers feature on a GGSN, use the following command in global configuration mode:

Command	Purpose
Router(config)# <b>gprs charging roamers</b>	Enables charging for roamers on a GGSN.

## Customizing the Charging Gateway

For the GGSN charging options, the default values represent recommended values. Other optional commands are also set to default values; however, we recommend modifying these commands to optimize your network as necessary, or according to your hardware.

The GGSN uses echo timing to maintain the path between SGSNs and external charging gateways. However, the GGSN can implement only a single method of echo timing for all the paths that it needs to maintain. To learn more about echo timing on the GGSN, or to modify the echo timing feature, see the [“Configuring Echo Timing on a GGSN”](#) section on page 3-5 in the [“Configuring GTP Services on the GGSN”](#) chapter.

Use the following global configuration commands to fine-tune charging processing on the GGSN:

Command	Purpose
Router(config)# <b>gprs charging cdr-aggregation-limit</b> <i>CDR_limit</i>	Specifies the maximum number of CDRs that a GGSN aggregates in a charging data transfer message to a charging gateway. The default is 255 CDRs.
Router(config)# <b>gprs charging cdr-option apn</b> [ <b>virtual</b> ]	Specifies that the APN IE be included or not included in G-CDRs. Optionally, specify the <b>virtual</b> keyword to include the virtual APN in G-CDRs, accounting records, and credit control requests (CCRs).
Router(config)# <b>gprs charging cdr-option apn-selection-mode</b>	Enables the GGSN to provide the reason code for access point name (APN) selection in G-CDRs. This is disabled by default.
Router(config)# <b>gprs charging cdr-option camel-charge-info</b>	Specifies that a copy of the tag and length of the Customized Application for Mobile Enhanced Logic (CAMEL) from the SGSN's CDR be included in G-CDRs.
Router(config)# <b>gprs charging cdr-option chch-selection-mode</b>	Specifies that the charging characteristics selection mode parameter be included or not included in G-CDRs.
Router(config)# <b>gprs charging cdr-option dynamic-address</b>	Specifies that the dynamic address flag IE be included or not included in G-CDRs.
Router(config)# <b>gprs charging cdr-option imeisv</b>	Specifies that the International Mobile Equipment Identity IMEI software version (IMEISV) IE be included in G-CDRs. The IMEISV identifies the mobile equipment used by the subscriber.
Router(config)# <b>gprs charging cdr-option local-record-sequence-number</b>	Enables the GGSN to use the local record sequence number IE in G-CDRs. This is disabled by default.

Command	Purpose
Router(config)# <b>gprs charging cdr-option ms-time-zone</b>	Specifies that the MS Time Zone (MSTZ) IE be included in G-CDRs. The MSTZ IE indicates the offset between universal time and local time.  A change of the MSTZ in an update request results in a CDR closure and the opening of a new CDR (as specified in R7 32.251). Additionally, an interim accounting record is generated when the MSTZ change occurs in an update request.
Router(config)# <b>gprs charging cdr-option nip</b>	Specifies that the Network-Initiated PDP IE be included in G-CDRs.
Router(config)# <b>gprs charging cdr-option no-partial-cdr-generation [all]</b>	Disables the GGSN from creating fully-qualified partial G-CDRs. Optionally, specify the <b>all</b> keyword option to configure the GGSN to copy the SGSN list for charging releases prior to Release 4 when an SGSN change limit trigger is configure as well.  The default is fully-qualified partial CDR creation is enabled.  <b>Note</b> Enable this feature only when there are no active PDP contexts. Enabling this feature will affect all subsequent PDP contexts.
Router(config)# <b>gprs charging cdr-option node-id</b>	Enables the GGSN to specify the node that generated the CDR in the node ID field in G-CDRs. This is disabled by default.
Router(config)# <b>gprs charging cdr-option packet-count</b>	Enables the GGSN to provide uplink and downlink packet counts in the optional record extension field in G-CDRs. This is disabled by default.
Router(config)# <b>gprs charging cdr-option pdp-address</b>	Specifies that the PDP address IE be included or not included in G-CDRs.
Router(config)# <b>gprs charging cdr-option pdp-type</b>	Specifies that the PDP type IE be included or not included in G-CDRs.
Router(config)# <b>gprs charging cdr-option rat-type</b>	Specifies that the radio access technology (RAT) IE be included in G-CDRs. The RAT indicates whether the SGSN serves the user equipment (UE) by Universal Terrestrial Radio Access Network (UTRAN) or GSM/EDGE RAN (GERAN).  A change of the RAT in an update request results in a CDR closure and the opening of a new CDR (as specified in R7 32.251). Additionally, an interim accounting record is generated when the RAT change occurs in an update request.
Router(config)# <b>gprs charging cdr-option served-msisdn</b>	Enables the GGSN to provide the mobile station ISDN (MSISDN) number from the Create PDP Context request in G-CDRs. This is disabled by default.
Router(config)# <b>gprs charging cdr-option service-record [value]</b>	Enables the GGSN to generate per-service records. Optionally, the maximum number of services records in a CDR can be specified. When the limit is reached, the current G-CDR is closed and a new partial CDR is opened. If a maximum number is not specified, the default of 5 is used.
Router(config)# <b>gprs charging cdr-option sgsn-plmn</b>	Configures the GGSN to include the SGSN PLMN ID in G-CDRS. This is disabled by default.

Command	Purpose
Router(config)# <b>gprs charging cdr-option user-loc-info</b>	Specifies that the user location information (ULI) IE be included in G-CDRs. The ULI provides the cell global identity (CGI) and service area identity (SAI) of the subscriber location.
Router(config)# <b>gprs charging cg-path-requests</b> <i>minutes</i>	Specifies the number of minutes that the GGSN waits before trying to establish the TCP path to the charging gateway when TCP is the specified path protocol. The default is 0 minutes, which disables the timer.
Router(config)# <b>gprs charging container change-limit</b> <i>number</i>	Specifies the maximum number of charging containers within each G-CDR from the GGSN. The default is 5.
Router(config)# <b>gprs charging container sgsn-change-limit</b> <i>number</i>	Specifies the maximum number of SGSN changes that can occur before closing a G-CDR for a particular PDP context. The default is 0, which disables the timer.
Router(config)# <b>gprs charging container time-trigger</b> <i>number</i>	Specifies a global time limit, that when exceeded by a PDP context causes the GGSN to close and update the G-CDR for that particular PDP context. The default is 0, which disables the timer.
Router(config)# <b>gprs charging container volume-threshold</b> <i>threshold_value</i>	Specifies the maximum number of bytes that the GGSN maintains in a user's charging container before closing it and updating the G-CDR. The default is 1,048,576 bytes (1 MB).
Router(config)# <b>gprs charging disable</b>	Disables charging transactions on the GGSN. Charging is enabled by default.
Router(config)# <b>gprs charging flow-control private-echo</b>	Implements an echo request with private extensions for maintaining flow control on packets transmitted to the charging gateway. This is disabled by default.
Router(config)# <b>gprs charging header short</b>	Enables the GGSN to use the GPRS tunneling protocol (GTP) short header (6-byte header) instead of the GTP long header. This is disabled by default.
Router(config)# <b>gprs charging map data tos</b> <i>tos_value</i>	Specifies an IP type of service (ToS) mapping for GPRS charging packets. The default is 3.
Router(config)# <b>gprs charging message transfer-request</b> <b>possibly-duplicate</b>	Specifies for the GGSN to retransmit Data Record Transfer Request messages (sent to a previously active charging gateway) with the value of the Packet Transfer Request IE set to Send Possibly Duplicate Data Record Packet (2).
Router(config)# <b>gprs charging packet-queue-size</b> <i>queue_size</i>	Specifies the maximum number of unacknowledged charging data transfer requests that the GGSN maintains in its queue. The default is 128 packets.
Router(config)# <b>gprs charging path-protocol</b> { <b>udp</b>   <b>tcp</b> }	Specifies the protocol that the GGSN uses to transmit and receive charging data. The default is UDP.
Router(config)# <b>gprs charging port</b> <i>port-num</i>	Configures the destination port of the charging gateway. The default is 3386.
Router(config)# <b>gprs charging send-buffer</b> <i>bytes</i>	Configures the size of the buffer that contains the GTP PDU and signaling messages on the GGSN. The default is 1460 bytes.
Router(config)# <b>gprs charging server-switch-timer</b> <i>seconds</i>	Specifies a timeout value that determines when the GGSN attempts to find an alternate charging gateway after a destination charging gateway cannot be located or becomes unusable. The default is 60 seconds.

Command	Purpose
Router(config)# <b>gprs charging tariff-time</b> <i>time</i>	Specifies a time of day when GPRS/UMTS charging tariffs change. There is no default tariff time.  <b>Note</b> If the system software clock is manually set using the <b>clock set</b> privileged EXEC command at the supervisor console prompt, the time a tariff change will occur must be reconfigured.
Router(config)# <b>gprs charging message transfer-request</b> <b>command-ie</b>	Specifies for the GGSN to include the Packet Transfer Command information element (IE) in Data Record Transfer Response messages.  <b>Note</b> Even though GGSN 4.0 and later supports the Packet Transfer Command IE, only the “Send Data Record Packet” value is used, even though the packet might be duplicated. The Cisco GGSN does not support the “Send Possibly Duplicated Data Record Packet,” “Cancel Data Record Packet,” or “Release Data Record Packet” values. Therefore, the CG or billing servers must have the ability to eliminate duplicate CDRs.
Router(config)# <b>gprs charging message transfer-response</b> <b>number-responded</b>	Specifies for the GGSN to use the Number of Requests Responded field instead of the Length field in the Requests Responded IE of Data Record Transfer Response messages. This is disabled by default.
Router(config)# <b>gprs charging reconnect</b> <i>minutes</i>	Configures the GGSN to periodically attempt to reconnect to a CG that is unreachable to determine when the link is back up.  <b>Note</b> Configuring the GGSN to automatically attempt to reconnect to an unreachable CG is necessary only when UDP is used as the charging transport protocol and the charging gateway does not support echo requests.
Router(config)# <b>gprs charging transfer interval</b> <i>seconds</i>	Specifies the number of seconds that the GGSN waits before it transfers charging data to the charging gateway. The default is 105 seconds.

For information about configuring GGSN GTP options, see the [“Customizing the GGSN Configuration” section on page 3-15](#) in the [“Configuring GTP Services on the GGSN”](#) chapter.

## Disabling Charging Processing



### Caution

The **gprs charging disable** command removes charging data processing on a GGSN, which means that the data required to bill customers for network usage is neither being collected by the GGSN nor being sent to the charging gateway. We recommend that you avoid using this command in production GPRS/UMTS network environments. When it is necessary to use this command, use it with extreme care and reserve its usage only under nonproduction network conditions.

You can disable charging on the GGSN only after all the open CDRs have been processed and sent to the charging gateway. To clear the current GGSN CDRs, use the **clear gprs charging cdr** privileged EXEC command.

To disable charging processing on a GGSN, use the following command, beginning in global configuration mode:

Command	Purpose
Router(config)# <b>gprs charging disable</b>	Disables charging transactions on the GGSN.

## Using Charging Profiles

Cisco GGSN 5.0 and later allows you to apply different charging methods on a per-PDP basis using *charging profiles* that you create, customize, and specify as the default charging method to use for a specific type of user at an APN level and global level. Charging profiles provide the ability to offer flexible services that are customized to subscriber preferences.

When using charging profiles, please note the following:

- The GGSN must be configured to include the charging characteristics selection mode parameter in CDRs using the `gprs charging cdr-option chch-selection-mode global` configuration command.
- The GGSN must be configured to receive the charging characteristics selection mode IE in CDRs by using the `gprs charging release global` configuration command.

To apply charging methods on a per-PDP basis using GGSN charging profiles, you must complete the tasks outline in the following sections:

- [Configuring a Charging Profile, page 5-13](#)
- [Defining the Charging Characteristics and Triggers of the Charging Profile, page 5-15](#)
- [Applying a Default Charging Profile to an APN, page 5-16](#)
- [Applying a Global Default Charging Profile, page 5-17](#)
- [Configuring How the GGSN Handles PDPs with Unmatched Charging Profiles, page 5-17](#)

## Configuring a Charging Profile

Charging profiles define the charging method to apply to a specific type of user (home, roamer, visitor).

The GGSN supports up to 256 charging profiles numbered 0 to 255.

Profile 0 is a set profile that always exists on the GGSN. It is not created by a GGSN operator, however, it can be modified using the charging-related global configuration commands. Profiles 1 to 255 are user-defined and customized using charging profile configuration commands.

When a Create PDP Context request is received, an appropriate charging profile is selected based on the following sources of input:

- SGSN/HLR via the charging characteristics IE.
- Local defaults.
- Charging profile index AAA attribute.

**Note**

The charging profile index received from AAA will take effect only if service-awareness has been configured globally on the GGSN (using the **gprs service-aware** global configuration command), and at the APN level (using the **service-aware** access-point configuration command).

For information on configuring a service-aware GGSN, see the “Configuring Enhanced Service-Aware Billing” chapter of the Cisco GGSN Configuration Guide.

The order in which a charging profile is selected for a PDP context, is as follows:

1. Charging profile index in the override rule on the APN—If a default charging profile has been configured at both the APN and global level to override the SGSN specification, the APN default charging profile is used first.
2. Charging profile index in the override rule on the box (global default charging profile)—If there is no default charging profile default configured at the APN, the default charging profile configured globally is use.
3. Charging profile index from AAA.
4. Charging profile index from SGSN/HLR
5. Charging profile index from the non-override rule on the APN.
6. Charging profile index from non-override rule on the box (global default charging profile).

If none of the above applies, the PDP context is rejected if the **gprs charging characteristics reject** global configuration command is configured and the create request is GTP v1. If the **gprs charging characteristics reject** command is not configured, the GTPv1 PDP context is created using charging profile 0.

**Note**

The default charging profile, i.e. charging profile 0, is not supported for service-aware PDPs. These PDP create requests will be rejected with error code 199.

To create or modify a charging profile and enter charging profile configuration mode, use the following global configuration command:

Command	Purpose
Router(config)# <b>gprs charging profile</b> <i>chp-num</i>	Creates a new charging profile (or modifies an existing one), and enters charging profile configuration mode. Valid values are 1 to 15.

## Defining the Charging Characteristics and Triggers of the Charging Profile

To configure the charging methods and triggers of a charging profile, use the following commands in charging profile configuration mode:

Command	Purpose
Router(ch-prof-conf)# <b>category</b> {hot   flat   prepaid   normal}	Identifies the category of subscriber to which a charging profile applies.
Router(ch-prof-conf)# <b>cdr suppression</b>	Specifies that CDRs be suppressed.
Router(ch-prof-conf)# <b>cdr suppression prepaid</b>	Specifies that CDRs be suppressed for prepaid users.
Router(ch-prof-conf)# <b>content dcca profile</b> <i>profile-name</i>	Specifies the profile to use to communicate with a DCCA server.
Router(ch-prof-conf)# <b>content postpaid</b> {qos-change   sgsn-change   plmn-change   rat-change}	<p>Configures a condition in a charging profile for postpaid users, that when it occurs, triggers the GGSN to request quota reauthorization for a PDP context.</p> <ul style="list-style-type: none"> <li>• <b>qos-change</b>—Configures a quality of service (QoS) change to trigger a quota reauthorization request.</li> <li>• <b>sgsn-change</b>—Configures a SGSN change to trigger a quota reauthorization request.</li> <li>• <b>plmn-change</b>—Configures a public land mobile network (PLMN) change to trigger a quota reauthorization request.</li> <li>• <b>rat-change</b>—Configures a radio access technology (RAT) change to trigger a quota reauthorization request.</li> </ul> <p><b>Note</b> The <b>plmn-change</b> and <b>rat-change</b> keyword options require that the GGSN has been configured to include the RAT and/or PLMN ID fields in the service-record IE in CDRs using the <b>gprs charging service record</b> include global configuration command.</p>
Router(ch-prof-conf)# <b>content postpaid time</b>	Configures, as a trigger condition for postpaid users when service aware billing is enabled, the time duration limit that when exceeded, causes the GGSN to collect upstream and downstream traffic byte counts and close and update the G-CDR for a particular PDP context.
Router(ch-prof-conf)# <b>content postpaid validity</b>	Configures, as a trigger condition in a charging profile for postpaid users when service-aware billing is enabled, the amount of time quota granted to a user is valid.
Router(ch-prof-conf)# <b>content postpaid volume</b>	Configures, as a trigger condition for postpaid users when service aware billing is enabled, the maximum number of bytes that the GGSN maintains across all containers for a particular PDP context before closing and updating the G-CDR.
Router(ch-prof-conf)# <b>content rulebase</b> <i>id</i>	Defines a default rulebase ID to apply to PDP contexts.
Router(ch-prof-conf)# <b>description</b>	Specifies the name or a brief description of a charging profile.

Command	Purpose
Router(ch-prof-conf)# <b>limit volume</b> <i>number</i> [ <b>reset</b> ]	Configures the maximum number of bytes that can be reported in each CDR from an active PDP context before the GGSN closes and updates the CDR, and opens a partial CDR for the PDP context while it remains in session on the GGSN.  If the <b>reset</b> keyword option is configured, the volume trigger is reset if the CDR is closed by any other trigger. If the <b>reset</b> keyword is not specified, the volume trigger will not be reset when the time trigger expires ( <b>limit duration</b> command), but it will be reset when any other trigger expires.
Router(ch-prof-conf)# <b>limit duration</b> <i>number</i> [ <b>reset</b> ]	Configures, as a trigger condition, the time duration limit (in minutes) that when exceeded causes the GGSN to collect upstream and downstream traffic byte counts and close and update the G-CDR for a particular PDP context.  If the <b>reset</b> keyword option is configured, the time trigger is reset if the CDR is closed by any other trigger. If the <b>reset</b> keyword is not specified, the time trigger will not be reset when the volume trigger expires ( <b>limit volume</b> command), but it will be reset when any other trigger expires.
Router(ch-prof-conf)# <b>tariff-time</b>	Specifies that a charging profile use the global tariff change time configured using the <b>gprs charging tariff-time</b> global configuration command.
Router(ch-prof-conf)# <b>limit sgsn-change</b>	Specifies that a charging profile use the global tariff changes configured using the <b>gprs charging tariff-time</b> global configuration command.

## Applying a Default Charging Profile to an APN

To configure a default charging profile to use for a specific type of user at an APN, use the following access-point configuration command:

Command	Purpose
Router(config-access-point)# <b>charging profile</b> { <b>home</b>   <b>roaming</b>   <b>visiting</b>   <b>any</b> } [ <b>trusted</b> ] <i>chp_num</i> [ <b>override</b> ]	Configures a default charging profile to be used for a specific type of user at an APN.



## Applying a Global Default Charging Profile

Default charging profiles configured at the global level are used when a default charging profile has not been specified for an APN.

To configure a default charging profile to use for a specific type of user globally, use the following global configuration command:

Command	Purpose
Router(config)# <b>gprs charging profile default</b> {home   roaming   visiting   any} [trusted] chp_num [override]	Applies a global default charging profile for a specific type of user.

## Configuring How the GGSN Handles PDPs with Unmatched Charging Profiles

The GGSN can be configured to reject or accept GTPv1 Create PDP Context requests for which a profile cannot be matched. If configured to accept these PDP context requests, the charging method defined by charging profile 0 is applied. By default, the Create PDP Context requests are accepted and the charging method defined in charging profile 0 is applied.

The following restrictions apply to charging profiles selected for service-aware PDPs:

- All PDP s belonging to the same user must use the same charging profile as that of the primary PDP.
- The default charging profile, i.e. charging profile 0, is not supported for service-aware PDPs. These PDP create requests will be rejected with error code 199.

To configure a GGSN to reject Create PDP Context requests for which a charging profile cannot be matched, use the following global configuration command:

Command	Purpose
Router(config)# <b>gprs charging characteristics reject</b>	Configures the GGSN to reject GTPv1 Create PDP Context requests for which a charging profile cannot be selected.

## Configuring G-CDR Backup and Auto-Retrieval using a PSD

Up to three CGs can be configured for a GGSN. One gateway at a time functions as the active CG to which the GGSN sends G-CDRs, while the remaining two gateways function as standby CGs in case the active CG goes down. If all three CGs should become inactive, the GGSN buffers G-CDRs into its memory until one of the three CGs becomes active. This can affect the GGSN's memory resources, and if the GGSN should fail, the G-CDRs buffered into memory are lost.

To avoid a situation in which the GGSN must buffer G-CDRs into memory, you can configure the GGSN to backup G-CDRs to, and retrieve G-CDRs from, a Cisco Persistent Storage Device (PSD).

### PSD Server Types

A PSD server can be configured to function as either a *backup* or *retrieve-only* server.

- Backup PSD

The backup server is a local PSD (located within the same chassis) to which the GGSN writes G-CDRs if a CG is not available.

A backup PSD shares the same properties of operation modes as a CG.

- Retrieve-Only PSD

In a GTP-SR implementation, a “retrieve-only” server must be configured in addition to the local backup server. The retrieve-only server is a remote PSD, located within the same chassis as the second GGSN of the GTP session redundancy (GTP-SR) pair, from which the GGSN collect G-CDRs if a GGSN failover should occur. In other words, the remote PSD of a GGSN functions as the local PSD for the redundantly-configured GGSN and vice versa.

If a GGSN is running in a GTP session redundancy (GTP-SR) configuration, the GGSN writes only to its local PSD and always retrieves from both the remote and local PSDs to guarantee no wedged G-CDRs remain in the GGSN in case of a double failure.

For example, if a previously active GGSN writes G-CDRs to its local PSD and there is a GGSN switchover before it can completely retrieve all the G-CDRs from that PSD, then, upon a retrieval event, the newly active GGSN retrieves all the G-CDRs from the remote PSD that was local to the previously active GGSN before the switchover. The new GGSN does not write G-CDRs to the remote PSD.

The maximum rate of G-CDRs retrieved from the PSD during the auto-retrieve process can be configure (using the **auto-retrieve** PSD group configuration command) to avoid overwhelming the system with live-CDRs along with auto-retrieved G-CDRs.



#### Note

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Up to two PSDs (one backup and one retrieve-only) can be configured in a PSD server group.

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#### Note

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One PSD server group can be configured per GGSN.

---

### Triggering Events

The following events trigger a G-CDR backup or retrieval:

- Backup Event—When all paths to the configured CGs fail, a backup event is triggered. When this event is triggered, the GGSN begins to send G-CDRs to the PSD.
- Retrieval Events—When a CG becomes active from a previously undefined state, a retrieval event occurs. When this event is triggered, the GGSN starts to retrieve G-CDRs from the PSDs (local and remote if configured for GTP-SR) and forwards them to the newly active CG. When a CG becomes available, the GGSN can be configured to automatically retrieve G-CDRs from a group of PSDs by specifying the **auto-retrieve** command when configuring the PSD server group, or the G-CDRs can be manually retrieved via FTP.

To view counters that indicate the number of event triggers received, use the **show data-store statistics** command.

### PSD Server Disk States

The state of a PSD disk is one of the following:

- Full—No disk space is available. When in a DISK FULL state, the PSD cannot be used for writing.
- Available—Disk space is available. By default, a GGSN assumes this disk state unless it receives a DISK FULL indication from the PSD.

To view the state of a PSD disk, use the **show data-store** command.

### PSD Client States

The states of a PSD client can be one of the following:

- Idle—Server is available. When a PSD moves from a Writing state to an Idle state, the pending write requests are copied and sent to the active CG.
- Writing—Server is being written to. When a backup event occurs, a PSD client in Idle state or Retrieving state enters Writing state if the PSD disk state is not full. If the PSD disk state is full, the PSD is moved to an idle state.
- Retrieving—Server is being retrieved from. When a retrieval event occurs, a PSD client in Idle or Writing state enters Retrieving state. G-CDRs are retrieved from the PSD and forwarded to the active CG. If there are two PSDs configured in a PSD server group, G-CDRs are retrieved from retrieve-only PSD first, and then the backup PSD. After all records are retrieved, the PSD client moves to an Idle state.

To view the state of a PSD client, use the **show data-store** command.

### PSD Operation Modes

The operation modes of the PSDs are as follows:

- Undefined—A PSD is configured on the GGSN but no network connection has been established. The operation mode of a retrieve-only PSD is always undefined.
- Standby—A local PSD is configured on the GGSN, a network connection has been established, but the PSD client (the GGSN) is neither nor retrieving G-CDRs from the PSD (G-CDRs are being sent to the CGs). If a backup event occurs, the GGSN moves to the PSD Active state.
- Active—G-CDRs are being sent to the local PSD. The operation characteristics configured for the CGs apply to the PSD.

To view the state of a PSD client, use the **show data-store** command.

To configure G-CDR auto-retrieval and backup support on the GGSN, complete the following tasks, beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# <b>data-store</b> <i>psd-group-name</i>	Configures a PSD server group on the GGSN to use for GGSN-to-PSD communication and enters PSD group configuration mode.
Step 2	Router(config-data-store)# <b>server</b> <i>psd-ip-address</i> [ <b>retrieve-only</b> ]	Defines the PSD server by IP address and optionally, specifies whether the server is a retrieve-only server.
Step 3	Router(config-data-store)# <b>auto-retrieve</b> <i>auto-retrieve-rate</i>	Configures the GGSN to automatically initiate a G-CDR retrieval from the PSD servers in a PSD group when a CG becomes active and specifies the maximum number of retrieval requests that can be sent from the GGSN to the PSDs per minute.

# Monitoring and Maintaining Charging on the GGSN

This section provides a summary list of the **show** commands that you can use to monitor charging functions on the GGSN.

The following privileged EXEC commands are used to monitor and maintain charging on the GGSN:

Command	Purpose
Router# <b>show gprs charging parameters</b>	Displays information about the current GGSN charging configuration.
Router# <b>show gprs service-mode</b>	Displays the current global service mode state of the GGSN and the last time it was changed.
Router# <b>show gprs charging statistics</b>	Displays cumulative statistics about the transfer of charging packets between the GGSN and charging gateways.
Router# <b>show data-store statistics</b>	Displays the PSD client statistics, including the number of requests sent and DRT responses received.
Router# <b>show data-store</b>	Displays the status of the PSD client and PSD server-related information.

## Configuration Examples

The following are examples of charging configurations implemented on the GGSN.

### Global Charging Configuration

#### GGSN Configuration

```
GGSN# show running-config
Building configuration...

Current configuration :7390 bytes
!
! Last configuration change at 16:56:05 UTC Wed Jun 25 2003
! NVRAM config last updated at 23:40:27 UTC Fri Jun 13 2003
!
version 12.3
.....
interface GigabitEthernet0/0.2
 description Ga/Gn Interface
 encapsulation dot1Q 101
 ip address 10.1.1.72 255.255.255.0
 no cdp enable
!
.....
ip route 40.1.2.1 255.255.255.255 10.1.1.1
!
gprs access-point-list gprs
 access-point 1
 access-point-name auth-accounting
 access-mode non-transparent
 aaa-group authentication first
 aaa-group accounting second
```

```

    ip-address-pool dhcp-proxy-client
    dhcp-server 10.60.0.1
    dhcp-gateway-address 10.60.0.1
    exit
    !
    . . .
    !
    gprs default charging-gateway 10.9.0.2
    gprs charging send-buffer 1000
    gprs charging container volume-threshold 500000
    gprs charging container change-limit 3
    gprs charging cdr-aggregation-limit 10
    gprs charging cdr-option apn-selection-mode
    gprs charging cdr-option served-msisdn
    !
    gprs memory threshold 512
    !
    . . .
    !
end

```

### Supervisor Engine Configuration

```

Sup# show running-config
Building configuration...

Current configuration :12672 bytes
!
version 12.2
...
interface FastEthernet8/22
 no ip address
 switchport
 switchport access vlan 302
!
interface Vlan101
 description Vlan to GGSN for GA/GN
 ip address 10.1.1.1 255.255.255.0
!
interface Vlan302
 ip address 40.0.2.1 255.255.255.0

```

## Charging Profile Configuration

The following partial configuration example shows two charging profiles (charging profile 1 and charging profile 2) configured on the GGSN, with charging profile 1 being configured as the global default charging profile to be used for “any” type of user if a charging profile is not specified at the APN:

```

GGSN# show running-config
Building configuration...

Current configuration :7390 bytes
!
! Last configuration change at 16:56:05 UTC Wed Jun 25 2003
! NVRAM config last updated at 23:40:27 UTC Fri Jun 13 2003
!
version 12.3
.....
interface GigabitEthernet0/0.2
 description Ga/Gn Interface
 encapsulation dot1Q 101

```

```
ip address 10.1.1.72 255.255.255.0
no cdp enable
!
.....
ip route 40.1.2.1 255.255.255.255 10.1.1.1
!
!
. . .
!
gprs charging profile default any 1

gprs charging profile 1
description "roamer_profile"
limit volume 500000 reset
limit duration 30 reset
!
gprs charging profile 2
description "any_unmatched"
limit volume 1000000 reset
limit duration 60 reset
. . .
!
. . .
!
end
```