



# Cisco Packet Data Serving Node Release 5.1 for Cisco IOS Release 12.4(22)XR2

---

## Feature History

This table describes feature support for Cisco Packet Serving Node (PDSN) releases.

Release	Modification
12.4(22)XR1	Release 5.1 of Cisco PDSN. The following new features are introduced: <ul style="list-style-type: none"><li>• <a href="#">Simple IP Client IP Accounting Support</a></li><li>• <a href="#">SNMP New MIB Objects for Per PCF</a></li><li>• <a href="#">Support for Common NAI</a></li><li>• <a href="#">Proxy MIP Changes for Latest IS-835</a></li><li>• <a href="#">Simple IPv6 Support</a></li><li>• <a href="#">Access-Request Attributes</a></li><li>• <a href="#">New PPP Per PCF Counters</a></li><li>• <a href="#">VPDN Conditional Debugging</a></li><li>• <a href="#">GRE CVSE and MN NAI Extension in Revocation Message</a></li></ul>



---

12.4(22)XR

Release 5.0 of Cisco PDSN. The following new features are introduced:

- Single IP per Blade
- Osler Support
- Improved Throughput and Transaction Handling
- Cluster Controller Support in Single IP Blade
- IMSI and PCF Redirection
- Mobile IP and AAA Attributes for China Telecom
- MIB Support
- Trap Generation for AAA Server Unresponsiveness
- Supervisor Support
- Data Over Signaling
- Differentiated Services Code Point Marking Support
- Nortel Aux A10 Support
- Masking Off IMSI Prefix
- Persistent TFT Support
- Conserve Unique IP-ID for FA-HA IP-in-IP Tunnel
- GRE CVSE Support in FA-HA Tunnel
- Remote Address Accounting
- Default Service Option Implementation
- Configurable Per-Flow Accounting Options
- IP Flow Discriminator Support for PCF Backward Compatibility
- Support for Remark DSCP to Max-class Value
- Command Support for Fragmentation Size
- New Statistics Counters for China Telecom

---

12.4(15)XR2

Release 4.1 of Cisco PDSN. The following new features are introduced:

- Attribute Support
    - Served MDN
    - Framed Pool
    - 3GPP2 DNS Server IP
  - Virtual Route Forwarding with Sub-interfaces
  - Conditional Debugging Enhancements
-

12.4(15)XR	<p>Release 4.0 of Cisco PDSN. The following new features are introduced:</p> <ul style="list-style-type: none"> <li>• <a href="#">Multiple Service Connections</a></li> <li>• <a href="#">Data Plane</a></li> <li>• <a href="#">Subscriber QoS Policy</a> (both downloading per-user profile from the AAA server and configuring a local profile)</li> <li>• <a href="#">QoS Signaling</a></li> <li>• <a href="#">Traffic Flow Templates</a></li> <li>• <a href="#">Per-flow Accounting</a></li> <li>• <a href="#">Call Admission Control</a></li> <li>• <a href="#">PDSN MIB Enhancements</a></li> <li>• <a href="#">PDSN on SAMI</a></li> </ul> <p>Closed-RP support is removed from release 4.0.</p> <p>PPPoGRE RP Interface support is removed from release 4.0.</p>
12.4(15)XN	<p>Release 3.5 of Cisco PDSN. The following new features are introduced:</p> <ul style="list-style-type: none"> <li>• <a href="#">Home Area, Maximum Authorized Aggregate Bandwidth, and Inter-user Priority Attributes Downloaded from AAA Server</a> <ul style="list-style-type: none"> <li>– <a href="#">Subscriber QoS Policy</a></li> <li>– <a href="#">Bandwidth Policing</a></li> </ul> </li> </ul>
12.3(14)YX8	<p>Release 3.0 of Cisco PDSN. The following commands are updated:</p> <ul style="list-style-type: none"> <li>• <code>cdma pdsn cluster member prohibit administratively</code></li> <li>• <code>subscriber redundancy rate</code></li> </ul> <p>Deleted sections on ODAP and PDSN Selection Peer-to-Peer clustering.</p>
12.3(14)YX1	<p>Release 3.0 of Cisco PDSN. The following new feature is introduced:</p> <ul style="list-style-type: none"> <li>• <a href="#">Support for Mobile Equipment Identifier</a></li> </ul>
12.3(14)YX	<p>Release 3.0 of Cisco PDSN. The following new features are introduced:</p> <ul style="list-style-type: none"> <li>• <a href="#">Packet Data Service Access</a> <ul style="list-style-type: none"> <li>– <a href="#">Simple IPv6 Access</a></li> </ul> </li> <li>• <a href="#">Session Redundancy Infrastructure</a></li> <li>• <a href="#">RADIUS Server Load Balancing</a></li> <li>• <a href="#">PPPoGRE RP Interface</a></li> <li>• <a href="#">Subscriber Authorization Based on Domain</a></li> <li>• <a href="#">PDSN MIB Enhancements</a></li> <li>• <a href="#">Conditional Debugging Enhancements</a></li> </ul>
12.3(11)YF3	<p>Release 2.1 of Cisco PDSN.</p> <p>Added support for:</p> <ul style="list-style-type: none"> <li>• <a href="#">Randomized IMSI Handling</a></li> </ul> <p>The following new command is added:</p> <ul style="list-style-type: none"> <li>• <code>ip mobile cdma imsi dynamic</code></li> </ul>

12.3(11)YF2	<p>Release 2.1 of Cisco PDSN.</p> <p>Added support for:</p> <ul style="list-style-type: none"> <li>• <a href="#">Identification of Data Packets For SDB Indication</a></li> <li>• <a href="#">SDB Indicator Marking for PPP Control Packets</a></li> <li>• <a href="#">Support for G17 Attribute in Acct-Stop and Interim Records</a></li> </ul> <p>The following new commands are added or modified:</p> <ul style="list-style-type: none"> <li>• <code>cdma pdsn a11 dormant sdb-indication match-qos-group</code></li> <li>• <code>cdma pdsn compliance</code></li> <li>• <code>cdma pdsn attribute send g17</code></li> </ul>
12.3(11)YF1	<p>Release 2.1 of Cisco PDSN.</p> <p>A restriction for Registration Revocation is removed.</p> <p>The following new commands are added or modified:</p> <ul style="list-style-type: none"> <li>• <code>cdma pdsn compliance</code></li> <li>• <code>debug cdma pdsn prepaid</code></li> <li>• <code>debug cdma pdsn radius disconnect nai</code></li> <li>• <code>show cdma pdsn statistics prepaid</code></li> <li>• <code>clear cdma pdsn session</code></li> <li>• <code>clear cdma pdsn statistics adds radius statistics</code></li> <li>• <code>cdma pdsn mobile-advertisement-burst</code></li> <li>• <code>ip mobile foreign-service</code></li> </ul>
12.3(11)YF	<p>Release 2.1 of Cisco PDSN. Four new features are added, including the Closed-RP Interface.</p>
12.3(8)XW	<p>Release 2.0 of Cisco PDSN. Five new features are added, including the Always On.</p>
12.3(4)T	<p>Cisco PDSN (a Cisco IOS software) feature is integrated into Cisco IOS Release 12.3(4)T.</p>
12.2(8)ZB8	<p>One new CLI command is added.</p>
12.2(8)ZB7	<p>Six CLI commands are added or modified.</p>
12.2(8)ZB6	<p>Two CLI commands are added or modified.</p>
12.2(8)ZB5	<p>Four new CLI commands are added.</p>
12.2(8)ZB1	<p>Cisco PDSN feature is introduced on the Cisco 7600 Series Router.</p>
12.2(8)ZB	<p>Cisco PDSN feature is introduced on the Cisco Catalyst 6500 Switch.</p>
12.2(8)BY	<p>Cisco PDSN feature is introduced on the Cisco 7200 Series Router.</p>

This document describes the Cisco Packet Data Serving Node (PDSN) software for use on the Cisco Service and Application Module for IP (SAMI) card that resides on the Cisco 7600 Series Router. It includes information on the features and functions of the product, supported platforms, related documents, and configuration tasks.

This document includes the following sections:

- [Feature Overview, page 5](#)
- [Features, page 21](#)
- [Cluster Controller Member Configuration, page 118](#)
- [Supported Platforms, page 256](#)
- [Supported Standards, MIBs, and RFCs, page 256](#)
- [Configuration Tasks, page 257](#)
- [System Requirements, page 258](#)
- [Monitoring and Maintaining the PDSN, page 279](#)
- [Configuration Examples, page 281](#)
- [PDSN Accounting, page 327](#)
- [AAA Server Authentication and Authorization Profile, page 333](#)
- [Attributes, page 336](#)
- [Glossary, page 351](#)

## Feature Overview

A PDSN provides access to the Internet, intranets, and Wireless Application Protocol (WAP) servers for mobile stations using a Code Division Multiple Access 2000 (CDMA 2000) Radio Access Network (RAN). The PDSN is a Cisco IOS software feature that runs on SAMI cards on the Cisco 7600 Series Router, where PDSN acts as an access gateway for Simple IP (SIP) and Mobile IP (MIP) stations. The PDSN provides foreign agent (FA) support and packet transport for virtual private networking (VPN). It also acts as an Authentication, Authorization, and Accounting (AAA) client.

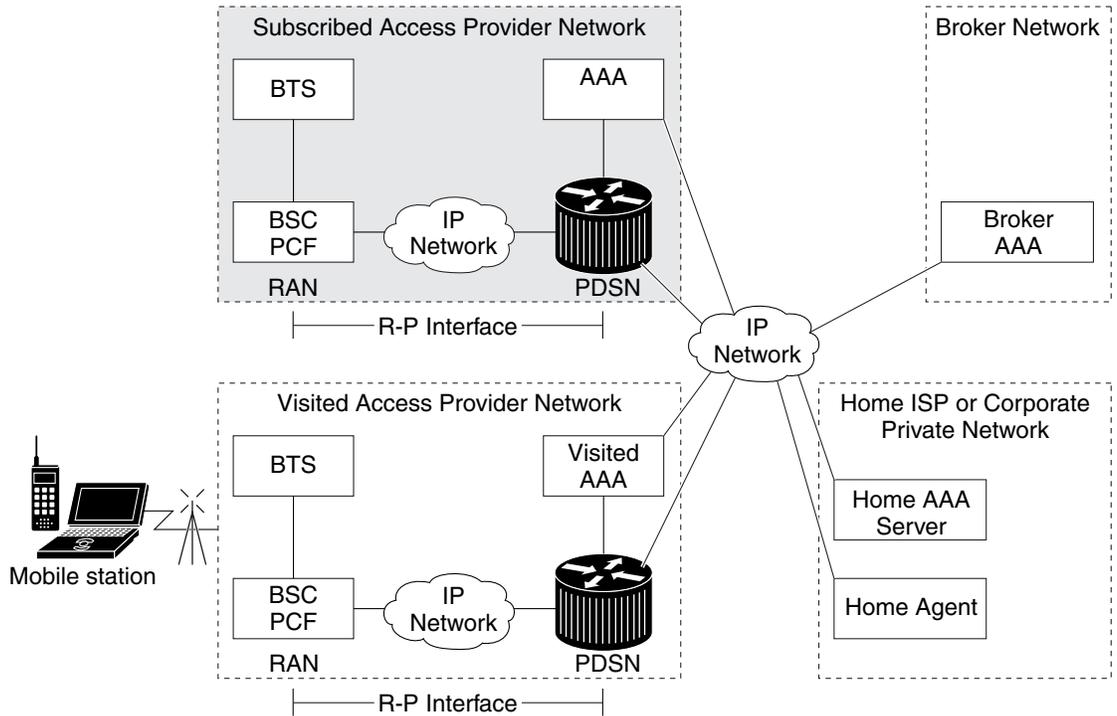
The PDSN supports all relevant 3rd Generation Partnership Project 2 (3GPP2) standards, including those that define the overall structure of a CDMA 2000 network, and the interfaces between radio components and the PDSN.

## System Overview

CDMA is one of the standards for Mobile Station communication. A typical CDMA 2000 network includes terminal equipment, mobile termination, base transceiver stations (BTSs), base station controllers (BSCs or Packet Control Functions (PCFs)), PDSNs, and other CDMA network and data network entities. The PDSN is the interface between a BSC or PCF and a network router.

[Figure 1](#) illustrates the relationship of the components of a typical CDMA 2000 network, including a PDSN. In this illustration, a roaming mobile station user receives data services from a visited access provider network, rather than from the mobile station user's subscribed access provider network.

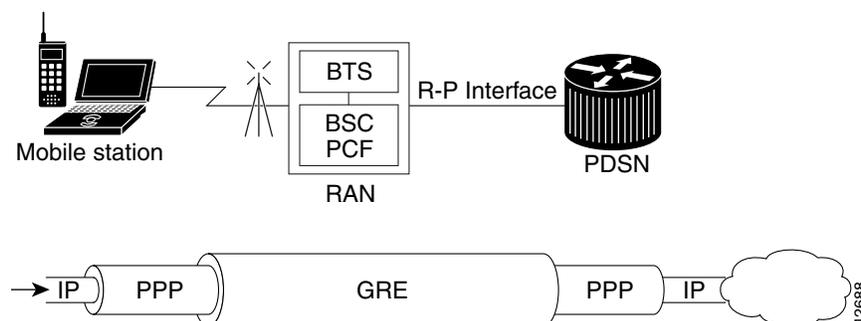
**Figure 1** *The CDMA Network*



As the illustration shows, the mobile station, which must support either SIP or MIP, connects to a radio tower and BTS. The BTS connects to a BSC, which contains a component called the Packet Control Function (PCF). The PCF communicates with the PDSN through an A10/A11 interface. The A10 interface is for user data and the A11 interface is for control messages. This interface is also known as the RAN-to-PDSN (R-P) interface.

Figure 2 illustrates the communication between the RAN and the PDSN.

**Figure 2 RAN-to-PDSN Connection: the R-P Interface**



The IP networking between the PDSN and external data networks is through the PDSN-to-intranet or Internet ( $P_i$ ) interface. For the Cisco PDSN Release 2.0 and higher, you can use either an FE or GE interface as the  $P_i$  interface.

For “back office” connectivity, such as connections to a AAA server, or to a RADIUS server, the interface is media independent. Any of the interfaces supported on the Cisco 7206 can be used to connect to these types of services; however, Cisco recommends that you use either an FE or GE interface.

## How PDSN Works

When a mobile station makes a data service call, it establishes a Point-to-Point Protocol (PPP) link with the PDSN. The PDSN authenticates the mobile station by communicating with the AAA server. The AAA server verifies that the user is a valid subscriber, determines available services, and tracks usage for billing.

The method used to assign an IP address and the nature of the connection depends on service type and network configuration. SIP operation and MIP operation are referred to as *service types*. The service type available to a user is determined by the mobile station, and by the type of service that the service provider offers. In the context of PDSN, a mobile station is the end user in both SIP and MIP operation.

Once the mobile station is authenticated, it requests an IP address. SIP stations communicate the request using the Internet Protocol Control Protocol (IPCP). MIP stations communicate the request using MIP registrations.

The following sections describe the IP addressing and communication levels for each respective topic:

- [PDSN Simple IP](#)
- [PDSN Mobile IP](#)
- [PMTU Discovery by Mobile IP Client](#)

### PDSN Simple IP

With SIP, a service provider’s Cisco PDSN assigns a dynamic or static IP address to the mobile station during the PPP link setup. The mobile station retains this IP address as long as it is served by a radio network that has connectivity to the address-assigning PDSN.

Therefore, as long as the mobile station remains within an area of RANs that is served by the same PDSN, the MS can move or roam inside the coverage area and maintain the same PPP links. If the mobile station moves outside the coverage area of the given PDSN, the mobile station is assigned a new IP address, and any application-level connections are terminated.

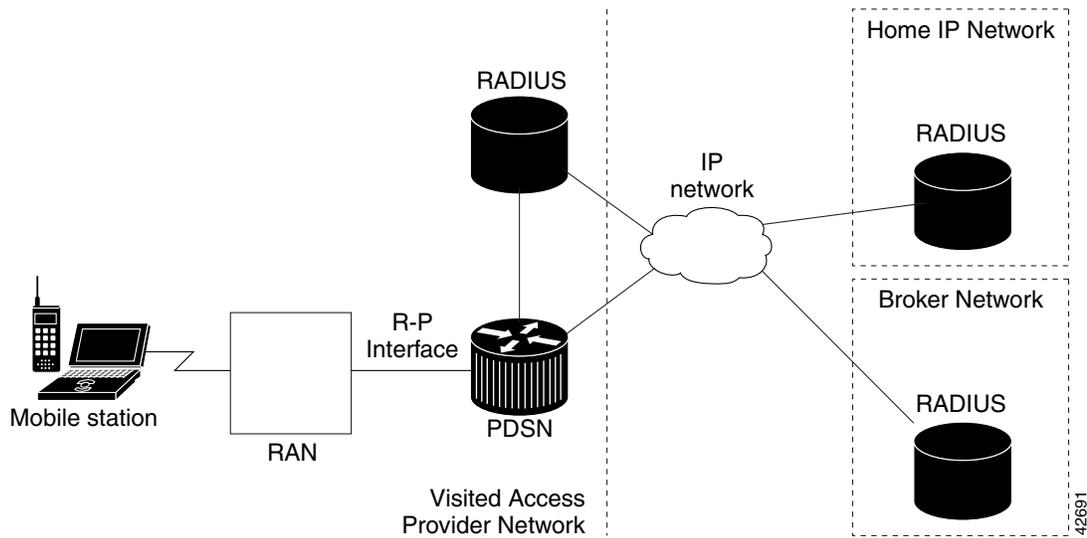


**Note**

A static IP address can be requested by the mobile station, and will be assigned if the address is within the pool of addresses and is available. Also an IP address can be statically specified in the AAA profile of the user using the “Framed-IP-Address” attribute.

Figure 3 illustrates the placement of the PDSN in a Simple IP scenario.

**Figure 3** CDMA Network - Simple IP Scenario

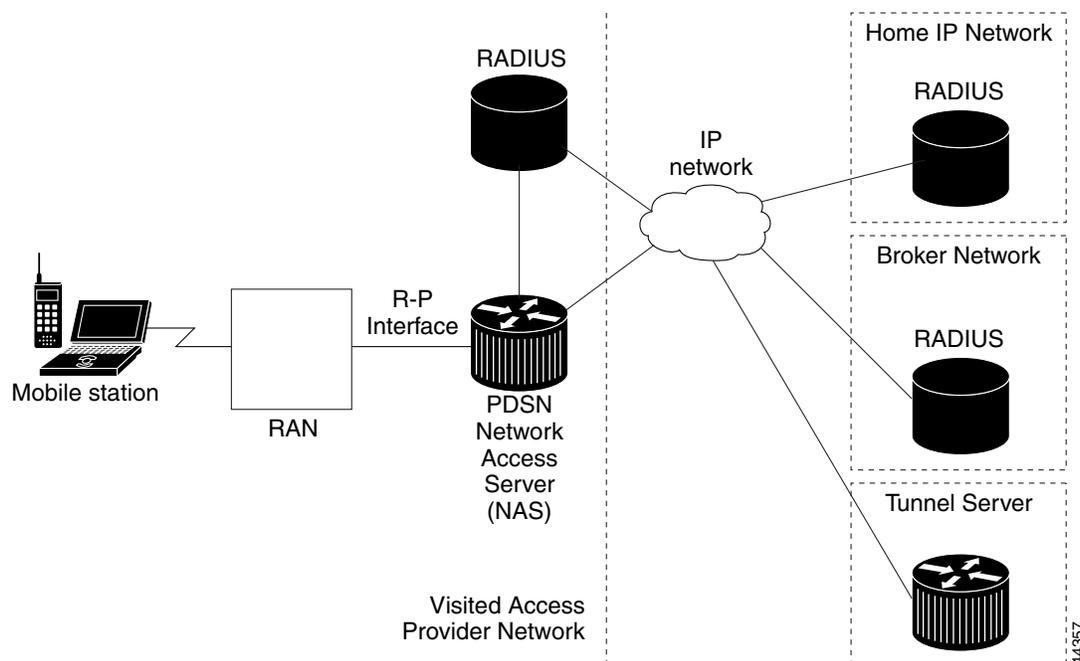


**PDSN Simple IP with VPDN Scenario**

A Virtual Private Data Network (VPDN) allows a private network dial-in service to span to a remote access server called Network Access Server (NAS).

Figure 4 illustrates a VPDN connection in the PDSN environment with SIP. In this scenario, the PDSN acts as the NAS.

Figure 4 CDMA Network – Simple IP with VPDN Scenario



A VPDN connection is established in the following order:

1. A PPP peer (mobile station) connects with the local NAS (the PDSN).
2. The NAS begins authentication when the client dials in. The NAS determines that the PPP link should be forwarded to a tunnel server for the client. The location of the tunnel server is provided as part of the authentication by the Remote Authentication Dial-in User Service (RADIUS) server.
3. The tunnel server performs its own authentication of the user and starts the PPP negotiation. It performs authentication for both the tunnel-setup and the client.

The PPP client is forwarded through a Layer 2 Tunneling Protocol (L2TP) tunnel over User Datagram Protocol (UDP).

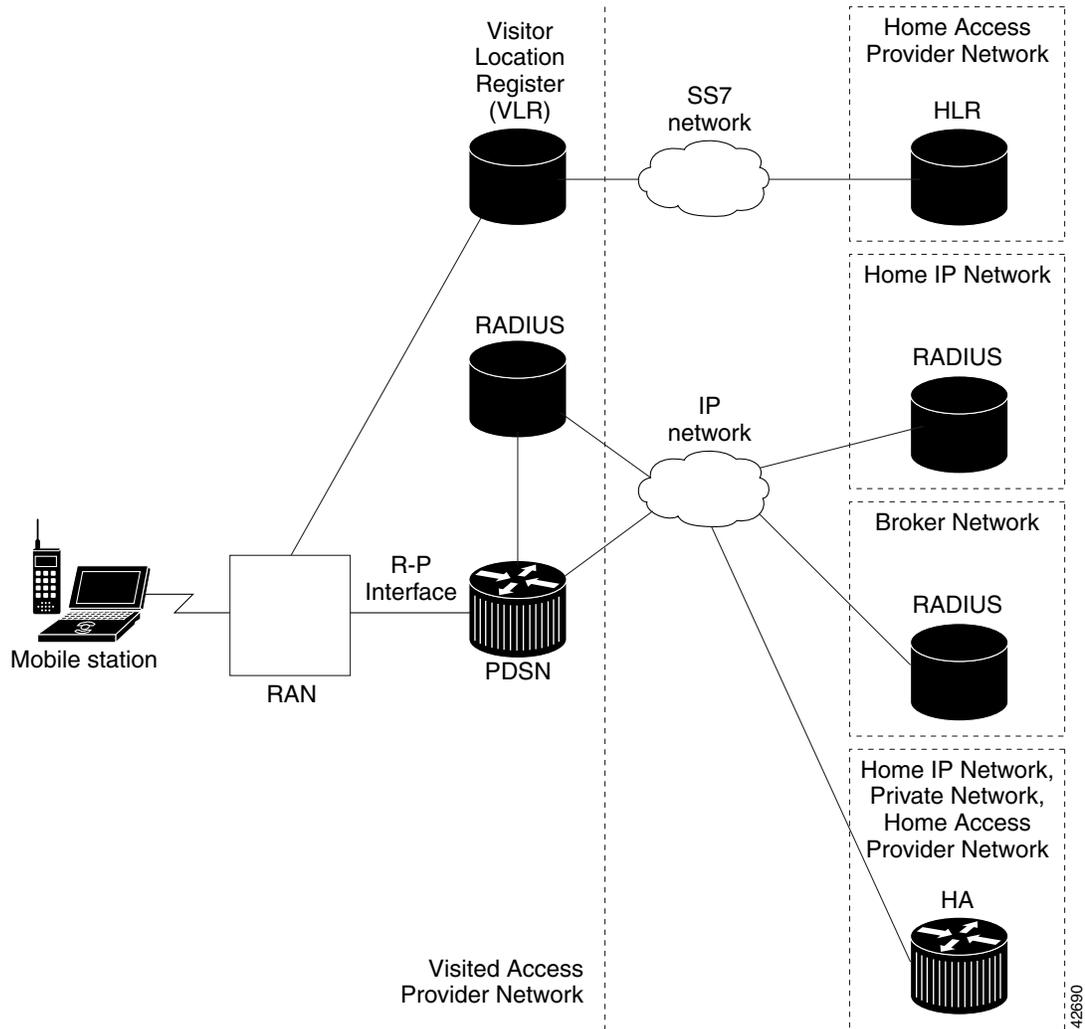
4. The PPP setup is completed and all frames exchanged between the client and tunnel server are sent through the NAS. The protocols running within PPP are transparent to the NAS.

## PDSN Mobile IP

With MIP, the mobile station can roam beyond the coverage area of a given PDSN and still maintain the same IP address and application-level connections.

Figure 5 shows the placement of the PDSN in a MIP scenario.

Figure 5 CDMA Network – Mobile IP Scenario



The communication process occurs in the following order:

1. The mobile station registers with its Home Agent (HA) through an FA; in this case, the PDSN.
2. The HA accepts the registration, assigns an IP address to the mobile station, and creates a tunnel to the FA. This results in a PPP link between the mobile station and the FA (or PDSN), and an IP-in-IP or Generic Routing Encapsulation (GRE) tunnel between the FA and the HA.

As part of the registration process, the HA creates a binding table entry to associate the mobile station's home address with its Care-of address.

**Note**

While away from home, the mobile station is associated with a care-of address. This address identifies the mobile station's current, topological point of attachment to the Internet, and is used to route packets to the mobile station. In IS-835-B networks, the foreign agent's address is always used as the Care-of address.

3. The HA advertises that the network is reachable to the mobile station, and tunnels datagrams to the mobile station at its current location.
4. The mobile station sends packets with its home address as the source IP address.
5. Packets destined for the mobile station go through the HA; the HA tunnels them through the PDSN to the mobile station using the care-of address.
6. When the PPP link is handed off to a new PDSN, the link is renegotiated and the MIP registration is renewed.
7. The HA updates its binding table with the new care-of address.

**Note**

For more information about MIP, refer to the Cisco IOS Release 12.2 documentation modules *Cisco IOS IP Configuration Guide* and *Cisco IOS IP Command Reference*. RFC 2002 describes the specification in detail. TIA/EIA/IS-835-B also defines how MIP is implemented for PDSN.

## Randomized IMSI Handling

The PDSN cannot recognize 1xRTT to EVDO as a handoff due to a change of IMSI. The result is that the "cdma-reason-ind" in the account stop message will not reflect the same.

By default, the PDSN keeps the first call session if the Mobile does a static home address. In this release, the PDSN supports deleting the first call session for dynamic home address cases (for example, 1x-RTT to EVDO handoff where the IMSI changes during the handoff).

- If the call lands on the same processor:
  - A new session does not come up on PDSN, and old session remains.
  - During the mobile handoff between 1XRTT and EVDO call, handoff does not succeed due to the above behavior of PDSN.
- If the call lands on a different processor:
  - Both the calls come up and the old call is deleted when registration lifetime expires. For new calls, downstream traffic is not processed.

A new CLI command is introduced in this release that allows you to delete the old session. When you issue the **ip mobile cdma imsi dynamic** command, the PDSN releases the old session and allows the new session to come up.

The limitation with this CLI command is that the error message "PLATFORM-3-SAMI\_IPC\_IXP\_FAIL: Msgcode 26: Bad Param Error received from IXP" may displayed during high stress scenarios.

## PMTU Discovery by Mobile IP Client

FTP upload and ping from the end node may fail when PMTU Discovery (done by setting the DF bit) is done by a MobileIP client (an end node) for packet sizes of about 1480. Due to failure of PMTUD algorithm, the IP sender will never learn the smaller path MTU, but will continue unsuccessfully to retransmit the too-large packet, until the retransmissions time out.

Refer to <http://www.cisco.com/warp/public/105/38.shtml#2000XP> for disabling PMTUD for Windows 2000 or Windows XP platforms.

## PDSN Proxy Mobile IP

Currently, there is a lack of commercially available MIP client software. Conversely, PPP, which is widely used to connect to an Internet Service Provider (ISP), is ubiquitous in IP devices. As an alternative to MIP, you can use Cisco Proxy Mobile IP (PMIP) feature. This capability of the PDSN, which is integrated with PPP, enables a MIP FA to provide mobility to authenticated PPP users.

**Note**

---

In PMIP, the MS can have only one IP flow per PPP Session.

---

The communication process occurs in the following order:

1. The Cisco PDSN (acting as an FA) collects and sends mobile station authentication information to the AAA server.
2. If the mobile station is successfully authenticated to use Cisco PDSN PMIP service, the AAA server returns the registration data and an HA address.
3. The FA uses this information, and other data, to generate a Registration Request (RRQ) on behalf of the mobile station, and sends it to the HA.
4. If the registration is successful, the HA sends a registration reply (RRP) that contains an IP address to the FA.
5. The FA assigns the IP address (received in the RRP) to the mobile station, using IPCP.
6. A tunnel is established between the HA and the FA/PDSN. The tunnel carries traffic to and from the mobile station.

## PDSN on SAMI

The SAMI blade supports the feature set of Cisco PDSN Release 5.1, and a Cisco 7600 chassis supports a maximum of six application modules. Each application module has six PPCs, each with two Gigabytes of RAM, and uses one instance of a Cisco IOS software application image. Each PPC can function as a PDSN.

Additionally, instances of the cluster controller functionality will be configured as required. One active and standby controller can support three single IP PDSN members. Each PDSN image supports 1,75,000 user sessions.

## Migration Scenarios

Table 1 lists currently available PDSN releases and the migration path to the SAMI platform.

**Table 1** Migration Path for Cisco PDSN

	Cisco PDSN Release 3.0 or earlier	Cisco PDSN Release 3.5	Cisco PDSN Release 4.0	Cisco PDSN Release 5.0 and 5.1
<b>Platform</b>	7200 NPE400/NPE-G1 and MWAM platform (5 processor only)	MWAM (5 processor only)	SAMI	SAMI
<b>Chassis/Power Supply, Fan Trays)</b>	7200VXR	6500/7600 chassis	7600 chassis	7600 chassis
—	—	SUP2/SUP720	SUP720/RSP720/SUP 32	SUP720
—	—	SUP32/SUP IOS SX based	SUP IOS - SRC-based image (for example: <i>c7600s72033-advipservicesk9-mz.122-33.SRC.bin</i> )	SUP IOS - Latest SRC-based image
—	—	SUP redundancy	SUP redundancy	SUP redundancy

Based on Table 2, there are many possible migration scenarios. In this section, we focus on those scenarios closest to current customer deployments. The actual migration path has to be determined per-customer end-to-end deployment. Additionally, migration should be engineered, and we recommend that you perform the migration in a maintenance window in your deployment.

Customers may take this opportunity to redesign their network, for example, redesigning IP addresses scheme and configuring the routing protocols, network connectivity between PDSN and HA, application connectivity between PDSN and AAA servers, routing on the new SAMI PDSN or HA, and so on.



**Note**

For all these migration plans, both hardware and software configurations have significant changes. This requires prudent operation planning and network redesign. The Migration Steps section describes the possible migration steps to minimize both network reconfiguration and service disruption.

Table 2 lists the most common migration scenarios:

**Table 2** *Migrations Scenarios for Cisco PDSN Release 5.1*

Scenario	Migration From	To	Remarks	Downtime
1	<ul style="list-style-type: none"> <li>• Non-SR</li> <li>• Non- clustering</li> <li>• 7600 chassis</li> <li>• Each processor can act as an individual Cisco PDSN</li> </ul>	<ul style="list-style-type: none"> <li>• Non-SR</li> <li>• Non- clustering</li> <li>• 7600 chassis</li> <li>• One Cisco PDSN per blade (single IP architecture)</li> </ul>	<ul style="list-style-type: none"> <li>• Erase existing configuration in all processors.</li> <li>• After upgrading to Cisco PDSN Release 5.0 or 5.1, ensure that the configuration is done only on the PCOP (that is, processor 3).</li> <li>• IP address-pool requirements in Cisco PDSN Release 5.0 and 5.1 (at the blade level) are five times that configured in PDSN Release 4.0 (at the processor level).</li> </ul>	Yes
2	<ul style="list-style-type: none"> <li>• Non-SR</li> <li>• Non-clustering</li> <li>• 7600 chassis</li> <li>• One blade with each processor acting as an individual Cisco PDSN</li> </ul>	<ul style="list-style-type: none"> <li>• SR enabled</li> <li>• Non-clustering</li> <li>• 7600 chassis</li> <li>• Two SAMI blades (in the same chassis) with a single Cisco PDSN at the blade level</li> <li>• Auto synchronization enabled</li> </ul>	<ul style="list-style-type: none"> <li>• Erase existing configuration in all processors on active and standby blades.</li> <li>• After upgrading to Cisco PDSN Release 5.0 or 5.1, ensure that the configuration is done only on an active blade PCOP (that is, processor 3).</li> <li>• Ensure that the standby SAMI blade is shutdown while configuring the active.</li> <li>• IP address-pool requirements in Cisco PDSN Release 5.0 and 5.1 (at the blade level) are five times that configured in PDSN Release 4.0 (at the processor level).</li> </ul>	Yes

**Table 2** *Migrations Scenarios for Cisco PDSN Release 5.1*

3	<ul style="list-style-type: none"> <li>• SR-enabled</li> <li>• Non-clustering</li> <li>• 7600 chassis</li> <li>• Two SAMI blades (in the same chassis)</li> </ul>	<ul style="list-style-type: none"> <li>• SR-enabled</li> <li>• Non-clustering</li> <li>• 7600 chassis</li> <li>• Two SAMI blades (in the same chassis)</li> <li>• Auto synchronization enabled</li> </ul>	<ul style="list-style-type: none"> <li>• Erase existing configuration in all processors on active and standby blades.</li> <li>• After upgrading to Cisco PDSN Release 5.0 or 5.1, ensure that the configuration is done only on an active blade PCOP (that is, processor 3).</li> <li>• Ensure that the standby SAMI blade is shutdown while configuring the active.</li> <li>• IP address-pool requirements in Cisco PDSN Release 5.0 and 5.1 (at the blade level) are five times that configured in PDSN Release 4.0 (at the processor level).</li> </ul>	Yes
4	<ul style="list-style-type: none"> <li>• Non-SR</li> <li>• Clustering enabled</li> <li>• 7600 chassis</li> <li>• One or more processors running a Cisco PDSN member</li> </ul>	<ul style="list-style-type: none"> <li>• Non-SR</li> <li>• Clustering enabled</li> <li>• 7600 chassis</li> <li>• One Cisco PDSN member per blade</li> </ul>	<ul style="list-style-type: none"> <li>• Erase existing configuration in all processors on active and standby blades.</li> <li>• After upgrading to Cisco PDSN Release 5.0 or 5.1, ensure that the configuration is done only on an active blade PCOP (that is, processor 3).</li> <li>• IP address-pool requirements in Cisco PDSN Release 5.0 and 5.1 (at the blade level) are five times that configured in PDSN Release 4.0 (at the processor level).</li> </ul>	Yes

**Table 2** *Migrations Scenarios for Cisco PDSN Release 5.1*

5	<ul style="list-style-type: none"> <li>SR enabled (controller redundancy)</li> <li>Clustering enabled</li> <li>7600 chassis</li> <li>Running controller in one of the processors</li> <li>Redundant SAMI blades (in the same chassis)</li> </ul>	<ul style="list-style-type: none"> <li>SR enabled</li> <li>Clustering enabled</li> <li>7600 chassis</li> <li>Can run both controller and collocated member</li> <li>Redundant SAMI blades (in the same chassis)</li> <li>Auto synchronization enabled</li> </ul>	<ul style="list-style-type: none"> <li>Erase existing configuration in all processors on active and standby blades.</li> <li>After upgrading to Cisco PDSN Release 5.0 or 5.1, ensure that the configuration is done only on an active blade PCOP (that is, processor 3).</li> <li>Ensure that the standby SAMI blade is shutdown while configuring the active.</li> <li>If collocated member is configured, ensure that session redundancy is enabled.</li> <li>IP address-pool requirements in Cisco PDSN Release 5.0 and 5.1 (at the blade level) are five times that configured in PDSN Release 4.0 (at the processor level).</li> </ul>	Yes
6	<ul style="list-style-type: none"> <li>SR-enabled</li> <li>Clustering-enabled</li> <li>7600 Chassis</li> <li>Redundant SAMI blades (in the dual chassis)</li> </ul>	<ul style="list-style-type: none"> <li>SR-enabled</li> <li>Clustering-enabled</li> <li>7600 Chassis</li> <li>Redundant SAMI blades (in the inter chassis)</li> <li>Auto synchronization disabled (default)</li> </ul>	<ul style="list-style-type: none"> <li>Erase existing configuration in all processors on active and standby blades.</li> <li>After upgrading to Cisco PDSN Release 5.0 or 5.1, ensure that the configuration is done only on an active blade PCOP (that is, processor 3).</li> <li>If configured, Cisco PDSN acts as controller and collocated member.</li> <li>IP address-pool requirements in Cisco PDSN Release 5.0 and 5.1 (at the blade level) are five times that configured in PDSN Release 4.0 (at the processor level).</li> </ul>	Yes

## Migration Steps

Migration to Cisco PDSN Release 5.1 is more than replacing Multi-processor WAN Application Module (MWAM) cards with SAMI modules. Your migration must be well planned and conducted in a way that has a minimal impact on an existing mobile subscriber's service connections. Migration to Cisco PDSN Release 5.1 image means changing to the architecture of the single PDSN per blade level. The single IP feature reallocates functionality on a SAMI service blade from the 4.0 model of six independent IOS processors. Each IOS processor executes both control and traffic plane functions, to a model where one IOS processor is designated as a Control Plane (PCOP) processor and the other five designated as Traffic Plane (TCOP) processors.

**Note**

- All these migration plans must be performed during a maintenance window.
- Auto synchronization feature supports configuration synchronization for intra-chassis setup only. In inter-chassis setup, autosynchronization needs to be disabled.

Table 3 lists the migration tasks that are based on the scenarios that were previously established in Table 2.

**Table 3 Migration Steps from Cisco PDSN 4.0 to 5.0 or 5.1**

Scenario	Migration Steps
1	<ul style="list-style-type: none"> <li>• In SAMI cards with Cisco PDSN Release 4.0, erase configuration on all processors and reload Cisco PDSN.</li> <li>• Configure the I/O memory (IOMEM) on all processors as 256 MB and save the configuration to the NVRAM.</li> </ul> <div data-bbox="532 772 574 810" style="text-align: center;"></div> <div data-bbox="532 814 1536 877"> <p><b>Note</b> If you have set the IOMEM size as 64 MB, ensure that you configure the <b>memory lite</b> command. The recommended memory size is, however, 256 MB.</p> </div> <ul style="list-style-type: none"> <li>• Upgrade to Cisco PDSN Release 5.0 or 5.1 and reconfigure the Cisco PDSN configuration on processor 3.</li> <li>• Provision MS and PCFs to use the newly added Cisco PDSN Release 5.0-based PDSN IP.</li> <li>• Provision the newly added PDSN with the HA to service MIP calls.</li> </ul> <p>To minimize provisioning tasks, Cisco PDSN Release 5.0 and 5.1 reuse the IP address and routing scheme used in one of the Cisco PDSN Release 4.0 processors.</p>

**Table 3 Migration Steps from Cisco PDSN 4.0 to 5.0 or 5.1 (continued)**

2, 3	<ul style="list-style-type: none"> <li>• Install the new SAMI card on 7600/720 that is to be used in redundant configuration.</li> <li>• In the existing Cisco PDSN Release 4.0, erase the existing configuration on all processors and reload the Cisco PDSN.</li> <li>• Configure the IOMEM size on all processors as 256 MB and save the configuration to the NVRAM.</li> </ul>
	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">  <p><b>Note</b> If you have set the IOMEM size as 64 MB, ensure that you configure the <b>memory lite</b> command. The recommended memory size is, however, 256 MB.</p> </div> <ul style="list-style-type: none"> <li>• Upgrade both the SAMI blades to Cisco PDSN Release 5.0 or 5.1.</li> <li>• Shut down the blade for configuration as standby (unit2).</li> <li>• Enable autosynchronization on the active blade (unit1). Configure the PDSN on active blade on processor 3. Keep unit2 as a standby in a redundant configuration. When configuring redundancy, you must configure Hot Standby Router Protocol (HSRP) main interface before configuring Interprocessor Communication (IPC).</li> <li>• Save the configuration on the active blade.</li> <li>• Bring up unit2 with Cisco PDSN Release 5.0 or 5.1 image. Configurations are autosynchronized from the active blade.</li> <li>• Verify the output of the <b>show redundancy state</b> and <b>show redundancy inter device</b> commands on both active and standby blades to confirm if redundancy is enabled. If the output for one of the blades requires a reload to enable redundancy, reload that blade.</li> <li>• Provision MS and PCFs to use the newly added Cisco PDSN Release 5.0 or 5.1-based PDSN IP.</li> <li>• Use the CDMA-1x IP address on the PDSN as controller or member IP when provisioning.</li> <li>• Provision the newly added PDSN with that of HA to service MIP calls.</li> </ul> <p>To minimize provisioning tasks, Cisco PDSN Release 5.0 and 5.1 reuse the IP address and routing scheme used in one of the Cisco PDSN Release 4.0 processors.</p>

**Table 3 Migration Steps from Cisco PDSN 4.0 to 5.0 or 5.1 (continued)**

4	<ul style="list-style-type: none"> <li>• In SAMI cards with Cisco PDSN Release 4.0, erase the existing configuration on all processors and reload Cisco PDSN. If the blade includes Cisco PDSN members as part of the cluster, we recommend that you remove the PDSN member part before reloading.</li> <li>• Configure the IOMEM size on all processors as 256 MB and save the configuration to the NVRAM.</li> </ul> <p> <b>Note</b> If you have set the IOMEM size as 64 MB, ensure that you configure the <b>memory lite</b> command. The recommended memory size is, however, 256 MB.</p> <ul style="list-style-type: none"> <li>• Upgrade to Cisco PDSN Release 5.0 or 5.1 and reconfigure the PDSN on processor 3.</li> <li>• You can configure the Cisco PDSN as both controller and collocated member. Cisco PDSN Release 5.0 and 5.1 interoperate with Cisco PDSN Release 3.0 or 4.0 controller or member.</li> <li>• Provision MS and PCFs to use the newly added Cisco PDSN Release 5.0 or 5.1-based PDSN IP.</li> <li>• Use the CDMA-1x IP address on the PDSN as controller or member IP when provisioning.</li> <li>• Provision newly added PDSN with that of HA to service MIP calls.</li> </ul> <p>To minimize provisioning tasks, Cisco PDSN Release 5.0 and 5.1 reuse the IP address and routing scheme used in one of the Cisco PDSN Release 4.0 processors.</p>
---	---

**Table 3 Migration Steps from Cisco PDSN 4.0 to 5.0 or 5.1 (continued)**

5	<ul style="list-style-type: none"> <li>• Install the new SAMI card on 7600/720 that is to be used in redundant configuration.</li> <li>• In the existing Cisco PDSN Release 4.0, erase the existing configuration on all processors and reload the Cisco PDSN.</li> <li>• Configure the IOMEM size on all processors as 256 MB and save the configuration to the NVRAM.</li> </ul> <hr/> <p> <b>Note</b> If you have set the IOMEM size as 64 MB, ensure that you configure the <b>memory lite</b> command. The recommended memory size is, however, 256 MB.</p> <hr/> <ul style="list-style-type: none"> <li>• Upgrade both the SAMI blades to Cisco PDSN Release 5.0 or 5.1.</li> <li>• Shut down the blade for configuration as standby (unit2).</li> <li>• Enable autosynchronization on the active blade (unit1). Configure the PDSN on active blade on processor 3. Keep unit2 as a standby in a redundant configuration. When configuring redundancy, you must configure Hot Standby Router Protocol (HSRP) main interface before configuring Interprocessor Communication (IPC).</li> <li>• Save the configuration on the active blade.</li> <li>• Bring up unit2 with Cisco PDSN Release 5.0 or 5.1 image. Configurations are autosynchronized from the active blade.</li> <li>• Verify the output of the <b>show redundancy state</b> and <b>show redundancy inter device</b> commands on both active and standby blades to confirm if redundancy is enabled. If the output for one of the blades requires a reload to enable redundancy, reload that blade.</li> <li>• Provision MS and PCFs to use the newly added Cisco PDSN Release 5.0 or 5.1-based PDSN IP.</li> <li>• Use the CDMA-1x IP address on the PDSN as controller or member IP when provisioning.</li> <li>• Provision the newly added PDSN with that of HA to service MIP calls.</li> <li>• You can configure the Cisco PDSN to act as controller and collocated member. <ul style="list-style-type: none"> <li>– In the case of a collocated member, ensure that you enable session redundancy, so that the standby is synchronized with sessions handled by the collocated member.</li> <li>– For an active controller to synchronize the information with the standby controller, ensure that all remote members connect to the HSRP main interface of the controller.</li> <li>– If the member IP is configured, ensure that it is the same as the CDMA -1x interface IP address.</li> </ul> </li> </ul>
---	--

**Table 3** *Migration Steps from Cisco PDSN 4.0 to 5.0 or 5.1 (continued)*

6	<ul style="list-style-type: none"> <li>• In the existing Cisco PDSN Release 4.0, erase the existing configuration on all processors and reload the Cisco PDSN.</li> <li>• Configure the IOMEM size on all processors to 256 MB and save the configuration to the NVRAM.</li> </ul>
	<hr/> <p><b>Note</b> If you have set the IOMEM size as 64 MB, ensure that you configure the <b>memory lite</b> command. The recommended memory size is, however, 256 MB.</p> <hr/>
	<ul style="list-style-type: none"> <li>• Upgrade both the SAMI blades to Cisco PDSN Release 5.0 or 5.1.</li> <li>• Reconfigure the Cisco PDSN and enable inter-chassis HSRP redundancy as in Cisco PDSN Release 4.0.</li> <li>• Provision MS and PCFs to use the newly added Cisco PDSN Release 5.0 or 5.1-based PDSN IP.</li> <li>• Use the CDMA-1x IP address on the PDSN as controller or member IP when provisioning.</li> <li>• Provision the newly added Cisco PDSN with the HA to service MIP calls.</li> </ul>

1. MS = Mobile Station.

2. PCF = Packet Control Function.

## Features

This section lists the features introduced in the current release (Cisco PDSN Release 5.1) and the previous releases:

- [New Features in This Release](#)
- [Features From Previous Releases](#)

### New Features in This Release

This section lists the new features in the Cisco PDSN Release 5.1:

- [Simple IP Client IP Accounting Support](#)
- [SNMP New MIB Objects for Per PCF](#)
- [Support for Common NAI](#)
- [Proxy MIP Changes for Latest IS-835](#)
- [Simple IPv6 Support](#)
- [Access-Request Attributes](#)
- [New PPP Per PCF Counters](#)
- [VPDN Conditional Debugging](#)
- [GRE CVSE and MN NAI Extension in Revocation Message](#)

## Features From Previous Releases

This section lists features that were introduced before Cisco PDSN Release 5.1:

- Support for Common NAI
- Single IP per Blade
- Osler Support
- Improved Throughput and Transaction Handling
- Cluster Controller Support in Single IP Blade
- IMSI and PCF Redirection
- Mobile IP and AAA Attributes for China Telecom
- Trap Generation for AAA Server Unresponsiveness
- Supervisor Support
- Data Over Signaling
- Differentiated Services Code Point Marking Support
- Nortel Aux A10 Support
- Masking Off IMSI Prefix
- Persistent TFT Support
- Conserve Unique IP-ID for FA-HA IP-in-IP Tunnel
- GRE CVSE Support in FA-HA Tunnel
- Remote Address Accounting
- Default Service Option Implementation
- Configurable Per-Flow Accounting Options
- IP Flow Discriminator Support for PCF Backward Compatibility
- Support for Remark DSCP to Max-class Value
- Command Support for Fragmentation Size
- New Statistics Counters for China Telecom
- Attribute Support
  - Served MDN
  - Framed Pool
  - 3GPP2 DNS Server IP
- Virtual Route Forwarding with Sub-interfaces
- Conditional Debugging Enhancements (for Cisco PDSN Release 4.1)
- Multiple Service Connections
- Data Plane
- Subscriber QoS Policy (both downloading per-user profile from the AAA server and configuring a local profile)
- QoS Signaling
- Traffic Flow Templates

- Per-flow Accounting
- Call Admission Control
- PDSN MIB Enhancements (for Cisco PDSN Release 4.0)
- PDSN on SAMI
- Inter-User Priority
- Roamer Identification
- Bandwidth Policing
- Packet Data Service Access
  - Simple IPv6 Access
- Session Redundancy Infrastructure
- RADIUS Server Load Balancing
- Subscriber Authorization Based on Domain
- PDSN MIB Enhancements
  - PPP Counters in Cisco PDSN Release 3.0
  - RP Counters in Cisco PDSN Release 3.0
- Conditional Debugging Enhancements
  - Trace Functionality in Cisco PDSN Release 3.0
- Randomized IMSI Handling
- Protocol Layering and RP Connections
- PPPoGRE RP Interface
- A11 Session Update
- SDB Indicator Marking
- Resource Revocation for Mobile IP
- Packet of Disconnect
- IS-835 Prepaid Support
- Prepaid Billing
- Mobile IP Call Processing Per Second Improvements
- Always On Feature
- PDSN MIB Enhancements
- Conditional Debugging Enhancements
- Cisco Proprietary Prepaid Billing
- 3DES Encryption
- Mobile IP IPsec
- Hardware IPsec Acceleration Using IPsec Acceleration Module—Static IPsec
- 1xEV-DO Support
- Integrated Foreign Agent
- AAA Server Support
- Packet Transport for VPDN

- [Proxy Mobile IP](#)
- [Multiple Mobile IP Flows](#)
- [PDSN Cluster Controller / Member Architecture](#)



**Note**

The PDSN software offers several feature options which are available on different images. Some features are image-specific, and are not available on all images. The [PDSN Feature Matrix](#) in [Table 4](#) lists the available image for the PDSN.



**Note**

The Cisco PDSN Release 3.5 is only supported on the Cisco MWAM card on the Cisco 7600 or Cisco 6500 Series Router. The features listed in the [PDSN Feature Matrix](#) reflect features that are still supported from previous releases.

Please note that Cisco PDSN Release 4.0 does not support Closed-RP clustering. Additionally, Closed-RP support is removed in the release.

**Table 4 PDSN Feature Matrix**

Feature Name	c7svcsami-c6i k9s-mz
Session Redundancy	X
Simple IPv6	X(P)
Resource Revocation Per User	X
Trace Functionality	X
RADIUS server load balancing	X
Selection of RADIUS Server Based On Realm	X
PPPoGRE RP Interface	X(P)
A11 Session Update	X
SDB Indicator Marking	X
Packet of Disconnect	X
Resource Revocation	X
Always On Feature	X
NPE-G1 Platform Support	—
PDSN MIB Enhancements	X
Conditional Debugging	X
10000 Sessions	—
25000 Sessions	X
RevA Support	X
Prepaid Billing (IS-835-C)	X(P)
PDSN Controller / Member Clustering	X
1xEV-DO Support	X

**Table 4** PDSN Feature Matrix (continued)

Feature Name	c7svcsami-c6i k9s-mz
ESN in Billing	X
3DES Encryption	X*
PPP Optimization	X

**P** indicates that this feature is only available with a Premium license.

\* Requires appropriate hardware support.

**Note**

If you require higher performance values for PDSN selection, use the c6is-mz images; these images contain the PDSN controller-member cluster feature for PDSN selection.

## PDSN Performance Metrics

Cisco PDSN Release 4.x and later releases deliver performance improvements such as significant improvement in 1XRTT call setup rates, compared to Release 3.0 and Release 3.5.

Performance metrics on the Cisco 7600 Series Router are as follows:

- 175,000 user sessions
- Maximum call setup rate for SIP and MIP sessions for a standalone PDSN
- Throughput on the R-P interface for non-fragmented packets of size 64, 350,512, and 1472 bytes
- Throughput on the R-P interface for fragmented packets of size 64,350,512, and 1472 bytes with fragmentation of 25 bytes
- Call setup rate for a standalone PDSN for SIP and MIP sessions
- Card level throughput is increased to 3 Gbps

**Note**

- The quoted figures are per image, and each SAMI can support six PDSN images.
- For detailed call setup rates, refer to the performance data sheet.

## Packet Data Service Access

The PDSN supports two types of service accesses. The type of service access for a mobile session is determined by the capabilities of the mobile station:

- Simple IP-based service access
- Mobile IP-based service access

## Simple IP-based Service Access

The PDSN facilitates a mobile user to access the internet and corporate intranet by using SIP-based service access. SIP mode of access, however, limits user mobility to the coverage area of the serving PDSN. Inter-PDSN handoff causes renegotiation of PPP between the mobile station and the new PDSN. The old IP address assigned at the previous PDSN cannot usually be assigned to the mobile user from the new PDSN, and results in reset and restart of user applications.

Some of the salient features for SIP-based service access are:

- Support for static IP addresses
- Public IP addresses
- Private IP addresses (for example, for VPDN service)
- Support for dynamic IP addresses
- Support for PPP PAP/CHAP authentication
- Support for MSID-based service access
- Support for packet data accounting per TIA/EIA/IS-835-B
- Support for packet filtering
- Ingress address filtering
- Input access lists
- Output access lists

User Network Access Identifier (NAI) is available during the PPP CHAP/PAP authentication phase. Domain name information in the NAI determines the domain responsible for user authentication. Based on the type of packet routing model, SIP-based service access can be categorized as follows:

- Simple IP Routed Access
- Simple IP VPDN Access
- Proxy-Mobile IP services

## Simple IP Routed Access

After receiving username and password during PPP LCP negotiations, the PDSN forwards authentication information to the local AAA server through an access-request message. This, in turn, may be proxied to the AAA server in the user's home domain, via broker AAA servers, if necessary. On successful authentication, the user is authorized services based on its service profile. User Class/CDMA\_IPTECH information, along with other authorization parameters are returned to the PDSN using an access-accept message from the home AAA server. On successful negotiation of an IP address, SIP-based services are made available to the mobile user.

SIP routed access method is applicable for users that are not configured for VPDN or PMIP services. With PPP terminated at the PDSN, uplink user traffic is routed toward the IP network from the PDSN. The address assigned to the mobile user would be from within the PDSN routable domain. Private addresses may also be used if a NAT is configured. User mobility is limited to the PDSN coverage area. Inter-PCF handoffs do not disrupt service. Inter-PDSN handoffs, however, result in PPP renegotiation at the new PDSN, another IP address being assigned at the new PDSN, and reset and restart of user applications.

## Simple IP VPDN Access

After receiving username and password during PPP LCP negotiations, the PDSN forwards authentication information to the local AAA server via an access-request message. This, in turn, may be proxied to the AAA server in the user's home domain, via broker AAA servers, if necessary. On successful authentication, the user is authorized services based on user's service profile. If the user is configured for VPDN based access services, User Class information, along with other authorization parameters including tunneling options and tunneling parameters, are returned to the PDSN through an access-accept message from the home AAA server. The following type of VPDN services is supported at the PDSN:

### L2TP - Layer 2 Tunneling Protocol

For L2TP type layer2 tunneling, the PDSN establishes an L2TP tunnel with the tunneling endpoints specified by the tunneling parameters. The L2TP tunnel would be established between the Link Control Protocol (LAC) at the PDSN and L2TP Network Server (LNS) at the NAS in user's home domain. The PPP connection would be between the mobile station and the LNS in the home network. Despite the PPP connection termination at the LNS, the PDSN monitors the PPP session for inactivity. Status of the PPP connection is also linked with the state of the underlying A10 connection. PPP connection is deleted when the underlying A10 connection is deleted. IPsec encryption methods can also be enabled over the L2TP tunnels for enhanced security.

On successful negotiation of an IP address between the mobile and the LNS, IP-based services are made available to the mobile.

The LNS may be configured to authenticate the mobile user based on the challenge and challenge response information from the PDSN. Additionally, the LNS may also be configured to challenge the user again after the layer2 tunnel has been established. The following authentication options are supported for L2TP:

- L2TP with proxy authentication

The LAC (PDSN) challenges the mobile user and forwards authentication-related information to the LNS as part of tunnel-setup parameters. The LNS may be configured to authenticate the user either locally or through the home AAA server, based on the authentication-related information from the LAC (PDSN). On successful authentication, the mobile and the LNS proceed with the IPCP phase and negotiate an IP address for the user session.

- L2TP with dual authentication

The LAC (PDSN) challenges the mobile and forwards authentication-related information to the LNS as part of tunnel-setup parameters. The LNS may be configured to authenticate the user either locally or through the home AAA server, based on the authentication-related information from the LAC (PDSN). On successful authentication, the LNS challenges the mobile again. After successful authentication, the LNS and the mobile proceed with IPCP phase and negotiate the IP address for the user session.

## Proxy Mobile IP Access

After receiving username and password during PPP LCP negotiations, the PDSN forwards authentication information to the local AAA server via an access-request message. This, in turn, may be proxied to the AAA server in the user's home domain, using broker AAA servers, if necessary. On successful authentication, the user is authorized services based on its service profile. User Class information, along with other authorization parameters, are returned to the PDSN via an access reply from the home AAA server.

If the user is configured for PMIP-based access, authorization parameters from the home AAA server include the HA address, and the security parameter (SPI) to be used for computing the MN-HA Authentication extension for the mobile station. The HA is allocated from the list of HAs configured at the home AAA server. Round robin or hashing algorithms based on user NAI can be used for allocating a HA at the AAA server. Other authorization attributes returned from the AAA server include MN-AAA authenticating extension as defined in RFC 3012. Based on this information, the PDSN performs PMIP procedures on behalf of the mobile user by sending a MIP Registration Request message to the allocated HA. On successful authentication of the mobile with the AAA server and registration at the HA, the HA assigns a home address for this mobile user. This address is returned to the mobile during IPCP IP address negotiation phase.

On successful negotiation of an IP address, PMIP-based services are made available to the mobile user. To the mobile, these services are no different from SIP services with tunneling being done through the HA. This feature, however, extends the coverage area of the call beyond the coverage area of the serving PDSN. If, as a result of a handoff event, another PDSN is allocated to the call, the target PDSN performs MIP registration with the HA, thereby ensuring that the same home address is allocated to the mobile.

## Mobile IP-based Service Access

The PDSN allows a mobile station with MIP client function to access the Internet and corporate intranet using MIP-based service access. With this mode of service access, user mobility is extended beyond the coverage area of currently serving PDSN. Resulting from a handoff, if another PDSN is allocated to the call, the target PDSN performs MIP registration with the HA, thereby ensuring that the same home address is allocated to the mobile.

Some of the salient features for MIP services access are:

- Support for static IP addresses
- Public IP addresses
- Private IP addresses
- Support for dynamic IP addresses
- Public IP addresses
- Private IP addresses
- Multiple MIP user flows over a single PPP connection
- Multiple flows for different NAIs using static or dynamic addresses
- Multiple flows for the same NAI using different static addresses
- Foreign Agent Challenge procedures in RFC 3012
- MIP Agent Advertisement Challenge Extension
- MN-FA Challenge Extension
- MN-AAA Authentication Extension
- MIP Extensions specified in RFC 2002
- MN-HA Authentication Extension
- MN-FA Authentication Extension
- FA-HA Authentication Extension
- MIP Extensions specified in RFC 3220
- Authentication requiring the use of SPI.

- Mobile NAI Extension, RFC 2794
- Reverse Tunneling, RFC 2344
- Multiple tunneling Modes between FA and HA
- IP-in-IP Encapsulation, RFC 2003
- Generic Route Encapsulation, RFC 2784
- Support for PPP PAP/CHAP authentication
- Support for MSID based service access
- Binding Update message for managing zombie PPP connections
- Flow based packet data accounting per TIA/EIA/IS-835-B
- Support for Packet Filtering
- Ingress address filtering
- Input access lists
- Output access lists

A MIP capable mobile client may be configured to skip PAP/CHAP based authentication during the PPP LCP phase. Once the PPP is established, the PDSN sends a burst of MIP Agent Advertisement messages that include the MIP Agent Advertisement Challenge extension specified in RFC 3012. The number and timing of the burst is configurable. The mobile user responds with a MIP Registration Request message that includes the mobile user's NAI and MN-FA Challenge extension in response to the challenge in the Agent Advertisement message. If the mobile user does not respond to the initial burst, advertisements can be solicited.

The Foreign Agent function at the PDSN can be configured to authenticate the mobile user by forwarding an access-request message to the local AAA server. The local AAA server would proxy the message to the home AAA server, through broker AAA servers, if necessary. On successful authentication, the home AAA server may assign a HA to the call and return its address in the access reply message. Other authorization parameters in the access-reply message include the SPI and IPsec shared key to be used between the FA and the HA. The PDSN or FA and HA establish a secure IPsec tunnel, if required, and the PDSN/FA forwards the Registration Request message to the HA. The Registration Request message includes the NAI and MN-FA-Challenge Extension also. It may also include MN-AAA Authentication extension.

The HA can be configured to authenticate the mobile again with the home AAA server. On successful authentication and registration, the HA responds with a Registration Reply message to the PDSN or FA that is forwarded to the mobile station. The Registration Reply message contains the home address also (static or dynamically assigned) for the user session.

Potential home addresses are available to the PDSN from the following:

- MIP Registration Request received from the Mobile Node
- FA-CHAP response received from the HAAA
- MIP Registration Reply received from the HA

The mobile may be configured to perform PPP PAP/CHAP authentication in addition to performing Foreign Agent Challenge based authentication specified in RFC 3012. In this case the PDSN would support one SIP flow, in addition to one or more MIP flows.

For MIP services, the HA would typically be located within an ISP network or within a corporate domain. However, many of the ISPs and/or corporate entities may not be ready to provision HAs by the time service providers begin rollout of third-generation packet data services. Access service providers could mitigate this situation by provisioning HAs within their own domain, and then forward packets to ISPs or corporate domains via VPDN services.

## Binding Update Procedures

When a mobile first registers for packet data services, a PPP session and associated MIP flows are established at the PDSN. In the event of an inter-PDSN handoff, another PPP session is established at the target PDSN, and the mobile registers with the HA through the new PDSN/FA. The Visitor list binding and the PPP session at the previous PDSN are, however, not released until the PPP inactivity timer expires.

Idle/unused PPP sessions at a PDSN consume valuable resources. The PDSN and HA support MIP Resource Revocation as defined in IS83C and Cisco Proprietary Binding Update and Binding Acknowledge messages for releasing such idle PPP sessions as soon as possible. MIP Resource Revocation is described in Section 16 in greater detail

If Cisco Proprietary binding update feature is used, in the event of an inter-PDSN handoff and MIP registration, the HA updates mobility binding information for the mobile with the Care-of-Address (COA) of the new PDSN/FA. If simultaneous bindings are not enabled, the HA sends a notification in the form of a Binding Update message to the previous PDSN/FA. The previous PDSN/FA acknowledges with Binding Acknowledge, if required, and deletes visitor list entry for the MIP session. The previous PDSN/FA initiates the release of the PPP session when there are no active flows for that mobile station.

The sending of the binding update message is configurable at the HA.



### Note

When multiple flows are established for the same NAI, a different IP address is assigned to each flow. This means that simultaneous binding is not required as this is used for maintaining more than one flow to the same IP address.

## Simple IPv6 Access

The PDSN SIP service has been enhanced to allow both simple IPv4 and simple IPv6 access. These protocols can be used one at a time, or at the same time. The ipcp and the ipv6cp are equivalent for each protocol.

An IPv6 access uses the same PPP LCP authentication and authorization procedures, as well as the AAA server access. When an RP connection is established, the MS sends a PPP Link Control Protocol (LCP) Configuration-Request for a new PPP session to the PDSN. The PPP authentication (CHAP/PAP/none) is one of the parameters negotiated during the LCP phase. After the LCP parameters are negotiated between the MS and the PDSN, an LCP Configure-Acknowledge message is exchanged. Once LCP is up, the PPP authentication is started.

The authentication phase uses CHAP, PAP, or none, depending on the configuration and LCP negotiation. After authentication, the NCPs, ipcp or ipv6cp or both, can be started. A simultaneous IPv4 and IPv6 access from an MS shares the common LCP authentication and authorization as well as the AAA server correlation-ID parameter.

The ipv6cp protocol negotiates a valid non-zero 64-bit IPv6 interface identifier for the MS and the PDSN. The PDSN has only one interface-identifier associated with the PPP connection, so it will be unique. Once ipv6cp has been successfully negotiated, the PDSN and MS both generate unique

link-local addresses for the IPv6 interface. The link-local addresses are generated by pre-pending the link-local prefix, FE80:/64, to the 64-bit interface-identifier negotiated during the ipv6cp phase (for example, FE80::205:9AFF:FEFA:D806). This gives a 128-bit link-local address.

The PDSN immediately sends an initial unsolicited Router Advertisement (RA) message on the PPP link to the MS. The link-local address of the PDSN is used as the source address and the destination address will be FF02::1, the “all nodes on the local link” IPv6 address. The PDSN includes a globally unique /64 prefix in the RA message sent to the MS. The prefix may be obtained from a local prefix pool or from the AAA server. The MS will construct a global IPv6 unicast address by prepending the prefix received in the RA to the lower 64-bit interface identifier. You should carefully configure the PDSNs so that the /64 prefix is globally unique for each MS.

After a successful ipv6cp negotiation phase and configuration of the link-local address, the MS transmits a Router Solicitation (RS) message if an RA message has not been received from the PDSN within some specified period of time. The RA is necessary for the MS to construct its 128-bit global unicast address.

In contrast to IPv4, an IPv6 MS will have multiple IPv6 addresses, including:

- Link-local address
- Global unicast address
- Various multicast addresses used for IPv6 Neighbor Discovery and IPv6 ICMP messages

An IPv6 address is 128-bits for both source and destination addresses. The /64 designation means that 64-bits are used for the prefix (upper 64-bits). This is similar to an IPv4 netmask. A /128 address would mean that the entire address is used. See RFC 3513 for additional IPv6 addressing details and information.



#### Note

For *Cisco Packet Data Serving Node (PDSN) Feature for Cisco IOS Release 12.3(14)YX*, Simple IPv6 support will be added in a future release.

## Configuring Simple IPv6

The following commands are used to configure simple IPv6 on the PDSN, and are listed in the *Cisco IOS IPv6 Command Reference* guide:

- The **cdma pdsn ipv6** command enables the PDSN IPv6 functionality.
- The **cdma pdsn ipv6 ra-count number** command configures the number of IPv6 Route Advertisements (RA).
- The **cdma pdsn ipv6 ra-count number ra-interval number** command controls the number and interval of RAs sent to the MN when an ipv6cp session comes up:
- The **cdma pdsn accounting send ipv6-flows** command control the number of flows and UDR records used for simultaneous IPv4, IPv6 sessions.
- The **show cdma pdsn flow mn-ipv6-address** command shows CDMA PDSN user information by MN IPv6 address.
- The **show cdma pdsn flow service simple-ipv6** command displays flow-based information for simple IPv6 sessions.
- The **debug cdma pdsn ipv6** command displays IPv6 error or event messages.

The following configuration commands are required for IPv6:

#### Global Configuration Commands

- **ipv6 unicast-routing**—IPv6 is disabled by default.

- **ipv6 cef**—Enables cef switching.
- **ipv6 local pool PDSN-Ipv6-Pool 2001:420:10::/48 64**—Enables a pool of IPv6 prefix addresses that can be sent to the MS as a Routing Advertisement (RA).

#### Virtual-template Interface Commands

- **ipv6 enable**—Enables IPv6 on this interface.
- **no ipv6 nd suppress-ra**—Disables the suppressing of the Neighbor Discovery Routing Advertisement messages (suppressed on non-ethernet interfaces).
- **ipv6 nd ra-interval 1000**—Sends a ND Routing Advertisement every 1000 seconds.
- **ipv6 nd ra-lifetime 5000**—Sets lifetime for the ND Routing Advertisement is 5000 seconds.
- **peer default ipv6 pool PDSN-Ipv6-Pool**—Sets this pool for RA prefixes.

#### Other commands

- **show ipv6**—Shows IPv6.

See the *Cisco IOS IPv6 Command Reference* at the following URL for detailed information about these configuration commands:

[http://www.cisco.com/en/US/docs/ios/ipv6/command/reference/ipv6\\_book.html](http://www.cisco.com/en/US/docs/ios/ipv6/command/reference/ipv6_book.html)

## Session Redundancy Infrastructure

In Cisco PDSN Release 5.0, a redundant PDSN is updated with the session details at the following two different times:

- Bulk synchronize when standby PDSN comes up
- When both active and standby PDSN are up and
  - Session comes up or goes down
  - Session is refreshed (includes details about updated auxiliary (aux) connections, IP flows and their mapping) on receiving a reregistration
  - Flow comes up or goes down (includes single IP or MIP or PMIP)
  - Session goes from active to dormant and vice versa
  - PPP renegotiation happens
  - TFT is received or updated

The new parameters introduced in this feature are synchronized to stand by for both scenarios.

## Functional Overview

PDSN session redundancy is focused on preserving user flows on failover. Support for the continuity of billing records, internal counters, and MIB variables is secondary. The following conditions need to exist for failover to be successful on the PDSN:

- Users perceive no service interruption.
- Users do not experience excessive or incorrect billing.
- Users are able to re-initiate data service after failover.

The PDSN Session Redundancy feature provides user session failover capability to minimize the impact of a PDSN failure on the mobile user experience. The PDSN uses a 1:1 redundancy model, with a standby present for every active PDSN. The active PDSN sends state information to the standby PDSN for synchronization on an as-needed basis. When a PDSN failure occurs, the standby PDSN has the necessary state information to provide service to all existing sessions. It then takes over as the active PDSN and services user sessions, thus providing session redundancy. When the previously active PDSN comes back online, it assumes the role of standby for the now active PDSN, and receives state information for all existing sessions from the newly active PDSN.

Under normal operating conditions, the active and standby PDSN pairs are two separate PDSN images that have identical configurations. They share one or more HSRP interfaces, which are used by all external entities to communicate with them. The active PDSN synchronizes session data to the standby PDSN based on events described below.

## Session Events

When a new user session needs to be established, the PCF first sets up an A10 connection to the active PDSN using the HSRP address known to the PCF. The MN then sets up a PPP connection with the active PDSN using the A10 tunnel. Once the call is in a stable state (the PPP session is successful), the active PDSN then synchronizes relevant state information to the standby PDSN. The standby then duplicates the actions of the active PDSN with regards to the A10 connection and the PPP session, and awaits further updates from the active. When any of the other events as listed below occurs, the active PDSN sends state information to the standby.

In order to minimize the loss of accounting data in the event of a failover, a periodic accounting update, with configurable frequency will run on the active PDSN. Every periodic update for a session will trigger a synchronization sent to the standby PDSN, which will update its accounting data. Only counters and attributes that undergo a change on the active PDSN are synchronized to the standby periodically. Information since the last accounting synchronization point will be lost. Also, in order to ensure that the latest information is correctly conveyed to the billing system, the standby unit will never send out any accounting records to the AAA server. The records are always sent from the active unit.

Session events that lead to a synchronization are:

- Call Setup
- Call teardown
- Flow setup
- Flow teardown
- Dormant-Active transition
- Handoff
- A11 Reregistrations
- Periodic accounting synchronization
- PPP renegotiation

## Active PDSN Failure

In the event that the standby PDSN detects that the active PDSN has failed (using HSRP), it then takes over as the active PDSN. Since all external entities, including PCFs, AAA servers, and HAs are configured to communicate with the PDSN pair only using the HSRP addresses, once the standby PDSN takes over those addresses, they are unable to detect a failure. All stable calls also have their state synchronized to the standby; therefore the standby is able to start forwarding user traffic once it takes

over as active. On the standby all timers (such as A11 lifetime, PPP timers, and MIP lifetime) are started at the time it takes over as active. Accounting data is also synchronized to the extent that the periodic accounting synchronization timer has been configured on the PDSNs.

### Standby PDSN Start-up

When a PDSN comes up when there is an existing active, it takes over the standby role. When the active PDSN learns that a standby PDSN is available, it goes through a process of transferring state data for all existing user sessions to the standby, called a Bulk synchronization. After this process is complete, the standby PDSN is then ready to take over as active in the event of a failure.

### Handling Active-Active Scenario

If there is a link failure or a failure in an intermediate node, HSRP packets sent will not reach the peer and the standby node would assume that the active has reloaded and transitioned to active state. This leads to a situation of Active-Active PDSN nodes. The requirement is that, in case one of the PDSNs continues to receive traffic while the other is isolated from the network, it is ensured that the node which received traffic should remain active once the link is restored.

To achieve this, an application tracking object is introduced and HSRP priority is altered based on whether PDSN is processing traffic after the HSRP peer is lost. The PDSN will lower its HSPR priority once it detects that the peer PDSN is lost. Afterward, when the PDSN processes traffic (either control or data packets), it raises its priority back to the configured value. This helps to choose the active node after the link is restored between the PDSNs. So the node which received traffic in Active-Active situation remains to be active after link restoration.

### Other Considerations

A Redundancy Framework (RF) MIB is available in order to monitor the active and standby status of the two PDSNs. Other MIB variables and internal counters are not synchronized between the active and standby. They start from the values following IOS-Load or Reload on the backup image. The backup image is treated as a new box.

The PDSN redundant pair is treated as a single member by the cluster controller, and is transparent to the PDSN clustering mechanism. The cluster controller is oblivious to a failover from an active PDSN to its redundant standby.

Similarly, a PDSN redundant pair appears as a single PDSN to all external entities, such as the PCF, the HA, and the AAA server.

IPSec security associations for FA-HA connectivity are maintained across failover.



#### Note

Currently, VPDN, Closed RP, IPv6, and prepaid services are not supported by the session redundancy implementation.



#### Note

Configuration synchronization between the active and standby units is supported in Cisco PDSN Release 5.0. You need to enable the autosync-all feature with the new set of CLI commands to synchronize the configuration on the active unit to the standby one.

## In Process Synchronization Events

The following subsections explain the expected behavior of the PDSN in session redundancy for various synchronization events in process.

### Call Setup

The state of “sessions-in-progress” is not preserved during failover. Mechanisms such as R-P connection retry from the PCF will ensure that sessions will be established as required.

It is possible that a failover can occur when the PCF has established an R-P session for a user flow, but user flow establishment is not completed. In this case, failover will result in the R-P session not being present on the standby. The PCF will timeout the R-P session on the next R-P session lifetime refresh. If the user attempts to establish a new session during this time, a new session will be created.

### Call Teardown

There are four scenarios for session termination and include:

- Mobile Terminal initiates session teardown
- PPP Idle Timeout expires on PDSN
- PDSN initiates a Registration Update
- PCF initiates a Registration request with lifetime 0

For each of these cases, session teardown is a multi-step process. For example, a failover can occur when a Registration Update message has been sent from the PDSN and the acknowledgement has not been received. In this case, the standby PDSN will already have been told to delete the session. The active PDSN will not wait for an update acknowledgement from the PCF.

If a failover occurs after sending the Registration Update to the PCF but before the standby has been told to delete the session, or the request to delete the session is lost, the session will remain established on the standby.

Another case is that the PPP context has been deleted as a result of mobile-initiated termination, and then failover occurs prior to the R-P session being terminated.

Similarly, expiry of the PPP Idle timer on the PDSN could also result in deleting the PPP context followed by failover prior to R-P session termination.

In these cases, either the MIP Registration Lifetime or the PPP Idle Timeout will expire, and the session is terminated.

### Flow Setup

Flows that are in the process of being established are not preserved. You will see this as failure to establish the flow, and you will have to re-establish the flow.

### Flow Teardown

This section applies when a session has two or more flows. Currently, only a MIP call supports this case. For a single IP call, only one flow is allowed.

Although a MIP flow is preserved after switchover, it is possible that registration lifetime expiration will lead to deleting the flow. If the same user registers again before the lifetime expires, it will be considered as a reregistration because this is an existing visitor. However, the reregistration may or may not succeed, depending on the following conditions:

- If the user got a Registration Reply (RRP) for previous deregistration from the active node before the switchover and if the Foreign Agent Challenge (FAC) included in that RRP is not synchronized to the now active node (if not, the flow is deleted from this node), this reregistration will be rejected

with an invalid challenge error. The user has to initiate a solicitation to the new active node, receive a new challenge, and then resend a Registration Request (RRQ). This time, the RRQ is treated as a valid reregistration and the lifetime is refreshed. It also gets the same IP address as the previous one even though the user considers this as a new registration (it is a reregistration, in the case of FA's and HA's).

- If the user did not get a RRP for its previous deregistration from the active node before the switchover, deregistration is resent to the now-active node. This deregistration is likely to be rejected because of an invalid FAC, which depends on whether the latest FAC is synchronized to the standby before the switchover. Then the user can either send a solicitation to get a new FAC, and then sends deregistration again or simply give up. If the user is not able to get a new FAC, then the user has to initiate a solicitation to the new active node, receive a new challenge, and then resend a Registration Request (RRQ).

### Dormant-Active Transition

The transition is synchronized between active and standby, and occurs in the following scenarios:

- If the PCF receives a RRP in response to the RRQ, and if the transition state is synchronized to the standby before the switchover, the now-active node will have the right session state and the transition is successful.
- If the PCF receives a RRP in response to the RRQ but the transition state is not synchronized to the standby before the switchover, the now-active node will have the wrong session state (the session is marked as dormant while it should be active). However, packets will be switched and counted. The PDSN-related **show** commands may not show all the right information about the session. The subsequent transition from active to dormant will not cause difficulties as the session remains dormant on the PDSN.
- If the PCF did not receive an RRP in response to the RRQ before the switchover and if it tries again with the now-active node, this is handled as the current date.
- If the PCF did not receive a RRP in response to the RRQ before the switchover, and if it exceeds the maximum number of retries with the now-active node, the packets will be switched and counted.

## Handoff

### Inter-PCF Handoff (Dormant or Active) - Same PDSN

The most significant problem with handoff is to re-establish the data path between the target PCF and the now-active PDSN for the preserved session, irrespective of whether this is an active or dormant handoff. Again, there is a window between handoff actually being completed and the state being synchronized within which a failover can occur.

These are the following scenarios:

- If the target PCF received an RRP from the active PDSN, and the handoff state is synchronized to the standby before switchover, the data path between the target PCF and the now-active PDSN is established for the handed-off session and the user would not perceive any service disruption. The old PCF may or may not receive the Registration Update from the previously active node, depending on the exact point of switchover. If it receives the Registration Update and sends out a RRQ (lifetime=0), the call should be treated correctly at the old PCF. In case that the old PCF does not receive the Registration Update, and that the session is handled back to it again, it's not clear how PCF will handle this case (this is similar to that the PCF has an existing call for a user and then receives a new call request from the same user). If the PCF ignores the new request, the correct data path is not present and therefore a user is not able to transfer traffic.

- If the target PCF received the RRP from the active PDSN, but the handoff state is NOT synchronized to the standby before switchover, the data path between the target PCF and the now-active PDSN will not be established (the session still points to the old PCF). As a result, the end user will notice service disruption. The user cannot gracefully de-register as PPP packets for call termination (TERMREQ) cannot reach the now-active PDSN, and the RRQ (lifetime=0) from the target PCF arrives on the now-active PDSN but the session does not recognize this as a valid remote tunnel endpoint. As a result, deregistration is ignored. The session will eventually be deleted on expiry of the PPP idle timer or registration lifetime. If the user re-registers again, this will be treated as handoff, because the session's current remote tunnel endpoint (the old PCF) is different from the target PCF. This time, the data path is established and the user will receive service.
- If the target PCF did not receive an RRP from the active PDSN before switchover, and if the PCF tries again with the now-active PDSN, the handoff is processed the same as of the current date.

#### **Inter-PCF Handoff (Dormant or Active) - Different PDSN**

This kind of handoff is indicated to the PDSN by receipt of an A11 Registration Request containing the PANID and CANID. It also includes the Mobility Event Indicator and Accounting Data (R-P Session Setup Air-link Record). From the perspective of High Availability, this looks like a new session establishment on the newly active PDSN and a 'regular' session termination on the old PDSN.

#### **A11 Reregistrations**

A11 Reregistration RRQ is received by the active unit. The registration life timer does not start on the standby, but it keeps track of the life timer value so that it can restart the life timer once it becomes active. If the lifetime in the reregistration RRQ is different from the previous RRQ, the new lifetime is synchronized to the standby. For example, if a previous RRQ carries a lifetime of 300 seconds and now a new RRQ has the value changed to 500 seconds, the new value is synchronized to the standby. Other significant parameters included in the reregistration RRQ are also synchronized to the standby.

Now, in the above example, if the failover occurs before synchronizing the new lifetime to the standby, the standby will start the lifetime for 300 seconds.

#### **PPP Renegotiation**

On PPP renegotiation, the PDSN deletes all the flows on the RP session and sends accounting STOP for each flow. After PPP is up again, the PDSN creates new flow(s) for the session. Therefore, when PPP renegotiation happens on the active, the active unit will send a PPP renegotiation notification to the standby which will then delete all the flows from the RP session on the standby. After PPP is up again and a new flow is created on the active, the active unit sends each flow's data to the standby. If the failover occurs during PPP renegotiation, the renegotiation will fail, and the session may be torn down on the newly active unit.

## **Other Considerations**

#### **Timers**

The following timers are normally running when a session is established:

- R-P Session Lifetime
- PPP Idle Timeout
- MIP Registration Lifetime
- PPP Absolute Session Timeout

The below timer may be running, depending on configuration

- Periodic accounting (not to be confused with the synchronization timer mentioned in the [Session Events](#) section).

These timers are restarted on the standby when failover occurs, and the elapsed time is not synchronized to the standby. The effect will be to extend the timers beyond their original values by a time equal to the time that has already expired. This ensures that the user will not perceive a session failure on failover.

## Restrictions

The following restrictions exist for the PDSN Session Redundancy Feature:

- Limitation for Resource Revocation with SR Setup.  
Setting the revocation timestamp to “msec” (**ip mobile foreign-service revocation timeout 5 retransmit 4 timestamp msec**) for PMIP flows with Session Redundancy is not permitted.  
The “msec” option puts the uptime in the timestamp field, and the uptime of the standby router is expected to be lower after switchover when the standby PDSN takes over as active (and when the PMIP flow was closed). Therefore, revocation on HA will be ignored because the identifier value in the revocation message is less than what is expected by HA.
- The **ip radius source interface** command does not support virtual address (HSRP), and hence the IP address configured in Loopback interface to be used as source interface (NAS IP address) for reaching the AAA server in SR setup.
- IP local pool recycle delay needs to be configured with a minimum delay of 30 (**ip local pool pdsn-pool first\_ip last\_ip recycle delay 30**).
- It is also advisable to have minimum of (calls per second \* recycle delay) extra IPs than required as a buffer, so that sessions do not drop because of IP depletion.

## Internals

The following sections identify information that is synchronized to the standby unit:

### Asynchronous High-Level Data Link Control

The control character mapping per used Asynchronous High-Level Data Link Control (AHDLC) channel is preserved. As the default is normally used, only those that are different are synchronized. The AHDLC channel number is not synchronized; an available channel will be selected independently on the standby.

### GRE - RP Interface

The GRE Key is synchronized. The flags are synchronized as the sequence flag can be set on a per user basis.

### RP Signaling

The contents of the A11 messaging will be treated as described here.

- Flags—Fixed and no synchronization is required.
- Lifetime—Synchronized.
- Home Address—No synchronization is required.
- HA—No synchronization is required. This is the HSRP address of the R-P interface. This is used for proposing a PDSN IP address when clustering is configured. This will be the HSRP address of the proposed PDSN. It is only used prior to session establishment.
- Care-of-Address—Synchronized. This is the PCF IP address for the R-P Session.

- A10 Source IP address—Synchronized. This is the PCF's A10 IP address.
- Identification—Not synchronized, contains timestamp to protect against replay attacks.
- Mobile-Home Authentication Extension—Not synchronized, calculated per message.
- Registration Update Authentication Extension—Not synchronized, calculated per message.
- Session-Specific Extension—Synchronized, covers Key, MN\_ID and SR-ID.
- C-VOSE—Contains multiple application types, Accounting, MEI and DAI. The accounting information will be synchronized. Details are in the accounting section.
- N-VOSE contents—ANID will be synchronized, both as part of the session establishment and when it changes as a result of handoff. Fast handoff is not supported, so PDSN Identifier and Identifiers are not relevant to the session redundancy discussion.
- Radio Network Packet Data Inactivity Timer (RNPDIT)—Synchronized.
- The source UDP port for the A11 traffic will be synchronized.

### PPP

All LCP options are synchronized. For IPCP, only the IP address and IPHC parameters are synchronized. DNS server IP address negotiated during IPCP negotiation is not synchronized to the standby unit. All per user attributes downloaded from the AAA server during authentication or authorization are synchronized to the standby unit.

### Compression - Header and Payload

There is no synchronization of compression context for either header or payload compression. Fail-over to a standby PDSN results in the compression context being re-established.

Header compression - First packet for a session after switchover is dropped, and peer retries the packet after acknowledge timeout.

Payload compression - There is no compression history present after switchover on the standby. A CCP reset is automatically generated when decode fails. No special treatment is needed.

### IP Address Assignment

When an IP address is dynamically assigned from a pool configured on the PDSN, it is necessary that the standby associates the same address with the session. The IP address will be synchronized as part of PPP state. If the IP address is received from the AAA server or a static IP address is used that does not come from a local pool, this address will also be associated with the session on the standby. Similarly, the address pool will be synchronized.

## AAA - Authentication and Authorization

Table 5 lists the relevant authentication and authorization parameters. This is required on the standby to allow accurate recreation of the AAA state.

**Table 5** Standard AVPs Supported for Authentication and Authorization

Authentication and Authorization AVPs Supported By Cisco IOS Name	Synchronized	Description	Allowed In	
			Access Request	Access Accept
User-Name	Yes	User name for authentication and authorization.	Yes	No
User-Password	No	Password for authentication.	Yes	No

**Table 5** Standard AVPs Supported for Authentication and Authorization (continued)

Authentication and Authorization AVPs Supported By Cisco IOS Name	Synchronized	Description	Allowed In	
			Access Request	Access Accept
CHAP-Password	No	CHAP password.	Yes	No
NAS-IP-Address	No	IP address of the PDSN interface used for communicating with RADIUS server. A loopback address could be use for this purpose.	Yes	No
Service-Type	No	Type of service the user is getting. Supported values include: <ul style="list-style-type: none"> <li>• “Outbound” for MSID-based user access</li> <li>• “Framed” for other type of user access</li> </ul>	Yes	Yes
Framed-Protocol	No	Framing protocol user is using. Supported values include: <ul style="list-style-type: none"> <li>• PPP</li> </ul>	Yes	Yes
Framed-IP-Address	Yes	IP address assigned to the user.	Yes	Yes
Session-Time-Out	Yes	Maximum number of seconds of service is to be provided to the user before session terminates.  This attribute value becomes the per-user “absolute time-out.”	No	Yes
Idle-Time-out	Yes	Maximum number of consecutive seconds of idle connection allowed to the user before the session terminates.  This attribute value becomes the per-user “idle-time-out”.	No	Yes
Calling-Station-ID	Yes	MSID identifier of the mobile user.	Yes	No
CHAP-Challenge (optional)	No	CHAP Challenge.	Yes	No
Tunnel-Type	No	VPN tunneling protocol(s) used. Supported values include: <ul style="list-style-type: none"> <li>• 1 for PPTP (not supported)</li> <li>• 3 for L2TP</li> </ul>	No	Yes
Tunnel-Medium-Type	No. Not supported	Transport medium type to use for the tunnel.	No	Yes
Tunnel-Client- Endpoint	No. Not supported	Address of the client end of the tunnel. When you specify Tunnel-Client-Endpoint, Tunnel-Server is not supported. Use L2TP	No	Yes
Tunnel-Server- Endpoint	No. Not supported	Address of the server end of the tunnel.	No	Yes
Tunnel-Password	No. Not supported	Password to be used for authenticating remote server.	No	Yes
Tunnel-Assignment-ID	No. Not supported	Indicates to the initiator of the tunnel, identifier of the tunnel to which the session is assigned.	No	Yes

**Table 5** Standard AVPs Supported for Authentication and Authorization (continued)

Authentication and Authorization AVPs Supported By Cisco IOS Name	Synchronized	Description	Allowed In	
			Access Request	Access Accept
addr-pool	No. Not supported	Name of a local pool from which to obtain address. Used with service=ppp and protocol=ip. “addr-pool” works in conjunction with local pooling. It specifies the name of a local pool (which must have been pre-configured locally). Use the ip-local pool command for configuring local pools. For example: <ul style="list-style-type: none"> <li>• ip address-pool local</li> <li>• ip local pool boo 10.0.0.1 10.0.0.10</li> <li>• ip local pool moo 10.0.0.1 10.0.0.20</li> </ul>	No	Yes
Inacl#<n>	Yes	ASCII access list identifier for an input access list to be installed and applied to an interface for the duration of the current connection. Used with service=ppp and protocol=ip, and service service=ppp and protocol =ipx. <b>Note</b> Per-user access lists do not currently work with ISDN interfaces.	No	Yes
Inacl	Yes	ASCII identifier for an interface input access list. Used with service=ppp and protocol=ip. Contains an IP output access list for SLIP or PPP/IP (for example, intacl=4). The access list itself must be pre-configured on the router.	No	Yes
outacl#<n>	Yes	ASCII access list identifier for an interface output access list to be installed and applied to an interface for the duration of the current connection. Used with service=ppp and protocol=ip, and service service=ppp and protocol=ipx.	No	Yes
Outacl	Yes	ASCII identifier for an interface output access list. Used with service=ppp and protocol=ip, and service service=ppp and protocol=ipx. Contains an IP output access list for SLIP or PPP/IP (for example, outacl=4). The access list itself must be pre-configured on the router.	No	Yes
interface-config	Yes	User-specific AAA server interface configuration information with Virtual Profiles. The information that follows the equal sign (=) can be any Cisco IOS interface configuration command.	No	Yes

**Table 5 Standard AVPs Supported for Authentication and Authorization (continued)**

Authentication and Authorization AVPs Supported By Cisco IOS Name	Synchronized	Description	Allowed In	
			Access Request	Access Accept
SPI	Yes	Carries authentication information needed by the HA for authenticating a mobile user during MIP registration.  Provides the Security Parameter Index (SPI), key, authentication algorithm, authentication mode, and replay protection timestamp range.  The information is in the same syntax as the <b>ip mobile secure host address</b> configuration command. Essentially, it contains the rest of the configuration command that follows that string, verbatim.	No	Yes
IP-Pool-Definition	Yes	Defines a pool of addresses using the format: X a.b.c Z; where X is the pool index number, a.b.c is the pool's starting IP address, and Z is the number of IP addresses in the pool.  For example, 3 10.0.0.1 5 allocates 10.0.0.1 through 10.0.0.5 for dynamic assignment.	No	Yes
Assign-IP-Pool	Yes	Assign an IP address from the identified IP pool.	No	Yes
Framed-Compression	Yes	Indicates a compression protocol used for the link. Supported values include: <ul style="list-style-type: none"> <li>0: None</li> <li>1: VJ-TCP/IP header compression</li> </ul>	No	Yes
Link-Compression	Yes	Link compression protocol to be used. Supported values include: <ul style="list-style-type: none"> <li>0: None</li> <li>1: Stac</li> <li>2: Stac-LZS</li> <li>3: MS-Stac</li> </ul>	No	Yes

**GPP2 Packet Data Service Attributes**

Table 6 lists the 3GPP2 Packet Data Service Attributes.

**Table 6 3GPP2 Packet Data Service Attributes**

Name	Synchronized	Description	Allowed In	
			Access Request	Access Accept
mobileip-mn-lifetime	Yes	Defines lifetime used in Proxy MIP RRQ.	No	Yes
mobileip-mn-ipaddr	Yes	MN IP address for static address assignment. If this attribute is present, this address is used in Proxy MIP RRQ.	No	Yes

**Table 6** 3GPP2 Packet Data Service Attributes (continued)

Name	Synchronized	Description	Allowed In	
mobileip-mn- flags	Yes	Defines Flags used in Proxy MIP RRQ.	No	Yes
CDMA-Realm	Yes	For MSID based access, “realm” information for construction of user name in the form MSID@realm. User names constructed this way are used for accounting purposes only.  The format of realm information is: <ul style="list-style-type: none"> <li>• ASCII string specifying realm of user’s registered domain.</li> </ul>	No	Yes
CDMA-User- Class	Yes	Type of service user is subscribed to.  Supported values are: <ul style="list-style-type: none"> <li>• 1 for SIP</li> <li>• 2 for MIP</li> </ul>	No	Yes
3GPP2-Reverse-Tunnel- Spec	Yes	Indicates whether reverse tunneling is required or not.  Supported values are: <ul style="list-style-type: none"> <li>• 0 for reverse tunneling not required.</li> <li>• 1 for reverse tunneling required.</li> </ul>	No	Yes
3GPP2-Home-Agent- Attribute	Yes	Address of the HA	Yes	Yes
3GPP2-IP-Technology	Yes	Indicates type of service user is subscribed to.  Supported values are: <ul style="list-style-type: none"> <li>• 1 for SIP</li> <li>• 2 for MIP</li> </ul>	No	Yes
3GPP2-Correlation-Id	Yes	Identifies all accounting records generated for a particular user flow.	Yes	Yes
3GPP2-Always-On	Yes	Indicates Always On Service.  Supported values are: <ul style="list-style-type: none"> <li>• 0 for non always on users</li> <li>• 1 for always on users</li> </ul>	No	Yes
3GPP2-Security Level	Yes	Indicates the type of security that the home network mandates on the visited network.	No	Yes
3GPP2- IKE Pre-shared Secret Request	No	Indicates that the PDSN needs a pre-shared secret for Phase 1 IKE negotiation with the HA.	Yes	No
3GPP2-Pre-shared secret	No	A pre-shared secret for IKE.	No	Yes
3GPP2-KeyID	No	Contains the KeyID parameter used during IKE exchange between the PDSN and the HA.	No	Yes
3GPP2-Allowed DiffServ marking	No	Specifies if the user is able to mark packets with AF (A), EF (E). The Max Class (i.e., Max Selector Class), specifies that the user may mark packets with a Class Selector Code Point that is less than or equal to Max Class.	No	Yes

**Table 6** 3GPP2 Packet Data Service Attributes (continued)

Name	Synchronized	Description	Allowed In	
3GPP2-MN-AAA Removal Indication	Yes	When received in a RADIUS access-accept message, the PDSN will not include the MN-AAA.	No	Yes
3GPP2-Foreign-Agent Address	No	The IPv4 address of the PDSN CoA contained in RRQ.	Yes	No
Service Option	Yes	Indicates the type of service being used.	Yes	No
DNS Update Required	No. Not supported	Indicates whether DNS update is required.	No	Yes
RN PDIT	Yes	Radio Network Packet Data Inactivity Timer.	No	Yes
Session Termination Capability	Yes	Indicates the nature of resource revocation supported.	Yes	Yes

## AAA Server Accounting

### GPP2 Accounting Records Fields

Table 7 identifies the GPP2 accounting records fields.

**Table 7** GPP2 Accounting Records Fields

Item	Parameter	Description	Synchronized
A. Mobile Identifiers			
A1	MSID	MS ID (for example: IMSI, MIN, IRM)	Yes
A2	ESN	Electronic Serial Number	Yes
A3	MEID	Mobile Equipment Identifier	Yes
B. User Identifiers			
B1	Source IP Address	IPv4 address of the MS.	Yes
B2	Network Access Identifier (NAI)	user@domain construct which identifies the user and home network of the MS.	Yes
B3	Framed-IPv6- Prefix	MS IPv6 prefix.	Not supported.
B4	IPv6 Interface ID	MS IPv6 interface identifier.	Not supported.
C. Session Identifiers			
C1	Account Session ID	The Account Session ID is a unique accounting ID created by the Serving PDSN that allows start and stop RADIUS records from a single R-P connection or P-P connection to be matched.	Yes
C2	Correlation ID	The Correlation ID is a unique accounting ID created by the Serving PDSN for each packet data session that allows multiple accounting events for each associated R-P connection or P-P connection to be correlated.	Yes
C3	Session Continue	This attribute when set to “true” means it is not the end of a Session and an accounting stop is immediately followed by an Account Start Record. “False” means end of a session.	Yes

**Table 7** GPP2 Accounting Records Fields (continued)

Item	Parameter	Description	Synchronized
C4	Beginning Session	The attribute when set to “true” means new packet data session is established; “false” means continuation of previous packet data session. This attribute is contained in a RADIUS Accounting-Request (Start) record.	No
C5	Service Reference ID	This is the service instance reference ID received from the RN in an A11 Registration-Request message.	Yes
<b>D. Infrastructure Identifiers</b>			
D1	HA	The IPv4 address of the HA.	Yes
D2	PDSN	The IPv4 address of the PDSN.	No. Should be configured to be the same on the active and standby.
D3	Address Serving PCF	The IP address of the serving PCF (the PCF in the serving RN).	Yes
D4	BSID	SID + NID + Cell Identifier type 2.	Yes
D5	IPv6 PDSN Address	The IPv6 address of the PDSN.	Not supported
D6	Foreign Agent Address	The IPv4 address of the FA-CoA.	Not supported
D7	Subnet	The subnet information for HRPD.	Yes
<b>E. Zone Identifiers</b>			
E1	User zone	Tiered Services user zone.	Yes
<b>F. Session Status</b>			
F1	Forward FCH Mux Option	Forward Fundamental Channel multiplex option.	Yes
F2	Reverse FCH Mux Option	Reverse Fundamental Channel multiplex option.	Yes
F5	Service Option	CDMA service option as received from the RN.	Yes
F6	Forward Traffic Type	Forward direction traffic type - either Primary or Secondary.	Yes
F7	Reverse Traffic Type	Reverse direction traffic type - either Primary or Secondary.	Yes
F8	FCH Frame Size	Specifies the FCH frame size.	Yes
F9	Forward FCH RC	The format and structure of the radio channel in the forward Fundamental Channel. A set of forward transmission formats that are characterized by data rates, modulation characterized, and spreading rates.	Yes
F10	Reverse FCH RC	The format and structure of the radio channel in the reverse Fundamental Channel. A set of reverse transmission formats that are characterized by data rates, modulation characterized, and spreading rates.	Yes
F11	IP Technology	Identifies the IP technology to use for this call: SIP or MIP.	Yes
F12	Compulsory Tunnel Indicator	Indicator of invocation of compulsory tunnel established on behalf of MS for providing private network and/or ISP access during a single packet data connection.	Yes
F13	Release Indicator	Specifies reason for sending a stop record.	Yes

**Table 7** GPP2 Accounting Records Fields (continued)

Item	Parameter	Description	Synchronized
F14	DCCH Frame Size	Specifies Dedicated Control Channel (DCCH) frame size.	Yes
F15	Always On	Specifies the status of Always On service.	Yes
F16	Forward PDCH RC	The Radio Configuration of the Forward Packet Data Channel. (This parameter can be used as an indication that the MS is 1xEV DV capable.)	Yes
F17	Forward DCCH Mux Option	Forward Dedicated Control Channel multiplex option.	Yes
F18	Reverse DCCH Mux Option	Reverse Dedicated Control Channel multiplex option	Yes
F19	Forward DCCH RC	The format and structure of the radio channel in the forward Dedicated Control Channel. A set of forward transmission formats that are characterized by data rates, modulation characterized, and spreading rates.	Yes
F20	Reverse DCCH RC	The format and structure of the radio channel in the reverse Dedicated Control Channel. A set of reverse transmission formats that are characterized by data rates, modulation characterized, and spreading rates.	Yes
F22	Reverse PDCH RC	The Radio Configuration of the Reverse Packet Data Channel.	Yes
<b>G. Session Activity</b>			
G1	Data Octet Count (Terminating)	The total number of octets in IP packets sent to the user, as received at the PDSN from the IP network (i.e. prior to any compression and/or fragmentation).	Yes
G2	Data Octet Count (Originating)	The total number of octets in IP packets sent by the user.	Yes
G3	Bad PPP frame count	The total number of PPP frames from the MS dropped by the PDSN due to incorrect able errors.	Yes
G4	Event Time	This is an event timestamp which indicates one of the following: <ul style="list-style-type: none"> <li>The start of an accounting session if it is part of a RADIUS start message.</li> <li>The end of an accounting session if it is part of a RADIUS stop message.</li> <li>An Interim-Update accounting event if it is part of a RADIUS Interim-Update message.</li> </ul>	Yes
G5	Remote IPv4 Address Octet Count	Contains the octet count associated with one or more remote IPv4 addresses; used for source or destination accounting.	Yes
G6	Remote IPv6 Address Octet Count	Contains the octet count associated with one or more remote IPv6 addresses; used for source or destination accounting.	Not supported
G8	Active Time	The total active connection time on traffic channel in seconds.	Yes
G9	Number of Active Transitions	The total number of non-active to active transitions by the user.	Not supported
G10	SDB Octet Count (Terminating)	The total number of octets sent to the MS using Short Data Bursts.	Yes

**Table 7** GPP2 Accounting Records Fields (continued)

Item	Parameter	Description	Synchronized
G11	SDB Octet Count (Originating)	The total number of octets sent by the MS using Short Data Bursts.	Yes
G12	Number of SDBs (Terminating)	The total number of Short Data Burst transactions with the MS.	Yes
G13	Number of SDBs (Originating)	The total number of Short Data Burst transactions with the MS.	Yes
G14	Number of HDLC layer octets received	The count of all octets received in the reverse direction by the HDLC layer in the PDSN.	Yes
G15	Inbound MIP Signaling Octet Count	This is the total number of octets in registration requests and solicitations sent by the MS.	Yes
G16	Outbound MIP Signaling Octet Count	This is the total number of octets in registration replies and agent advertisements sent to the MS prior to any compression and/or fragmentation.	Yes
G17	Last User Activity Time	This is a Timestamp (in number of seconds from Jan 1 1970 UTC) of the last known activity of the user.	Yes
<b>I. Quality of Service</b>			
I1	IP Quality of Service (QoS)	This attribute is deprecated.	Not supported
I2	Airlink Priority	Identifies Airlink Priority associated with the user. This is the user's priority associated with the packet data service.	Not supported
<b>Y. Airlink Record Specific Parameters</b>			
Y1	Airlink Record Type	3GPP2 Airlink Record Type.	No
Y2	R-P Connection ID	Identifier for the R-P Connection. This is the GRE key that uniquely identifies an R-P connection (an A10 connection) between the PCF and the PDSN.	Yes
Y3	Airlink Sequence Number	Sequence number for Airlink records. Indicates the sequence of airlink records for an R-P connection.	Yes
Y4	Mobile Originated / Mobile Terminated Indicator	Used only in SDB airlink records. Indicates whether the SDB is Mobile Originated or Mobile Terminated. (0=Mobile Originated and 1=Mobile Terminated).	Yes
<b>Z. Container</b>			
Z1	Container	3GPP2 Accounting Container attribute. This attribute is used to embed 3GPP2 AVPs.	Not supported

**RADIUS Server Group Support**

The IP address of the AAA server chosen will not be synchronized.

**Mobile IP Signaling**

For MIP service, the parameters to be synchronized, per MIP flow, include the following:

- MIP Registration Lifetime
- MIP Flags indicated in the Registration Request
- MN-AAA Removal Indication received from the AAA server

- HA IP address
- Mobile's IP address
- Reverse Tunneling indication
- Care of Address from MIP Registration Request
- FA-Challenge (used during Mobile Node reregistration)

#### Mobile IP Tunneled Traffic

This traffic is carried in either GRE tunnels or IP-in-IP tunnels. The only information that needs to be synchronized is the tunnel endpoint of the peer.

#### Locally Configured IPSec

For the PDSN on the Catalyst 76xx series, IPSec tunnels are terminated on the VPN Acceleration Module. The role of the PDSN is to retrieve parameters from the AAA server and, based on these parameters, 'trigger' IPSec tunnel establishment. Synchronization of these parameters is sufficient to preserve IPSec tunnels in the event of PDSN failover for intra-chassis configurations. PDSN failover is not coupled with VPN Acceleration Module/SUP failover. Inter chassis configurations and intra-chassis SUP failover does not currently support stateful IPSec.

#### FA-HA IPSec

FA-HA IPSec tunnels will be preserved when PDSN on 7600 failover occurs for intra-chassis configurations. They will not be preserved for inter chassis configurations.

## AAA Server Accounting

#### Periodic Accounting Synchronization

Accounting information is optionally synchronized between the active and standby images. This synchronization occurs at the configured periodic accounting interval. The counters that are synchronized are g1 and g2, along with the packet counts. Sending an Interim Accounting record will trigger synchronization of the byte and packet counts. Setting the operator-defined periodic accounting interval determines the accuracy of the user-billing record as impacted by PDSN failover. It is possible that undercharging could occur; however, overcharging is not possible.

#### Accounting with VSA Approach

After a switchover takes place, the first interim or stop accounting record (as appropriate) includes a Vendor Specific Attribute (VSA) (cdma-rfswact) indicating that a switchover has occurred. The inclusion of this VSA is controllable by issuing the **cdma pdsn redundancy accounting send vsa swact** command.



#### Note

G1 and G2 counters will not synchronize.

Here is a sample accounting debug with vsa:

```
Sep 13 18:23:10.179: RADIUS:   Cisco AVpair      [34] 16
Sep 13 18:23:10.179: RADIUS:   63 64 6D 61 2D 72 66 73 77 61 63 74 3D 31
[cdma-rfswact=1]
```

### System Accounting

In a session redundancy setup, an accounting ON will be sent by the active unit only when the whole setup is brought up (accounting ON will not be sent by the newly active unit after a failover). The standby unit does not send any system accounting events under any scenarios. The events, however, are sent in a standalone mode.

A sys-off is sent if reload is issued on the active unit.

## New Features in This Release

This section explains new features in Cisco PDSN Release 5.1:

- [Simple IP Client IP Accounting Support](#)
- [SNMP New MIB Objects for Per PCF](#)
- [Support for Common NAI](#)
- [Proxy MIP Changes for Latest IS-835](#)
- [Simple IPv6 Support](#)
- [Access-Request Attributes](#)
- [New PPP Per PCF Counters](#)
- [VPDN Conditional Debugging](#)
- [GRE CVSE and MN NAI Extension in Revocation Message](#)

## Simple IP Client IP Accounting Support

Cisco PDSN provides support for simple IP customers to connect to the L2TP Network Server (LNS) on their home network for IP address assignment. The Cisco PDSN watches for the IPCP configuration acknowledgement returning from the LNS during PPP negotiation between the MS and the LNS. It then extracts the IP address and uses this address, instead of 0.0.0.0 for all subsequent AAA packets.



**Note**

---

Simple IP accounting does not support IPv6 addresses that are assigned by the LNS.

---

A new CLI command, **cdma pdsn accounting vpdn address [include renegotiation]**, is introduced in Cisco PDSN Release 5.1. In earlier releases of Cisco PDSN, the accounting-start (with MN IP using all zeroes) is sent out as soon as an L2TP tunnel is established. When you enable the **cdma pdsn accounting vpdn address [include renegotiation]** command, the accounting-start is delayed till Cisco PDSN gets a valid IP address for the mobile. If the call goes down before the IP address is negotiated, no accounting message is sent.



**Note**

---

When you enable the CLI command with an extension (including renegotiation), all the packets for VPDN are snooped, thus impacting the performance of Cisco PDSN. If the LNS does not change the IP address during renegotiation, you can remove the extension of the CLI (including renegotiation). By so doing, after the mobile IP address is received, snooping is stopped.

---

## SNMP New MIB Objects for Per PCF

The Cisco PDSN requires SNMP management support for per-PCF PPP statistics. The MIB object defines the manageable objects. Table 8 and 9 describe the new MIB objects per PCF and the VPDN MIB objects that are introduced in Cisco PDSN Release 5.1, respectively.

Table 8 lists the new MIB objects per PCF in Cisco PDSN Release 5.1.

**Table 8** *New MIB Objects Per PCF in Cisco PDSN Release 5.1*

Object	Description
<b>ccpCdmaExtCacEnabled</b>	Determines if the Cisco PDSN supports call admission control feature.
<b>ccpCdmaExtPcfSoPppPreLCPdsnA10Rls</b>	Specifies the total number of A10 connections released per PCF by Cisco PDSN before PPP enters into the LCP negotiation phase.
<b>ccpCdmaExtPcfSoPppPreLCPpcfA10Rls</b>	Specifies the total number of A10 connections released by PCF before the PPP enters into the LCP negotiation phase.
<b>ccpCdmaExtPcfSoPppLcpOptionIssueFailures</b>	Specifies the total number of PPP connection requests terminated per PCF due to the LCP option negotiation failure.
<b>ccpCdmaExtPcfSoPppLcpFailuresMaxRetrans</b>	Specifies the total number of PPP connections requests failed per PCF at the LCP phase after the maximum number of retransmissions.
<b>ccpCdmaExtPcfSoPppLcpFailuresUnknown</b>	Specifies the total number of PPP connection requests failed per PCF at the LCP phase due to unknown reasons.
<b>ccpCdmaExtPcfSoPppLcpPhaseRxTermreqs</b>	Specifies the total number of PPP negotiations terminated per PCF due to PPP receiving term request during the LCP phase.
<b>ccpCdmaExtPcfSoPppLcpPcfA10Rls</b>	Specifies the total number of A10 connections released by PCF during the LCP negotiation phase.
<b>ccpCdmaExtPcfSoPppAuthFailures</b>	Specifies the total number of PPP setup connections that failed per PCF at the authentication phase.
<b>ccpCdmaExtPcfSoPppAuthAAATimeouts</b>	Specifies the total number of PPP authentication failures per PCF, due to AAA timeouts.
<b>ccpCdmaExtPcfSoPppAuthFailuresUnknown</b>	Specifies the total number of PPP connection per PCF requests that failed at authentication phase due to unknown reasons.
<b>ccpCdmaExtPcfSoPppAuthMaxRetransFailure</b>	Specifies the total number of PPP connection per PCF requests, which failed at the authentication phase after the maximum number of retransmissions.

**Table 8**      *New MIB Objects Per PCF in Cisco PDSN Release 5.1 (continued)*

<b>ccpCdmaExtPcfSoPppAuthPhaseRxTermreqs</b>	Specifies the total number of PPP negotiations terminated per PCF due to PPP receiving term request during the authentication phase.
<b>ccpCdmaExtPcfSoPppAuthPcfA10RIs</b>	Specifies the total number of A10 connections that are released by the PCF during the PPP authentication phase.
<b>ccpCdmaExtPcfSoPppIpcpOptionIssueFailures</b>	Specifies the total number of PPP connections terminated per PCF due to the IPCP option negotiation failure, such as IP address negotiation.
<b>ccpCdmaExtPcfSoPppIpcpFailuresMaxRetrans</b>	Specifies the total number of PPP connection requests failed per PCF at the IPCP phase after the maximum number of retransmissions
<b>ccpCdmaExtPcfSoPppIpcpFailuresUnknown</b>	Specifies the total number of PPP connection requests failed per PCF at IPCP phase due to unknown reasons.
<b>ccpCdmaExtPcfSoPppIpcpPhaseRxTermreqs</b>	Specifies the total number of PPP negotiations terminated per PCF due to PPP receiving a term request during the IPCP phase.
<b>ccpCdmaExtPcfSoPppIpcpPcfA10RIs</b>	Specifies the total number of A10 connections released by the PCF during the IPCP negotiation phase.
<b>ccpCdmaExtPcfSoPppIpcpIpResourceFail</b>	Specifies the total number of PPP negotiations terminated per PCF due to address exhaustion in the IP pool.
<b>ccpCdmaExtPcfSoPppRenegTotalReqs</b>	Specifies the total number of PPP connections renegotiated per PCF by either Cisco PDSN or the MN.
<b>ccpCdmaExtPcfSoPppRenegByPdsnReqs</b>	Specifies the total number of PPP connections renegotiation requests initiated per PCF by Cisco PDSN.
<b>ccpCdmaExtPcfSoPppRenegByMobileReqs</b>	Specifies the total number of PPP connections renegotiation requests initiated per PCF by the MN.
<b>ccpCdmaExtPcfSoPppRenegSuccesses</b>	Specifies the total number of PPP renegotiations per PCF that have been successfully brought to active state.
<b>ccpCdmaExtPcfSoPppRenegFailures</b>	Specifies the total number of PPP renegotiations failed per PCF at Cisco PDSN.
<b>ccpCdmaExtPcfSoPppRenegConnectionsAborted</b>	Specifies the total number of PPP renegotiations terminated per PCF prematurely due to reasons such as MN power is being off.
<b>ccpCdmaExtPcfSoPppRenegAddrMismatchReqs</b>	Specifies the total number of PPP connections renegotiated per PCF due to IP address mismatch.

**Table 8** *New MIB Objects Per PCF in Cisco PDSN Release 5.1 (continued)*

<b>ccpCdmaExtPcfSoPppRenegAccessNwidChanges</b>	Specifies the total number of PPP connections renegotiated per PCF due to access-network identification (ANID) change during session handoff.
<b>ccpCdmaExtPcfSoPppRenegGreChangeReqs</b>	Specifies the total number of PPP connections renegotiated per PCF due to GRE key change requests received from the MN.
<b>ccpCdmaExtPcfSoPppRenegOtherReasonReqs</b>	Specifies the total number of PPP connections renegotiated per PCF due to reasons other than IP address mismatch.
<b>cCdmaClusterRole</b>	<p>Specifies the role that Cisco PDSN assumes within a controller-member.</p> <p>Type of cluster:</p> <ul style="list-style-type: none"> <li>• <b>notApply</b> indicates that Cisco PDSN does not assume any cluster role. Cisco PDSN assumes the cluster role, if the <b>cCdmaClusterType</b> is not a controller-member.</li> <li>• <b>controller</b> indicates that Cisco PDSN is the controller of the cluster.</li> <li>• <b>member</b> indicates that Cisco PDSN is a member of the cluster.</li> <li>• <b>collocated</b> indicates that Cisco PDSN is both controller and a member of the cluster.</li> </ul>

Table 9 lists the new VPDN MIB objects in Cisco PDSN Release 5.1.

**Table 9** *New VPDN MIB Objects in Cisco PDSN Release 5.1*

<b>Object</b>	<b>Description</b>
<b>cvpdnSystemInitialConnReq</b>	Specifies the total number of connection attempts in all the VPDN tunnels of this tunnel.
<b>cvpdnSystemSuccessConnReq</b>	Specifies the total number of successful connection attempts in all the VPDN tunnels of this tunnel.
<b>cvpdnSystemFailedConnReq</b>	Specifies the total number of failed connection attempts in all the VPDN tunnels of this tunnel.

## Support for Common NAI

The common NAI feature, introduced in Cisco PDSN Release 5.1, involves a global NAI and calling station identification (CLID) on all interactions with external entities, and the CLID as the local identifier (local NAI) within the entity (Foreign Agent).

With a redundancy setup, this attribute is synchronized to standby mode for each flow in both active and standby modes. This attribute is synchronized to standby mode along with other flow attributes. The following CLI command is used to enable this feature:

```
router(config)# ip mobile foreign-agent mn-identifier calling-station-id
```

To remove the configuration, use:

```
router(config)# no ip mobile foreign-agent mn-identifier calling-station-id
```

Configure the following CLI commands also.

To send 3GPP2 CLID NVSE in MIP RRQ:

```
router(config)# [no] cdma pdsn attribute send a1 mip-rrq
```

To send CT CLID NVSE in MIP RRQ:

```
Router(config)# [no] cdma pdsn attribute vendor 20942 send a1 mip rrq
```

To send CLID VSA in FA-CHAP:

```
Router(config)# [no] cdma pdsn attribute send a1 fa-chap
```


**Note**

Ensure that you configure this command only when there are no sessions.

## Proxy MIP Changes for Latest IS-835

The proxy MIP changes for the IS-835 feature, introduced in Cisco PDSN Release 5.1, supports the draft version of 3GPP2 X.S0061-0 Version 1.0, entitled *Network PMIP Support for PMIPv4*.

The following are different PMIP-related attributes that are used at the AAA server level to indicate different functionalities of PMIP:

- [Network-PMIP-NAI Attribute](#)
- [PMIP-based Mobility Capability Attribute](#)
- [PMIP-HA-Info-IPv4-Service Attribute](#)

### Network-PMIP-NAI Attribute

The network-PMIP-NAI VSA specifies the NAI to be used by the access gateway (AGW) for network PMIP binding between AGW and HA. The network-PMIP-NAI attribute is included in the RADIUS access-accept message if the AGW supports network PMIP and the AT is authorized for network PMIP-based mobility.


**Note**

The network-PMIP NAI attribute is received from the AAA server only in the access-reply message. Also, this attribute specifies the NAI for mobile node for a PMIP call and is used as the NAI. Cisco PDSN accepts this attribute only if you enable the PMIP-based mobility capability command **cdma pdsn attribute send 3gpp2 pmip-indicator auth-req** from the CLI. Otherwise, the call is rejected.

### PMIP-based Mobility Capability Attribute

The PMIP-based mobility capability VSA indicates that the AGW supports network PMIP to the AAA server. A new PMIP-based mobility capability CLI command, **cdma pdsn attribute send 3gpp2 pmip-indicator auth-req**, is introduced in Cisco PDSN Release 5.1.

The PMIP-based mobility capability attribute is included in the RADIUS access-request message sent from the AGW to the HAAA server if the AGW supports network PMIP. Cisco PDSN sends this attribute through RADIUS to the AAA server in the access-request message to indicate to the AAA server that the Cisco PDSN supports PMIP and that PMIP is enabled. The absence of the PMIP-based mobility capability attribute indicates that PMIP is not supported by the Cisco PDSN.

While sending the access-request message, Cisco PDSN checks whether the CLI command, **cdma pdsn attribute send 3gpp2 pmip-indicator auth-req**, is enabled. If yes and if FA service is enabled, the PMIP-based mobility capability attribute with value 1 (representing PMIP4 support) is sent in the access-request message to the AAA server.

**Note**

- To ensure that the attribute is forwarded, you must enable the **cdma pdsn attribute send 3gpp2 pmip-indicator auth-req** CLI command.
- If FA service is disabled, then the attribute is not sent even if the CLI command is enabled.

Cisco PDSN supports only sending the PMIP-based mobility capability attribute with value 1 (representing PMIP4 support).

The AAA server supports both PMIPv4 and PMIPv6. The AAA server may send this attribute with value either 1 (supports PMIPv4), or 2 (supports PMIPv6), 3 (supports both) to Cisco PDSN in access-reply. Because the AAA server supports PMIPv4 and PMIPv6, Cisco PDSN too supports PMIPv4 establishing the call.

In the access-reply message from the AAA server, if the PMIP-based mobility capability attribute is present, Cisco PDSN verifies the value. The value of the attribute must be either 1 (PMIP4 support) or 3 (for both PMIP4 and PMIP6 support). Otherwise, Cisco PDSN rejects the call.

If a customer-specific PMIP indicator is received along with the PMIP-based mobility capability attribute in the access-accept message from the AAA server, priority is given to the PMIP-based mobility capability attribute.

## PMIP-HA-Info-IPv4-Service Attribute

The PMIP-HA-Info-IPv4-Service VSA specifies the network PMIP4 HA or PMIP6 local mobility anchor (LMA)-related information that is used for IPv4 services. This VSA is included in the RADIUS access-request message sent from the AGW or the visiting AAA (VAAA) server to the Home AAA (HAAA) server. This VSA is also included in the RADIUS access-accept message that is sent from the HAAA server to the VAAA or the AGW.

**Note**

If Cisco PDSN receives HAAA-assigned and VAAA-assigned HA IP addresses together, priority is given to the HAAA-assigned HA IP address.

This attribute will be received from the AAA server in the access-reply message only.

**Note**

Cisco PDSN accepts this attribute only when you enable the PMIP-based mobility capability CLI command (**cdma pdsn attribute send 3gpp2 pmip-indicator auth-req**). Otherwise, the call is rejected.

This attribute has the following subtypes:

- VAAA-Assigned-HA-IPv4-Service

- HAAA-Assigned-HA-IPv4-Service
- PMN-HA key
- PMN-HA-SPI



**Note** When a Cisco pair of the security parameter index (SPI) key is received along with this attribute containing the PMN HA key and the SPI, priority is given to the PMN key and the SPI.

- VAAA-Assigned-LMA-IPv4-Service
- HAAA-Assigned-LMA-IPv4-Service

When this attribute is received from the AAA server, the presence of the subtypes is verified and the subtype values are retrieved.



**Note**

Cisco PDSN does not support subtypes 5 and 6, that is:

- VAAA-Assigned-LMA-IPv4-Service
- HAAA-Assigned-LMA-IPv4-Service

Also, Cisco PDSN does not support sending this attribute to HAAA or VAAA in access-request.

## Simple IPv6 Support

While Cisco PDSN supported IPv6 in releases earlier than Cisco PDSN 5.0, Cisco PDSN Release 5.1 extends IPv6 support for single IP architecture.

Cisco PDSN is the PPP termination point for wireless MS with simple IP access. The MS currently supports IPv4 and has been enhanced to support IPv6. An MS may choose IPv4, IPv6, or both simultaneously to access simple IP services in the network. Cisco PDSN supports simple IPv6 access and existing simple IPv4 access.

## Access-Request Attributes

Cisco PDSN configures CLI commands to send the attributes in the AAA server authorization request depending on requirements. In Cisco PDSN Release 5.1, Cisco PDSN optionally sends the other existing attributes in the AAA server access-requests. These options are available for prepaid online access-request also and for framed-IP with value 0.0.0.0.

When Cisco PDSN sends an access-request or fa-chap or online-req to the AAA server, Cisco PDSN checks for the respective CLI commands and updates the attributes accordingly.

For example, if `cdma pdsn attribute send d4 {auth-req | fa-chap | online-req}` is enabled, the D4 attribute is sent in the access-request message along with the other attributes.

The following attributes are sent in the AAA server access-requests:

- [Base Station Identifier \(D4\) Attribute](#)
- [PCF IP Address \(D3\) Attribute](#)
- [User Zone \(E1\) Attribute](#)
- [NAS Port Attribute](#)

- [Framed IP Address \(B1\) Attribute](#)

## Base Station Identifier (D4) Attribute

The base station identifier (BSID) attribute represents the BSID, which is a number formed by combining the SID (4 octets), NID (4 octets) and cell identifier (type 2 of 4 octets).

While sending the access-request, Cisco PDSN checks whether the required CLI command, **cdma pdsn attribute send d4 {auth-req | fa-chap | online-req}**, is enabled. If the CLI command is not enabled, the attribute is not sent in the authentication-request message to the AAA server. The BSID attribute is added for prepaid online access-request message in much the same manner.

## PCF IP Address (D3) Attribute

The PCF IP address attribute represents the IP address of the serving PCF; in other words, the PCF in the serving RAN. While sending the access-request message, Cisco PDSN checks whether the required CLI command, **cdma pdsn attribute send d3 {auth-req | fa-chap | online-req}**, is enabled. If yes, Cisco PDSN sends the PCF IP address attribute set to the PCF IP address in the authentication-request message to the AAA server. The PCF IP address attribute is added for prepaid online access-request message in much the same manner. If the CLI command is not enabled, the attribute is not sent in the authentication-request message to the AAA server.

## User Zone (E1) Attribute

The user zone attribute represents the tiered services user zone. While sending the access-request message, Cisco PDSN checks whether the required CLI command, **cdma pdsn attribute send e1 {auth-req | fa-chap | online-req}**, is enabled. If yes, Cisco PDSN sends the user zone attribute in an authentication-request message to the AAA server. This attribute is added in much the same manner for prepaid online access-request. If the CLI command is not enabled, the attribute is not sent in the authentication-request message to the AAA server.

## NAS Port Attribute

The NAS port attribute represents NAS port identification. While sending the access-request message, Cisco PDSN checks whether the required CLI command is enabled. If yes, Cisco PDSN sends the NAS port attribute set to the NAS port identification in the authentication-request message to the AAA server. For prepaid online access-request messages, this attribute is already sent by default. If the CLI command, **cdma pdsn attribute send nas-port include-in-authen-req**, is disabled, the attribute is not sent in the authentication-request message to the AAA server.

## Framed IP Address (B1) Attribute

The framed IP address attribute represents the IP address of the MS. While sending the access-request message, Cisco PDSN checks whether the required CLI command, **cdma pdsn attribute send b1 auth-req**, is enabled. If yes, Cisco PDSN sends the framed IP address attribute set to 0.0.0.0 in the authentication-request message to the AAA server. For prepaid online access-requests, this attribute is already sent by default. If the CLI command is disabled, the attribute is not sent in the authentication-request message to the AAA server.

**Note**

- Disable the RADIUS attribute CLI command **radius-server attribute 8 include-in-access-req** to use the new CLI command **cdma pdsn attribute send b1 auth-req**.
- To send framed ip address (0.0.0.0) in an FA-CHAP request for MIP call, use the CLI command **ip mobile foreign-agent send-mn-address**.

To configure the CLI command **cdma pdsn attribute send b1 auth-req**, the CLI command **ip mobile foreign-agent send-mn-address** must be configured already. Without configuring the **ip mobile foreign-agent send-mn-address** CLI command, you can not configure **cdma pdsn attribute send b1 auth-req**.

Similarly, if both the CLI commands, **ip mobile foreign-agent send-mn-address** and **cdma pdsn attribute send b1 auth-req** are enabled, then to disable the CLI command **ip mobile foreign-agent send-mn-address**, first disable the **cdma pdsn attribute send b1 auth-req** CLI command.

## New PPP Per PCF Counters

The Cisco PDSN supports PPP-related failure and success global statistics. From Cisco PDSN Release 5.1, Cisco PDSN also supports PPP failure statistics per PCF.

The following PPP failure statistics are added per PCF:

- [LCP Phase Failure Counters](#)
- [Authentication Phase Failure Counters](#)
- [IPCP Phase Failure Counters](#)

## LCP Phase Failure Counters

[Table 10](#) lists the LCP phase failure counters.

**Table 10** LCP Phase Failure Counters

Failure Counter	Description
LCP Timeout(MaxRetry)	Total number of PPP connection requests that failed at the LCP phase after the maximum number of retransmission, since the system was last restarted. When configuring the CLI command <b>cdma pdsn mib ignore mn-failures no-lcp-confreq</b> in Cisco PDSN, the maxretry counter does not increment.
MS Term-Req in LCP Phase (LCP Term Req during LCP nego rcvd)	Total number of LCP term requests received from the MN during LCP negotiation since the system was last restarted.
A11 De-Registration in LCP Phase(A10 release during LCP nego by PCF)	Total number of A10 releases during LCP negotiation by the PCF since the system was last restarted.

**Table 10** LCP Phase Failure Counters (continued)

<b>LCP Negotiation Fail(Failure Reasons Options)</b>	Total number of PPP failures due to options at the LCP phase.
<b>Other Failures in LCP Phase(Unknown)</b>	Total number of PPP connection requests that failed at the LCP phase due to unknown reasons since the system was last restarted.

## Authentication Phase Failure Counters

Table 11 lists the authentication phase failure counters.

**Table 11** Authentication Phase Failure Counters

<b>Failure Counter</b>	<b>Description</b>
<b>Username/Password Mis-Match(Auth failure)</b>	Total number of authentication failures due to username or password mismatch since the system was last restarted.
<b>AAA Timeout(AAA Timeouts)</b>	Total number of PPP authentication failures due to AAA timeouts.
<b>Timeout in Authentication Phase(Auth timeouts)</b>	Total number of PPP authentication failures due to authentication timeout.
<b>MS Term-Req in Authentication Phase(LCP Term Req during Auth nego rcvd)</b>	Total number of LCP term requests received from the MN during IPCP negotiation since the system was last restarted.
<b>A11 De-Registration in Authentication Phase( A10 release during Auth nego by PCF)</b>	Total number of A10 releases during authentication negotiation by the PCF since the system was last restarted.
<b>Other Failures in Authentication Phase(Unknown):</b>	Total number of PPP connection requests that failed at authentication phase due to unknown reasons since the system was last restarted.

## IPCP Phase Failure Counters

Table 12 lists the IPCP phase failure counters.

**Table 12** IPCP Phase Failure Counters

<b>Failure Counter</b>	<b>Description</b>
<b>IPCP Timeout(MaxRetry)</b>	Total number of PPP connection requests that failed at the IPCP phase after the maximum number of retransmission attempts since system was last restarted.

**Table 12** *IPCP Phase Failure Counters (continued)*

<b>MS Term-Req in IPCP Phase(LCP Term Req during IPCP nego rcvd)</b>	Total number of LCP term requests received from the MN during authorization negotiation since the system was last restarted.
<b>A11 De-Registration in IPCP Phase(A10 release during IPCP nego by PCF)</b>	Total number of A10 releases during IPCP negotiation by the PCF since the system was last restarted.
<b>IPCP Negotiation Fail( Failure Reasons Options)</b>	Total number of PPP IPCP failures due to options.
<b>Not enough IP resource for allocation(Not enough IP resource for allocation)</b>	Total number of PPP negotiations terminated per PCF due to inadequate IP resources in the IP pool for allocation. The IP pool is downloaded from the AAA server or locally.  When configuring the local IP pool or the wrong local IP pool in Cisco PDSN, this counter does not increment; however, the global counter is incremented.  In earlier releases, if the remote IP pool is configured on Cisco PDSN, the unknown counter was incremented along with this counter. In Cisco PDSN Release 5.1, however, the unknown counter does not increment along with this counter.
<b>Other Failures in IPCP Phase (Unknown)</b>	Total number of PPP connection requests that failed at the IPCP phase due to unknown reasons, since system was last restarted.

## VPDN Conditional Debugging

The conditional debugging feature enables you to verify or observe the debugs of a particular session. You can enable conditional debugging depending on the IMSI or the username, by using the following CLI command.

```
PDSN# debug condition ?
called          called number
calling         calling -----> for IMSI
glbp           interface group
interface       interface
ip             IP address
mac-address     MAC address
match-list     apply the match-list
standby        interface group
username       username -----> for username
vcid           VC ID
voice-port     voice-port number
xconnect       Xconnect conditional debugging on segment pair
```

In Cisco PDSN Release 5.1, conditional debugging is enabled for VPDN calls. If you enable IMSI (calling station ID)-based conditional debugs, you must verify if the session IMSI matches the IMSI that was set through the conditional debugging CLI command. If a match exists, VPDN context debug flags are set. If a match does not exist, the debug flags in the VPDN context are not set, avoiding printing of

the debugs for other sessions. If IMSI-based debugging is enabled, the IMSI is added in the debug message; similarly for username condition also. If both the username and IMSI-based conditional debugs are enabled for a session, priority is given to the IMSI to display with L2TP and VPDN call event debug messages.

The following command shows the condition as part of L2TP and VPDN call event debugs, which is set through the conditional debug CLI command, when the username or IMSI conditional debugging is enabled for VPDN session.

```
lac(config)# vpdn debug ?
  show-conditions  Show Conditions (IMSI/Username) with debug messages
lac(config)# vpdn debug show-conditions ?
```

## GRE CVSE and MN NAI Extension in Revocation Message

Cisco PDSN Release 5.1 meets the CDMA standard 3GPP2 X.S0011-003-D. As per the CDMA standard (3GPP2 X.S0011-003-D), Cisco PDSN sends previously negotiated GRE encapsulation and GRE key in the revocation message and MN-NAI extension in all the revocation messages.

The following are the conditions for sending GRE CVSE and MN NAI extension in the revocation message:

- If GRE CVSE is negotiated between FA and HA, the GRE CVSE with FA assigned key must be included in the revocation message.
- If FA has received the revocation message with GRE CVSE and with HA assigned key, the FA must send the revocation acknowledgement message with GRE CVSE as FA assigned key to HA.
- The GRE CVSE must be included before the FA-HA authentication extension, if present in revocation and revocation acknowledgement message.
- With the CLI command **ip mobile foreign-service revocation exclude-nai** disabled, the MN NAI extension must be included in revocation message.
- If FA has received the revocation message with the MN NAI extension from HA, then FA must include the MN NAI extension in the revocation acknowledgement message while sending to HA.
- The MN NAI extension must be included before the FA-HA authentication extension if present in revocation and revocation acknowledgement message.

## Single IP per Blade

This section discusses concepts related to single IP Infrastructure and Manageability requirements for the Service Provider PDSN gateway application. This application is resident on the SAMI service blade of the Cisco 7600 Series Router and is part of the Mobile Internet product family. This section also provides details about how to configure this feature.

This section includes the following sub sections:

- [Overview of Single IP Feature](#)
- [Single IP Interface](#)
  - [Single Interface for MIP, Simple IP, VPDN-based calls or A11 Registrations](#)
  - [Single Interface for Configuration](#)
  - [Single Interface for SNMP Management](#)
  - [Single Interface for Troubleshooting and Debugging](#)
  - [Single Interface for AAA](#)
  - [Single Interface for Failover](#)
- [Operation and Management](#)
  - [Chassis-Wide MIB for Application-Related Parameters](#)
  - [Trap Generation for AAA Unresponsiveness](#)
  - [Show Subscriber](#)
  - [Intra-Chassis Configuration Synchronization](#)
  - [Configuration Details](#)
  - [Monitor Subscriber](#)
  - [Show Subscriber Session](#)
  - [Bulk Statistics Collection](#)
- [Redundancy Support in Cisco PDSN Release 5.0](#)
- [Performance Requirements](#)
- [Single IP Support - Reused and New CLI Commands](#)
- [Distributed Configuration, Show and Debug commands in Single IP PDSN](#)
- [Features Not Supported](#)

### Overview of Single IP Feature

The current Mobile Internet gateway-on-SAMI solutions, (WiMax ASNGW, GGSN, and PDSN except HA) all offer a multiple-routers-on-a-stick model with the attendant manageability and operational issues. The system design for PDSN single IP allows you to manage the gateway-on-SAMI on a per-blade basis. This results in a “factor-of-6 decrease” in operational complexity compared to the previous presentation of six individual processors per blade.

Here is an additional targeted subset of functionality that is presented in a per-chassis model. The presentation of a per-blade model applies to the following areas:

- AAA interactions
- Network Management interaction through SNMP for MIB retrieval

- Configuration, Show, and Debug functionality
- Failure detection and failover of a blade
- AAA server response time determinations and alarm indications

Additionally, the presentation of a per-chassis model applies to the following targeted functionality:

- Show subscribers present across a chassis with various output-filtering capabilities.
- Display the session activity for one or more subscribers across a chassis.
- Monitor Subscriber (Call Trace) for one or more specific subscribers for the purposes of troubleshooting.
- Collation, transfer, and storage of bulk statistics for a chassis.

## Single IP Interface

The following features fall under the umbrella of a single IP per blade:

- [Single Interface for MIP, Simple IP, VPDN-based calls or A11 Registrations](#)
- [Single Interface for Configuration](#)
- [Single Interface for SNMP Management](#)
- [Single Interface for Troubleshooting and Debugging](#)
- [Single Interface for AAA](#)
- [Single Interface for Failover](#)

### Single Interface for MIP, Simple IP, VPDN-based calls or A11 Registrations

The service blade presents one IP address for the A11 registration request. This IP address is common across all processors in the blade. The IP address for vaccess interface is also common across all processors in the blade. Thus, the blade presents one IP address for the single IP calls. Similarly, the service blade presents a distinct IP address (PDSN IP address) for each of its service including Simple IPv6. These addresses are configured as done for Cisco PDSN Release 4.0, but only on one of the processors of the blade. The IP address configuration is present on both control plane and traffic plane processors.

The service blade implements a packet distribution function in IXP ucode, which ensures that user traffic packets are dispatched to the correct traffic plane processor. Packets identified as control plane traffic (such as A11 packets, packet of disconnect POD packets, MIP registration revocation packets, and so on) are sent to the control plane processor. The rest of the control plane packets (PPP Negotiation, AAA authentication, accounting, MIP, and so on) are dispatched to the correct traffic plane processor. Packets that do not match a specific identification are sent to the control plane processor for treatment.

### Single Interface for Configuration

The service blade provides a single point of configuration for blade functionality. This means that you can establish a session to the service blade, the same as performed in Cisco PDSN Release 4.0. The session is established to the control processor on the service blade. From that single session to the service blade, you can configure PDSN features each command required for a feature. That configuration is then propagated to all processors that require the same configuration without you performing any additional configuration.

The default treatment for any IOS configuration command is that the configuration takes effect on all IOS processors on the service blade. It is possible to define a set of commands that only executes on the processor hosting the configuration session. Some examples of filtered configuration commands are those relating to OSPF, SNMP, HSRP, BGP, Eigrp, CDP, and sub-commands in the interface configuration mode relating to any of the above.

## Single Interface for SNMP Management

The service blade provides a distinct configurable IP address that is the target address for SNMP operations. This IP address is hosted on the control plane processor. All MIBs on a service blade related to PDSN functionality are accessible through this IP address. Information required from processors other than the control plane processor is either pushed or pulled depending on the MIB target.

There are two MIBs related to processor resource usage and memory usage that present information on a per-processor basis. There is a single Processor Resource MIB result returned with six individual entries, one per processor. Similarly, this also occurs for memory usage.

## Single Interface for Troubleshooting and Debugging

The service blade provides a single point of entry (session into the control plane processor) to execute **show** and **debug** commands. By default, **show** commands are executed on the control plane processor only. Each command that requires execution on one or more traffic plane processors is individually instrumented.

For debug commands the HA model for single IP is followed for the PDSN as well. For commands that require additional information from the traffic plane processor and are qualified per user (either NAI or IP address), the traffic plane processor hosting that user is identified and the command executed on that specific processor.

The results from the various processors are combined into a single presentation before a response to the command is provided.

Conditional debug commands use a similar approach. The model proposed by Osler for HA is followed in the PDSN as well.

## Single Interface for AAA

The service blade presents a single IP address for AAA interactions. This IP address may be one address for both RADIUS-based interactions, or separate IP address configurations for each protocol.

RADIUS-based authentication and authorization is executed from the traffic plane processor.

The service blade packet distribution function directs RADIUS traffic to a specific processor based on the destination UDP port.

## Single Interface for Failover

The current SAMI failure mode is for a per-processor failure whenever possible. For the single IP model, a failure detected on the blade results in a blade-level failover, even if a processor-level failover is sufficient. This feature is similar to the HA single IP.

## Operation and Management

This section discusses features that fall under the umbrella of Operation and Management and describes:

- [Chassis-Wide MIB for Application-Related Parameters](#)
- [AAA Responsiveness Test Tool and Traps](#)
- [Trap Generation for AAA Unresponsiveness](#)
- [Show Subscriber](#)
- [Intra-Chassis Configuration Synchronization](#)
- [Monitor Subscriber](#)
- [Show Subscriber Session](#)
- [Bulk Statistics Collection](#)

### Chassis-Wide MIB for Application-Related Parameters

This feature provides a single MIB within which all application-related parameters are reported across the chassis. For PDSN, this functionality is provided on a per-PDSN instance basis.

For all PDSN instances on a single service blade, this information is available through an SNMP Get to a single IP address. The information is available in the CISCO-PDSN-MIB.

CISCO-CDMA-PDSN-EXT-MIB and in the CISCO-IP-LOCAL-POOL-MIB. The SNMP manager is responsible for executing the necessary number of SNMP GET operations to retrieve a MIB per PDSN instance. This release of the single IP PDSN feature supports one PDSN instance per service blade, thereby reducing the number of Get operations from 12 per service blade to 2.

### AAA Responsiveness Test Tool and Traps

There are two aspects to this function:

- Manual verification of AAA server availability using a locally initiated binding with AAA authentication.
- Indication of lack of server responsiveness during normal operations based on SNMP traps.

#### AAA Responsiveness Test Tool

This release does not support the AAA responsiveness test tool.

#### Trap Generation for AAA Unresponsiveness

See [Trap Generation for AAA Server Unresponsiveness](#) section.

#### Show Subscriber

This feature provides—from a single point in the chassis—summary listings of subscribers hosted by the PDSN instances in the chassis. This release supports a single PDSN instance per service blade, so the sequence of steps necessary is limited to requesting the desired information using IOS CLI commands for one, or all, service blades.

Table 12 lists the feature's functionality:

**Table 13 List of Show Subscriber Functionality**

All	Summary of all users on the chassis	To display the total number of all registered users on the chassis, use the <b>show cdma pdsn session {summary   brief   detail}</b> command on the TCOPs per active service blade. The total from each blade is then summed, and the result is displayed.  A single command can display maximum number of subscribers. We recommend that you configure a value of 1000. If the number of registered subscribers exceeds the value, the output is saved to a file, and the name and location of the file is indicated.
Card	Summary of all users on one specific Card or Slot	To display the total of all registered users on one service blade, use the <b>show cdma pdsn session {summary   brief   detail}</b> command. The command is executed on the control processor of the service blade identified with the desired result being the <b>total</b> line.
Member	Summary of all users on one specific member (CPU)	To display the total of all registered users on a given traffic processor on a service blade, use the <b>show cdma pdsn session {summary   brief   detail}</b> command on the service blade, in addition to the TCOP identified in the command.
Connect	Summary of all users with a connect time greater than, lower than, or equal to a time value (use of AGE)	To display the time since the subscriber first registered, not the time since the last reregistration.  <b>show cdma pdsn session lifetime age {lesser   greater   equals} [hh:mm:ss] {detail   brief   summary}</b>
FA-Chassis	Summary of all visitors on FAs within PDSN	To display the total number of visitors serviced by the FA in the chassis, use the <b>show cdma pdsn session visitor summary</b> command on all the TCOPs in the service blades in the chassis.
FA-Member	Summary of all users on one specific FA within the PDSN	To display the total number of visitors serviced by the FA in the service blade, use the <b>show cdma pdsn session visitor summary</b> command in the requested service blade.
HA-User	Summary of all users registered with a particular HA	To display the total number of visitors registered with a HA, use the <b>show ip mobile visitor ha-addr [ha-ip]</b> command on all TCOPs.

**Table 13 List of Show Subscriber Functionality (continued)**

Calltype	Summary of all users for this Call Type (such as RTT, EVDO rev A, and rev 0)	To display the total number of visitors for a specific call type, use the <b>show cdma pdsn session service-option [so]</b> on all TCOPs.
NAI or User	Summary of all users for this NAI (supports wildcards in the NAI). For example, <b>show user summary nai *ptt*</b> finds Push to Talk users on the box. Filter by realm is also supported.	To display the total number of visitors for the NAI, use the <b>show cdma pdsn session user [nai]</b> command on all the TCOPs.  (Existing CLI command but NAI to support regular expression.)
Address Range CLI	Summary of all users within the given address space	To display the total number of visitors for a specific address space, use the <b>show cdma pdsn flow mn-ip-address range [startIP] [endIP] {brief   summary   detail}</b> command on all the TCOPs.

Here is a list of the possible output display formats:

- Summary - Total number of sessions, bytes in or out, packets in or out, dropped in, and out by ACL.
- Brief - Single line of output per user matching the command filters. The output comprises the assigned IP address, NAI, dormant, and PCF address.
- Verbose - Full display as provided by the output of the **show cdma pdsn session** command.

This functionality is not supported through SNMP.

## Intra-Chassis Configuration Synchronization

This feature provides that any configuration command executed on the active blade must automatically be synchronized on the partner standby blade by enabling autosynchronization feature. This applies to all commands, except the configuration commands on the active or standby partnering model, PDSN redundancy, and the configuration commands for configuring HSRP, standby command, as a failure detection mode for redundancy.

This feature is disabled by default and can be enabled by the **auto-sync all** command in configuration mode. The "write memory" needs to be performed before the standby is up.



### Note

It is not possible to execute configuration commands on the standby PDSN. EXEC commands are permitted.

How an active or standby PDSN is determined is based on the Radio Frequency (RF) infrastructure that is used for Stateful SwitchOver (SSO) support, as well as for Session Redundancy support for various Mobile Severely Errored Frames (mSEF) gateways.

## Initialization

The SSO configuration synchronization happens automatically during bootup without any pre-required configurations. The same synchronization cannot be applied to the PDSN as IP connectivity between the redundant units is required before RF negotiation. Therefore, different yet related configurations are necessary for the active and standby blades.

Additionally, the SSO configuration synchronization feature does not support any unique configuration on each of the redundant units. On the PDSN, HSRP and RF Interdev protocols are required, both of which require certain unique configurations on the redundant units.

The existing commands that require unique configurations for each unit are modified to accommodate configurations for the peer unit. A new command identifies the peer slots. These commands are parsed and the RF negotiation state RF\_PROG\_STANDBY\_CONFIG is used to trigger configuration synchronization automatically. See the [Configuration Details](#) section for the new commands.

## RF Client

As in the case of SSO configuration synchronization, the PDSN configuration synchronization is also an RF client. The configuration synchronization feature registers a callback with RF for the progression and status events. The RF notifies each of these registered clients in order with the progression and status of events, thus allowing the PDSN to know when to synchronize the configuration files.

## Configuration Files and Synchronization

The configuration synchronization feature comprises the startup configuration and the running configuration processes.

The startup configuration is stored in the NVRAM as a text file. This file is synchronized whenever you perform operations such as write memory, copy running startup, and so on. If the file is opened for a write operation, synchronization starts after the file is closed.

A running configuration synchronization is dynamically generated by certain operations, so any time a synchronization is performed, the running configuration must be generated.

In the SSO implementation, before the synchronization process begins, the primary is locked. A bulk synchronization of the startup configuration and the running configuration is performed, followed up by a parser mode synchronization.

After both the processes are in synchronization and the primary is unlocked, the line-by-line synchronization begins.

All the synchronizing processes require a transport mechanism to communicate between the redundant units.

The PDSN configuration synchronization feature may use one the following transport mechanisms:

- Reliable IPC mechanism currently being used for CP-TP messaging
- RF or CF SCTP-based approach for IPC messaging
- New SCTP-based approach for IPC messaging

The first is the fastest solution from an implementation perspective but it does not scale well for an inter-chassis solution. In this release, PDSN supports the second option, RF or CF SCTP.

## Bulk Synchronization

RF Interdev communication needs to be established between the two units prior to initiating the bulk synchronization. Each unit parses its startup configuration and this will cause the unit to become active or go into standby. The active unit will then bulk synchronize its running and private configuration files to the standby if there has been running or private configuration modifications on it after bootup.

After the bulk synchronization, the standby will reload itself and come up with the altered configurations. During this standby reload phase, no configurations are allowed on the active unit.

The configurations that are synchronized during initialization include:

- Private configuration
- Running configuration

The startup configuration is not synchronized because the startup config files in the SUP are always in synchronization.

If a private configuration is changed after bootup, the active unit copies its private configuration file into a buffer and transports the file using RF Interdev SCTP to the standby.

If running configurations change after bootup, the active unit copies its running configuration file to a buffer and transports the file using RF Interdev SCTP to the standby. Following these steps, the active sends a message to the standby to start parsing the received buffers.

The standby unit saves the received buffer contents locally, and reloads itself to apply the modified configuration to itself.



#### Note

There are two types of NVRAM configuration files, the public configuration files and the private configuration files. The private configuration files cannot be displayed on the console. Examples of the uses for private NVRAM configuration files are maintaining persistent SNMP interface indices over a system reboot, saving the lawful intercept username and password, and so on.

## Line-by-Line Synchronization

When both active and standby units are up and running, the CLI command entered from the active unit is executed first, the command is then propagated to the standby and executed, and the results are returned back to the active unit.

The Parser Return Code (PRC) scheme is used in the SSO implementation to have all the parser action routine for each CLI command set the return code. This return code is a combination of the class of the error code, component ID, sync-bit, sub-code, and so on.

Parser Mode Synchronization maintains the same parser mode between the active and standby units before a command is sent to slave for synchronization.

In the SSO implementation, the synchronization is done through RPC, which blocks the current process until the active RP receives return code message from the standby RP. Thus, the commands are executed in order for both units.

If a command fails on the standby unit, then the result is conveyed back to the active. On the active, a stub registry for the policy maker is invoked that leaves the decision on what to do with the returned result to the calling or upper layer.

The single IP PDSN configuration synchronization feature uses the SSO line-by-line synchronization implementation as is.

## Startup Configuration Synchronization

In the SSO implementation, the startup configuration is synchronized during bootup when the RF state is ready to perform bulk synchronization. You must lock the router before initiating the startup configuration synchronization.

When a **write memory** or **copy file1 startup-config** is executed, there are two ways to handle the scenario:

- Bulk synchronize the startup configuration file.
- Perform a line-by-line synchronization of the EXEC command.

For the single IP PDSN, bulk synchronization of the startup configuration file is used because it allows the active unit to save configuration changes to the standby location.

## Running Configuration Synchronization

With a running configuration synchronization, the redundancy units carry the same state of information.

Initially, after the secondary unit establishes RF Interdev communication, the running configuration file is bulk synchronized. The bulk synchronization induces a self-reload of the standby unit if the running configuration has changed on the active unit prior to its bootup. After the reload, the standby comes up with the running config of the active unit.

After this the line-by-line synchronization occurs between the two units. As you configure each command, the same command is passed on to the secondary side after executing the same on the primary.

The bulk synchronization of the running configuration is done using the RF Interdev SCTP for the single IP PDSN feature.

## Limitations

The following are the limitations when configuring the intra-chassis:

- No configuration commands are allowed on the standby unit. Only the active is configurable and the active drives the standby.
- When configuring the redundancy synchronization feature for the first time, only one of the redundant units is up. Make the necessary configuration and save it before the other unit is up. Doing so avoids configuring on the standby unit even for the first time.
- The **write memory** command is not allowed on the standby unit.
- With autosynchronization feature enabled, you only need to run the unit1-unit2 set of CLI commands. You cannot use the local-remote set of commands with autosynchronization feature enabled. You can use the local-remote commands only after disabling the autosynchronization feature.

## Configuration Details

Using the autosynchronization feature, the configurations are synchronized, and the CLIs on both the units must be identical. This feature is disabled by default. The following commands are currently unique to each redundant unit and have been modified:

- **ipc zone default**
- **association** *no*.
- **protocol sctp**
- **unit1-port** *port1*
- **unit1-ip** *ip1*
- **unit2-port** *port2*
- **unit2-ip** *ip2*

The following new command is introduced under the interface GigabitEthernet0/0.23:

```
redundancy ip address unit1 ip1 mask1 unit2 ip2 mask2
```

The **redundancy ip address** command is a per-interface command. The HSRP protocol uses this IP address configured for its negotiation, and not the one configured using the regular **ip address** command. You do not require the **ip address** configuration for a sub-interface that is dedicated for HSRP negotiation with the peer.

```
redundancy unit1 slot x unit2 slot y
```

The redundancy slot command is a global configuration and is used for identifying the peer slot.

To configure intra-chassis configuration synchronization, perform the following tasks:

```
redundancy unit1 slot x unit2 slot y
```

```
unit1-port portnum , unit2-port portnum
```

under the ipc-assoc-protocol-sctp mode.

```
unit1-ip address1 , unit2-ip address2
```

under the ipc-unit1-port and ipc-unit2-port modes respectively.

```
redundancy ip address unit1 address1 mask1 unit2 address2 mask2
```

under the interface and sub-interface modes.

Sequence of configuration steps that must be performed on each of the cards:

	Command	Purpose
Step 1	Router# <b>show redundancy states</b>	Execute the following commands on both SAMIs before running any redundancy commands. <b>my state</b> should be active on both the cards.  <b>Note</b> Power down one unit, configuration has to be done only on one unit.
Step 2	Router(config)# <b>auto-sync all</b>	Enables intra-chassis configuration synchronization.
Step 3	Router(config)# <b>redundancy unit1 slot 9 unit2 slot 6</b>	Configures global redundancy unit-slot mapping.
Step 4	Router(config)# <b>redundancy unit1 hostname name1 unit2 hostname name2</b>	Identifies and configures the peer slot name in the same chassis.
Step 5	Router(config)# <b>interface GigabitEthernet0/0.2 encapsulation dot1Q 20 redundancy ip address unit1 4.0.0.1 255.255.255.0 unit2 4.0.0.2 255.255.255.0 standby 0 ip 4.0.0.4 standby 0 name hsrp</b>	Configures an interface for HSRP.  HSRP needs unique IPs for the standby and active units and you need to use the <b>redundancy ip address</b> command.  <b>Note</b> Do not configure the <b>ip address</b> command on this interface.

	Command	Purpose
Step 6	<pre>Router(config)#<b>ipc zone default</b> Router(config-ipczone)# <b>association 1</b> Router(config-ipczone-assoc)# <b>no shutdown</b> Router(config-ipc-protocol-sctp)# <b>protocol sctp</b> Router(config-ipc-protocol-sctp)# <b>unit2-port 5000</b> Router(config-ipc-unit2-sctp)# <b>unit2-ip 4.0.0.2</b> Router(config-ipc-protocol-sctp)# <b>unit1-port 5000</b> Router(config-ipc-unit1-sctp)# <b>unit1-ip 4.0.0.1</b></pre>	Configures IPC information for the RF interdevice.
Step 7	<pre>Router(config)# <b>redundancy inter-device</b> Router(config-red-interdevice)# <b>scheme standby hsrp</b></pre>	Associates the HSRP scheme name to the RF interdevice.

When session redundancy is configured for the first time with autosynchronization feature enabled, you must configure only one unit and the other unit must be powered down.

After the configuration is done, ensure that you run the **write memory** on unit1, then power up unit2.

## Monitor Subscriber

This feature allows you from a single point in the chassis to establish conditional debugs based on the NAI or the assigned IP address. This is possible without knowing which PDSN instance in the chassis hosts the subscriber session or is selected to host the subscriber session for cases when the session is not yet established. This feature make use of the Osler tool that allows centralized execution of IOS commands with the ability to receive responses and present those responses in a clear and concise format.

There are two output formats, **brief**, where the debug output is succinctly presented, and **verbose** which is the complete debug output.

You must log in to the Supervisor of the 7600, and then execute the command `debug condition "qualifier" protocols`.

You need to implement the below two-stage process:

1. Determine the PDSN instance in the chassis hosting the session.
2. If a session is present, apply the **debug conditional** command on that PDSN instance and then apply the specific **debug** commands requested. If no session is present, establish a pre-trigger condition for debug followed by the requested **debug** commands on all PDSN instances configured in the chassis.

It is possible to specify the protocol subsystems for which conditional debugging applies. The choices are **Session, Accounting, TFT, VPDN, MIP, PMIP, All** and so on.

There is a limit of ten simultaneous pre-triggers.



### Note

The Session Manager on the PCOP is used to locate the subscriber, if the subscriber already exists. The APIs for lookup of the Session Manager are used to search, if the subscriber has already registered. The lookups are based on IMSI, NAI, or mobile-assigned IP address.

## Show Subscriber Session

You log in to the Supervisor of the 7600 and then execute the **show subscriber session** command where the subscriber is identified by IMSI, NAI or IP address.

You need to implement the below two-stage process:

- Determine the PDSN instance in the chassis hosting the session
- Execute the commands for **show ip mobile host {ip-address | nai}**, **show ip mobile secure host {ip-address | nai}**, **show {ip mobile violation address | nai string}** and **show ip mobile host-counters**.

## Bulk Statistics Collection

This feature is capable at a single point:

- Begin the periodic collection of the available PDSN statistics, identifiable by name, from each active service blade in the chassis.
- Collect the specified statistics by enabling IOS Bulk Statistics collection at each selected service blade. This mechanism allows the collection of statistics for MIB variables. If the required measure is not part of a MIB, it cannot be collected as part of the bulk statistics collection feature.
- Transfer the file to an external TFTP server identified by a URL.

You can set the statistics collection period to increment by 15 minutes, the minimum collection period being 30 minutes. The maximum collection period is 24 hours.

The file content contains summary statistics for each blade except that relating to CPU usage and memory occupation available on a per-CPU basis collected per blade. The per-blade file has an entry for each application CPU on that blade.

The file format is a sequence of “variable\_name value” pairs separated by commas.

In Cisco PDSN Release 5.0, the variable name is the OID of the variable as this is the level of support available from the IOS Bulk Statistics Collection CLI command.

There is a predefined set of statistics that is collected, including the variables available in the MIBs that are supported by the PDSN application. The OID assigned to the statistic corresponds directly to the OID in the related MIB.

The following variables of interest are not present in a MIB. These are not supported as part of the Bulk Statistics Collection feature:

- PDSNRegRevocationsSent
- PDSNRegRevocationsReceived
- PDSNRegRevocationsIgnored
- PDSNRegRevocationAcksSent
- PDSNRegRevocationAcksReceived
- PDSNRegRevocationAcksIgnored

The time-period over which collection is made is indicated in the file in the format *yy:mm:dd:hh:mm:ss yy:mm:dd:hh:mm:ss*. The first date is the start; the second date the end.

If you want to alter the set of subsystems for which statistics collection is enabled, you must first cancel the ongoing statistics collection and begin a new collection. Any information that you collect during the cancelled session is saved.

In the event that the external server is unavailable, the file is saved in local non-volatile memory. The last transferred file is saved locally until the next file is successfully transferred. On successful transfer of the new file, the currently saved file is replaced with the new one.

No new IOS commands are used to support the bulk statistics feature in the single IP PDSN Release 5.0.

## Redundancy Support in Cisco PDSN Release 5.0

Redundancy support for Cisco PDSN Release 5.0 features is identical to that supported in Release 4.0.

The session redundancy is extended to support the single IP architecture. Only one processor (that is PCOP) per SAMI is involved in redundancy management. All the other processors (such as TCOPs) follow the PCOP's state. Configuration synchronization from active to standby is supported in Cisco PDSN Release 5.0.

## Performance Requirements

The single IP PDSN supports the following performance figures:

- 175,000 registered subscribers per service blade.
- 3.0 Gbps throughput with 20 percent upstream, 80 percent downstream, IMIX throughput using measurement techniques applied for validating the six independent processor. This model represents 5/6 of the throughput proven as part of those measurements.
- The time required to bulk synchronize an active HA service blade hosting 200,000 subscriber registrations to a reloaded standby PDSN service blade takes no longer than the time taken to bulk synchronize a fully loaded active to standby service blade in the “six independent processor” model.
- The call per second (CPS) rate is no slower than for a single processor in the “six independent processor” model. The call per second rate meets or exceeds the rate measured during performance verification (100 CPS).

## Single IP Support - Reused and New CLI Commands

The following CLI commands are provided to allow IPC to communicate with IXP, and to allow GTP and IPC over GTP modules to provide reliable, acknowledged and unacknowledged communication capabilities between the SAMI PPCs:

### EXEC Mode

- `debug sami ipc gtp processor 3-8`
- `debug sami ipc gtp processor`
- `debug sami ipc gtp any`
- `debug sami ipc detail`
- `debug sami ipc`
- `debug sami ipc stats detail`
- `debug sami ipc stats`
- `test sami tp-config {enable | disable}` (available on TPs in SingleIP image)

### Show Commands

- `show sami ipcp ipc gtp`
- `show sami ipcp ipc ixp`
- `show sami ipcp ipc processor`

**Configuration Mode:**

- **default sami ipc crashdump**
- **default sami ipc keepalive**
- **default sami ipc retransmit**
- **default sami ipc retries**
- **sami ipc crashdump**
- **sami ipc keepalive**
- **sami ipc retransmit**
- **sami ipc retries**

The **sami ipc crashdump** command in configuration mode is as follows:

```
pdsn-Stdby-ftb3-73(config)# sami ipc crashdump ?
```

**never** Do not crash in response to an IPC failure.

**tolerance** Specifies permitted duration of IPC link failure.

## Distributed Configuration, Show and Debug commands in Single IP PDSN

The following sections describe the distributed configuration, show and debug commands in single IP PDSN.

### Distributed Configuration

The Distributed CLI agent distributes the configuration information from the PCOP to each of the TCOPs using the IPC protocol.

By default, the CLI agent allows all the commands, but filter the ones that may trigger some functionality on the TCOP that is not needed.

### Non-CDMA (the Rest of IOS) Configuration Commands

A set of non-CDMA CLI commands are blocked or filtered on the PCOP.

The list of commands that are filtered on the PCOP are:

- **router ospf**
- **router bgp**
- **router eigrp**
- **router rip**
- **router [any routing protocol]**
- **cdp [related commands]**
- Any subcommands related to the above in interface configuration

The routing protocols are not sent to TCOPs. We do not recommend configuring the routing protocols on SAMI, it is preferable to set up static routing configurations between SAMI and SUP.

While allocating the IP address pools on the SAMI, we recommend you to configure their respective static routing entries on the SUP.

### IP Local Pool Command Change

This command is reused from the GGSN Centralized Pools implementation.

### CDMA-related Configuration Commands

For the single IP model, an EXEC banner appears when logging in to a TCOP and warns you to be aware that “normal” maintenance activities should be run from PCOP.

The [Table 14](#) lists the commands that PDSN single IP supports, and indicates whether they are filtered at the PCOP or also sent to the TCOPs.

If the command is sent to the TCOPs, then it is executed at each of the TCOPs.

**Table 14** PDSN Commands for Single IP

Command (Configuration Commands)	Purpose	Used at
<b>cdma pdsn multiple service-flows</b> [maximum number]	Enables the multiple flow support. The maximum number defines the maximum number of auxiliary A10s that can be created between PDSN and PCF. The default number of auxiliary A10s allowed is 7.	TCOP
<b>cdma pdsn multiple service-flows qos subscriber profile</b>	Enables you to configure the local subscriber QoS profile. This profile is used for a MN when subscriber QoS profile is not downloaded from the AAA server.	TCOP
<b>cdma pdsn multiple service-flows qos remark-dscp</b> [value]	Enables you to configure the DSCP remark value to be used for marking when the data packets from the mobile toward the Internet do not have the DSCP within the allowed DSCP value for that mobile.	TCOP
<b>cdma pdsn tft reject include error extension</b>	Includes the error extension in the reject message when a TFT is rejected.	TCOP
<b>cdma pdsn cac maximum bandwidth</b> [number] <b>cdma pdsn cac maximum cpu-threshold</b> [number]	Enables the call admission control. Use one of these CLIs to control the CAC parameters such as bandwidth and CPU.	CPU (memory) on PCOP Bandwidth on TCOP
<b>cdma pdsn attribute send</b> {f16   f17   f18   f19   f20   f22}	Forwards the accounting message.	TCOP

### PDSN Commands for Local Subscriber QoS Profile

The `cdma pdsn multiple service flows qos subscriber profile` command takes you to a submode. [Table 15](#) lists the commands that you can use to configure various parameters in the local subscriber QoS profile.

**Table 15** PDSN Commands for Local Subscriber QOS Profile

Command (Configuration Commands)	Purpose	Used at
<b>Bandwidth</b> [number]	Configures the maximum aggregate bandwidth value.	TCOP
<b>inter-user-priority</b> [value]	Configures inter-user priority parameter.	TCOP
<b>tft-allowed</b> [value]	Configures the allowed number of persistent TFTs parameter.	TCOP
<b>link-flow</b> [value]	Configures the maximum service connection parameter in service option profile.	TCOP
<b>flow-priority</b> [value]	Configures the maximum per-flow priority parameter.	TCOP
<b>flow-profile direction</b> {forward   reverse   bi-direction} <b>flow-id</b> [flow-id]	Configures authorized flow profile IDs for each direction.	TCOP
<b>dscp</b> {allowed-class {AF   EF   O}   max-class [value]   reverse-marking [value]}	Configures the allowed differentiated services markings parameter.	TCOP



#### Note

For any configuration command that is filtered, its sub configuration commands are also filtered.

See the [Configuring the PDSN Image](#) section for the below configuration tasks:

- Enabling PDSN Services
- Creating the CDMA Ix Interface
- Creating a Loopback Interface
- Creating a Virtual Template Interface and Associating it with the PDSN Application
- Enabling R-P Interface Signaling
- Configuring User Session Parameters
- Enabling HSRP and Configuring Redundancy
- Using the Loopback Interface For the PDSN-AAA Server Interface
- Configuring Application Tracking to Handle active-active Situation
- Configuring AAA Server in the PDSN Environment
- Configuring RADIUS in the PDSN Environment

- Configuring Prepaid in the PDSN Environment
- Enabling VPDN in a PDSN Environment
- Configuring the Mobile IP FA
- Configuring Proxy Mobile IP Attributes Locally
- Configuring Mobile IP Security Associations
- Enabling Network Management
- Configuring Always On Service
- Configuring A11 Session Updates
- Configuring SDB Indicator Marking
- Configuring SDB Indicator Marking for PPP Control Packets
- Configuring PoD on the PDSN
- Configuring Mobile IP Resource Revocation on the PDSN
- Configuring PDSN Accounting Events
- Configuring CDMA RADIUS Attributes

### Configuring Host Routes

Host routes are added in general on the TCOPs for the mobile. In case of SingleIP, any ARP request for the MIP address lands on the PCOP. To enable PCOP to respond to ARP requests, enable this CLI command. This CLI command installs the host route for the mobile on the PCOP when the flow comes up, and deletes the host route whenever the flow goes down.

This CLI command is required only when the host routes are not added at the Supervisor for MIP. By default, this CLI command is not configured (Table 16):

**Table 16**      **Configuring Host Routes**

Command	Purpose	Used at
[no] <b>cdma pdsn sm add mobile route</b>	Configures or removes configuration of host route on the PDSN.	TCOP

## Clear Commands

Table 17 lists the **clear** commands:

**Table 17**      **Clear Commands**

Command	Purpose	Used at
Router# <b>clear cdma pdsn session</b> {all   pcf <i>ip-addr</i>   msid <i>octet-stream</i> } {send {all-update   termreq}}	Clears the session.	TCOP
Router# <b>clear cdma pdsn statistics</b>	Clears the RAN-to-PDSN interface (RP) or PPP statistics on the PDSN.	
		TCOP
Router# <b>clear ip mobile binding</b> {all [load <i>standby-group-name</i> ]   <i>ip-address</i>   nai string <i>ip_address</i> }	Removes mobility bindings.	TCOP

Table 17 Clear Commands (continued)

Command	Purpose	Used at
Router# <b>clear ip mobile visitor</b> [ <i>ip-address</i>   <b>nai string</b> <i>ip_address</i> ]	Clears visitor information.	TCOP
Router# <b>clear vpdn tunnel l2tp ?</b>	Clears VPDN L2TP Tunnel information. <b>all</b> All L2TP tunnels <b>hostname</b> Based on the hostnames <b>id</b> Based on the tunnel ID <b>ip</b> Based on IP address	TCOP

## Distributed Show and Debug

By default, all the **debug** commands are executed in the TCOPs, and the trace is displayed from the PCOP. The PCOP does not perform any aggregation for distributed debug.

Distributed Show - The rule to be followed for distributed show command is that, only for the commands mentioned in the [Existing show Commands](#), aggregation is done at the PCOP for the data collected from the TCOPs. By default, the show commands are not executed at all TCOPs.

Distributed Debug - The rule to be followed for distributed debug commands is that, by default, all the debug commands are executed in the TCOPs, and the trace is displayed from the PCOP. The PCOP does not perform any aggregation for distributed debug.

## New Show Commands in The Single IP Architecture

The following example snippets show the new show commands in the single IP architecture:

```

pdsn# show sami sm imsi IMSI
show sami sm imsi 12345678910112
  Session Manager User Details
    IMSI: 12345678910112          Location:7(7000000)

  Call Details
    IP Address: 12.1.1.31          VRF ID:0
    HA IP Address: 0.0.0.0         NAI: user1

pdsn# show sami sm statistics
Session Manager Statistics
Request Sent:
  Session: 4                      Control: 0
  Control AAA: 0                  Control HA: 0

Request Received:
  Session Create: 5                Session Delete: 4
  Flow Create: 6                   Flow Delete: 5
  Agg resp: 0

Response Sent:
  Session Create Success: 5        Session Create Failure: 0
  Session Delete Success: 4        Session Delete Failure: 0
  IMSI update: 0                   IMSI delete Generated : 0
  Flow Create Success: 6           Flow Create Failure: 0
  Flow Delete Success: 5           Flow Delete Failure: 0

```

```

IXP Update:
  Total: 0                Success: 0
  Failure: 0

Failure:
  Message parsing: 0      Internal 1: 0
  Internal 2: 0           PPC not found: 0
  Timer Expiry: 0        Pool Manager: 0
  Flow message parse : 0

PDSN-Act-ftb3-83# sh cdma pdsn statistics sm
PC Stats:
  Imsi Create Request to PPC Success 4, Failure 0
  Imsi Delete Request to PPC Success 4, Failure 0
  Imsi Response from PPC Success 4, Failure 0
  CCB Create Request to PPC Success 0, Failure 0
  CCB Delete Request to PPC Success 0, Failure 0
  CCB HA Create Request to PPC Success 4, Failure 0
  CCB HA Delete Request to PPC Success 4, Failure 0
  CCB Response from PPC Success 4, Failure 0
  IXP A10 Add Send Success 4 Failure 0, Received Success 4 Failure 0
  IXP A10 Delete Send Success 4 Failure 0, Received Success 4 Failure 0
  IXP CCB Add Send Success 0 Failure 0, Received Success 0 Failure 0
  IXP CCB Delete Send Success 0 Failure 0, Received Success 0 Failure 0
  IXP CCB HA Add Send Success 4 Failure 0, Received Success 4 Failure 0
  IXP CCB HA Delete Send Success 4 Failure 0, Received Success 4 Failure 0
  IXP Nack terminated session 0 flow 0
  Ack timer expiry Imsi 0, Ccb 0

Tunnel PPC Stats:
  Tunnel Create Request Rcvd 3, Sent Ack 3 Nack 0
  Tunnel Delete Request Rcvd 3, Deleted 3
  Invalid Tunnel Request Type Rcvd 0
PDSN-Act-ftb3-83#
PDSN-Act-ftb3-83#

```

Table 18 lists the distributed **show** commands.

**Table 18** *Distributed Show Commands*

Option	Description	CLI Command	Category
Connect	Summary of all users with a connect time greater than, lower than, or equal to a time value (use of AGE).	<b>show cdma pdsn session age</b> {less   greater   equals} <i>time</i>	C
HA-User	Summary of all users registered with a particular HA.	<b>show ip mobile visitor home-agent</b> <i>ha-ip</i>	C
Address space	Summary of all users in this address space.	<b>show cdma pdsn flow mn-ip</b> <i>start ip end ip</i>	C
Calltype	Summary of all users for this Call Type (such as RTT, EVDO rev A, and rev 0).	<b>show cdma pdsn session service-option</b> <i>so</i>	C
NAI or User	Summary of all users for this NAI (supports wildcards in the NAI). For example, <b>show user summary nai *ptt*</b> finds Push to Talk users on the box. Filter by realm is also supported.	<b>show cdma pdsn session user</b> <i>nai</i>	C

## Existing show Commands

The show commands can be categorized into Data Aggregator (DA)/Data Provider (DP) model or remote console and logging (RCAL) model. Commands under the RCAL model are executed directly on the TCOP from either the SUP or the PCOP without any aggregation using execute-on command. All non-cdma related commands can be executed only through this method.

Commands under DA/DP category are executed on the PCOP and either show the values present in the PCOP itself or show the aggregated output received from all TCOPs.

These commands are further classified as push commands and pull commands.

Push commands - The push commands do aggregation from all the TCOPs periodically and get displayed on the PCOP on demand (that means, on executing the corresponding CLI command).

The list of existing push-based **show** commands are:

- **show cdma pdsn statistics**
- **show cdma pdsn statistics qos**
- **show cdma pdsn statistics ahdlc**
- **show cdma pdsn statistics tft**
- **show cdma pdsn statistics traffic**
- **show cdma pdsn statistics prepaid**
- **show cdma pdsn statistics radius disconnect**
- **show cdma pdsn statistics ppp**
- **show cdma pdsn statistics rp**
- **show cdma pdsn statistics rp error**

Pull commands - The pull commands do aggregation only on executing the commands under this category. On executing the CLI command, the data or statistics are fetched from the TCOPs at that instant and displayed.

The list of existing pull-based **show** commands are:

- **show cdma pdsn**
- **show cdma pdsn pcf**
- **show cdma pdsn pcf *pcfipaddr***
- **show cdma pdsn pcf brief**
- **show cdma pdsn pcf *pcfip psi psivalue***
- **show l2tp counters tunnel**
- **show l2tp counters tunnel authentication**
- **show cdma pdsn statistics rp pcf**
- **show cdma pdsn statistics rp pcf *pcfip***
- **show cdma pdsn statistics ppp pcf**
- **show cdma pdsn statistics ppp pcf *pcfip***
- **show cdma pdsn statistics sm**
- **show cdma pdsn statistics service-option**
- **show cdma pdsn statistics service-option *sovalue pcf pcfip***

- **show cdma pdsn statistics prepaid pcf** *pcfip*

## Changes to Clustering show Commands

The changes to clustering **show** commands are given below:

```
show cdma pdsn cluster controller member 2.1.1.1
PDSN cluster member 2.1.1.1 (local) state      ready, Group NONE <--- New
  registered with PDSN controller 11.1.1.50
  reported load 1 percent, will be sought in 2 seconds
```

Member 2.1.1.1 statistics:

```
  Number of sessions 0
  Controller seek rcvd 6122, Member seek reply rcvd 6122
  Member state changed 0 time to ready
  Member state changed 0 time to Admin prohibited
  Session-Up message rcvd 0, Session-Down message received 0
  Member seek not replied in sequence 0
```

```
show cdma pdsn cluster controller configuration
cluster interface GigabitEthernet0/0.341 (collocated)
no R-P signaling proxy
timeout to seek member = 10 seconds
window to seek member is 2 timeouts in a row if no reply (afterwards the member is
declared offline)
default: spi 101, Timestamp +/- 0, key ascii hello
this PDSN cluster controller is configured
```

Controller maximum number of load units = 100

```
show cdma pdsn cluster member configuration
cluster interface GigabitEthernet0/0.341
IP address of controller is 11.1.1.50 (collocated) <--- New
no prohibit administratively
timeout to resend status or seek controller = 10 sec or less, randomized
resend a msg for 2 timeouts sequentially if no reply, then inform operator
default: spi 101, Timestamp +/- 0, key ascii hello
this PDSN cluster member is configured
```

## Changes to Show commands

The changes to **show** commands are given below:

```
show cdma pdsn pcf:
psdn_act# show cdma pdsn pcf
PCF 2.2.2.4 has 1 session, 1 service flow
Received 382 pkts (9750 bytes), sent 391 pkts (10585 bytes)
psdn_act#
Displays only the tunnel information. Sessions associated with that tunnel will not be
displayed.
```

```
show cdma pdsn pcf <pcf-ip-addr>:
psdn_act# show cdma pdsn pcf 2.2.2.4
PCF 2.2.2.4 has 1 session, 1 service flow
Received 382 pkts (9750 bytes), sent 391 pkts (10585 bytes)
psdn_act#
Displays only the tunnel information. Sessions associated with that tunnel will not be
displayed.
```

```
show cdma pdsn statistics:
san-psdn# show cdma pdsn statistics
```

```

Last clearing of "show cdma pdsn statistics" counters never
Last Update received at 00:12:54 UTC Mar 1 2009 <--- New
RP Interface:
Reg Request rcvd 0, accepted 0, denied 0, discarded 0
Initial Reg Request rcvd 0, accepted 0, denied 0, discarded 0, AuxRequest 0
Re-registration requests rcvd 0, accepted 0, denied 0, discarded 0
Re-registration requests containing Active-Start 0, Active-Stop 0
Re-registration requests containing new connections 0, missing connections 0, remapping
flows 0
Handoff requests rcvd 0, accepted 0, denied 0, discarded 0,AuxRequest 0
De-registration rcvd 0, accepted 0, denied 0, discarded 0
De-registration Reg Request with Active-Stop 0
Registration Request Errors:
Unspecified 0, Administratively prohibited 0
Resource unavailable 0, Authentication failed 0
Identification mismatch 0, Poorly formed requests 0
Unknown PDSN 0, Reverse tunnel mandatory 0
Reverse tunnel unavailable 0, Bad CVSE 0
Max Service Flows 0, Unsupported So 0, Non-Existent A10 0
Bandwidth Unavailable 0
Update sent 0, accepted 0, denied 0, not acked 0
Initial Update sent 0, retransmissions 0
Acknowledge received 0, discarded 0
Update reason lifetime expiry 0, PPP termination 0, other 0
Registration Update Errors:
Unspecified 0, Identification mismatch 0
Authentication failed 0, Administratively prohibited 0
Poorly formed request 0
Handoff statistics:
Inter PCF handoff active 0, dormant 0
Update sent 0, accepted 0, denied 0, not acked 0
Initial Update sent 0, retransmissions 0
Acknowledge received 0, discarded 0
De-registration accepted 0, denied 0
Handoff Update Errors:
Unspecified 0, Identification mismatch 0
Authentication failed 0, Administratively prohibited 0
Poorly formed request 0
RP Session Update statistics:
Update sent 0, accepted 0, denied 0, not acked 0
Initial Update sent 0, retransmissions 0
Acknowledge received 0, discarded 0
Sent reasons Always On 0, RN-PDIT 0, Subscriber Qos 0
RP Session Update Errors:
Unspecified 0, Identification mismatch 0
Authentication failed 0, Session parameters not updated 0
Poorly formed request 0
Service Option:
Address Stats:
Simple IP: Static 0, Dynamic 0
Mobile IP: Static 0, Dynamic 0
Proxy Mobile IP: Static 0, Dynamic 0
Simple IP VPDN: Static 0, Dynamic 0
Flow Stats:
Simple IP: Success 0, Failure 0
Mobile IP: Success 0, Failure 0
Proxy Mobile IP: Success 0, Failure 0
Simple IP VPDN: Success 0, Failure 0
Unknown Service Failures: 0
PPP:
Current Connections 0
Connection requests 0, success 0, failure 0, aborted 0
Connection enters stage LCP 0, Auth 0, IPCP 0
Connection success LCP 0, AUTH 0, IPCP 0

```

```

Failure reason LCP 0, authentication 0, IPCP 0, other 0
Failure reason lower layer disconnect 0
A10 release before LCP nego by PDSN 0, by PCF 0
LCP Stage
Failure Reasons Options 0, MaxRetry 0, Unknown 0
LCP Term Req during LCP nego sent 0, rcvd 0
A10 release during LCP nego by PDSN 0, by PCF 0
Auth Stage
CHAP attempt 0, success 0, failure 0, timeout 0
PAP attempt 0, success 0, failure 0, timeout 0
MSCHAP attempt 0, success 0, failure 0, timeout 0
EAP attempt 0, success 0, failure 0
MSID attempt 0, success 0, failure 0
AAA timeouts 0, Auth timeouts 0, Auth skipped 0
LCP Term Req during Auth nego sent 0, rcvd 0
A10 release during Auth nego by PDSN 0, by PCF 0
IPCP Stage
Failure Reasons Options 0, MaxRetry 0, Unknown 0
Options failure reason MN Rejected IP Address 0
LCP Term Req during IPCP nego sent 0, rcvd 0
A10 release during IPCP nego by PDSN 0, by PCF 0
CCP Stage
Connection negotiated compression 0
Compression type Microsoft 0, Stac 0, other 0
Connections negotiated MRRU 0, IPX 0, IP 0
Connections negotiated VJ-Compression 0, BAP 0
PPP bundles 0
Connections failed to negotiate compression 0
Renegotiation total 0, by PDSN 0, by Mobile Node 0
Renegotiation success 0, failure 0, aborted 0
Renegotiation reason: address mismatch 0, lower layer handoff 0
GRE key change 0, other 0
Release total 0, by PDSN 0, by Mobile Node 0
Release by ingress address filtering 0
Release reason: administrative 0, LCP termination 0
Idle timeout 0, echo missed 0
L2TP tunnel 0, insufficient resources 0
Session timeout 0, service unavailable 0
De-Reg from PCF 0, lifetime expiry 0, other 0
Echo stats
Request sent 0, resent 0, max retransmit timeout 0
Response rcvd 0
Discarded Packets
Unknown Protocol Errors 0, Bad Packet Length 0
RSVP:
IEs Parsed 0
TFTs Created Success 0, Failure 0
TFTs Updated Success 0, Failure 0
TFTs Deleted Success 0, Failure 0
Other Failure 0
Unknown 0, Unsupported Ie types 0
Tft Ipv4 Failure Stats
Tft Unauthorized 0, Unsuccessful Processing 0
Tft Treatment Unsupported 0
Packet Filter Add 0, Replace 0
Packet Filter Precedence Contention 0, Unavailable 0
Packet Filter Maximum Limit 0, Non-Existent Tft add 0
QOS:
Total Profile Download Success 0, Failure 0
Local Profile selected 0
Failure Reason DSCP 0, Flow Profile ID 0,
Service option profile 0, Others 0
Total Consolidated Profile 0, DSCP Remarkd 0
Total policing installed 0, failure 0, removed 0

```

```

slot 0:
AHDLC Engine Type: CDMA HDLC SW ENGINE
Engine is ENABLED
total channels: 375000, available channels: 375000
Framing input 0 bytes, 0 paks
Framing output 0 bytes, 0 paks
Framing errors 0, insufficient memory 0, queue overflow 0
Invalid size 0
Deframing input 0 bytes, 0 paks
Defaming output 0 bytes, 0 paks
Deframing errors 0, insufficient memory 0, queue overflow 0
Invalid size 0, CRC errors 0
RADIUS DISCONNECT:
Disconnect Request rcvd 0, accepted 0
Disconnect Request Errors:
Unsupported Attribute 0, Missing Attribute 0
Invalid Request 0, NAS Id Mismatch 0
Session Cxt Not Found 0, Administratively Prohibited

```

Similar to **show cdma pdsn statistics**, if we execute any of the individual statistics except for **sm**, the following line appears at the start:

```

Last Update received at 00:12:54 UTC Mar 1 2009 <--- New
router# show cdma pdsn statistics ?
ahdlc AHDLC information
ppp CDMA PDSN ppp statistics
prepaid CDMA PDSN prepaid statistics
qos CDMA PDSN QOS statistics
raa      CDMA PDSN RAA statistics
radius CDMA PDSN traffic statistics
rp CDMA PDSN RP statistics
sm      CDMA PDSN SM statistics
tft CDMA PDSN TFT statistics
| Output modifiers
<cr>
router#

```

```
show cdma pdsn statistics rp error:
```

```

san-pdsn# show cdma pdsn statistics rp error
Last clearing of "show cdma pdsn statistics rp error" counters never
Last Update received at 00:12:54 UTC Mar 1 2009 <--- New
RP Registration Request Error Reasons:
Invalid Packet length 0, Protocol 0, Flags 0
Invalid Connection ID 0, Authentication Key 0, SPI 0, Mismatch SPI 0
Invalid Mobile ID 0, ID type 0, ID length 0
Invalid Extension Order 0, VSE type 0, Vendor id 0
Invalid Application type 0, Sub Application type 0
Missing extension SSE 0, MHAE 0
Duplicate Application type 0, GRE Key 0, CVSE 0
Airlink Retransmission with same sequence number 0
Airlink Invalid attribute length 0, sequence number 0, record 0
Airlink Unknown attribute 0, Duplicate attribute 0
Airlink Initial RRQ No Setup 0, Contains Stop 0, Contains SDB 0
Airlink Start before Setup 0, Start in De-Registration 0
Airlink GRE Key change no Setup 0, Rereceive Setup with same GRE Key 0
Airlink Start rcvd during active 0, Stop rcvd during dormant 0
De-Registration received for unknown session 0
Re-Registration received during session disconnect 0
Processing error due to memory failure 0
RP Registration Update Ack Error Reasons:
Invalid Packet length 0, Protocol 0
Invalid Connection ID 0, Authentication Key 0, SPI 0

```

```

Invalid Mobile ID 0, ID type 0, ID length 0
Invalid Extension Order 0, VSE type 0
Missing extension SSE 0, RUAE 0
Received for unknown session 0, discard memory failure 0
RP Session Update Ack Error Reasons:
Invalid Packet length 0, Protocol 0
Invalid Connection ID 0, Authentication Key 0, SPI 0
Invalid Mobile ID 0, ID type 0, ID length 0
Invalid Extension Order 0, VSE type 0
Missing extension SSE 0, RUAE 0
Received for unknown session 0, discard memory failure 0
RP Registration Reply Error Reasons:
Not sent memory allocation failure 0, Internal error 0
Reply not sent to PCF security not found/parse error 0
RP Registration Update Error Reasons:
Not sent memory allocation failure 0, Internal error 0
RP Session Update Error Reasons:
Not sent memory allocation failure 0, Internal error 0
Other Error Reasons:
Maximum configured/limit number of session reached 0

```

```
show cdma pdsn cac:
```

```

psdn_act# show cdma pdsn cac
                                Output in Values          Output in percentage
Total configured bandwidth      2000000 b              100%
Allocated bandwidth              100 b                 0%
Available bandwidth             1999900 b            100%

Sessions allocated               1                     0%
Max sessions allowed            175000               100%
PDSN_ACT#

```

**Note**

The **show cdma pdsn cac** command does not display CPU and memory related details.

## Debug Commands in the Single IP Architecture

Table 19 shows the **debug** commands in the single IP architecture:

**Table 19** *Debug Commands in the Single IP Architecture*

Command	Aggregation Required?	Is the exec command sent to TCOP?
debug cdma pdsn *	No	Yes
debug ppp negotiation	No	Yes
debug aaa id	No	Yes
debug aaa accounting	No	Yes
debug aaa authentication	No	Yes
debug aaa authorization	No	Yes
debug ip mobile	No	Yes

**Table 19**      **Debug Commands in the Single IP Architecture**

debug aaa pod	No	Yes
debug radius	No	Yes
debug tacacs	No	Yes

## Network Management and MIBs

See the [Radius disconnect enabled](#) section.

## Features Not Supported

Cross chassis configuration synchronization.

### Summary of Features Reused from Other Gateways

- SAMI or HA 5.0
- Osler - User Interface, show commands, bulk statistics
- SNMP single interface
- Config single interface
- IXP lookup for GRE/IP, IP/IP, MIP/UDP tunnels
- IXP defragmentation for tunnels
- AAA responsiveness traps
- Crash information or single interface for failovers
- Intra-chassis configuration sync

### Summary of Features Reuseable in Other Gateways

The following features that are included in the single IP subsystem as part of PDSN single IP are reused by other gateways:

- L2TP
- MIP RRQ forwarding
- TCOP-TCOP redundancy
- IXP - per user table

See the *Command Reference for Cisco PDSN Release 5.1 in IOS Release 12.4(22)XR1* for more information about configuration commands for Single IP per Blade in Cisco PDSN Release 5.1.

## Osler Support

The Operator Interface for Multiple Service blades for the single IP PDSN product is used to provide a single OAM viewpoint for a defined set of functionality. This support means that you can see the whole chassis as a black box without worrying about the multiple service blades having multiple processors, active or standby configuration, and so on.

The implementation reduces dependence on customer OAM deployments and provides real-time diagnostics to allow quick or proactive problem resolution. It also helps in ongoing verification of dimensioning parameters; namely, network predictability, repair or recovery based on problem identification.

This section describes:

- [Installing Osler](#)
- [Show Subscriber Commands](#)
- [Monitor Subscriber Commands](#)
- [Show Subscriber Session](#)
- [Bulk Statistics Collection](#)

## Installing Osler

The PDSN Osler Package is a TCL executable file (`pdsn_Osler-Package.tcl`) along with an archival file (`pdsn_osler.tar`). You need to download the executable file and archival file to the flash of the supervisor from where you choose to use PDSN Osler Policies.

As the PDSN Osler Package is bundled as part of the SAMI image, first you need to copy both the files (that is, `pdsn_Osler-Package.tcl` and `pdsn_osler.tar`) from the respective SAMI LCP (Processor 0) to `disk0:` of SUP.

### Installation Commands for Osler

You need to issue the following commands on SUP prompt:

```
pdsn-osler# copy sami# slot_number-fs:image/scripts/pdsn_Osler-Package.tcl disk0:
```

```
pdsn-osler# copy sami# slot_number-fs:image/scripts/pdsn_osler.tar disk0:
```

Once both the files have been copied to the `disk0:` of SUP, to see the options available within the package on the SUP execute the command `tclsh disk0:pdsn_Osler-Package.tcl --help`. The command output is as shown below (Table 20).

**Table 20**      *Installing Osler*

Command	Description
<code>: tclsh disk0:pdsn_Osler-Package.tcl</code>	
<code>-pkg install/uninstall</code>	Installs or uninstalls the PDSN Osler package. If <code>uninstall</code> is specified, there is no need to specify the rest of the arguments.
<code>-f file name</code>	The file archive on SUP flash for installing the Osler package.
<code>-maxP number</code>	Maximum number of policies that can be run simultaneously. Minimum must be five and maximum must not exceed nine.
<code>-tftpN IP address</code>	IP address or hostname of the TFTP server to store the statistics, traces and subscriber information.

**Table 20**      **Installing Osler**

<b>-statsLD Directory Path</b>	Local directory path on SUP to store the statistics temporarily.
<b>-statRD Directory Path</b>	Directory path on remote TFTP server to store the bulk statistics for Osler.
<b>-statT [Periodicity [min]]</b>	Bulk statistics reporting periodicity in minutes. (Default is 30 minutes). Must be in increments of 15 and in the range of 30 to 1440.
<b>-subRD Directory Path</b>	Directory path on remote TFTP server to store the subscriber data.
<b>-traceLD [Directory Path]</b>	Local directory path on SUP to store the traces temporarily.
<b>-traceRD Directory Path</b>	Directory path on remote TFTP server to store the trace subscriber data.

### Sample Installation of Osler

To install the PDSN Osler Package, the following is an example:

Single chassis environment:

```
tclsh disk0:pdsn_Osler-Package.tcl -pkg install -f disk0:pdsn_osler.tar -maxP 9 -tftpN
1.1.1.19 -statLD disk0:stats -statRD dirname/stats/globalStats -statT 30 -subRD
nishigup/Osler_Lib -traceLD disk0:/traces -traceRD dirname/traces
```

The above example assumes that:

- There is a TFTP server running on IP 1.1.1.19 with the directory **dirname** writable for the TFTP access.
- **/fttpboot/utharani/stats/globalStats, /fttpboot/dirname/traces** and **/fttpboot/dirname/Osler\_Lib** directories are present and writable for all on 1.1.1.19



#### Tip

If the PDSN Osler installation package stops in between, press the Enter key to let installation script to continue further.

To uninstall the PDSN Osler Package, the following is an example:

Single chassis environment:

```
tclsh disk0:pdsn_Osler-Package.tcl -pkg uninstall
```



#### Note

- Dual chassis mode is not present in the PDSN Osler package.
- The PDSN-Osler installation script assumes that the path specified in all of the statsRD, subRD and traceRD arguments exist and is writable at the TFTP server (as specified with tftpN argument).

- All the files contained in the installation package must be copied in the same directory path to that of EEM user policy directory configuration (that is, "event manager directory user policy") on SUP. If there is no configuration related to EEM user policy directory, then all the installation files must be copied to `disk0:/pdsn_osler` and the EEM user policy configuration is set to `disk0:/pdsn_osler`.
- Before uninstalling the PDSN-Osler package, make sure that the bulk statistic reporting is stopped.

## Show Subscriber Commands

The CLI commands are invoked on the processors running the active PDSN instances to query the subscriber, matching one or more of various conditions. The conditions are:

- All - Summary of all sessions of users at the chassis level.
- Card - Summary of all user sessions on a particular card, slot, or blade.
- CPU - Summary of all users on a particular CPU.
- Connect - Summary of all users with a connect time greater than, less than, or equal to a time value.
- FA - Chassis - Summary of all visitors on FAs within the PDSN.
- FA - member - Summary of all users FA-specific-FA within the PDSN.
- HA - User - Summary of all users registered with a particular HA.
- Address space - Summary of all users in this address space.
- Calltype - Summary of all users for this Call Type.
- NAI/User - Summary of all users for this NAI.

Three display formats are provided: summary, brief, and verbose.

- Summary - A simple total of subscribers matching the display policy including packets in, packets out and bytes in, bytes out.
- Brief - 'One-line-of-output-per-subscriber' format for each subscriber matching the display policy.
- Verbose - 'Multiple-lines-of-output-per-subscriber' format for each subscriber matching the display policy.

The Osler CLI collects the output of the commands from the processors, collates the results and presents, as if one command is executed. You must provide the option to collect the data in a file or to display the data on the screen for the verbose and brief options.

## Show Subscriber Verbose All

This command shows all the subscribers on the chassis. This command internally use **show cdma pdsn session detail** and parse the output.



### Caution

We do not recommend that you run this policy. Because of the huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose. **tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server.

**Note**

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```

----- Slot 1/CPU 5, show cdma pdsn session detail-----

Mobile Station ID IMSI 09003000001
PCF IP Address 6.6.6.2, PCF Session ID 1
A10 connection time 02:25:51, registration lifetime 65535 sec
Number of successful A11 reregistrations 0
Remaining session lifetime INFINITE
Always-On not enabled for the user

Current Access network ID 0006-0606-02
Last airlink record received is Active Start, airlink is active
GRE protocol type is 0x8881
GRE sequence number transmit 867, receive 860
Using interface Virtual-Access2.1, status OPN
Using AHDLC engine on slot 0, channel ID 10
Service Option EV-DO Flow Discrimination 0 DSCP Included 0
Flow Count forward 0 reverse 0
This session has 1 flow
This session has 0 service flows
Session Airlink State Active
This session has 0 TFTs
Qos subscriber profile
  Max Aggregate Bandwidth : 1
Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505

Flow service Simple, NAI osler1
  Mobile Node IP address 4.4.4.1
  Packets in 0, bytes in 0
  Packets out 0, bytes out 0

Qos per flow : osler1
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Number of Persistent Tft : 34567

  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505

```

## Show Subscriber Brief All

This command is implemented to show all the subscribers in the chassis. This command internally uses **show cdma pdsn session brief** and parses the output.



### Caution

We do not recommend you to run this policy because it is through huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, and the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**ftftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server.



### Note

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
----- Slot 1/CPU 5, show cdma pdsn session brief-----
MSID          PCF IP Address      PSI      Age   St SFlows Flows Interface
09003000001   6.6.6.2             1 00:27:02 OPN     0    1 Virtual-Access2.1
09003000053   6.6.6.5             51 00:00:32 OPN     0    1 Virtual-Access2.2
```

## Show Subscriber Summary All

This command is implemented to show summary of all the subscribers in the chassis. This command internally uses **show cdma pdsn session summary** and parse the output.

The below example is a snippet of the display output:

```
SHOW SUBSCRIBER SUMMARY
-----
Total Number of sessions :121
Total Number of Paks in :83866
Total Number of Paks out :87872
Total Number of bytes in :1341130
Total Number of bytes out :2601436
```

## Show Subscriber Verbose Card

This command shows all the subscribers on a specific SAMI card. This command internally uses **show cdma pdsn session detail** on the specified card and then parse the output.



### Caution

We do not recommend you to run this policy because it is through huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, and the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server.

**Note**

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
>> Now enter the SAMI Card ID ([1-13]): 1
----- Slot 1/CPU 5, show cdma pdsn session detail-----
```

```
Mobile Station ID IMSI 09003000003
PCF IP Address 6.6.6.5, PCF Session ID 1
A10 connection time 00:08:36, registration lifetime 65535 sec
Number of successful A11 reregistrations 0
Remaining session lifetime INFINITE
Always-On not enabled for the user
Current Access network ID 0006-0606-05
Last airlink record received is Active Start, airlink is active
GRE protocol type is 0x8881
GRE sequence number transmit 14, receive 0
Using interface Virtual-Access2.1, status OPN
Using AHDLC engine on slot 0, channel ID 54
Service Option EV-DO Flow Discrimination 0 DSCP Included 0
Flow Count forward 0 reverse 0
This session has 1 flow
This session has 0 service flows
Session Airlink State Active
This session has 0 TFTs
Qos subscriber profile
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505

Flow service Mobile, NAI scdma_osler3@ark.com
  Mobile Node IP address 9.9.9.2

  HA IP address 5.5.5.2
  Packets in 0, bytes in 0
  Packets out 0, bytes out 0

Qos per flow : scdma_osler3@ark.com
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Number of Persistent Tft : 34567
  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
```

```
Reverse profile-id : 6295
Reverse profile-id : 17185
Bidirectional profile-id : 22136
Bidirectional profile-id : 26505
```

## Show Subscriber Brief Card

This command shows all the subscribers on a specific card. This command internally uses **show cdma pdsn session brief** on the specified card and then parse the output.



### Caution

We do not recommend you to run this policy. Because of the huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server.



### Note

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
>> Now enter the SAMI Card ID ([1-13]): 1
----- Slot 1/CPU 5, show cdma pdsn session brief-----
MSID          PCF IP Address      PSI      Age  St SFlows Flows Interface
09003000001   6.6.6.2             1 00:28:39 OPN    0    1 Virtual-Access2.1
09003000053   6.6.6.5             51 00:02:09 OPN    0    1 Virtual-Access2.2
```

## Show Subscriber Summary Card

This command shows summary of all the subscribers on a specific card. This command internally uses **show cdma pdsn session summary** on the specified card and parse the output.

The below example is a snippet of the display output:

```
>> Now enter the SAMI Card ID ([1-13]): 1
SHOW SUBSCRIBER SUMMARY <-> (All Subscribers on the Card: 1)
-----
Total  Number of sessions :121
Total  Number of Paks in  :84555
Total  Number of Paks out :88561
Total  Number of bytes in :1352154
Total  Number of bytes out :2620915
```

## Show Subscriber Verbose CPU

This command shows all the subscribers from the specific TCOP on a SAMI card. This command internally uses **execute-on [TCOP] show cdma pdsn session detail** on the specified {Card, PCOP} and parse the output.

**Caution**

We do not recommend you to run this policy. Because of the huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.

**Note**

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
>> Now enter the ',' separated SAMI Card & CPU ID (e.g. 4,5): 1,5
----- Slot 1/CPU 5, show cdma pdsn session detail-----
```

```
Mobile Station ID IMSI 09003000051
  PCF IP Address 6.6.6.2, PCF Session ID 51
  A10 connection time 00:08:24, registration lifetime 65535 sec
  Number of successful A11 reregistrations 0

  Remaining session lifetime INFINITE
  Always-On not enabled for the user
  Current Access network ID 0006-0606-02
  Last airlink record received is Active Start, airlink is active
  GRE protocol type is 0x8881
  GRE sequence number transmit 62, receive 55
  Using interface Virtual-Access2.2, status OPN
  Using AHDLC engine on slot 0, channel ID 53
  Service Option EV-DO Flow Discrimination 0 DSCP Included 0
  Flow Count forward 0 reverse 0
  This session has 1 flow
  This session has 0 service flows
  Session Airlink State Active
  This session has 0 TFTs
  Qos subscriber profile
    Max Aggregate Bandwidth : 1
    Inter User Priority : 1000
    Maximum Flow Priority : 120980
    Forward profile-id : 4660
    Forward profile-id : 9097
    Forward profile-id : 14454
    Reverse profile-id : 6295
    Reverse profile-id : 17185
    Bidirectional profile-id : 22136
    Bidirectional profile-id : 26505

  Flow service Simple, NAI osler1
  Mobile Node IP address 4.4.4.5
  Packets in 0, bytes in 0
  Packets out 0, bytes out 0

  Qos per flow : osler1
  Max Aggregate Bandwidth : 1
```

```

Inter User Priority : 1000

Maximum Flow Priority : 120980
Number of Persistent Tft : 34567
Forward profile-id : 4660
Forward profile-id : 9097
Forward profile-id : 14454
Reverse profile-id : 6295
Reverse profile-id : 17185
Bidirectional profile-id : 22136
Bidirectional profile-id : 26505

```

## Show Subscriber Brief CPU

This command shows all the subscribers from the specific TCOP on a SAMI card. This command internally uses **execute-on [TCOP] show cdma pdsn session brief** on the specified {Card, PCOP} and parse the output to present it in short form.



### Caution

We do not recommend you to run this policy. Because of the huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose. **tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.



### Note

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```

>> Now enter the ',' separated SAMI Card & CPU ID (e.g. 4,5): 1,5
>> Large number of records to process. Should I tftp it (y/n): y
Redirected the file PPC3-SLOT1-04_33_58.19_Feb_2009
*****
===== Total OP-REDIRECTED Records Found =====

```

## Show Subscriber Summary CPU

This command shows the subscribers from the specific TCOP on a SAMI card. This command internally uses **execute-on [TCOP] show cdma pdsn session summary** on the specified {Card, PCOP} and parse the output.

The below example is a snippet of the display output:

```

>> Now enter the ',' separated SAMI Card & CPU ID (e.g. 4,5): 1,5
SHOW SUBSCRIBER SUMMARY <-> (All Subscribers on the Slot,CPU: [1,5])
-----
Total Number of sessions :121
Total Number of Paks in :120771
Total Number of Paks out :124777
Total Number of bytes in :1931750
Total Number of bytes out :3648760

```

## Show Subscriber Verbose with Connect

This command shows the subscribers with a lifetime within the specified parameters in *hh:mm:ss* format. This command internally uses **show cdma pdsn session lifetime age** {greater | less | equals} [time] detail and parse the output.

Because of the huge amount of data to the SUP card, the policy takes an extended period of time to process the data, if the criterion matches for large number of subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.



### Note

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
>> Now enter the lifetime (hh:mm:ss format): 0:2:29
>> Enter the value type for Life Time Record (e.g: greater|lesser|equals): greater
----- Slot 1/CPU 5, show cdma pdsn session lifetime age greater 0:2:29
detail-----
```

```
Mobile Station ID IMSI 09003000051
PCF IP Address 6.6.6.2, PCF Session ID 51
A10 connection time 00:04:25, registration lifetime 65535 sec
Number of successful A11 reregistrations 0
Remaining session lifetime INFINITE
Always-On not enabled for the user
Current Access network ID 0006-0606-02

Last airlink record received is Active Start, airlink is active
GRE protocol type is 0x8881
GRE sequence number transmit 38, receive 31
Using interface Virtual-Access2.2, status OPN
Using AHDLC engine on slot 0, channel ID 55
Service Option EV-DO Flow Discrimination 0 DSCP Included 0
Flow Count forward 0 reverse 0
This session has 1 flow
This session has 0 service flows
Session Airlink State Active
This session has 0 TFTs
Qos subscriber profile
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505

Flow service Simple, NAI osler1
  Mobile Node IP address 4.4.4.5
  Packets in 0, bytes in 0
```

```

Packets out 0, bytes out 0

Qos per flow : osler1
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Number of Persistent Tft : 34567
  Forward profile-id : 4660

  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505

```

### Show Subscriber Brief with Connect

This command shows the subscribers with a lifetime within the parameters in the *hh:mm:ss* format. This command internally uses **show cdma pdsn session lifetime age** {greater | less | equals} [**time**] **brief** and parse the output.

Because of large amount of data to the SUP card, the policy takes an extended period of time to process the data, if the criterion matches for large number of subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose. **ftftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.



#### Note

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```

>> Now enter the lifetime (hh:mm:ss format): 0:2:59
>> Enter the value type for Life Time Record (e.g.: greater|lesser|equals): greater

----- Slot 1/CPU 5, show cdma pdsn session lifetime age greater 0:2:59
brief-----
MSID          PCF IP Address      PSI      Age  St SFlows Flows Interface
09003000051   6.6.6.2             51 00:05:10 OPN      0    1 Virtual-Access2.2

```

### Show Subscriber Summary with Connect

This command shows the subscribers with a lifetime within the parameters in the *hh:mm:ss* format. This command internally uses **show cdma pdsn session lifetime age** {greater | less | equals} [**time**] **summary** and parse the output.

The below example is a snippet of the display output:

```

>> Now enter the lifetime (hh:mm:ss format): 1:23:0
>> Enter the value type for Life Time Record (e.g: greater|lesser|equals): greater

SHOW SUBSCRIBER SUMMARY <-> (With specified lifetime: 1:23:0)
-----
Total Number of sessions with lifetime greater than the given time :120

```

```
Total Number of Paks in :121117
Total Number of Paks out :125114
Total Number of bytes in :1937152
Total Number of bytes out :3657995
```

## Show Subscriber Verbose from FA-Chassis

This command shows the total number of visitors serviced by the FA in the chassis. This command internally uses **show ip mobile visitor** and parse the output.



### Caution

We do not recommend you to run this policy. Because of the huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.



### Note

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
----- Slot 1/CPU 5, show ip mobile visitor-----

Mobile Visitor List:
Total 1
scdma_osler3@ark.com:
  Home addr 9.9.9.2
  Interface Virtual-Access2.1, MAC addr 0000.0000.0000
  IP src 0.0.0.0, dest 5.5.5.1, UDP src port 434
  HA addr 5.5.5.2, Identification CD1EB19A.10000
  Lifetime 00:10:00 (600) Remaining 00:03:05
  Tunnel0 src 5.5.5.1, dest 5.5.5.2, reverse-allowed
  Routing Options
```

## Show Subscriber Brief From FA-Chassis

This command shows total number of visitors serviced by the FA in the chassis. This command internally uses **show ip mobile visitor brief** and parses the output to present in a short form.

If the specific FA has a large number of subscribers in the chassis, the policy may take an extended period of time to display all the subscribers. In such cases, we recommend that you do not run this command often.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.

**Note**

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
----- Slot 1/CPU 5, show ip mobile visitor brief-----
Mobile Visitor List:
Total 1
scdma_osler3@ark.com:
  Home addr 9.9.9.1
  MAC addr 0000.0000.0000
  HA addr 5.5.5.2
  FA addr 5.5.5.1
  Lifetime 00:10:00 (600) Remaining 00:08:03
```

**Show Subscriber Summary from FA-Chassis**

This command shows the total number of visitors serviced by the FA in the chassis. This command internally uses **show ip mobile visitor summary** and parse the output.

The below example is a snippet of the display output:

```
SHOW SUBSCRIBER SUMMARY <-> (FA-Chassis Visitors)
-----
FA-Chassis visitors List:
Total 1
```

**Show Subscriber Verbose from FA-Member**

This command shows the total number of visitors serviced by FA in the specified service card. This command internally uses **show ip mobile visitor [Card]** and parse the output.

**Caution**

We do not recommend you to run this policy. Because of the huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.

**Note**

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
>> Now enter the Card number for FA-Member visitors: 1
----- Slot 1/CPU 5, show ip mobile visitor-----

Mobile Visitor List:
Total 1
scdma_osler3@ark.com:
```

```

Home addr 9.9.9.2
Interface Virtual-Access2.3, MAC addr 0000.0000.0000
IP src 0.0.0.0, dest 5.5.5.1, UDP src port 434
HA addr 5.5.5.2, Identification CD229382.10000
Lifetime 00:10:00 (600) Remaining 00:02:39
Tunnel0 src 5.5.5.1, dest 5.5.5.2, reverse-allowed
Routing Options

```

### Show Subscriber Brief from FA-Member

This command shows the total number of visitors serviced by FA in the specified service card. This command internally uses **show ip mobile visitor [card] brief** and parse the output.

If the specific FA has a large number of subscribers in card, the policy takes an extended period of time to display all the subscribers. In such cases, we recommend that you do not run this command often.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.



#### Note

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```

>> Now enter the Card number for FA-Member visitors: 1
----- Slot 1/CPU 5, show ip mobile visitor brief-----
Mobile Visitor List:
Total 1
scdma_osler3@ark.com:
  Home addr 9.9.9.2
  MAC addr 0000.0000.0000
  HA addr 5.5.5.2
  Lifetime 00:10:00 (600) Remaining 00:04:57

```

### Show Subscriber Summary from FA-Member

This command shows the total number of visitors serviced by FA in the specified service card. This command internally uses **show ip mobile visitor [card] summary** and parse the output.

The below example is a snippet of the display output:

```

SHOW SUBSCRIBER SUMMARY <-> (FA-Member Visitors: 1)
-----
FA-Member Visitors List:
Total 1

```

### Show Subscriber Verbose from HA-User

This command shows the total number of users registered with a particular HA. This command internally uses **show ip mobile visitor ha-addr [ha-ip]** on all the TCOPs and parse the output.

**Caution**

We do not recommend you to run this policy. Because of the huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.

**Note**

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
>> Now enter the HA-User address (HA IP): 5.5.5.2
----- Slot 1/CPU 5, show ip mobile visitor ha-addr 5.5.5.2-----
Mobile Visitor List:
Total 1
scdma_osler3@ark.com:
  Home addr 9.9.9.2
  Interface Virtual-Access2.3, MAC addr 0000.0000.0000
  IP src 0.0.0.0, dest 5.5.5.1, UDP src port 434
  HA addr 5.5.5.2, Identification CD228505.10000
  Lifetime 00:10:00 (600) Remaining 00:07:33
  Tunnel0 src 5.5.5.1, dest 5.5.5.2, reverse-allowed
  Routing Options
```

**Show Subscriber Brief from HA-User**

This command shows the total number of users registered with a particular HA. This command internally uses **show ip mobile visitor ha-addr [ha-ip] brief** and parse the output.

If the specific HA has large number of subscribers in card, the policy takes an extended period of time to display all the subscribers; not recommended to run more often.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.

**Note**

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
>> Now enter the HA-User address (HA IP): 5.5.5.2
----- Slot 1/CPU 5, show ip mobile visitor ha-addr 5.5.5.2 brief-----
Mobile Visitor List:
```

```
Total 1
scdma_osler3@ark.com:
  Home addr 9.9.9.2
  MAC addr 0000.0000.0000
  HA addr 5.5.5.2
  Lifetime 00:10:00 (600) Remaining 00:04:07
```

### Show Subscriber Summary from HA-user

This command is implemented to show the total number of users registered with a particular HA. This command internally uses **show ip mobile visitor ha-addr [ha-ip] summary** and parses the output.

The below example is a snippet of the display output:

```
>> Now enter the HA-User address (HA IP): 5.5.5.2
SHOW SUBSCRIBER SUMMARY <-> (HA-User IP: 5.5.5.2)
-----
HA User Subscriber List:
Total 1
```

### Show Subscriber Verbose within Address Space

This command shows all the subscribers within the given address space. This command internally uses **show cdma pdsn flow mn-ip-address range [mn-ip] detail** and parse the output.



#### Caution

We do not recommend you to run this policy. Because of the huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.



#### Note

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
>> Now enter the ',' separated starting IP address & end IP address(e.g.
10.114.200.49,10.114.200.180) : 4.4.4.1,4.4.4.10
----- Slot 1/CPU 5, show cdma pdsn flow mn-ip-address range 4.4.4.1 4.4.4.10
detail-----

Flow service Simple, NAI osler1@cisco.com

Mobile Node IP address 4.4.4.1
Packets in 0, bytes in 0
Packets out 0, bytes out 0

Qos per flow : osler1@cisco.com
Max Aggregate Bandwidth : 1
Inter User Priority : 1000
Maximum Flow Priority : 120980
Number of Persistent Tft : 34567
```

```

Forward profile-id : 4660
Forward profile-id : 9097
Forward profile-id : 14454
Reverse profile-id : 6295
Reverse profile-id : 17185
Bidirectional profile-id : 22136
Bidirectional profile-id : 26505

Flow service Simple, NAI osler1@cisco.com
Mobile Node IP address 4.4.4.2
Packets in 1, bytes in 108
Packets out 1, bytes out 76

Qos per flow : osler1@cisco.com
Max Aggregate Bandwidth : 1
Inter User Priority : 1000
Maximum Flow Priority : 120980
Number of Persistent Tft : 34567
Forward profile-id : 4660
Forward profile-id : 9097
Forward profile-id : 14454
Reverse profile-id : 6295
Reverse profile-id : 17185
Bidirectional profile-id : 22136
Bidirectional profile-id : 26505

```

## Show Subscriber Brief within Address Space

This command shows all the subscribers within the given address space. This command internally uses **show cdma pdsn flow mn-ip-address range <mn-ip> brief** and parse the output.



### Caution

We do not recommend you to run this policy. Because of the huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.



### Note

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```

>> Now enter the ',' separated starting IP address & end IP address(e.g.
10.114.200.49,10.114.200.180) : 4.4.4.1,4.4.4.10
----- Slot 1/CPU 5, show cdma pdsn flow mn-ip-address range 4.4.4.1
4.4.4.10-----
MSID          NAI                               Type          MN IP Address  St
09003000001   osler1@cisco.com                    Simple        4.4.4.2        ACT

```

## Show Subscriber Summary within Address Space

This command shows summary of all the subscribers within the given address space. This command internally uses **show cdma pdsn flow mn-ip-address range [mn-ip] summary** and parse the output.

The below example is a snippet of the display output:

```
>> Now enter the ',' separated starting IP address & end IP address (e.g.
10.114.200.49,10.114.200.180) : 4.4.4.1,4.4.4.10
SHOW SUBSCRIBER SUMMARY <-> (Subscriber in address range: 4.4.4.1 4.4.4.10)
-----
Number of flows having mn-ip-address between 4.4.4.1 4.4.4.10 : 8
Total Number of Packs in :0
Total Number of Packs out :0
Total Number of bytes in :0
Total Number of Packs out :0
```

## Show Subscriber Verbose for Calltype

This command shows the total number of users for a particular Calltype. This command internally uses **show cdma pdsn session service-option [so] detail** and parse the output.



### Caution

We do not recommend you to run this policy. Because of the huge amount of data (500,000 subscribers per blade multiplied by the number of SAMI blades) to the SUP card, the policy takes an extended period of time to process it. The fully-loaded chassis may take one to two hours to display all the subscribers.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose. **tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.



### Note

If the total number of subscribers exceeds 1000 per PCOP, this policy does not display the subscribers on screen. However, you can view the list of subscribers by redirecting output to a file.

The below example is a snippet of the display output:

```
Select Service type:
1. EVDO
2. 1xRTT
3. Quit
Enter the service Type choice from the above menu (1/2/3): 1
----- Slot 1/CPU 5, show cdma pdsn session service-option 59 detail-----

Mobile Station ID IMSI 09003000051
PCF IP Address 6.6.6.2, PCF Session ID 51
A10 connection time 00:11:13, registration lifetime 65535 sec
Number of successful A11 reregistrations 0
Remaining session lifetime INFINITE
Always-On not enabled for the user
Current Access network ID 0006-0606-02
Last airlink record received is Active Start, airlink is active
GRE protocol type is 0x8881
GRE sequence number transmit 78, receive 71
Using interface Virtual-Access2.2, status OPN
Using AHDLC engine on slot 0, channel ID 55
```

```
Service Option EV-DO Flow Discrimination 0 DSCP Included 0
Flow Count forward 0 reverse 0
This session has 1 flow
This session has 0 service flows
```

```
Session Airlink State Active
This session has 0 TFTs
Qos subscriber profile
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505
```

```
Flow service Simple, NAI osler1
Mobile Node IP address 4.4.4.5
Packets in 0, bytes in 0
Packets out 0, bytes out 0
```

```
Qos per flow : osler1
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Number of Persistent Tft : 34567
  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505
```

## Show Subscriber Brief for Calltype

This command shows the total number of users for a particular Calltype. This command internally uses **show pdsn session service-option [so] brief** and parse the output.

If the specific card has large number of subscribers, the policy may take an extended period of time to display all the subscribers; not recommended to run more often.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose.

**tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.



### Note

This policy does not allow to show subscribers on the screen, if the total number of subscribers are above 1000 per PCOP. However, the file option must still work.

The below example is a snippet of the display output:

```
Select Service type:
1.  EVDO
2.  1xRTT
```

```

3. Quit
Enter the service Type choice from the above menu (1/2/3): 1

----- Slot 1/CPU 5, show cdma pdsn session service-option 59 brief-----
MSID          PCF IP Address      PSI      Age  St SFlows Flows Interface
09003000051   6.6.6.2             51 00:12:00 OPN    0    1 Virtual-Access2.2
09003000003   6.6.6.5             1 00:04:33 OPN    0    1 Virtual-Access2.1

```

## Show Subscriber Summary for Calltype

This command shows the total number of users for a particular Calltype. This command internally uses **show pdsn session service-option [so] summary** and parse the output.

The below example is a snippet of the display output:

```

Select Service type:
1. EVDO
2. 1xRTT
3. Quit
Enter the service Type choice from the above menu (1/2/3): 1

SHOW SUBSCRIBER SUMMARY <-> With CallType Option 59
-----
Total Number of sessions with service option 59:121
Total Number of Paks in :124122
Total Number of Paks out :128128
Total Number of bytes in :1985366
Total Number of bytes out :3744118

```

## Show Subscriber Verbose with NAI

This command shows the subscribers with specific string within the NAI. For example, you can view subscribers for the push to talk that will have "ptt" within the NAI. This command internally uses **show cdma pdsn session user \*ptt\* detail** and parse the output. It returns only bindings that match the "ptt" string in the NAI.

Because of the large amount of data to the SUP card, depending on the matching criterion, the policy takes an extended time to process the data.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose. **ftftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.



### Note

This policy does not allow to show subscribers on the screen, if the total number of subscribers are above 1000 per PCOP. However, the file option must still work.

The below example is a snippet of the display output:

```

>> Now enter the NAI (wild-carded or specific): *_osler*
----- Slot 1/CPU 5, show cdma pdsn session user *_osler* detail-----

Mobile Station ID IMSI 09003000053
PCF IP Address 6.6.6.5, PCF Session ID 51
A10 connection time 00:01:37, registration lifetime 65535 sec
Number of successful A11 reregistrations 0
Remaining session lifetime INFINITE

```

```

Always-On not enabled for the user
Current Access network ID 0006-0606-05
Last airlink record received is Active Start, airlink is active
GRE protocol type is 0x8881
GRE sequence number transmit 14, receive 0
Using interface Virtual-Access2.3, status OPN
Using AHDLC engine on slot 0, channel ID 11
Service Option EV-DO Flow Discrimination 0 DSCP Included 0
Flow Count forward 0 reverse 0
This session has 1 flow
This session has 0 service flows
Session Airlink State Active

```

```

This session has 0 TFTs
Qos subscriber profile
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505

```

```

Flow service Mobile, NAI scdma_osler3@ark.com
Mobile Node IP address 9.9.9.2
HA IP address 5.5.5.2
Packets in 0, bytes in 0
Packets out 0, bytes out 0

```

```

Qos per flow : scdma_osler3@ark.com
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Number of Persistent Tft : 34567
  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505

```

## Show Subscriber Brief with NAI

This command shows the subscribers with specific string within the NAI. For example, you can view subscribers for the push to talk that will have "ptt" within the NAI. This command internally uses **show cdma pdsn session user \*ptt\* brief** and parse the output. It returns only bindings that match the "ptt" string in the NAI.

The policy runs the summary command first and checks for the users per PCOP. If the number of the subscribers exceeds the recommended numbers for the terminal display, you need to select the file option. If you have not selected the file option, the PCOP is ignored.

You can use the IOS CLI command **show cdma pdsn session detail** for this purpose. **tftp://tftp-ip/user/[dir]/PPC3-SLOTNumber-subs-[date-time].txt** is used collect all the data into a file on the TFTP server location.

**Note**


---

This policy does not allow to show subscribers on the screen, if the total number of subscribers are above 1000 per PCOP. However, the file option must still work.

---

The below example is a snippet of the display output:

```
>> Now enter the NAI (wild-carded or specific): osler*

----- Slot 1/CPU 5, show cdma pdsn session user osler* brief-----
MSID          PCF IP Address      PSI      Age  St SFlows Flows Interface
09003000051   6.6.6.2             51 00:01:35 OPN      0    1 Virtual-Access2.2
```

**Show Subscriber Summary With NAI**

This command shows the subscribers with specific string within the NAI. For example, you can view subscribers for the push to talk that will have "ptt" within the NAI. This command internally uses **show cdma pdsn session user \*ptt\* summary** and parse the output. It returns only bindings that match the "ptt" string in the NAI.

The below example is a snippet of the display output:

```
>> Now enter the NAI (wild-carded or specific): osler1*
SHOW SUBSCRIBER SUMMARY <-> (Matching NAI: osler1*)
-----
Total  Number of sessions with user osler1* :121
Total  Number of Paks in :124644
Total  Number of Paks out :128650
Total  Number of bytes in :1993718
Total  Number of bytes out :3759382
```

**Monitor Subscriber Commands**

Osler implements trace commands to perform all the tasks for subscriber tracing. The subscriber is identified based on the NAI or IMSI.

To trace the subscriber, the policy invokes multiple CLI commands on the processors running the active or standby PDSN to set conditional debugs, using existing IOS CLIs for that subscriber.

The set of conditional debugs is based on session, accounting, MIP, PMIP, VPDN and TFT, which results in invoking multiple commands on the processors. You do not have to set the debug conditions on all the processors.

The monitor commands must configure each SAMI processor mode command **debug condition [username | calling] {NAI | IMSI}** to enable the inclusion of your name or NAI in the traces.

**Note**


---

For VPDN and PDSN, IMSI-based conditional debugging is not supported in Osler version 1.0.

---

The following command provides an option to start the subscriber tracing based on NAI or IMSI:

**Note**


---

To start the subscriber tracing, the **start subscriber tracing** command sets the trace conditions on all active and standby PDSN instances. To avoid trace flooding, the trace condition must be set first on all the PDSN instances and then set PDSN specific traces.

---

SUP-7600#traces

For NAI-based tracing, the traces command uses the following commands to set the trace conditions:

**trace condition****debug condition username [NAI]**

For IMSI-based tracing, the traces command uses the following commands to set the trace conditions:

**trace condition****debug condition calling [IMSI]**

To configure show debug condition, use the command **cdma pdsn debug show-conditions** in configuration mode. For MIP and PMIP debugs to display debug conditions, use the **ip mobile debug include username** command in configuration mode.

The application specific traces are configured as below:

**application specific traces**

Session

**debug cdma pdsn a11****debug cdma pdsn session****debug ppp negotiation****debug radius authentication**

Accounting

**debug radius accounting****debug cdma pdsn accounting**

TFT

**debug cdma pdsn rsvp****debug cdma pdsn tft**

VPDN

**debug vpdn l2x-errors****debug vpdn l2x-events**

MIP

**debug ip mobile**

PMIP

**debug ip mobile proxy**

After debugging on PDSN instances, the traces command creates a trace log file on the local disk of the supervisor card to dump the traces. It also displays the traces on the terminal.

The trace command continuously collects the traces of subscriber, until it receives the trace stop request or the trace command registration time (default is one hour) expires. On receiving the trace stop request, it stops the subscriber tracing and it resets the trace conditions that were set while starting the tracing for the subscriber.

**Stop Subscriber Tracing**

You can send the trace stop request to a single subscriber at a time to stop tracing. The trace stop request contains information about transferring the trace log file to an external host and you need to confirm this information before PDSN sends the trace stop request to the corresponding trace session.

If the trace stop request needs transferring the trace log file to an external host, the trace command transfers the trace log file to an external host and deletes the trace log file from the local directory of the supervisor card.

If the trace stop request does not need transferring the trace log file to an external host, the traces command retains the trace log file in a local directory of the supervisor card.

### Show Subscriber Trace Sessions

You can use the trace command to view information about all the existing trace sessions in the system.

This option shows the number of existing trace sessions and the list of subscribers for which tracing is enabled. To view the information about Osler trace conditions, this option invokes the CLI command **show debugging** on all PDSN instances.

### Clear All Subscriber Trace Sessions

You can also clear all existing trace sessions.

Before clearing the trace sessions, this option displays the information about all the existing trace sessions in the system.

The trace clear session request also contains the information about transferring the trace log file to an external host and you need to confirm this information before PDSN sends the trace clear session request.

After sending the clear trace session request, the policy removes the conditional debug from all active and standby PDSN instances for the specific NAI or assigned IP address.

If only one debug condition exists, the application-specific traces are removed first to avoid trace flooding and then the condition is removed.

If there is no active trace session in system, this option provides the mechanism to reset the Osler trace condition which are left unclear (if any) on PDSN instances.



#### Note

---

This option provides a mechanism to clear all trace sessions that are active or left uncleared. So this option resets the whole Osler trace facility on the chassis.

---

### Traces Representation

After starting the subscriber tracing, the traces command continuously reads the traces from the system log. While logging the traces in trace log file and displaying the traces on the terminal, the trace command reformats them and categorizes the traces based on timestamps and protocols. Within the protocol, the traces are sub-categorized based on the processing stage of a particular request from the subscriber.

### Trace Mode

Osler implements the subscriber tracing for brief and verbose mode, where brief mode includes only meaningful traces and verbose mode includes all subscriber traces. All the brief mode traces are maintained in one separate database file. If you want to get more traces, you can add the tokens in the database file. Pre-defined tokens are default tokens for brief traces. To add a new token, add it in a new line in a particular topic.

## Protocol Selection

Osler provides the subscriber tracing on Session, Accounting, TFT, MIP, PMIP and VPDN protocols. You can thus trace the subscribers for specific protocols only.

While starting the tracing, the trace command provides an option to select one or more protocols among Session, Accounting, TFT, MIP, PMIP and VPDN protocols. The trace command enables the trace conditions, logs, and displays the conditions for selected protocols only.

## Other Conditions

Because the tracing is a continuous process, it consumes CPU resources. Therefore, to meet the CPU requirements, the trace command performs the following checks:

- Returns a warning to you, if the available disk space on the supervisor card is less than 20 percentage. If the available disk space is less than 20 percent, the trace command does not start tracing.
- If the trace command finds more than 50 trace log files on the local trace directory of the supervisor card, then it transfers the oldest trace log file to an external host and deletes the file from the local supervisor trace directory before starting the subscriber tracing.
- If logging console is enabled at severity level seven on the supervisor card, the trace command does not start the tracing.
- If **debug all** is enabled on the supervisor card, the trace command does not start the tracing.
- Before starting the tracing, the traces command must configure an applet to track the logging console command. So whenever supervisor card is configured with logging console command, the applet sends the trace stop request to all existing trace sessions.
- Before starting the tracing, the trace command configures an applet to track the **debug all** command. So whenever debug all is enabled, the applet sends the trace stop request to all existing trace sessions.

## Show Subscriber Session

The CLI or script commands are implemented as part of this module to determine which service blade is hosting the subscriber and then executes the set of IOS CLIs on that service blade and collates the results and presents in a single coherent output format.

This module runs the following CLIs on all the active SAMI card and get the session and accounting details from the card which is holding the session.

The CLI command for NAI as the condition is:

```
pdsn# show cdma pdsn session user NAI detail
```

```
pdsn# show cdma pdsn accounting user NAI
```

The CLI command for IMSI as the condition is:

```
pdsn# show cdma pdsn session msid IMSI_value detail
```

```
pdsn# show cdma pdsn accounting session IMSI_value
```

The CLI command for Mobile Node (mn) IP address as condition is:

```
pdsn# show cdma pdsn session mn-ip-address IP-Address detail
```

**pdsn# show cdma pdsn accounting mn-ip-addr IP-Address**

The below example is a snippet of the display output for the command **showSession**:

```
pdsn-osler# showSession
Subscriber IP Address/NAI/IMSI: osler1@cisco.com

##### SUBSCRIBER SESSION FOUND #####

User ID: osler1@cisco.com      [Slot:1 CPU:3]
Session Details:
  Mobile Station ID IMSI 09003000001
  PCF IP Address 6.6.6.2, PCF Session ID 1
  A10 connection time 00:00:12, registration lifetime 65535 sec
  Number of successful A11 reregistrations 0
  Remaining session lifetime INFINITE
  Always-On not enabled for the user
  Current Access network ID 0006-0606-02
  Last airlink record received is Active Start, airlink is active
  GRE protocol type is 0x8881
  GRE sequence number transmit 14, receive 7
  Using interface Virtual-Access2.1, status OPN
  Using AHDLC engine on slot 0, channel ID 3
  Service Option EV-DO Flow Discrimination 0 DSCP Included 0
  Flow Count forward 0 reverse 0
  This session has 1 flow
  This session has 0 service flows
  Session Airlink State Active
  This session has 0 TFTs
  Qos subscriber profile
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505
  Flow service Simple, NAI osler1@cisco.com
  Mobile Node IP address 4.4.4.1
  Packets in 0, bytes in 0
  Packets out 0, bytes out 0
  Qos per flow : osler1@cisco.com
  Max Aggregate Bandwidth : 1
  Inter User Priority : 1000
  Maximum Flow Priority : 120980
  Number of Persistent Tft : 34567
  Forward profile-id : 4660
  Forward profile-id : 9097
  Forward profile-id : 14454
  Reverse profile-id : 6295
  Reverse profile-id : 17185
  Bidirectional profile-id : 22136
  Bidirectional profile-id : 26505

Accounting Details:
  UDR for session
  session ID: 1
  Mobile Station ID IMSI 09003000001
  A - A1:09003000001 A2: A3:
  C - C3:0
```

```

D - D3:6.6.6.2 D4:000000000000
E - E1:0000
F - F1:00F1 F2:00F2 F5:003B F6:F6 F7:F7 F8:F8
F9:F9 F10:FA F14:00 F15:0
F16:00 F17:00 F18:00
F19:00 F20:00 F22:00
G - G3:0 G8:0 G9:1 G10:0 G11:0 G12:0
G13:0 G14:245 G15:0 G16:270 G17:0
I - I1:0 I4:0
Y - Y2:1
UDR for flow
Mobile Node IP address 4.4.4.1
B - B1:4.4.4.1 B2:osler1@cisco.com
C - C1:000F C2:7 C4:0
D - D1:0.0.0.0
F - F11:01 F12:00 F13:00
G - G1:0 G2:0 G4:1232699771
G22:0 G23:0 G24:0 G25:0
Packets- in:0 out:0

```

**Note**

After running the **showSession** command, you must enter the NAI, IP address, or IMSI to look for session information for a particular subscriber.

## Bulk Statistics Collection

Statistics is collected with the SNMP MIB bulk statistics feature available on the Cisco router. With the help of Osler script, the SNMP MIB object list is configured on the control processor. After enabling the bulk statistics feature, for a specified time interval, the statistics is collected and sent to the configured TFTP server. If TFTP file transfer failed, the statistics is sent to the SUP disk specified in the secondary URL.

### Start Bulk Statistics

This command configures SNMP MIB objects on all the control processor. While running this command you must not use the Telnet connection, as the command fails to configure SNMP MIB objects on each PCOP. The command establishes Telnet session to each active PCOP and configures various SNMP options such as transfer parameters, object list, and schema definition. Finally, it enables statistics collection.

To enable periodic reporting of the bulk statistics, you must run **startStats** command. The below example is a snippet of the display output:

```

pdsn-osler# startStats
mwtcp-PDSN_SUP-ftb6#startStats
Address or name of remote host to dump statistics[9.11.44.1]?
Directory path on remote host[raseshad/stats]?
Directory path on local host[disk0:/stats]?
Statistics dumping periodicity (in minutes)[30]?
Add MIP object names for statistics reporting? [y/n]y      <<<<<
Add VPDN object names for statistics reporting? [y/n]y    <<<<<
Collecting Cisco Object Names for Statistics Reporting ....

#####
Configuring Slot:1, Processor:3...
#####

```

Successfully enabled bulk stats reporting for Slot:1, Processor:3

```
#####
Configuring Slot:2, Processor:3..
#####

Successfully enabled bulk stats reporting for Slot:2, Processor:3

#####
```

## Stop Bulk Statistics

This command removes configuration of SNMP MIB objects on all the control processors. While running this command, you must not telnet to any processor, as the command fails to remove configurations of SNMP MIB objects from that processor. The telnet session to each active PCOP disables statistics collection, and removes all the configuration from the control processor.

To disable the periodic reporting of the bulk statistics, you must run the **stopStats** command. The below example is a snippet of the display output:

```
pdsn-osler# stopStats
Stopping periodic bulk statistics collection and dumping...

#####
Configuring Slot:1, Processor:3..
#####

Successfully stopped the periodic bulk stats reporting for Slot:1, Processor:3

#####
Configuring Slot:2, Processor:3..
#####

Successfully stopped the periodic bulk stats reporting for Slot:2, Processor:3

#####

Successfully stopped the periodic reporting of bulk statistics for all active CPs!
```



### Timesaver

Before uninstalling Osler from the supervisor module, remember to stop statistics reporting. Otherwise, you have to manually stop statistics reporting from all active PCOPs.

## Update Statistics Mapping File

Adds new OIDs to the mapping file, which contains all the OIDs with the Cisco object name, vendor object name, and object ID. To update the mapping file with new OIDs that need to be included in the global statistics, you can run the **upStatsMap** command.

The following example shows output for the **upStatsMap** command:

```
pdsn-osler# upStatsMap
Enter the Cisco Object Name: cCdmaServiceOptionSucesses
Enter the SNMP OID: 1.3.6.1.4.1.9.9.157.1.7.6.2.1.3
Enter the Vendor Object Name: ServiceOptionSucesses
Updating the mapping file disk0:/pdsn_osler/pdsn_Mappings.txt...
Done !!
```

See the *Command Reference for Cisco PDSN Release 5.0 in IOS Release 12.4(22)XR1* for more information about configuration commands for Osler Support in Cisco PDSN Release 5.1.

## Improved Throughput and Transaction Handling

This release provides improved throughput, enabling PDSN to deliver 3 Gbps. Improved throughput at 3 Gbps is possible under the following assumptions:

- 80 percent of the sessions has only one session and represent 1xRTT traffic.
  - CPS for this traffic is 20.
  - Average throughput or user is 12.5 kbps.
  - Average packet size is 1440 bytes.
- 20 percent of the sessions has an average of 2 flows, or Point-to-Point Protocol (PPP) sessions and represent Rev A traffic.
- 10 percent of the Rev A traffic has QoS enabled.
  - CPS for this traffic is 5.
  - Average throughput or user is 100 kbps.
  - Average packet size is 384 bytes.

All throughput parameters must be **No Drop Rate (NDR)**, with 1 in 10,000 packet drop allowable.

## Cluster Controller Support in Single IP Blade

This release introduces support for cluster controller in single IP blade. The cluster controller improves cluster capacity by reducing the resource utilization on the PDSN cluster member.

The following sections describe:

- [Clustering Architecture in PDSN](#)
- [Functions of Cluster Controller](#)
- [Metrics for Cluster Controller](#)
- [Metrics Between Member and Controller](#)
- [Backward Compatibility of Cluster Controller](#)
- [The Controller Redundancy](#)
- [Configuring Cluster Controller Support](#)

## Clustering Architecture in PDSN

The following flow describes the clustering architecture in PDSN:

- One of the PCOPs on the chassis is configured to act as the controller in addition to work as a PDSN member. On this PCOP alone, the functionality of the controller and member co-exists. The single IP is only for the functionality of the member.
- For a collocated controller or member, the controller and member shares the same CDMA-Ix 1 IP address.
- Any packet destined for controller IP address follows the default case on the IXP and lands at PCOP, unless the session is already hosted on the collocated member. In such a case, IXP directly forwards the A11 RRQ to the appropriate TCOP. The controller shares the IMSI database of the session manager.

- The session manager has both the member IP address and the TCOP address, or TCOP address against each of the IMSI it stores. For the IMSI in other members, the session manager stores the member IP address. For the IMSI hosted in the same blade, the session manager has the TCOP address. As records are reused for controller and collocated member, prohibiting the collocated member does not clear the records. But the collocated member is not considered in the load selection.
- Session-up or session-down from a collocated member is informed directly to the controller instead of a separate message. So periodic update does not have any effect on the collocated member and controller.
- The member queuing is not required as the single IP session manager itself queues the packets when processing.
- The collocated member and controller share the same interface. On a standalone controller with collocated member, controller IP is optional. Controller IP is the HSRP address in controller redundancy and is mandatory as in earlier releases.
- Other PCOPs in the chassis act only as members.

## Functions of Cluster Controller

The call flow of cluster controller starts with receiving the A11 RRQ from PCF. On receiving the A11 RRQ, the controller checks whether a session already exists for IMSI. If no session exists, the controller selects the member based on the load. The load table is maintained by the controller and contains the load of all the registered members.

If the member-selected resides on another blade, the controller adds the IMSI in a temporary queue in the session manager (if the controller-periodic is configured) and rejects the A11.

The PCF then resends the A11 RRQ to the suggested member. When the session comes up on the selected member, the member sends a session-up for the IMSI. The controller, on processing the session-up from the member, makes the IMSI permanent on the session manager. The member, selected based on the load, is the co-existing member and the A11 RRQ is given to the session manager.

During handoff, the new PCF sends the A11 RRQ to the controller and the controller looks up the IMSI. The session manager returns the IMSI with the hosted Member IP address.

If the IMSI already exists on the member, the controller sends a reject message with the already hosted member IP address. If the session manager returns TCOP address, the controller forwards the A11 RRQ to the session manager, which forwards to the selected TCOP.

## Metrics for Cluster Controller

The load-balancing metric used between PCOP and TCOP is on the lines of Dynamic Feedback Protocol (DFP). The TCOPs calculate the TCOPs overall weight and send to PCOP. The PCOP performs load balancing based on the weight.

The same metric is also extended to members and the controller.

$$\text{Weight} = \frac{(\text{MaxSessions} - \text{NumberOfSessions})}{\text{MaxSessions}} (\text{cpu} + \text{mem}) * \frac{\text{dfp\_max\_weigh}}{(32)}$$

The default value for dfp\_max\_weight is 100 as release 4.0 is based on percentage. So the weight reported is from dfp\_max\_weight (when no load is present) to zero (when load is maximum).

The CPU and memory utilization are converted to a range between 0 and 16 and included in the weight calculation. When the CPU reaches 100 percentage utilization, the weight reported is zero, so that no further redirection happens to the member for the period of time. The DFP parameters are tuned after performance tests are done.

When the available bandwidth reaches the total configured bandwidth, the weight is sent as zero. The TCOP sends this metric to the PCOP.



**Note**

The maximum CPU value is configurable upto 100 percentage. The default value is 90 percentage. The default value (that is 90 percentage) is not displayed in running configuration when configured.

## Metrics Between Member and Controller

The controller is based on percentage (based on Cisco PDSN Release 4.0) and also assumes 0 is lightweight and 100 is maximum weight. To retain the logic, the consolidated weight is inverted and converted to percentage when sent to the controller. So, when the member sends the data, it is loaded in terms of 0 as lightly loaded and 100 as heavily loaded.

The consolidated weight is the weight of the least-loaded TCOP. If the maximum number of sessions or the maximum bandwidth for the blade is reached, the load is reported as 100 (heavily loaded).

The metric used between the controller and member has changed from Cisco PDSN Release 3.0 and release 4.0. To retain the backward compatibility, the new member also uses the load extension. Also, session count and maximum session count are "short" (two bytes) fields. With the member now handling the whole blade, the session count and maximum session count are exceeding their limit. So the extension must be reused but replaced with the newly defined weight.

The attributes in the load extension are:

- Session count is the weight.
- Maximum session count is the maximum DFP weight on the member (100).
- Percentage is the percentage of the weight.

## Backward Compatibility of Cluster Controller

The maximum weight (or old maximum session count) in the PDSN\_LOAD extension is only two bytes, and the blade capacity is close to 200,000 sessions; the session count extension cannot be used as in previous versions of PDSN.

As the session load CVSE is reused, Cisco PDSN Release 3.0 or release 4.0 controllers still assume it to be the session counts. So, when the member session count is zero, the controllers flush their session records. In Cisco PDSN Release 5.1, the member session count is a weight and weight can be zero in the initial phases of the PDSN member that services sessions. To avoid the earlier controllers from clearing when the reported weight is zero, the new PDSN release 5.0 member sends the weight as one, if the weight computed is zero but has some sessions servicing it.

The following section describes about the various scenarios of controller and member combination:

### Case 1: 3.0 Controller and 5.0 Member

As the load is sent in session count CVSE, Cisco PDSN Release 3.0 controller proceeds to work based on the session count. But we recommend the round robin selection.

**Case 2: 4.0 Controller and 5.0 Member**

As with Cisco PDSN Release 3.0 controller, the session count CVSE is considered and the controller continues to work. But we recommend the round robin selection.

**Case 3: 5.0 Controller and 3.0 Member**

The member reports the load only in terms of sessions. The load is calculated as a percentage and is used.

**Case 4: 5.0 Controller and 4.0 Member**

The Cisco PDSN Release 4.0 controller interprets the data and gathers the weight in terms of percentage. This weight must be used for the member.

## The Controller Redundancy

The controller redundancy is not affected in the single IP. When standby controller is configured, the whole blade is used for redundancy. With single IP, when a processor in a blade reloads, the whole blade reloads. So with single IP, it is necessary to configure the session redundancy also on the blade. This configuration ensures that all the member functionality on the active blade are synchronized to the standby blade.

## Configuring Cluster Controller Support

The below example snippet shows the cluster controller configuration:

```
pdsn# show cdma pdsn cluster controller configuration
cluster interface GigabitEthernet0/0.341 (collocated)
no R-P signaling proxy
timeout to seek member = 10 seconds
window to seek member is 2 timeouts in a row if no reply (afterwards the member is
declared offline)
default: spi 101, Timestamp +/- 0, key ascii hello
this PDSN cluster controller is configured
```

Controller maximum number of load units = 100

The below example snippet shows the cluster controller-member configuration:

```
pdsn# show cdma pdsn cluster member configuration
cluster interface GigabitEthernet0/0.341
IP address of controller is 11.1.1.50 (collocated)
no prohibit administratively
timeout to resend status or seek controller = 10 sec or less, randomized
resend a msg for 2 timeouts sequentially if no reply, then inform operator
default: spi 101, Timestamp +/- 0, key ascii hello
this PDSN cluster member is configured
```

## Cluster Controller Member Configuration

The below example snippet shows the cluster controller-member configuration:

```
cdma pdsn cluster controller interface GigabitEthernet0/0.20
cdma pdsn cluster controller standby PDSN-ssp2-43-RP
cdma pdsn cluster controller timeout 120
cdma pdsn cluster controller member periodic-update
cdma pdsn cluster member controller 20.2.43.254
cdma pdsn cluster member interface GigabitEthernet0/0.20
cdma pdsn cluster member timeout 120
```

```
cdma pdsn redundancy
```

To enable round-robin method for member selection on controller, you need to enable the **cdma pdsn cluster controller member selection-policy round-robin** command.

The below example snippet shows the cluster member configuration:

```
cdma pdsn cluster member controller 20.2.43.254
cdma pdsn cluster member interface GigabitEthernet0/0.20
cdma pdsn cluster member timeout 120
cdma pdsn cluster member periodic-update 300
```

Also, the **show** command output in context with the above configuration:

For controller:

```
PDSN-controller-member# show cdma pdsn cluster controller configuration
cluster interface GigabitEthernet0/0.20 (collocated)
no R-P signaling proxy
timeout to seek member = 10 seconds
window to seek member is 2 timeouts in a row if no reply (afterwards the member is
declared offline)
default: spi 300, Timestamp +/- 0, key ascii cisco
this PDSN cluster controller is configured
```

For controller redundancy:

```
database in-sync or no need to sync
group: PDSN-ssp2-43-RP
Controller maximum number of load units = 100
```

For collocated member:

```
PDSN-controller-member# show cdma pdsn cluster member configuration
cluster interface GigabitEthernet0/0.20
IP address of controller is 20.2.43.254 (collocated)
no prohibit administratively
timeout to resend status or seek controller = 120 sec or less, randomized
resend a msg for 2 timeouts sequentially if no reply, then inform operator
default: spi 300, Timestamp +/- 0, key ascii cisco
this PDSN cluster member is configured
```

For remote member:

```
PDSN-cluster-member# show cdma pdsn cluster member configuration
cluster interface GigabitEthernet0/0.20
IP address of controller is 20.2.43.254
no prohibit administratively
timeout to resend status or seek controller = 120 sec or less, randomized
resend a msg for 2 timeouts sequentially if no reply, then inform operator
default: spi 300, Timestamp +/- 0, key ascii cisco
this PDSN cluster member is configured
```

## IMSI and PCF Redirection

This release supports International Mobile Subscriber Identifier (IMSI) and Packet Control Function (PCF) redirection in both cluster controller and standalone PDSN. This feature enables directing a call to a specific PDSN for troubleshooting. You can also use this feature to send specific line ranges of IMSI to a different set of PDSNs.

The following sections describe:

- [IMSI-based Redirection](#)
- [PCF-based Redirection](#)
- [Features of IMSI and PCF-based Redirection](#)
- [Functions of Controller PDSN](#)
- [Limitations of IMSI and PCF-based Redirection](#)

## IMSI-based Redirection

You can add IMSI-based redirection feature to the cluster controller, member, or standalone PDSN to redirect A11 Registration Requests (RRQ) from a specific or a range of IMSIs to a configured member or non-member PDSN IP.

## PCF-based Redirection

You can add PCF-based redirection feature to the cluster controller, member, or standalone PDSN. Adding PCF-based redirection redirects A11 RRQs from a specific or a range of PCFs to a configured member or non-member PDSN IP.

## Features of IMSI and PCF-based Redirection

This section describes the common functionality between IMSI and PCF-based redirection. Both features follow the same functionality in storage and lookup, except that IMSI-based lookup is performed before PCF-based redirection. IMSI-based redirection, therefore, takes precedence over PCF-based redirection.

The workflow of IMSI and PCF-based redirection begins with receiving the A11 RRQ. On receiving the A11 RRQ, PDSN checks whether any session exists for the IMSI. If a session exists, the packet is handed over for normal A11 processing. If no session exists, PDSN looks for a match in the IMSI redirection table that is configured with the IMSI derived from the A11 RRQ. On identifying a match, the A11 RRQ is rejected with the matched PDSN IP filled under unknown HA with code as 0x88H (136 decimal).

If no match is found, PDSN looks for a match in the PCF redirection table configured with the PCF IP address in the A11 RRQ. On identifying a match, the A11 RRQ is rejected with the matched PDSN IP filled under unknown HA with code as 0x88H (136 decimal). If no match is found in the IMSI and PCF redirection table, or if PCF or IMSI redirection is not configured, the A11 RRQ is handled by normal A11 processing.

When removing configuration of the IP address range or IMSI range, it is sufficient to give the start value of the IP or IMSI to delete the entire range. When removing a configuration, PDSN ignores the upper value of the IP or IMSI range, even if you have provided the value.

## Limitations of IMSI and PCF-based Redirection

The following are the limitations that impact the functioning of IMSI and PCF-based redirection:

- If you have enabled IMSI Mobile Identification Number (MIN) equivalence, PDSN takes only the ten digits of the input during lookup for IMSI redirection. The rest of the digits in the configuration are ignored. However, when you use the **show run** command, irrespective of the presence of IMSI MIN equivalence, the command displays the exact input; it does not print the ten-digit output that is used internally for lookup.

- In PCF redirection configuration, if you provide the second IP address in the PCF range as 0.0.0.0, the second IP address is discarded; only the first IP address is considered. But if you provide the first IP address as 0.0.0.0, the CLI command configuration fails.
- In IMSI or PCF redirection configuration, if you try to configure the CLI command without configuring the CDMA-Ix 1 interface or IP address, redirection fails. But if you remove the CDMA-Ix 1 interface after configuring the redirection using the CLI command, redirection from the CLI command remains without throwing up any errors or warnings.
- In the IMSI or PCF redirection configuration, if you try to configure the CLI command with member value equal to IP address of the CDMA-Ix 1 interface, the redirection configuration fails. But if you change the IP address of the CDMA-Ix 1 interface after configuring redirection from the CLI command with the value equal to the member IP configured in the redirection CLI command, the redirection from the CLI command remains without throwing up errors or warnings.

## Functions of Controller PDSN

The workflow of the controller PDSN starts with receiving the A11 RRQ. On receiving the A11 RRQ, PDSN checks whether a session exists for the IMSI. If a session already exists, the packet is handed over for normal A11 processing. If no session exists, PDSN checks for a match in the IMSI redirection table that is configured with the IMSI derived from the A11 RRQ. If no match is found in the IMSI redirection table, PDSN checks if the PCF address in the A11 RRQ falls within the IP address range configured under different PCF groups. If there is no match with the PCF group, the A11 RRQ is handed over to the controller load balancer to select the member PDSN from all the members available in the cluster.

If a match is identified (either IMSI or PCF), the controller gets a PDSN group. The controller then checks whether the "force" option has been configured. If "force" is configured, the controller sends an A11 Reject with the primary IP configured under PDSN. If "force" is not configured, the controller checks the PDSN whether any least-loaded member is available in the matched PDSN group.

If all the member PDSNs under the group are loaded, then the controller sends a A11 Reject with the reason "Insufficient Resources". If the controller returns a least-loaded member from the PDSN group, then with that least-loaded member a A11 Reject is sent.

Before configuring IMSI and PCF redirection, note the following points:

- It is possible to configure the PDSN group without configuring any IP address range and configure the PDSN group as part of IMSI or PCF redirection. If any A11 RRQ matches this redirection, then the controller will send a A11 Reject with the reason "Insufficient Resources". Therefore, we recommend that you specify the IP address range when configuring a PDSN group.



### Caution

Do not configure the IMSI or PCF redirection in both controller and member, because it leads to double redirection.

- When you have configured an IP address range in a PDSN group that is configured for redirection, ensure that you do not remove the IP address range. If a PCF or PDSN group has been configured for redirection and if you delete the same PDSN group, then all the IMSI or PCF redirection configurations associated with this PDSN group are removed from the configuration.
- If a PDSN group is configured for redirection with "force" option enabled and the primary address from the group is deleted, then the corresponding "force" option in the redirection configuration is removed. If you configure "force" option in the redirection CLI command without the primary address in the PDSN group, then the redirection CLI command configuration fails.

**Note**


---

For the "force" option to function, you must have configured the primary address in the PDSN group.

---

- If the primary IP is configured to controller CDMA-Ix 1 address and not configured as a member, then the A11 RRQ is enqueued to the local PDSN through the session manager. If the primary IP is configured to controller CDMA-Ix 1 address and configured as a member, then the A11 RRQ is enqueued to the local member.
- If the IP address range configured under PDSN or PCF group matches the range configured in a different group, then the configuration fails with an error message. If the IP address range configured under PDSN or PCF group matches the range configured in the same group, then the old configuration is retained.
- When removing the configuration of IP address range in a group, if the given IP address matches the range in a different group, then the configuration is not removed because it is not possible to delete the IP address range of a different group. When removing the configuration of the IP address range or IMSI range, you can give the start value of the IP or IMSI to delete the entire range. When removing a configuration, PDSN ignores the upper value of the IP or IMSI range, even if you have provided the IP or IMSI range.
- If you have enabled IMSI MIN equivalence, PDSN takes only the ten digits of the input during lookup for IMSI redirection. The rest of the digits in the configuration are ignored. However, when you use the **show run** command, irrespective of the presence of IMSI MIN equivalence, the command displays the exact input; it does not print the ten-digit output that is used internally for lookup.

The following is a sample configuration that enables you to configure IMSI redirection for a standalone PDSN from the CLI command:

```
pdsn# cdma pdsn redirect imsi {Single-bound IMSI | Lower-bound IMSI} [Upper Bound IMSI]
member [Member IP]
```

```
cdma pdsn redirect ?
imsi - IMSI Redirection
pcf - PCF Redirection
```

```
cdma pdsn redirect imsi ?
Single or Start IMSI - 15 digit IMSI address
```

```
cdma pdsn redirect imsi 123456789012345 ?
Ending IMSI - 15 digit IMSI address
```

```
cdma pdsn redirect imsi 123456789012345 123456789012400 ?
member - PDSN member
```

```
cdma pdsn redirect imsi 123456789012345 123456789012400 member ?
PDSN IP address - IP address of PDSN where A11 need to be redirected
```

To remove IMSI redirection for a standalone PDSN from the CLI command:

```
pdsn# no cdma pdsn redirect imsi {Single-bound IMSI | Lower-bound IMSI}
```

**Note**


---

Lower-bound IMSI identifies the lower value in the IMSI range; you do not need to give the higher value in the IMSI range.

---

To configure PCF redirection CLI command for a standalone PDSN from the CLI command:

```
pdsn# cdma pdsn redirect pcf {Single or Lower-bound PCF IP_address | Upper-bound PCF
IP_address} member Member_IP
```

```
pdsn# cdma pdsn redirect ?
imsi - MSID Redirection
pcf - PCF Redirection
```

```
pdsn# cdma pdsn redirect pcf ?
PCF IP address - Single or Start of the range of PCF IP address
```

```
pdsn# cdma pdsn redirect pcf 11.11.11.11 ?
PCF IP address - Last PCF address in the range
```

```
pdsn# cdma pdsn redirect pcf 11.11.11.11 11.11.11.200 ?
member - PDSN member
```

```
pdsn# cdma pdsn redirect pcf 11.11.11.11 11.11.11.200 member ?
PDSN IP address - IP address of PDSN where All need to be redirected
```

To remove PCF redirection for a standalone PDSN from the CLI command:

```
pdsn# no cdma pdsn redirect pcf Single or Lower-bound PCF IP address
```




---

**Note** To remove a single PCF IP or a range of PCF IPs configured, you only need to give the lower value of the range.

---

The following commands introduced in Cisco PDSN Release 5.0 enable you to configure the cluster controller PDSN:

To configure the cluster controller for a PCF group:

```
pdsn# cdma pdsn cluster controller pcf group number
description group name
pcf ip [end_ip]
pcf ip [end_ip]
```

To configure the cluster controller for a PDSN group:

```
pdsn# cdma pdsn cluster controller pdsn group number
description group name
pdsn ip [end_ip]
pdsn ip [end_ip]
primary ip
```

To configure the cluster controller for IMSI or PCF redirection:

```
pdsn# cdma pdsn cluster controller redirect
imsi IMSI_range pdsn pdsn_group_number [force]
pcf pcf_group_number pdsn pdsn_group_number [force]
```

## Mobile IP and AAA Attributes for China Telecom

This release introduces support for MIP and AAA attributes required for China Telecom (CT).

The following sections describe:

- [Calling Station ID in MIP RRQ](#)
- [Correlation ID in MIP RRQ](#)
- [Proxy Mobile IP Indicator Attribute, page 124](#)
- [Proxy Mobile IP Indicator Attribute](#)
- [Proxy Mobile IP Capability Indicator Attribute](#)
- [PDSN Service Address](#)
- [Charging Type](#)

## Calling Station ID in MIP RRQ

The calling station ID as the normal vendor specific extension (NVSE) is the carrier in MIP Registration Request (RRQ) between the FA and HA.

The configuration for the calling station ID:

```
router(config)# cdma pdsn attribute vendor 20942 send a1 mip_rrq
```

## Correlation ID in MIP RRQ

The correlation ID as NVSE is the carrier in the MIP RRQ between the FA and HA. The correlation ID from PDSN is sent in the MIP RRQ to the HA. This ID is sent in all HA-generated accounting records.

The configuration for the correlation ID:

```
router(config)# cdma pdsn attribute vendor 20942 send c2 mip_rrq
```

## Proxy Mobile IP Indicator Attribute

The PMIP indicator is a VSA. The PMIP indicator is returned via Remote Authentication Dial-In User Service (RADIUS) to PDSN as an access-accept packet, so that PDSN starts PMIP on behalf of the subscriber.

## Proxy Mobile IP Capability Indicator Attribute

The PMIP capability indicator is a VSA. PDSN sends the capability indicator through RADIUS to the AAA server as an access-request packet to indicate to the AAA server that PDSN supports PMIP and it is enabled. If the capability indicator attribute is missing, then PMIP is not supported by PDSN.

The configuration for the PMIP capability indicator:

```
router(config)# cdma pdsn attribute vendor 20942 send pmip_capability access_request
```

## PDSN Service Address

PDSN service address is a VSA. This service address is sent to AAA by accounting-start message.

The configuration for PDSN service message:

```
pdsn-stby-ftb4-73(config)# cdma pdsn attribute vendor 20942 send pdsn-src-addr ?
```

```
pdsn-stby-ftb4-73(config)# acct_reqs Send pdsn-src-addr attribute in acct_reqs ?
```

```
pdsn-stby-ftb4-73(config)# cdma pdsn attribute vendor 20942 send pdsn-src-addr ac ?
pdsn-stby-ftb4-73(config)# cdma pdsn attribute vendor 20942 send pdsn-src-addr acct_reqs
```

## Charging Type

The charging type is a CT VSA that is downloaded in the access-accept message form the AAA server (if charging type is configured in the AAA subscriber profile for a particular user). Cisco PDSN sends this downloaded attribute value to the AAA server by using the accounting-start message.

This charging type is of three types as below:

- 0x00000001 - Postpaid
- 0x00000002 - Prepaid
- 0x00000003 - Postpaid and prepaid

To download the charging type, the following CLI command must be enabled:

```
pdsn_active(config)# cdma pdsn attribute vendor 20942
```

To remove the configuration:

```
pdsn_active(config)# no cdma pdsn attribute vendor 20942
```

The following example snippet shows the downloaded charging type for each flow:

```
pdsn_active# show cdma pdsn session
Mobile Station ID MIN 2000000003
  PCF IP Address 10.1.1.1, PCF Session ID 1
  A10 connection time 00:00:05, registration lifetime 500 sec
  Number of successful All re-registrations 0
  Remaining session lifetime 494 sec
  Always-On not enabled for the user
  Current Access network ID 000A-0101-01
  Last airlink record received is Connection Setup, airlink is active
  GRE protocol type is 0x8881
  GRE sequence number transmit 14, receive 22
  Using interface Virtual-Access2.1, status OPN
  Using AHDLC engine on slot 0, channel ID 6
  Service Option EV-DO Flow Discrimination 0 DSCP Included 0
  Flow Count forward 0 reverse 0
  This session has 1 flow
  This session has 0 service flows
  Session Airlink State Setup
  This session has 0 TFTs
  Qos subscriber profile
    Max Aggregate Bandwidth : 200
    Inter User Priority : 1000

Flow service Mobile, NAI mwts-mip-np-user11@ispxyz.com
  Mobile Node IP address 12.1.1.10
  Home Agent IP address 4.1.1.2
  Packets in 0, bytes in 0
  Packets out 0, bytes out 0
  Charge Type 1
  Radius disconnect enabled
```

## MIB Support

This release introduces support for several new MIBs, related to single IP and chassis-wide MIBs. Many MIBs are used as a source of Key Performance Indicators (KPIs).

The following sections describe:

- [MIBs as source of KPIs](#)
- [Model for MIBs](#)

### MIBs as source of KPIs

The MIBs that are used as a source of KPIs are:

- RFC 2006 MIB
- CISCO-CDMA-PDSN-MIB
- CISCO-CDMA-PDSN-EXT-MIB
- CISCO-VPDN-MGMT-MIB
- CISCO-VPDN-MGMT-EXT-MIB
- CISCO-AAA-SERVER-MIB
- RFC 2618 RADIUS Authentication Client MIB
- IF-MIB
- CISCO-IP-LOCAL-POOL-MIB
- CISCO-PROCESS-MIB
- CISCO-MEMORY-POOL-MIB (Replaced by ENHANCED-MEMPOOL-MIB)
- CISCO-ENHANCED-MEMPOOL-MIB

The CISCO-PROCESS-MIB,

<http://tools.cisco.com/Support/SNMP/do/BrowseMIB.do?local=en&mibName=CISCO-PROCESS-MIB>, and the CISCO-MEMORY-POOL-MIB,

<http://tools.cisco.com/Support/SNMP/do/BrowseMIB.do?local=en&step=2&mibName=CISCO-MEMORY-POOL-MIB> are affected by the requirement to provide a single MIB report per-service blade, PDSN-SIP-50.



#### Note

- You cannot set a value using SNMPSET through SNMP; that is, no write access is allowed for a read-write or read-create object.
- TCOP-level traps (MN authentication failure, registration ID mismatch) and load high trap because CPU, I/O, and process memory are not supported in single IP.
- There are no SNMP SET for CDMA PDSN MIBs, TCOP-level traps (MN authentication failure, registration ID mismatch) and load high trap because of CPU, I/O, and process memory are not supported in single IP.
- There are no SNMP SET and traps for CISCO-VPDN-MGMT MIBs and CISCO-AAA\_-SERVERS-MIB.

Both these MIBs contain per-processor content. The information for all six application processors is reported with one SNMP GET, each MIB contains six entries, one per-application processor.

The IF-MIB contains information for interfaces of the traffic plane processors, in addition to the interfaces of the control plane processor.

The CISCO-PROCESS-MIB contains a facility to provide information for one or more CPUs. The CSG2 project developed a solution, which requires usage of the ENTITY-MIB in conjunction with the CISCO-PROCESS-MIB.

The CISCO-MEMORY-POOL-MIB does not support this capability. However, the CSG2 project developed a solution, incorporating the CISCO-ENHANCED-MEMPOOL-MIB, <http://tools.cisco.com/Support/SNMP/do/BrowseMIB.do?local=en&step=2&submitClicked=true&mibName=CISCO-ENHANCED-MEMPOOL-MIB#dependencies>, which is reused for this release.

Both CISCO-CDMA-PDSN-MIB and CISCO-CDMA-PDSN-EXT-MIB currently support only global statistics and PCF-based statistics. All these attributes are independent of multiple CPUs. So, aggregation of values is done on the PCOP.

Both CISCO-VPDN-MGMT-MIB and CISCO-VPDN-MGMT-EXT-MIB currently support only VPDN information, VPDN tunnel information, VPDN tunnel user information, and failure history per-user. All these attributes are independent of multiple CPUs. Aggregation of values is done on the PCOP.

CISCO-AAA-SERVER-MIB currently supports only distinct statistics for each AAA function, status of servers providing AAA functions, and table for configuring AAA servers. All these attributes are independent of multiple CPUs (except configuration table). Aggregation of values is done on the PCOP.

## Model for MIBs

The model followed for each MIBs is described in this section. The TCOPs are provided with a mechanism whereby they periodically PUSH data that is required by the SNMP MIBs to the PCOP. A process on the PCOP periodically receives this data and puts it into appropriate temporary structures indexed by TCOP index.

When an SNMP GET arrives at the PCOP, the PCOP aggregates the data or in the case of individual entries per-TCOP, does not aggregate the data; and fills in the summed value or the non-summed value into the SNMP variables that are relevant to the GET request. The rest of the code fills in the SNMP variables into the response PDU and sends it back to the entity that requested the GET.

Aggregate counters are available on PCOP or each counter is turned into a table, indexed by the TCOP index. PCOP either pulls the data at the time of SNMP GET to fill in the SNMP response PDU or it uses the values in the pushed data in temporary structures to fill in the SNMP variables; and then fill in the SNMP response PDU back to the manager entity. The model for MIBs is either a push model or an on-demand pull model to get the data on the PCOP.

[Table 21](#) describes the different MIBs that are supported in this release:

**Table 21 PDSN Supported MIBs**

<b>MIB</b>	<b>Description</b>	<b>Does it need information from TCOP?</b>	<b>If Yes, mechanism</b>
RFC 2006-MIB	Uses the RFC 2006 definitions of managed objects for IP mobility support using SMIPv2.	No. There are no traffic counters.	—
CISCO-CDMA-PDSN-MIB / CISCO-CDMA-PDSN-EXT-MIB	Supports CDMA PDSN feature.	Yes.	PDSN global statistics is aggregated periodically every minute. Registrations and PCF-based statistics are based on pull mechanism. Data aggregator on PCOP, and data provider on TCOP.
RFC 2618 RADIUS Authentication Client MIB	Uses the definitions defined in RFC 2618.	No. There are no traffic counters.	Reused from HA 5.0.
IF-MIB	Contains information for interfaces of the traffic plane processors in addition to the interfaces of the control plane processor.	Yes.	Data aggregator on PCOP and data provider on TCOP, follows push paradigm. Resource intensive for virtual-access interface. So these interfaces do not respond to the queries. Other interfaces are as in HA 5.0.
CISCO-IP-LOCAL-POOL-MIB	Defines the configuration and monitoring capabilities relating to local IP pools.	No. There are no traffic counters.	—
CISCO-ENHANCED-MEMPOOL-MIB	For monitoring the memory pools of all physical entities on a managed system.	Yes.	Data aggregator on PCOP and data provider on TCOP. Follows push paradigm. Each TCOP sends update every second to PCOP.
CISCO-PROCESS-MIB	Describes the statistics of active system processes on processors running IOS, the six processors on the two daughter cards.	Yes.	Data aggregator on PCOP and data provider on TCOP. Follows push paradigm. CPU statistics from TCOP is sent every second; other statistics are sent every minute to PCOP.
CISCO-ENTITY-MIB	The MIB module for representing multiple logical entities supported by a single SNMP agent.	Yes.	Data aggregator on CP and data provider on TP.

Table 21 PDSN Supported MIBs (continued)

MIB	Description	Does it need information from TCOP?	If Yes, mechanism
CISCO-VPDN-MGMT-MIB/CISCO-VPDN-MGMT-EXT-MIB	Supports the VPDN feature of Cisco IOS. The following entities are managed: <ul style="list-style-type: none"> <li>• Global VPDN information</li> <li>• VPDN tunnel information</li> <li>• VPDN tunnel user information</li> <li>• Failure history per user</li> </ul>	Yes.	Global information, tunnel information, user information, and failure history per-user-based statistics are based on pull mechanism. Data aggregator on PCOP and data provider on TCOP.
CISCO-AAA-SERVER-MIB	Provides configuration and statistics reflecting the state of the AAA server operations within the device.  The AAA server MIB provides the following information: <ul style="list-style-type: none"> <li>• A table for configuring AAA servers.</li> <li>• Distinct statistics for each AAA function.</li> <li>• Status of servers providing AAA functions.</li> </ul>	Yes.	Data aggregator on PCOP and data provider on TCOP. Follows pull paradigm.

## Trap Generation for AAA Server Unresponsiveness

This release introduces support for sending an SNMP trap or a notification to NMS server when the AAA server unresponsiveness is noticed by PDSN while authenticating MNs.

For each RADIUS server, you can configure the threshold percentage values; that is, normal or high threshold values. When the round-trip time of RADIUS messages between PDSN and the AAA server exceeds or falls below the threshold values, an SNMP trap or notification is sent to the NMS server indicating the AAA server's responsiveness or unresponsiveness. Similarly, when the number of RADIUS retransmit messages rises above or falls below the threshold values, an SNMP trap or message is sent to the NMS server indicating the AAA server's responsiveness or unresponsiveness. By default, the threshold values for both round-trip time and retransmits are:

- Normal—0
- High—100

For example, when the round-trip time or the number of retransmits exceeds the high threshold value, an SNMP trap or notification is sent to the NMS server indicating that the AAA server state is BUSY or DOWN. Similarly, when round-trip time or number of retransmits falls below the low threshold value, an SNMP trap or notification is sent to the NMS server indicating that the AAA server state is NORMAL. Round-trip time and retransmits generate separate traps for the threshold values configured on them.

The conditions for notification are:

- An AAA server state is notified as BUSY for round-trip time, no further traps or notifications are sent to the NMS server for that particular AAA server until that server state becomes NORMAL for the round-trip time.
- After a retransmission BUSY trap is sent, no retransmission BUSY trap is sent to the same server until the server state becomes retransmission NORMAL.
- After an AAA server state is informed as NORMAL for round-trip time, no further round-trip time NORMAL traps or notifications are sent to the NMS server unless the server state is identified as BUSY for round-trip time.
- After the retransmission NORMAL trap is sent, no retransmission NORMAL trap is sent to the same server until the server state becomes retransmission BUSY.

To enable this feature, perform the following tasks:

	Command	Purpose
Step 1	Router(config)# <b>radius-server snmp-trap timeout-threshold</b> <i>normal high</i>	Enables you to generate SNMP traps that denote AAA unresponsiveness.  <i>normal</i> is the normal threshold in percentage (that is, 50 to 75 normal value in percentage), used to generate traps.  <i>high</i> is the high threshold in percentage (that is, 60 to 100 high value in percentage), used to generate traps.
Step 2	Router(config)# <b>radius-server snmp-trap retrans-threshold</b> <i>normal high</i>	Generates a trap (SNMP notification) when round-trip time or retransmit value exceeds the high threshold value and falls below the normal threshold value. The trap is generated for either round-trip time or retransmit time.  <i>normal</i> is the normal threshold in percentage, used to generate traps.  <i>high</i> is the high threshold in percentage, used to generate traps.
Step 3	Router(config)# <b>snmp-server enable traps aaa_server</b> snmp-server host [ip address] version [1   2c   3] [community-string]	Enables you to generate SNMP traps that denote AAA unresponsiveness and the IP address.



**Note**

This feature is supported only on the Cisco SAMI card on the 7600.

The RADIUS-CLIENT-AUTHENTICATION-MIB is implemented per PDSN instance and each of these instances generate a trap.

The RADIUS-CLIENT-AUTHENTICATION-MIB contains entries for timeout on AAA access. A trap is added based on this timeout occurring. It is also possible to set a threshold on round trip delay (defined as a percentage of the maximum response time), and generate a trap when that threshold is exceeded. An additional trap is generated when the round-trip delay falls below a second threshold. This provides a level of delay for trap generation.

## Supervisor Support

This release introduces support for SUP32, SUP720, and RSP720 variants.

Supervisor support is provided for: Cisco Catalyst 6500 Supervisor Engine 32 (WS-SUP32-GE-3B and WS-SUP32-10GE-3B), Cisco Catalyst 6500 Supervisor Engine 720 (WS-SUP720-3B and WS-SUP720), and the new Cisco Route Switch Processor 720 (RSP720-3C-GE, RSP720-3CXL-GE, and RSP720-3CXL-10GE)

## Data Over Signaling

This release introduces support for Data Over Signaling (DOS), also known as Short Data Burst feature enabling you to send short data bursts to and from mobile station (MS) using the available signaling channel.

IOS uses the Modular QoS CLI (MQC) command set and Common Classification Engine (CCE) APIs to support the flow-based infrastructure for policing. CCE is a general framework that provides classification and feature association functions to IOS applications (for example, QoS and ACL). An IOS flow is defined in CCE as a unique instance of a class and as a whole or subset of source address, source port, destination address, destination port, and protocol.

While only one vaccess per MIP session is available, there are multiple flows and each flow downloads a different policy name. So, vaccess is not a target. To enable flow-based QoS on PDSN, a virtual object is created on PDSN, which acts as an interface and attaches the service policy. This virtual object identifies flow and marking parameters to QoS.

DOS packet is identified based on the policy map configured (flow-based policy) on the router. This policy map must be downloaded from the AAA server during access-accept for each direction. The downloaded policy is installed on the PDSN over that virtual interface for that particular direction.

QoS marks the packet as eligible for DOS marking. PDSN must mark the packets with DOS attribute in the GRE header in downstream or forward direction only based on the classification criteria and only when the session is in dormant state.



### Note

To enable DOS feature, you need to configure **cdma pdsn dos**.



### Note

You can install the policy either as vaccess or flow; both are not supported together. If vaccess-based installation is used, then ensure that you disable CDMA PDSN QoS policy flow-only using the **no cdma pdsn QoS policy flow-only** command.

The following sections describe:

- [Flow Trigger Classification for DOS](#)
- [Flow Marking Based on Classification Criteria for DOS](#)
- [AT-terminated DOS](#)
- [AT-generated DOS](#)
- [SDB Accounting Record sent by 1xRTT PCF](#)
- [Limitations for DOS](#)
- [Configuring DOS](#)

## Flow Trigger Classification for DOS

When a packet arrives at the PDSN, based on the flow, the service policy associated with the virtual interface is identified and the QoS functions that need to be applied to the data packet are also identified. IOS QoS triggers flow classification because of virtual object, which is unique per flow to indicate that the classification criteria is a PDSN flow.

## Flow Marking Based on Classification Criteria for DOS

For PDSN, each packet is classified and marked based on classification criteria. Currently, PDSN supports only **set marking**; **set dos** is used to mark the SDB packet based on the classification criteria.




---

**Note** DOS marking is done for downstream direction only.

---

## AT-terminated DOS

When a PDSN sends downstream traffic over a dormant session, PDSN adds the SDB or DOS attribute in the GRE header with a flag to indicate that it is SDB traffic. This attribute signals to the PCF that it must handle the traffic appropriately while sending it to the Access Network (AN).

### 1x SDB/HRPD DoS Indicator

If the packet is tagged by PDSN as being suitable for 1x SDB or High Rate Packet Data (HRPD) DoS transmission, it is identified by an attribute defined as:

Type '000 0001' – Short Data Indication

Length 02H

SDI/DoS 0 – Reserved

1 – packet suitable for 1x SDB or HRPD DoS transmission

## AT-generated DOS

In case of AT-generated DOS, PDSN does not perform any special handling of the received packet.

## SDB Accounting Record sent by 1xRTT PCF

1xRTT PCF sends an airlink record to indicate to PDSN that an SDB transaction has occurred; this is done by sending an airlink-record Y1 set to four. PDSN increments G11 by the value of G10 and increments G13 by one, when mobile originated (y4) or mobile terminated equals zero. PDSN increments G10 by the value of G10 and increments G12 by one, when mobile originated (y4) or mobile terminated equals one.

## Limitations for DOS

Performing DOS is subject to the following limitations:

- If you download a new policy in the reregistration case, this new policy is not handled and only the policy downloaded during initial registration is installed. You can install the policy either as vaccess or flow (default). If you install using vaccess, ensure that you disable flow-based policy using the **no cdma pdsn qos policy flow-only** command.
- If you have installed a particular policy-map, you can not make changes in the policy-map, associated class-maps, and action groups.
- DOS marking using flow-based policy is not supported for Virtual Private dial-up Network (VPDN) calls.

## Configuring DOS

To enable DOS in the PDSN:

### cdma pdsn dos

For flow-based DOS classification and marking:

```
class-map class-pdsn
  Match any
policy-map policy-pdsn
  Class class-pdsn
  set dos
```

The following CLI command in Exec mode displays flow-based QoS marking statistics when flow-based classification is enabled for a particular flow. The statistics include details such as the number of DOS-marked packets. The statistics is displayed based on specific NAI.

```
pdsn_active# show policy-map apn realm user1
```

MSID	NAI	Type	MN IP Address	St	HA IP
01002647325	user1	Simple	3.1.1.5	ACT	0.0.0.0

Service-policy output: SIP-POLICY

```
Class-map: SIP-CLASS (match-all)
  5 packets, 520 bytes
  30 second offered rate 0 bps, drop rate 0 bps
Match: any
QoS Set
  dos
  Packets marked 5

Class-map: class-default (match-any)
  0 packets, 0 bytes
  30 second offered rate 0 bps, drop rate 0 bps
Match: any
```

The following CLI command in Exec mode displays flow-based QoS policy installation and download statistics:

```
pdsn_active-4# show cdm pds stat qos
```

QoS:

```
Total Profile Download Success 10, Failure 0
Local Profile selected 1
Failure Reason DSCP 0, Flow Profile ID 0,
Service option profile 0, Others 0
Total Consolidated Profile 5, DSCP Remarkd 5
Total policing installed 5, failure 0, removed 3
```

Flow based QoS:  
Input policy:

```

Total policy download success 2, failure 0
Failure reason policy not configured 0, policy downloaded already 0
Total policy installed 1, failure 0, removed 1
Output policy:
Total policy download success 2, failure 0
Failure reason policy not configured 0, policy downloaded already 0
Total policy installed 1, failure 0, removed 1

```

The following CLI command in Exec mode displays the number of flows using flow-based QoS:

```

pdsn_active-4# show cdm pds
PDSN software version 5.0, service is enabled

All registration-update timeout 5 sec, retransmissions 5
All session-update timeout 5 sec, retransmissions 3
Mobile IP registration timeout 10 sec
A10 maximum lifetime allowed 65534 sec
GRE sequencing is on
Maximum PCFs limit not set
Maximum sessions limit not set (default 35000 maximum)
SNMP failure history table size 100
MSID Authentication is disabled
Ingress address filtering is disabled
Sending Agent Adv in case of IPCP Address Negotiation is enabled
Allow CI_ADD option during IPCP Phase is disabled
Aging of idle users disabled
Radius Disconnect Capability enabled
Multiple Service flows enabled
Maximum number of service-flows per MN allowed is 7
Call Admission Control disabled
Police Downstream enabled
Data Over Signaling disabled
Flow based policy enabled

Number of pcfs connected 1,
Number of pcfs 3GPP2-RP 1,
Number of sessions connected 1,
Number of sessions 3GPP2-RP 1,
Number of sessions Active 1, Dormant 0,
Number of sessions using HDLCoGRE 1, using PPPoGRE 0
Number of sessions using Auxconnections 0, using Policing 1, using DSCP 1
Number of service flows 0
Number of flows using flow based qos 1
Number of sessions connected to VRF 0,
Simple IP flows 1, Mobile IP flows 0,
Proxy Mobile IP flows 0, VPDN flows 0

```

## Differentiated Services Code Point Marking Support

This release introduces support for Differentiated Services Code Point (DSCP) marking, which uses flow-based policy.

IOS uses Modular QoS CLI (MQC) command set and Common Classification Engine (CCE) APIs to support the flow-based infrastructure for policing. CCE is a general framework that provides classification and feature association functions to IOS applications (for example, QoS, ACL, and so on). An IOS flow is defined in CCE as a unique instance of a class and as a whole or subset of source address, source port, destination address, destination port, and protocol.

While only one vaccess per MIP session is available, there are multiple flows and each flow downloads a different policy name. So, vaccess is not a target. To enable flow-based QoS on PDSN, a virtual object is created on PDSN, which acts as an interface and attaches the service policy. This virtual object identifies flow and marking parameters to QoS.

DSCP packet is identified based on the policy map configured (flow-based policy) on the router. This policy map must be downloaded from AAA during access-accept for each direction, The downloaded policy is installed on the PDSN over the virtual interface for that particular direction.

PDSN must mark the packets with DSCP in both upstream or reverse and downstream or forward direction based on the classification criteria.

**Note**

You can install the policy either as vaccess or flow; both are not supported together. If vaccess-based installation is used, ensure that you disable CDMA PDSN QoS policy flow-only using the **no cdma pdsn qos policy flow-only** command.

The following sections describe:

- [Flow Trigger Classification for DSCP](#)
- [Flow Marking Based on Classification Criteria for DSCP](#)
- [Limitations for DSCP](#)
- [Configuring DSCP](#)

## Flow Trigger Classification for DSCP

When a packet arrives at the PDSN, based on the flow, the service policy associated with the virtual interface is identified and the QoS functions that need to be applied on the data packet are also identified. IOS QoS triggers flow classification because of "apn\_qos\_info\_t", which is unique per flow to indicate that the classification criteria is a PDSN flow.

## Flow Marking Based on Classification Criteria for DSCP

For PDSN, each packet is classified and marked based on classification criteria. PDSN supports only set marking, such as **set dos**, **set dscp**, and **set qos-group**. Because **qos-group** and **set dos** are mutually exclusive, you must use either **qos-group** or **set dos**.

**Note**

If reverse tunnel is enabled, DSCP marking happens only in the inner packet.

## Limitations for DSCP

Performing DSCP is subject to the following limitations:

- If you download a new policy in the reregistration case, this new policy is not handled and only the policy downloaded during initial registration is installed. You can install the policy either as vaccess or flow (default). If you install using vaccess, ensure that you disable flow-based policy using the **no cdma pdsn qos policy flow-only** command.
- DOS marking using flow-based policy is not supported for VPDN calls.
- If you have installed a particular policy map, you cannot make changes in the policy map, associated class maps, and action groups.

## Configuring DSCP

For flow-based DSCP classification and marking:

```

Class-map class-pdsn
  Match any
Policy-map policy-pdsn-out
  Class class-pdsn
    set dscp 1

Policy-map policy-pdsn-in
  Class class-pdsn
    set dscp 1

```

The following CLI command in Exec mode displays flow-based QoS marking statistics when flow-based classification is enabled for a particular flow. The statistics include details such as the number of DSCP marked packets. The statistics is displayed based on specific NAI.

```

pdsn_active# show policy-map apn realm user1

MSID           NAI           Type           MN IP Address   St  HA IP
01002647325   user1        Simple         3.1.1.5         ACT 0.0.0.0

Service-policy input: policy-pdsn-in

Class-map: class-pdsn (match-all)
  5 packets, 520 bytes
  30 second offered rate 0 bps, drop rate 0 bps
Match: any
QoS Set
  dscp 1
  Packets marked 5

Class-map: class-default (match-any)
  0 packets, 0 bytes
  30 second offered rate 0 bps, drop rate 0 bps
Match: any

Service-policy output: policy-pdsn-out

Class-map: class-pdsn (match-all)
  5 packets, 520 bytes
  30 second offered rate 0 bps, drop rate 0 bps
Match: any
QoS Set
  dos
  Packets marked 5

Class-map: class-default (match-any)
  0 packets, 0 bytes
  30 second offered rate 0 bps, drop rate 0 bps
Match: any

```

The following CLI command in execution mode displays flow-based QoS policy installation and download statistics:

```

pdsn_active-4# show cdm pds stat qos

QOS:
Total Profile Download Success 10, Failure 0
Local Profile selected 1
Failure Reason DSCP 0, Flow Profile ID 0,
Service option profile 0, Others 0

```

```
Total Consolidated Profile 5, DSCP Remarked 5
Total policing installed 5, failure 0, removed 3
```

Flow based QoS:

```
Input policy:
  Total policy download success 2, failure 0
  Failure reason policy not configured 0, policy downloaded already 0
  Total policy installed 1, failure 0, removed 1
Output policy:
  Total policy download success 2, failure 0
  Failure reason policy not configured 0, policy downloaded already 0
  Total policy installed 1, failure 0, removed 1
```

The following CLI command in execution mode displays the number of flows using flow-based QoS:

```
pdsn_active-4# show cdm pds
PDSN software version 5.0, service is enabled

All registration-update timeout 5 sec, retransmissions 5
All session-update timeout 5 sec, retransmissions 3
Mobile IP registration timeout 10 sec
A10 maximum lifetime allowed 65534 sec
GRE sequencing is on
Maximum PCFs limit not set
Maximum sessions limit not set (default 35000 maximum)
SNMP failure history table size 100
MSID Authentication is disabled
Ingress address filtering is disabled
Sending Agent Adv in case of IPCP Address Negotiation is enabled
Allow CI_ADD option during IPCP Phase is disabled
Aging of idle users disabled
Radius Disconnect Capability enabled
Multiple Service flows enabled
Maximum number of service-flows per MN allowed is 7
Call Admission Control disabled
Police Downstream enabled
Data Over Signaling disabled
Flow based policy enabled

Number of pcfs connected 1,
Number of pcfs 3GPP2-RP 1,
Number of sessions connected 1,
Number of sessions 3GPP2-RP 1,
Number of sessions Active 1, Dormant 0,
Number of sessions using HDLCoGRE 1, using PPPoGRE 0
Number of sessions using Auxconnections 0, using Policing 1, using DSCP 1
Number of service flows 0
Number of flows using flow based qos 1
Number of sessions connected to VRF 0,
  Simple IP flows 1, Mobile IP flows 0,
  PMIP flows 0, VPDN flows 0
```

## Nortel Aux A10 Support

This release introduces support for Nortel Aux A10, which enables PDSN to accept the Aux A11 Request with protocol type set to 0x88D2. The Aux A10 connection with protocol type set to 0x88D2 carries a packet with AHDLC encoding. With the new support, PDSN can handle AHDLC encoding and decoding for the packets destined to the Aux A10 with protocol type 0x88D2.

## Masking Off IMSI Prefix

This release introduces support for masking off the IMSI prefix. Masking off the IMSI prefix is needed for inter-technology handoff (1xRTT to or from EVDO). In inter-technology handoff, the same PPP session is maintained when the subscriber's IMSI changes from 15 digits to or from 10 digits, or vice versa, with the upper five digits set as all ones or all zeros to or from EVDO that uses the country code in the upper five digits.

This feature masks off the upper five digits and then looks for a matching session on the PDSN. Any handoff from 1xRTT to EVDO or vice versa is treated as the same session.

The following sections describe:

- [Changes Related to Single IP Architecture](#)
- [Functional Flow in SingleIP Architecture](#)
- [Limitations for Masking Off the IMSI Prefix](#)
- [Configuring Masking Off the IMSI Prefix](#)

### Changes Related to Single IP Architecture

With the IMSI MIN equivalence feature, a new flag, "strict", is introduced in the message communicated between TCOP and the IXP. The "strict" flag is set to false on enabling the IMSI MIN equivalence feature, while the default is true. For any incoming IMSI, the IXP tries to match all the digits with any IMSI entry (strict or non-strict). If it does not match, IXP checks the last 10 digits and tries to match with non-strict IMSI entries.

### Functional Flow in SingleIP Architecture

The functional flow in a single IP architecture is as follows:

- MN begins a call through PCF1, which sends the 10-digit IMSI as part of the A11 RRQ. IXP in SAMI receives the 10-digit IMSI and does a lookup. As the A11 RRQ is new, the lookup fails and the A11 RRQ is sent to PCOP.
- PCOP does the IMSI-lookup based on the 10 digits and the lookup fails. PCOP then forwards the A11 RRQ to the TCOP selected by the Load Balancer (LB).
- TCOPx processes the A11 RRQ and creates the session. On session creation, it installs the entry in IXP by sending a message with the following data, "PCF1 IP + GRE + 10 digits of IMSI with strict = FALSE".
- PCF1 re-registers. After every few minutes, A11 RRQ is sent with the same 10 digits.
- When the mobile roams into a different PCF2, which prefixes five zeros or different digits (country code and other data for roaming) are added to the 10-digit IMSI and sent as a 15-digit IMSI in A11 RRQ.
- The IXP does a lookup in its 15-digit table and the lookup fails. Again, it does a lookup in the 10-digit table with the least 10 digits of the received 15-digit IMSI and gets a valid entry. The valid entry's strict flag is set to false, so the lookup passes and the IXP forwards the A11 RRQ to the same TCOPx.
- TCOPx receives the A11 RRQ. As it receives from a different PCF, it does the handoff. On successful completion of handoff, it updates IXP with the following message "PCF2 IP + GRE + 10 digits IMSI with strict = FALSE"
- PCF2 re-registers. After every few minutes, PCF2 sends A11 RRQ with the same 15 digits.

- On receiving the A11 RRQ, PDSN masks the first five digits and checks whether a session is already existing for the lower ten digits IMSI.
  - If a session already exists, and the request received is also from the same PCF, PDSN re-registers the session.
  - If a session already exists and the request received is from a different PCF, PDSN does a handoff.
- If no session exists, PDSN opens the new session with IMSI.
- With this feature enabled, PDSN maintains all sessions based on lower ten digits of IMSI. So, we recommend not to configure or remove configuration of this feature when sessions already exist in PDSN.
- The show command **show cdma pdsn session msid** prints the same session output if you give the lower 10 to 15 digits MSID, and the show output contains the latest IMSI received. The same case applies for **clear cdma pdsn session msid** command.
- If you execute the show command **show cdma pdsn session msid** with upper 10 to 15 digits, the command does not print any session information. The same case applies for **clear cdma pdsn session msid** command.

## Limitations for Masking Off the IMSI Prefix

- In a cluster controller architecture, you must enable masking off the IMSI prefix feature in both the controller and member.
- You must enable this feature in PDSN without having any sessions; it is not possible to configure or remove configuration of this feature when sessions exist in PDSN.
- If you enable this feature, accounting records goes with 10-digit IMSI.
- Configure the POD IMSI in the AAA server; PDSN compares with lower 10 digits and finds out whether the session exists or not.
- Enable this feature in 5.0 controller and using 3.0 or 4.0 members. In this case, controller records with lower 10 digits and replies the member with 15 digits.

## Configuring Masking Off the IMSI Prefix

The following CLI command configures masking off the IMSI prefix in PDSN. We recommend you to configure this CLI command in a new window (with no sessions).

```
Router(config)# cdma pdsn imsi-min-equivalence
```

To remove the configuration:

```
Router(config)# no cdma pdsn imsi-min-equivalence
```

The following example snippet shows the output with lower 11 digits for **show cdma pdsn session msid** command:

```
pdsn-act# show cdma pdsn session msid 45678987655
```

```
Mobile Station ID IMSI 112345678987655
PCF IP Address 4.0.0.1, PCF Session ID 1
A10 connection time 00:02:33, registration lifetime 20000 sec
Number of successful A11 reregistrations 0
Remaining session lifetime 19846 sec
Always-On not enabled for the user
```

```

Current Access network ID 0004-0000-01
Last airlink record received is Active Start, airlink is active
GRE protocol type is 0x8881
GRE sequence number transmit 13, receive 0
Using interface Virtual-Access3, status OPN
Using AHDLC engine on slot 0, channel ID 2
Service Option 1xRTT Flow Discrimination 0 DSCP Included 0
Flow Count forward 0 reverse 0
This session has 1 flow
This session has 0 service flows
Session Airlink State Active
This session has 0 TFTs
Qos subscriber profile

```

The following example snippet shows the output with lower 10 digits for **show cdma pdsn session msid** command:

```

pdsn-act# show cdma pdsn session msid 5678987655
Mobile Station ID IMSI 112345678987655
PCF IP Address 4.0.0.1, PCF Session ID 1
A10 connection time 00:02:48, registration lifetime 20000 sec
Number of successful A11 reregistrations 0
Remaining session lifetime 19831 sec
Always-On not enabled for the user
Current Access network ID 0004-0000-01
Last airlink record received is Active Start, airlink is active
GRE protocol type is 0x8881
GRE sequence number transmit 13, receive 0
Using interface Virtual-Access3, status OPN
Using AHDLC engine on slot 0, channel ID 2
Service Option 1xRTT Flow Discrimination 0 DSCP Included 0
Flow Count forward 0 reverse 0
This session has 1 flow
This session has 0 service flows
Session Airlink State Active
This session has 0 TFTs
Qos subscriber profile

```

The following example snippet shows the output for **show cdma pdsn accounting** command:

```

pdsn1# show cdma pdsn accounting
UDR for session
session ID: 1
Mobile Station ID IMSI 112345678987655

A - A1:5678987655 A2: A3:
C - C3:0
D - D3:11.1.1.12 D4:000000000000
E - E1:0000
F - F1:0000 F2:0000 F5:003B F6:00 F7:00 F8:00
  F9:00 F10:00 F14:00 F15:0
  F16:00 F17:00 F18:00
  F19:00 F20:00 F22:00
G - G3:0 G8:0 G9:0 G10:0 G11:0 G12:0
  G13:0 G14:176 G15:0 G16:0 G17:0
I - I1:0 I4:0
Y - Y2:1

UDR for flow
Mobile Node IP address 9.1.1.9
B - B1:9.1.1.9 B2:g7SIP1@xxx.com
C - C1:0025 C2:98 C4:0
D - D1:0.0.0.0
F - F11:01 F12:00 F13:00

```

```
G - G1:0 G2:0 G4:1243836799
      G22:0 G23:0 G24:0 G25:0
Packets- in:0 out:0
```

The following example snippet shows the output for **show cdma pdsn accounting detail** command:

```
pdsn1# show cdma pdsn accounting detail
UDR for session
session ID: 1
Mobile Station ID IMSI 112345678987656

Mobile Station ID (A1) IMSI 5678987656
ESN (A2)
MEID (A3)
Session Continue (C3) ' ' 0
Serving PCF (D3) 11.1.1.12 Base Station ID (D4) 000000000000
User Zone (E1) 0000
Forward Mux Option (F1) 0      Reverse Mux Option (F2) 0
Service Option (F5) 59      Forward Traffic Type (F6) 0
Reverse Traffix type (F7) 0      Fundamental Frame size (F8) 0
Forward Fundamental RC (F9) 0      Reverse Fundamntal RC (F10) 0
DCCH Frame Format (F14) 0      Always On (F15) 0
Forward PDCH RC (F16) 0      Forward DCCH Mux (F17) 0
Reverse DCCH Mux (F18) 0      Forward DCCH RC (F19) 0
Reverse DCCH RC (F20) 0      Reverse PDCH RC (F22) 0

Bad PPP Frame Count (G3) 0 Active Time (G8) 0
Number of Active Transitions (G9) 0
SDB Octet Count Terminating (G10) 0
SDB Octet Count Originating (G11) 0
Number of SDBs Terminating (G12) 0
Number of SDBs Originating G13 0
Number of HDLC Layer Bytes Received (G14) 290
In-Bound Mobile IP Signalling Octet Count (G15) 0
Out-bound Mobile IP Signalling Octet Count (G16) 0
Last User Activity Time (G17) 0
IP Quality of Service (I1) 0
Airlink Quality of Service (I4) 0
R-P Session ID (Y2) 1

UDR for flow
Mobile Node IP address 9.1.1.1
IP Address (B1) 9.1.1.1, Network Access Identifier (B2) g7SIP1@xxx.com
Account Session ID (C1) 2
Correlation ID (C2) ' ' 18
Beginning Session (C4) ' ' 0
MIP Home Agent (D1) 0.0.0.0
IP Technology (F11) 01 Compulsory Tunnel indicator (F12) 00
Release Indicator (F13) 00
Data Octet Count Terminating (G1) 0
Data Octet Count Originating (G2) 0 Event Time G4:1243950581
Rsvp Signaling Inbound Count (G22) 0 Outbound Count (G23) 0
Rsvp Signaling Packets In (G24) 0 Packets Out (G25) 0
Packets- in:0 out:0
```

## Persistent TFT Support

This release introduces support for installing Traffic Flow Template (TFT), which requires dependency on the AAA server attribute. PDSN rejects Resource reSerVation Protocol (RSVP) messages and fails to install the TFT if it does not receive the 3GPP2 attribute Type 89 (cdma-num-persistent) attribute from the AAA server as part of access-accept. To remove dependency on the AAA server attribute, this release merges the AAA server and local QoS profiles.

The following new command enables you to check the 3rd Generation Partnership Project 2 (3GPP2) attribute Type 89 (cdma-num-persistent) downloaded from the AAA server before installing TFT:

```
router(config)# cdma pdsn tft persistent-check
```

Depending on your configuration, PDSN behaves in the following ways:

- If the new command is not configured by default, PDSN installs the TFT when it receives an RSVP packet.
- If the new command is configured,
  - And the persistent TFT attribute has been downloaded from the AAA server, PDSN installs the TFT.
  - And PDSN has not downloaded the cdma-num-persistent attribute from the AAA server, PDSN applies the local QoS profile.
  - And the AAA server returns a value other than Type 89 (cdma-num-persistent), PDSN does not install the TFT.
  - And the AAA server does not return any attributes, and if PDSN is not configured with the local subscriber profile, PDSN does not install the TFT.
  - And the AAA server does not return any attributes, and if PDSN is not enabled to using the **tft-allowed** command in the local subscriber profile, PDSN does not install the TFT.
- If the CLI command is configured, the Cisco PDSN Release 4.0 behavior is retained.

To remove the configuration, use the following command:

```
router(config)# no cdma pdsn tft persistent-check
```

## Conserve Unique IP-ID for FA-HA IP-in-IP Tunnel

This release enables PDSN to set a valid value to the ID field in the IP header when the packet has the chance of fragmenting, by conserving the unique ID in the IP header. By using this feature, you can avoid repeating the ID number within a short time, preventing the duplication of the packet.

The following new command enables you to configure the threshold for the packet size:

```
Router(config)# ip mobile tunnel ip-ip conserve-ip-id threshold value
```

Where *value* represents the threshold value of the packet and now the ip-id could be:

- Any number other than zero if the packet size is above the threshold value.
- Zero, if the packet size is less than the threshold value.

The following example snippets show the outputs for the **ip mobile tunnel ip-ip conserve-ip-id threshold** command:

```
pdsn_active(config)# ip mobile tunnel ip-ip conserve-ip-id threshold ?
<576-1500> length in bytes
```

```
pdsn_active(config)# ip mobile tunnel ip-ip conserve-ip-id threshold 600
pdsn_active(config)# end
pdsn_active#
```

To remove the configuration:

```
pdsn_active(config)# no ip mobile tunnel ip-ip conserve-ip-id threshold 600
pdsn_active(config)# end
pdsn_active#
```

## GRE CVSE Support in FA-HA Tunnel

This release enables PDSN and the HA to negotiate a Generic Routing Encapsulation (GRE) key, though in the earlier releases, the packets passing through the GRE-enabled reverse tunnel (FA-to-HA) have the default key value as zero. This negotiation is made possible using GRE critical vendor-specific extension (CVSE) support in the Foreign Agent-Home Agent (FA-HA) tunnel.

Here, the FA and HA can generate their own key or both of them can use the FA-generated key. You can send the GRE key CVSE to the HA by configuring the following commands:

- To send the GRE CVSE in all MIP RRQs to all HAs:  
Router(config)# **cdma pdsn attribute send gre\_cvse mip\_rrq**
- To send GRE CVSE on a per-HA basis:  
Router(config)# **ip mobile foreign-agent extension gre home-agent *address range or a single address***

The following example snippet shows the output for the **show ip mobile visitor** command:

```
pdsn_active# show ip mobile visitor
Mobile Visitor List:
Total 1
mwts-mip-np-user11@ispxyz.com:
  Home addr 12.1.1.10
  Interface Virtual-Access2.1, MAC addr 0000.0000.0000
  IP src 0.0.0.0, dest 4.1.1.1, UDP src port 434
  HA addr 4.1.1.2, Identification CDF2DC2A.10000
  Lifetime 00:01:00 (60) Remaining 00:00:45
  Tunnel0 src 4.1.1.1, dest 4.1.1.2, reverse-allowed
  gre cvse enable
  FA provided key 1253037210, HA returned key 2926312514
  Routing Options - (G)GRE (T)Reverse Tunneling
```

The following example snippet shows the output for the **show ip mobile proxy registration** command:

```
pdsn_active# show ip mobile proxy registration

Proxy Mobile Node Registrations:

userpmip1@ispxyz.com:
  Registration accepted 06/29/09 06:27:11
  Next Re-registration 00:00:13
  Registration sequence number 1
  Care-of addr 4.1.1.1, HA addr 4.1.1.2, Home addr 12.1.1.12
  gre cvse enable
  FA provided key 1527991487, HA returned key 3076709629
  Flags sbdmG-T-, Identification CDF2DD3F.8CB49CB8
  Lifetime requested 00:01:00 (60), granted 00:01:00, remaining 00:00:43
```

The following example snippet shows the output for **show ip mobile tunnel** command:

```
pdsn_active# show ip mobile tunnel
Mobile Tunnels:
Total mobile ip tunnels 1
Tunnel0:
  src 4.1.1.1, dest 4.1.1.2
  encaps GRE/IP, mode reverse-allowed, tunnel-users 1
Multiple GRE keys supported
  Input ACL users 0, Output ACL users 0
  IP MTU 1472 bytes
  Path MTU Discovery, mtu: 0, age: 10 mins, expires: never
  outbound interface Ethernet1/0
  FA created, CEF switching enabled, ICMP unreachable enabled
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
  0 packets input, 0 bytes, 0 drops
  0 packets output, 0 bytes
```

To configure the **cdma pdsn attribute send gre\_cvse mip\_rrq** command:

```
pdsn_active# conf term
pdsn_active(config)# cdma pdsn attribute send gre_cvse mip_rrq
pdsn_active(config)# end
```

To configure the **ip mobile foreign-agent extension gre home-agent** command:

```
pdsn_active# conf term
pdsn_active(config)# ip mobile foreign-agent extension gre home-agent 4.1.1.2
pdsn_active(config)# end
```

To remove the configuration:

```
pdsn_active# conf term
pdsn_active(config)# no cdma pdsn attribute send gre_cvse mip_rrq

pdsn_active# conf term
pdsn_active(config)# no ip mobile foreign-agent extension gre home-agent 4.1.1.2
```

## Remote Address Accounting

This release enables the PDSN to support remote address-based accounting (RAA). Using RAA, the number of octets exchanged between the Mobile Station (MS) and a remote IP address during a packet-data session can be counted. The PDSN enables this accounting functionality on a per-user basis, as specified in the User Profile received from the Home RADIUS server during authentication procedures. The PDSN supports Remote Address Table Index attributes from the AAA server to enable RAA in a session. The PDSN supports RAA only when the IP address is visible to it. For example, in Virtual Packet Data Networks (VPDNs), there are no IP packets and hence, the PDSN does not support RAA for VPDN calls.

The following sections describe:

- [Setting up a Session](#)
- [About the G5 Attribute](#)
- [Support for 835B-Compliant RAA Table Index Downloaded from RADIUS](#)

## Setting up a Session

This section describes the workflow to set up a session. During initial call setup, the PDSN authenticates with the AAA server and downloads the remote table index attribute as part of the access-accept. On downloading the RAA table index during access-accept, the downloaded RAA Table indices are matched against the table index configured on the PDSN. The matched indices are associated with the session; unmatched indices are dropped and not associated with the session. If the force index match is configured, and the downloaded index does not match with the configured RAA table index, the session is dropped.

## About the G5 Attribute

The G5 container contains counters for forward octet count, reverse octet count, either the RAA index or the remote-network-and-mask pair, forward octet overflow count, and reverse octet overflow count.



### Note

---

Here, the G5 contains either the RAA table index or network or mask combination to be monitored.

---

A remote address mask is used to indicate a range of addresses for remote address accounting. The PDSN aggregates the octet counts for all the remote IP addresses of that mask and generates one remote IPv4 octet-count attribute.

The G5 attribute is included in the accounting stop and accounting interim. Some features of the attribute are:

- Instances of the G5 attribute are removed after sending accounting stop. New instances are created based on a match.
- Matching packets are accounted in both session and flow.
- If the summarize option is not set, the G5 container contains the network-and-mask pair (that is, the unique host mask used to represent a single IP address). The table index is not present at this point; the index is present only if the summarize option is configured for the table index.
- In case of redundancy, the table parameters along with the G5 containers are synchronized to standby. Here, the table parameters are synchronized to standby when configuring in active PDSN. If the G5 container is present, it is synchronized whenever an accounting request is sent.
- The octet overflow attribute is present as a part of the accounting request even if the byte count does not overflow.

The following workflow describes updates to the G5 attribute during traffic flow:

1. For downstream traffic, if RAA is enabled for this session and a valid index is associated with the session, the PDSN checks if the source IP address matches the IP addresses of the associated index. For upstream traffic, the PDSN checks if the destination IP address matches the IP addresses of the associated index.
2. On finding a match:
  - a. If a G5 instance is present, the PDSN accounts the bytes or octet count. If the traffic matches to the existing G5 container, PDSN accounts the bytes used in that container.
  - b. If summarize is enabled, PDSN accounts the packet in a single G5 instance. You can enable or disable the summarize option using the Remote Table Index AAA server attribute.
  - c. If a match and corresponding G5 instance are not present (that is, created already), the PDSN creates a G5 instance and accounts it.

## Support for 835B-Compliant RAA Table Index Downloaded from RADIUS

To support the IS835B-compliant RAA table index downloaded from the AAA server, use the new **cdma pdsn accounting remote address compliance 835b** command in global configuration mode:

Note that:

- On configuring the CLI command, only the table index that is compliant with 835B is accepted; other forms are rejected and the corresponding sessions go down.
- If the CLI command is disabled, table indexes that are compliant with 835C or D and B are accepted; other forms are rejected and the corresponding sessions go down. By default, the command is disabled.
- For RAA table indexes compliant with IS835B and IS835C, the remote address octet count is in the IS835C format only.
- The IS835B-compliant RAA table index downloaded from RADIUS is supported by default. This command is configured to mandate the downloaded table indices, which are in IS835B format.



### Note

When RAA is enabled:

- IP flow accounting is not enabled.
- IPv6 addressing is not supported.
- Prepaid exempt is not supported.
- RAA table cannot be removed if RAA enabled session exists. However, the contents of the RAA table can be modified; these changes are effective for subsequent sessions and re-registered sessions.
- Remote address downloaded from the AAA server during access-accept is not supported. Only the remote table index is supported.

## Configuring Remote Address Accounting

The following commands have been introduced for configuring remote address accounting.

To configure the remote address table:

```
pdsn(config)# cdma pdsn accounting remote address table
pdsn(config-raa)# index number
pdsn(config-raa-table)# description string
pdsn(config-raa-table)# remote address ip-addr ip-addr mask
```

To remove the remote address that is configured in the table:

```
pdsn(config)# cdma pdsn accounting remote address table
pdsn(config-raa)# index number
pdsn(config-raa-table)# no remote address ip-addr
```

To remove the index:

```
pdsn(config)# cdma pdsn accounting remote address table
```

```
pdsn(config-aaa)# no index number
```

To remove the remote address table and to disable remote address accounting feature:

```
pdsn(config)# no cdma pdsn accounting remote address table
```

**Note**


---

Disabling the configuration is not allowed when RAA enabled sessions are present.

---

To force remote address accounting:

```
pdsn(config)# cdma pdsn accounting remote address table index match
```

**Note**


---

This command is configured to force a check with the RAA indices downloaded against the indices configured in the PDSN. If any of the table indexes downloaded for the session are not configured in the PDSN, the session is not created.

---

To remove force remote address accounting:

```
pdsn(config)# no cdma pdsn accounting remote address table index match
```

The following example snippet shows output for the **show run** command when remote address accounting is enabled:

```
cdma pdsn accounting remote address table
index 1
  description test1
  remote address 1.1.1.1 255.255.255.255
  remote address 2.2.2.0 255.255.255.0
  remote address 10.10.10.5 255.255.255.255
index 2
  description test2
  remote address 3.3.3.3 255.255.255.255
  remote address 4.4.4.0 255.255.255.255
cdma pdsn accounting remote address index match
```

The following command clears all RAA-related statistics:

```
pdsn# clear cdma pdsn statistics
```

The following command enables support for the 835B-compliant RAA table index that is downloaded from the AAA server:

```
pdsn(config)# cdma pdsn accounting remote address compliance 835b
```

When you use this command, the PDSN accepts only the IS835B-compliant RAA table index downloaded from the AAA server. On disabling this command, the PDSN accepts the RAA table indexes downloaded from the AAA server that are compliant with IS835C or D and B; other forms are rejected. This command is disabled by default.

The following command disables support only for the 835B-compliant RAA table index that is downloaded from the AAA server:

```
pdsn(config)# no cdma pdsn accounting remote address compliance 835b
```

The following new commands enable you to debug remote address accounting:

`pdsn# debug cdma pdsn accounting raa errors`

CDMA PDSN Remote address based accounting errors debugging is on.

`pdsn#debug cdma pdsn accounting raa events`

CDMA PDSN Remote address based accounting events debugging is on.

See the debug commands in the *Cisco Packet Data Serving Node Release 5.0 for Cisco IOS Release 12.4(22)XR1* for more information about debugging remote address accounting in Cisco PDSN Release 5.1.

## Default Service Option Implementation

As part of accounting records, the PDSN sends zero to the AAA server in either these instances:

- It receives a zero as the value for the F5 Service Option.
- or
- It did not receive the airlink start.

To set the F5 Service Option value to be a non-zero value in a controlled manner, you can now set the default SO value for accounting using the following new command:

Router(config)# **[no] cdma pdsn a11 default-service-option** *value*

The new command enables you to configure a default SO value for accounting.

To remove this setting, use the **no** form of this command.



### Note

---

When the F5 attribute value is not present in the received airlink start record, and if it already has a non-zero value, do not modify the Usage Data Record's (UDR) F5. If the UDR's F5 value is zero, then update F5 with the A10 service option value. If the A10 service option value is not available, update the attribute with the value configured using the new command.

---

## Configurable Per-Flow Accounting Options

Currently, the PDSN supports per-flow based accounting, which means accounting records are sent per flow (IP flow). This release enables the PDSN to support configurable per-flow accounting optionally, which is decided either by configuring the CLI command or downloading the accounting option.

The following sections describe:

- [Configuring Per-Flow Accounting Options](#)
- [Functional Flow for Configuring Per-Flow Accounting Options](#)
- [Session and Flow Setup for Configurable Per-Flow Accounting Options](#)
- [Limitations in Configuring Per-Flow Accounting Options](#)

## Configuring Per-Flow Accounting Options

The following commands are used to configure per-flow accounting options in the PDSN.

To configure CDMA PDSN accounting with main flow:

```
pdsn_act(config)# cdma pdsn accounting [main flow] ?
```

where, **main flow** configures main flow optionally for accounting.

To configure CDMA PDSN accounting main flow, including IP flows:

```
pdsn_act(config)# cdma pdsn accounting [main flow include ipflows]
```

where, **main flow include ipflows** includes IP flow data optionally in the accounting main flow.

To remove the configuration of CDMA PDSN accounting:

```
pdsn_act(config)# no cdma pdsn accounting ?
```

local-timezone Enable local timezone values for accounting

main flow Accounting on Main Flow

prepaid Prepaid related configurations

remote Configure Remote Accounting

send Accounting option

time-of-day Generate accounting record at specified time

```
pdsn_act(config)# no cdma pdsn accounting main flow ?
```

The following are the options for configuring the accounting options:

### Option 1 - Configuring Accounting Option Only for Main Flow:

If the accounting option (Cisco VSA generic) is downloaded from the AAA server as 2 or the **cdma pdsn accounting main flow** command is enabled.

### Option 2 - Configuring Accounting Option for Including Ipflows in Main Flow:

If the accounting option (Cisco VSA generic) is downloaded from the AAA server as 3 or the **cdma pdsn accounting main flow include ipflows** command is enabled, the accounting records are sent for main flow alone and include IPflows details.

### Default Option - Per-Flow Accounting:

Per-flow accounting is performed, if option 1 is configured. If the accounting option (Cisco VSA generic) downloaded from the AAA server is other than option 1 or option 2, or if neither **cdma pdsn accounting main-flow** or **cdma pdsn accounting main-flow include ipflows** commands are enabled, the default option is configured.

## Functional Flow for Configuring Per-Flow Accounting Options

The functional flow for this feature includes three options: Only Main Flow, Include IP flow in Main Flow, and Per-Flow Accounting (default).

**Option 1 - Only Main Flow:**

Accounting is done only on main flow. No accounting records are sent for IPflows. But upstream and downstream traffic are accounted in the respective IPflows and aux A10, if the TFT matches. However, the accounting records (start or stop or interim) are not sent for IPflows. Counters for G1 or G2, packets in or out for IPflows are not included, when the accounting records (interim and stop) of the main flow are sent.

**Option 2 - Include IP Flow in Main Flow:**

Accounting is done only on main flow. No accounting records are sent for IPflows. But upstream and downstream traffic are accounted in the respective IPflows and aux A10, if the TFT matches. However, the accounting records (start or stop or interim) are not sent for IPflows. Counters for G1 or G2, packets in or out for IPflows are added to G1 or G2 and packets in or out of main flow, when the accounting records (interim and stop) of main flow are sent.

**Default Option - Per Flow Accounting:**

Per-flow (IP flow)-based accounting is done. Accounting records are sent for main flow and IPflows.

**Session and Flow Setup for Configurable Per-Flow Accounting Options**

During initial call setup, the PDSN authenticates with the AAA server and downloads the accounting option as part of access-accept. On downloading the attribute, the PDSN checks whether the downloaded option is valid. If it is a valid option, the option is copied to the session. If it is not valid, the PDSN checks for configured CLI command. If the accounting option is configured, it is copied to the session. If the accounting option is not configured, there is no accounting option.

If airlink records are received for the IPflows, the records are parsed and updated. If the accounting option is valid, the accounting records for the IPflows, however, are not sent. The upstream and downstream traffic are sent over the respective IPflows and aux A10s after checking the TFT.

Before sending the accounting records (interim and stop), the PDSN checks for the accounting option and depending on the accounting option value, you can decide about including the G1 or G2, packets in or packets out to the respective attributes of the main flow. If accounting option is valid, you can reset G1 or G2, packets in or out of IPflows when you flush the IPflows for main flow.

**Limitations in Configuring Per-Flow Accounting Options**

The following are the limitations in configuring per-flow accounting options:

- If the accounting option is downloaded twice, only the first downloaded version is considered.
- The downloaded attribute is preferred to the configured value.
- The accounting option is session-based and not flow-based.
- The accounting option is considered only for single flow. If multiple MIP flows or a SIP, MIP flow are opened, the same accounting option is applied for each flow.
- Removing the configurations commands **cdma pdsn accounting main flow** or **cdma pdsn accounting main flow include ipflows**, removes the accounting option configuration.
- To maintain redundancy, the accounting option is synchronized to standby.

## IP Flow Discriminator Support for PCF Backward Compatibility

PDSN adds the 4-byte IP flow discriminator to the GRE header. But some PCFs are based on the standard A.S0008 v3.0, or a lesser value that defines the IP flow discriminator to be 3 bytes without the reserved byte.

This release supports IP flow discriminator for backward compatibility of PCFs using the following new command in global configuration mode:

```
pdsn# cdma pdsn compliance hrpd ipflow-discriminator
```

On configuring this command, the IP flow discriminator is defined in the new format of 3 bytes. The A10s carry the IP flow discriminator of 3 bytes without a reserved byte. By default, the command is disabled.

## Support for Remark DSCP to Max-class Value

The PDSN remarks the upstream packet with the value of the unauthorized Differentiated Services Code Point (DSCP), either to zero or to the value specified by the global configuration command **cdma pdsn multiple service-flows qos remark-dscp remark\_value**. So all unauthorized packets are remarked only to 0 or to a global value as specified in the command.



### Note

The DSCP value is greater than the max-class value which is either downloaded from the AAA server or configured locally.

To remark the DSCP value of the unauthorized packet to a DSCP value on per-user basis, this release introduces a new command.

To remark the DSCP value of the packet either to the max-class value downloaded from the AAA server or to be configured locally:

```
pdsn# cdma pdsn multiple service-flows qos remark-maxclass
```

From this release, the PDSN remarks the DSCP value in the following three ways:

- When the new command **cdma pdsn multiple service-flows qos remark-maxclass** is not configured and only **cdma pdsn multiple service-flows qos remark-dscp remark\_value** is configured, the PDSN remarks the DSCP value with the *remark\_value* specified in the configured **cdma pdsn multiple service-flows qos remark-dscp remark\_value** command if the incoming packet's DSCP value is greater than max-class value.
- When both the commands **cdma pdsn multiple service-flows qos remark-max-class** and **cdma pdsn multiple service-flows qos remark-dscp remark\_value** are configured, the PDSN remarks the DSCP value with the max-class value, if the incoming packet's DSCP value is greater than the max-class value.
- When both the commands **cdma pdsn multiple service-flows qos remark-maxclass** and **cdma pdsn multiple service-flows qos remark-dscp remark\_value** are not configured, the PDSN remarks the DSCP value to 0x00 if the incoming packet's DSCP value is greater than the max-class value.

## Command Support for Fragmentation Size

This release introduces a new command that enables you to set the fragmentation size of the first packet and thereby avoid further fragmentation of the second fragment in the network. With IP fragmentation, the first fragment may not include the Layer-4 header information of the inner packet. Thus, firewalls on the network that performs extensive inspection up to Layer 4, may drop the first fragment.

You can use the following new command in global configuration mode to set the fragmentation size of the first packet with `Offset = 0` to set the first fragment size and ensure that the network does not drop the first segment.

```
pdsn# ip fragment first minimum size ?
```

where, *size* represents a number between 8 and 560 in bytes.

The *size* must include only the payload in multiples of 8 bytes and not any header. Otherwise, the command is rejected with the following error message:

```
%% First fragment payload size is not in multiples of 8.
```

## New Statistics Counters for China Telecom

This release introduces support for new statistics counters for China Telecom.

Currently, only the PDSN-related statistics in the CLI are supported and Exhaustion of Prepaid Quota is provided by the CLI. This release supports A11 registration update per-PCF counter.

A list of new metrics is made available to China Telecom through SNMP on the PDSN. The following statistics counters are supported:

- [Prepaid Statistics per PCF level](#)
- [Inter-PCF Handoff RRQ](#)
- [Accepted Inter-PCF Handoff](#)
- [EVDO Network Initial Aux A10 Connection Request](#)
- [Successful PPP Connection Request](#)
- [Successful PPP Initial Request](#)
- [Failed PPP Connection Request](#)
- [PCF Terminate A10 Before LCP Stage](#)
- [Initial Connection Requests for L2TP tunnel](#)
- [Successful Request for L2TP Tunnel](#)
- [Failed Request for L2TP Tunnel](#)
- [Outbound and Inbound Bytes on RP Interface](#)

### Prepaid Statistics per PCF level

The CLI command in Exec mode `show cdma pdsn statistics prepaid` is enhanced to per-PCF level. The updated command gives prepaid statistics at the per-PCF level.

The per-PCF level prepaid statistics counter does not have the Total Online Access Response Received and Discarded counters. But, these counters are available at the global-level prepaid statistics; if the session is deleted while processing an online response, you cannot control to increment the per-PCF level of the counters.

The following example snippet shows the output for the **show cdma pdsn statistics prepaid pcf** command:

```
pdsn1_act# show cdma pdsn statistics prepaid pcf 2.2.2.1
PCF 2.2.2.1, Service Option 59
Total prepaid flows opened: 0
  Volume-based 0, Duration-based 0
  Simple IP 0, VPDN 0, Proxy Mobile IP 0, Mobile IP 0
Total online Access Requests sent 0
Total online Access Response
Accepted 0, Timeout 0
Online Access Requests sent with Update Reason:
  Pre-Initialization          0
  Initial Request            0
  Threshold Reached          0
  Quota Reached              0
  Remote Forced Disconnect   0
  Client Service Termination 0
  Main SI Released           0
  SI not established         0
  Tariff Switch Update       0
```

## Inter-PCF Handoff RRQ

Currently, only the PDSN-related statistics in the CLI are supported. This release supports inter-PCF handoff RRQ. A counter for inter-PCF handoff on a per-PCF basis is provided in the PDSN.

## Accepted Inter-PCF Handoff

Currently, only the PDSN-related statistics in the CLI are supported. This release supports accepted inter-PCF handoff. A counter for accepted inter-PCF handoff on a per-PCF basis is provided in the PDSN.

## EVDO Network Initial Aux A10 Connection Request

Currently, only the PDSN-related statistics in the CLI are supported. This release supports EVDO network initial aux A10 connection request. In this release, the total number of aux A10 connections is requested and a new counter is added under "statistics rp", and the per-PCF level is supported.

## EVDO Network Accepted Initial Aux A10 Connection

This release supports EVDO network-accepted initial auxiliary A10 connection. In this release, the total number of aux A10 connections is successfully created and a new counter is added under "statistics rp", and a per-PCF level is supported.

## New Aux Connection Requested and Accepted

Two new counters, New Aux Connection Requested and New Aux Connection Accepted are added under the **show cdma pdsn statistics rp** CLI command in the Exec mode. These counters are also available at the per-PCF level.

Whenever a registration or reregistration request is received by the PDSN to create  $n$  number of new aux connections, the New Aux Connection Requested counter is incremented by  $n$ . If all the aux connections are successfully created, the New Aux Connection Accepted counter is incremented by  $n$ . In case there are problems in creating any of the requested aux connections, the New Aux Connection Accepted is not incremented.

The following example snippet shows the output for the **show cdma pdsn statistics rp pcf pcf IP address** command:

```
pdsn1_act# show cdma pdsn statistics rp pcf 2.2.2.1

PCF 2.2.2.1, Service Option 59
  Reg Request rcvd 2, accepted 2, denied 0, discarded 0
  Initial Reg Request rcvd 1, accepted 1, denied 0, discarded 0, AuxRequest 0
  Re-registration requests rcvd 1, accepted 1, denied 0, discarded 0
  Re-registration requests containing Active-Start 1, Active-Stop 0
  Re-registration requests containing new connections 0, missing connections 0,
remapping flows 0
  New Aux Connection Requested 4, New Aux Connection Accepted 4
  Handoff requests rcvd 0, accepted 0, denied 0, discarded 0, AuxRequest 0.
```

## Successful PPP Connection Request

Currently, the successful PPP connection request counter is not compliant with China Telecom. In this release, this counter is updated and also added to MIB and per-PCF-based counters.

IPCP is updated in the PPP connection request counter, in both negotiations and renegotiations. For VPDN, the PDSN receives an authentication response success message from the AAA server, and updates this counter. The total successful PPP connection request is calculated as below:

Total successful PPP connection request = (Connection success + Renegotiation success).

PPP renegotiation for a VPDN call is transparent to the PDSN. Only the initial PPP connection status is updated for the VPDN call.

## Successful PPP Initial Request

Currently, the successful PPP initial request counter is not compliant with China Telecom definition. In this release, this counter is updated and also added to the per-PCF-based counter.

IPCP is updated in the PPP initial request counter in the initial stage. For VPDN case, PDSN receives authentication response success message from AAA, and updates this counter.

## PPP Statistics Connection Success Counter

For a VPDN call, as soon as an authentication get success is received, the connection success counter is incremented regardless of the status of the L2TP tunnel.

The following example snippet shows the output for the **show cdma pdsn statistics ppp** command:

```
pdsn1_act# show cdma pdsn statistics ppp
Last clearing of "show cdma pdsn statistics ppp" counters never
PPP:
  Current Connections 2
  Connection requests 2, success 2, failure 0, aborted 0
```

## Failed PPP Connection Request

Not having IP resource for allocation is one of the reasons for code failure. Currently, this failure reason is not supported and only the PDSN-related statistics in CLI commands are supported. This release supports this failure reason and a failed PPP connection request is added in MIB and per-PCF-based counter.

## New Counter for Not Having IP Resource for Allocation in PPP Statistics

Currently, when the IP pool is exhausted, the unknown count available under the IPCP stage is incremented if the IP pool name is downloaded from the AAA server. The other counters under release are incremented, if the pool name is locally configured. A new counter is introduced, under the **show cdma pdsn statistics PPP** command, to reflect the number of sessions that failed at the IPCP stage because of the IP pool exhaustion, irrespective of whether the pool name is downloaded from the AAA server or locally configured.

The old counter's behavior related to IP address exhaustion has not been changed. The new counter value does not match with the total number of failures under IPCP stage, because the IP pool exhaustion of a local pool is not considered an IPCP failure.

The following example snippet shows the output for the **show cdma pdsn statistics ppp** command:

```
pdsn_act# show cdm pdsn statistics ppp
Last clearing of "show cdma pdsn statistics ppp" counters 00:09:33
Last update received at 02:51:38 UTC Mar 1 2002
PPP:
  Current Connections 2
  Connection requests 11, success 2, failure 9, aborted 0
  Connection enters stage LCP 11, Auth 11, IPCP 11
  Connection success LCP 11, AUTH 11, IPCP 2
  Failure reason LCP 0, authentication 0, IPCP 9, other 0
  Failure reason lower layer disconnect 0

  A10 release before LCP nego by PDSN 0, by PCF 0

  IPCP Stage
  Failure Reasons Options 0, MaxRetry 0, Unknown 9
  Options failure reason MN Rejected IP Address 0
  LCP Term Req during IPCP nego sent 9, rcvd 0
  A10 release during IPCP nego by PDSN 0, by PCF 0
  No enough IP resource for allocation 9
```

## PCF Terminate A10 Before LCP Stage

Currently, only the PDSN-related statistics in the CLI are supported. This release supports PCF terminate A10 before the LCP stage counter.

## PPP Statistics at Per-PCF Level

The counter that gives the PPP statistics about "PCF Terminate A10 before LCP Stage" and renegotiation details are now made available at the per-PCF level.

The following example snippet shows the output for the **show cdma pdsn statistics ppp pcf pcf ip address** command:

```
pdsn1_act# show cdma pdsn statistics ppp pcf 2.2.2.1

  PCF 2.2.2.1, Service Option 59
```

```

Current Connections 1
Connection requests 1, success 1, failure 0, aborted 0

A10 release before LCP nego by PDSN 0, by PCF 0

Renegotiation total 0, by PDSN 0, by Mobile Node 0
Renegotiation success 0, failure 0, aborted 0
Renegotiation reason: address mismatch 0, lower layer handoff 0
GRE key change 0, other 0

```

## Initial Connection Requests for L2TP tunnel

Currently, only the PDSN-related statistics in the CLI are supported. This release supports initial connection requests for L2TP tunnel as a global counter. The Start-Control-Connection-Reply (SCCRQ) counter from XMIT gives the details about the initial connection request for the L2TP tunnel, when you execute the command **show l2tp counters tunnel**.

## Successful Request for L2TP Tunnel

Currently, only the PDSN-related statistics in CLI are supported. This release supports successful request for the L2TP tunnel as a global counter. The Start-Control-Channel-Connected (SCCCN) counter from XMIT gives the details about the successful connection request for the L2TP tunnel, when you execute the **show l2tp counters tunnel** command.

## Failed Request for L2TP Tunnel

Currently, only the PDSN-related statistics in the CLI are supported. This release supports failed request for the L2TP tunnel as a global counter. The SCCRQ - SCCCN counter from XMIT gives the details about the failed request for the L2TP tunnel, when you execute the **show l2tp counters tunnel** command.

## Active and Dormant Session Counters

The active counters, also available at the per-PCF level, and dormant session counters give details about the total number of main connections in dormant state.

The following example snippet shows the output for the **show cdma pdsn statistics pcf pcf ip address** command:

```

pdsn1_act# show cdma pdsn pcf 2.2.2.1
PCF 2.2.2.1 has 1 session
  Received 6 pkts (185 bytes), sent 15 pkts (640 bytes)

  PCF Session ID 1, Mobile Station ID IMSI 09884708943
  A10 connection age 01:40:24
  A10 registration lifetime 65535 sec, time since last registration 6024 sec
Number of sessions Active 2, Dormant 0,

```

## Outbound and Inbound Bytes on RP Interface

This release supports outbound and inbound bytes on RP interface (SO=33,SO=59,SO=64,SO=67) are added in the per-PCF-based counter.

## Counters for Inbound and Outbound Bytes on RP Interface by Service Option

A new CLI command in Exec mode is introduced to give the total number of inbound and outbound bytes on the RP interface based on service option. This command is also available at the per-PCF level.

The following example snippet shows the output for the **show cdma pdsn statistics service-option** command:

```
san-pdsn# show cdma pdsn statistics service-option 33 ?
pcf  give pcf ip for faster response!!
|    Output modifiers
<cr>

san-pdsn# show cdma pdsn statistics service-option 33 pcf ?
A.B.C.D  PCF IP address

san-pdsn# show cdma pdsn statistics service-option 33 pcf 41.1.1.2
Service Option: 50 PCF: 41.1.1.2
  Bytes in: 0                               Bytes out: 0
  Packs in: 0                               Packs out: 0

san-pdsn# show cdma pdsn stat serv 59
Service Option: 59
  Bytes in: 184                             Bytes out: 506
  Packs in: 30                              Packs out: 1

san-pdsn# show cdma pdsn stat serv 59 pcf 41.1.1.3
Service Option: 59 PCF: 41.1.1.3
  Bytes in: 0                               Bytes out: 0
  Packs in: 0                               Packs out: 0
```

## Features From Previous Releases

This section explains the features that were introduced in releases earlier than Cisco PDSN Release 5.1.

### Inter-User Priority

PCF uses the inter-user priority attribute to schedule packets to the MN. PDSN receives this attribute from the AAA server in a RADIUS access-accept message.

### Roamer Identification

Roamer Identification is a home area attribute defined by Lucent, and PDSN receives this attribute from the AAA server in a RADIUS access-accept message.

### Served MDN

Served MDN is a vendor-specific attribute defined by China Telecom. It is similar to the Class IETF attribute. The Served MDN attribute is received by the PDSN from the AAA server in a RADIUS-access accept message and is included in all the accounting request messages sent to the AAA server for the session or IP flow.

The Served-MDN attribute is a China Telecom VSA that is downloaded from the AAA server as part of RADIUS access-accept message per user.

When you configure the **cdma pdsn attribute vendor 20942** command, the PDSN parses the served MDN attribute, and sends the attribute in accounting messages. If parsed successfully, the attribute value is stored as part of the flow structure for the user that has received the RADIUS access-accept message.

If downloaded, this attribute is sent in all accounting request messages (start, stop, and interim-update) of the corresponding flow and its associated IP flows. If the PDSN receives multiple values of this attribute in a single access-accept message, and if they are parsed successfully, the last instance in the list of attributes downloaded is stored in the flow structure.

The PDSN drops the access-accept if it gets an invalid format or incorrect length for the Served-MDN VSA. The corresponding failure counter is then incremented. When a new value of the attribute is received in an access-accept during PPP-renegotiation or MIP reregistration, the latest value downloaded will update the existing value. And when a subsequent access-accept does not download this value, then the existing value is retained.

In case of inter-PCF handoff, this attribute is sent in both the accounting stop and accounting start message. In case of PPP renegotiation, if PDSN receives a new value, then the new value is stored in the flow structure. If a new attribute value is downloaded when the session is dormant and accounting start stop is not enabled, the accounting stop contains the old served MDN attribute value and the accounting start contains the new served MDN attribute value.

If unknown China Telecom attributes are received, these attributes are ignored.

If both IETF class attribute and CT VSA served MDN attribute is downloaded as a part of access-accept, both attributes are sent to the AAA server in accounting messages for the session.

To support the served MDN attribute in accounting, show and debugging, run the following command:

```
router (config)# cdma pdsn attribute vendor 20492
```

This new command enables the PDSN to parse the served MDN attribute, and send the attribute in accounting messages.

## Framed Pool

The Framed Pool attribute is an IETF attribute downloaded by the PDSN from the AAA server in RADIUS access-accept message. This attribute value is used by the PDSN to match the IP pools configured in the PDSN, and allocates an IP address from the selected pool through PPP IPCP negotiation. The PDSN supports Cisco VSA for downloading the pool names from the AAA server. This feature is required to download the pool name as an IETF VSA.

The PDSN downloads the IETF framed-pool attribute from the AAA server as part of the access-accept message per user flow. If the local pool name matches the pool name downloaded, and if the pool has an IP address available for allocation, an IP address is allocated to the MN and the allocated IP address is sent as part of the IPCP CONFNAK message to the MN.

If the MN requests a static IP address and the IETF pool name is downloaded as well during the access-accept, the static IP address requested by the MN is given preference only when the IP address preferred is within the pool range configured in the PDSN. Otherwise, the IP address is assigned from the downloaded Pool.

If no local pool matches the pool name configured in the PDSN, or if the matched pool name does not have any address to allocate, the PPP IPCP negotiation fails, and the call is terminated. If framed IP pool and Cisco av pair pool name attributes are downloaded, the IP address is allocated from the framed pool. When multiple framed IP pool names are downloaded, the IP address is allocated from the first of the downloaded pools. If the IP addresses in the framed IP pool are exhausted, the session goes down.

The IETF pool name is synchronized to the standby unit by the AAA server subsystem. Parsing and validation of this attribute is performed by the AAA server subsystem.

#### Other Considerations

SIP calls are supported. For all other calls, IP address assignment will be done by the HA and the pool configuration in VAAA will be ignored by the PDSN.

For PMIP calls, the address allocated by the HA is negotiated with the MN as a part of IPCP even if a IETF pool name attribute value was downloaded.

## 3GPP2 DNS Server IP

The DNS server IP address attribute is a 3GPP2 VSA downloaded by PDSN from the AAA server in RADIUS access-accept message. These IP addresses downloaded from the AAA server must be sent to the MN if requested during IPCP negotiation.

The PDSN downloads the 3GPP2 DNS IP address VSA with Vendor ID 117 from the AAA server as a part of the access-accept message. Downloaded attributes are parsed for the primary and secondary IP addresses and are stored in the AAA server list for the user session. The values that are sent in sub-type 3 and 4 are not used by the PDSN. This attribute (if requested) is sent to the MN during IPCP negotiation from the AAA server list.

During PPP IPCP negotiation, the MN requests an IP address in the IPCP CONFREQ message by sending the primary DNS IP address as 0.0.0.0 and secondary DNS IP address as 0.0.0.0. If a user is authorized for the DNS IP addresses, addresses downloaded from the AAA server are sent to the MN through the IPCP CONFNAK message.

If invalid attributes are downloaded in the DNS VSA (for example, an invalid length or an invalid subtype), the PDSN drops the access-accept, and the corresponding failure counter is incremented. The PDSN does not check the content of the IP address in the primary and secondary fields and the value is sent to the MN as received.

If a user requests is sent for the DNS IP address, but the PDSN does not download the DNS IP address VSA, an IPCP CONFREJ message is sent rejecting the DNS request sent by the MN. Then the MN sends a new CONFREQ without the primary DNS address or secondary DNS address in its CONFREQ.

The attributes downloaded are sent to the MN for SIP calls when configured in VAAA. Flags downloaded are ignored by the PDSN for SIP and PMIP calls. For MIP calls, DNS is sent by the HA through MIP RRP. No configuration is required in the VAAA.

For PMIP calls, the DNS address downloaded by the HA is given preference. If the DNS IP address is downloaded from the AAA server for PMIP calls, it would not be suggested to the MN even if the MN requests for the DNS server IP address.

If multiple 3GPP2 attributes, or a combination of 3GPP2 attributes, and CISCO VSA DNS attribute are downloaded, the last downloaded attribute value is taken into consideration. In case the 3GPP2 DNS server IP address attribute is downloaded but not negotiated with the MN, it would be displayed on the session.

## Virtual Route Forwarding with Sub-interfaces

The Virtual Route Forwarding (VRF) attribute is a Cisco-specific vendor attribute downloaded by the PDSN from the AAA server in a RADIUS access-accept message. The vaccess (sub-interface created per session on the PDSN) is added to the VRF matching the VRF attribute value downloaded from the AAA server. The PDSN downloads the Cisco vendor-specific VRF attribute from the AAA server as a part of the access-accept message. If this VSA is received in user authorization, and if the VRF name returned from RADIUS is configured globally on the PDSN, the PDSN will apply this VRF information for the session.

The current support on IOS creates a full vaccess interface for this user session to support VRF. VRF forces the creation of a full access interface that limits the number of sessions to 8,000 (only 8K software IDBs exist).

The VRF, when configured in PDSN, creates an instance of the routing table. When the VRF is applied to the vaccess created, after the PPP IPCP negotiation, the route inserted is in the VRF routing table and not in the global routing table. The current implementation supports VRF as an LCP-based configuration request.

### Basic Functionality

- The PDSN downloads the Cisco vendor-specific VRF attribute from the AAA server as a part of access-accept message. For sub-interface support of VRF, the VRF value is downloaded as an IP level attribute.
- IP CEF has to be enabled for VRF to work.
- If this VSA is received in user authorization, and if the VRF name returned from RADIUS is configured globally on the PDSN, then the PDSN applies this VRF information to the vaccess interface created for this user session.
- You must download the “ip unnumbered” attribute with the VRF to apply the VRF attribute in the session.
- If the VRF attribute is downloaded as an IP-level attribute, the vaccess created for the session is a sub-interface, and this sub-interface is added to the VRF on the PDSN that matched the VRF attribute value downloaded. If the downloaded VRF name is not configured, the call is dropped.
- You must download the “ip unnumbered” attribute with the VRF to create sub-interface support in the VRF routing table. If the access-accept message from the AAA server has both the LCP and IP VRF attributes downloaded, we always create a full vaccess interface. The order of LCP VSA in the user profile does not matter. It will override any VRF-ID VSA specifications.
- If the access-accept message from the AAA server has multiple IP VRF attributes downloaded, the session is dropped.
- If the VRF attribute is not downloaded in order (VRF ID followed by unnumbered interface), the session will be dropped.
- If the VRF attribute is configured in the virtual-template, and if no VRF is downloaded from the AAA server, the VRF attribute configured locally gets updated in the session.
- If the VRF attribute is configured in the virtual template and if a different VRF attribute is downloaded from the AAA server, the VRF attribute downloaded from the AAA server is updated in the session.
- The errors in the AAA server VRF attribute handling is handled by the AAA server sub-system.
- The PDSN supports overlapping IP addresses for the user session with VRF.

- In case of PPP renegotiation, when a VRF name is downloaded, the vaccess created for the session is now associated with new VRF.
- In case a PPP renegotiation does not download a VRF name, then the vaccess for the session is not associated with the VRF.
- In case a VRF attribute is downloaded during MIP and VPDN call, the VRF attribute is not used.
  - If for a PMIP call, the VRF attribute is downloaded, Virtual Access will be associated with VRF routing table and the reverse traffic will be sent only through the VRF enterprise.
  - In case of SIP+MIP calls, if the SIP call is established with VRF association, and if a MIP call is requested as the SIP call is associated with a VRF, the MIP call will not be up as the MIP RRQ from MN is sent to the VRF enterprise.
- Any traffic received on VRF applied V-Access will always be forwarded to VRF enterprise, and this is an expected IOS behavior.
- The PDSN supports only IPv4 addresses as a part of the VRF. IPv6 behavior is undefined.
- The data traffic for a vaccess in the forward direction (toward the MN) is received from outside the enterprise, the packet will be dropped by the IOS.
- Accounting of packets at the PDSN occurs normally.
- MN to MN routing packets in case of associated to the same VRF are sent to the enterprise and routed back to the destination MN. The PDSN does not switch this traffic.
- In cases where traffic is destined for the PDSN from the MN, the packets are not routed to the VRF, but are processed at PDSN.
- VRF attributes are synchronized to the standby unit only during session creation. Any changes in the VRF during PPP renegotiation are not synchronized to standby.

#### Other Considerations

- VRF information on the PDSN is applied only when the call established is a SIP session.
- In cases of Mobile-IP users and Proxy Mobile-IP users, this support is not needed since it can already handle over-lapping IP address.
- Overlapping IP addresses in SIP are differentiated by its vaccess and the VRF interface configured. The VRF routing table has a vaccess entry that identifies the corresponding MN.
- VRF support on the PDSN ensures there are separate routing tables per enterprise, and users accessing the enterprise/corporate network have a separate routing table. The packets originated from the user cannot be forwarded outside of this routing table ensuring there is no security risk.

#### Performance

- Additional memory is needed to create the VRF routing table.

#### Scalability

- This feature supports a maximum of 175,000 PDSN sessions.
- The CPS might be impacted due to additional processing per session.

## Configuring PDSN Session Redundancy

The following new commands have been introduced for PDSN Session Redundancy:

### Enabling PDSN Session Redundancy

The active PDSN will be able to synchronize the session and flow related data to its standby peer provided the redundancy capability has been enabled. By default this capability is disabled.

The commands syntax is as follows:

**[no] cdma pdsn redundancy**

When the above CLI command is configured, session redundancy is enabled provided the underlying redundancy infrastructure has been configured. The redundancy functionality for PDSN is disabled when the above command with **no** is executed.

### Periodic Accounting Counters Synchronization

The active PDSN by default will not try synchronizing accounting counters periodically. To enable periodic accounting counters synchronization, configure the following command:

**[no] cdma pdsn redundancy accounting update-periodic**

The **no** form of the command is used to return to the default behavior. When configured, the byte and packet counts for each flow are synchronized from the active to the standby unit (only if they undergo a change) at the configured periodic accounting interval (using **aaa accounting update periodic xxx**). If periodic accounting is not configured, the byte and packet counts are not synchronized.

### Debug Commands for PDSN-Session Redundancy

In order to facilitate the identification of problem areas of PDSN high availability, the following debug commands are introduced for debugging. All of these debug can be turned off using either **undebug all** or **no debug all**, if desired.

**[no] debug cdma attribute**

**[no] debug cdma pdsn redundancy packets**

To debug and collect any data pertaining to PDSN-SR, the above command is executed and the details pertaining to redundancy data is sent to the console.

**[no] debug cdma pdsn redundancy errors**

To debug the PDSN-SR redundancy errors the above command is executed and the details pertaining to A11 data is sent to the console.

**[no] debug cdma pdsn redundancy events**

To debug events for PDSN session redundancy events, above command is executed and the details pertaining to PDSN (for example, RP) data is sent to the console.

### Display of Redundancy Statistics

When a pair of PDSNs is operating in an active and a standby mode, it is desirable to show or display a variety of information about the sessions and its associated flows that have been synchronized to the standby. The following command allows you to view the session redundancy data for PDSN:

**show cdma pdsn redundancy statistics**

On execution the above command displays a number of data items; some of the examples are as follows:

- Number of sessions synchronized
- Number of SIP flows
- Number of MIP flows
- Number of synchronized sessions up after a switch-over.

- Number of sessions failed to synchronize.



**Note** `show cdma pdsn redundancy statistics` will be hidden until **service internal** is configured.

### **show cdma pdsn redundancy**

Running this command, in addition to existing data being displayed, it will also output “pdsn redundancy is enabled,” or “redundancy is not enabled,” depending on whether the redundancy feature for PDSN has been turned on, or not.

### **Clearing of PDSN Session Redundancy Statistics**

```
clear cdma pdsn redundancy statistics
```

On execution of this command, all the data counters associated with the PDSN session redundancy will be actualized to initial value.

### **Other Debug Commands**

In addition to the PDSN-SR debugging commands described above, the following commands associated with high availability are also useful debugging aid:

```
debug redundancy inter-device
```

```
debug ccm
```

### **Other Show Commands**

In addition to the PDSN-SR show commands described above, the following commands associated with high availability are also useful:

```
show redundancy inter-device
```

## **Configuring PDSN Session Redundancy Infrastructure**

The PDSN-SR feature uses the Cisco IOS Check-point Facility (CF) to send stateful data over Stream Control Transmission Protocol (SCTP) to a redundant PDSN. Additionally, in conjunction with Cisco IOS HSRP, the PDSN uses the Cisco IOS Redundancy Facility (RF) to monitor and report transitions on active and standby PDSNs.

Before you configure PDSN-SR, you need to configure the inter-device redundancy infrastructure.

## **Configuring HSRP**

The HSRP provides high network availability because it routes IP traffic from hosts on networks without relying on the availability of any single router. HSRP is used in a group of routers for selecting an active router and a standby router. HSRP monitors both the inside and outside interfaces so that if any interface goes down, the whole device is deemed to be down and the standby device becomes active and takes over the responsibilities of an active device.

When configuring HSRP, note that the following recommendation and restrictions apply:

- At minimum, HSRP must be enabled and an HSRP a “master” group defined on one interface per PDSN instance. A “follow” group can be configured on all other PDSN interfaces using the standby interface configuration command with the follow keyword option specified. The advantages of using follow groups are:

- The follow group feature enables all interfaces on which it is configured to share the HSRP parameters of the master group.
- Interfaces that share the same group will follow the state of master interface and will use same priority as master interface. This will ensure that all interfaces are in the same HSRP state. Otherwise there is a possibility of one or more interfaces to assume another role than the master HSRP interface.
- This optimizes HSRP group number and hence minimizes the configuration and maintenance overhead when having large configurations.
- It eliminates unnecessary network traffic over all interfaces by eliminating HSRP Hello messages from follow groups, if configured.
- Do not configure a preemption delay on the standby PDSN using the standby preempt interface configuration command.
- When the **standby use-bia** command is not used to allow bridge and gateways to learn the virtual MAC address, for optimization purposes, configure the **standby mac-refresh** command to a value greater than the default (hello messages are sent every 10 seconds) under the main interface (gig0/0). This value is used as the hello message interval.




---

**Note** If **standby use-bia** is configured, no hello messages are sent out of the follow group interfaces. We recommended that you use the default virtual MAC address with HSRP unless explicitly required not to.

---

- An ARP multicast packet is sent out when there is a HSRP state change to active. ARP requests for follow group virtual IP address are responded if HSRP state is active. Also an ARP multicast is sent on the follow group VLAN when a slave virtual IP address is configured and if the master group is active.

Use the same group number for each PDSN follow group as is defined for the primary group. Using the same group number for the primary and follow groups facilitates HRSP group setup and maintenance in an environment that contains a large number of PDSN interfaces and HRSP groups.

More information on HSRP configuration and HSRP groups can be found here:

[http://www.cisco.com/en/US/partner/tech/tk648/tk362/tk321/tsd\\_technology\\_support\\_sub-protocol\\_home.html](http://www.cisco.com/en/US/partner/tech/tk648/tk362/tk321/tsd_technology_support_sub-protocol_home.html)

and

[http://www.cisco.com/en/US/partner/tech/tk648/tk362/technologies\\_configuration\\_example09186a0080094e90.shtml](http://www.cisco.com/en/US/partner/tech/tk648/tk362/technologies_configuration_example09186a0080094e90.shtml)

## Enabling HSRP and Configuring an HSRP Master Group

To enable HSRP on an interface and configure the primary group, use the following commands in interface configuration mode:

- 
- Step 1** Router(config-if)# **standby [group-number] ip [ip-address [secondary]]**  
Enables the HSRP on the interface.
- Step 2** Router(config-if)# **standby [group-number] priority *priority***

Set the Hot Standby priority used in choosing the active router. The priority value range is from 1 to 255, where 1 denotes the lowest priority and 255 denotes the highest priority. Specify that, if the local router has priority over the current active router, the local router should attempt to take its place as the active router.

**Step 3** Router(config-if)# **standby** [group-number] **name** *name*

Specifies the name of the standby group.

**Step 4** Router(config-if)# **standby use-bia** [scope interface]

(Optional) Configures HSRP to use the burned-in address of an interface as its virtual MAC address instead of the preassigned MAC address.

## Configuring Follow Groups

HSRP follow groups are configured to share the HSRP parameters of the primary group by defining a follow group on the interface using the standby interface configuration command with the follow keyword option specified. Interfaces that share a group track states together and have the same priority.

To configure an interface to follow a primary group, use the following command in interface configuration mode:

**Step 1** Router(config-if)# **standby** *group-number* **follow** *group-name*

Specifies the number of the follow group and the name of the primary group to follow and share status.



**Note** It is recommended that the group number specified is the same as the primary group number.

**Step 2** Router(config-if)# **standby** *group-number* **ip** *virtual-ip-address*

Specifies the group number and virtual IP address of the follow group.



**Note** The group number specified above should be same as the master group number.

## Enabling Inter-Device Redundancy

To enable inter-device redundancy, use the following commands beginning in global configuration mode.

**Step 1** Router(config)# **redundancy inter-device**

Configures redundancy and enters inter-device configuration mode.

To remove all inter-device configuration, use the **no** form of the command.

**Step 2** Router(config-red-interdevice)# **scheme standby** *standby-group-name*

Defines the redundancy scheme that is to be used. Currently, “standby” is the only supported scheme.

*standby-group-name*-Must match the standby name specified in the **standby name** interface configuration command (see the “Configuring HSRP” section). Also, the standby name should be the same on both PDSNs.

- Step 3** Router(config-red-interdevice)# **exit**  
Returns to global configuration mode.
- 

## Configuring the Inter-Device Communication Transport

Inter-device redundancy requires a transport for communication between the redundant PDSNs. This transport is configured using Interprocess Communication (IPC) commands.

To configure the inter-device communication transport between the two PDSNs, use the following commands beginning in global configuration mode:

---

- Step 1** Router(config)# **ipc zone default**  
Configures the Inter-device Communication Protocol (IPC) and enters IPC zone configuration mode. Use this command to start the communication link between the active device and the standby device.
- Step 2** Router(config-ipczone)# **association 1**  
Configures an association between two devices and enters IPC association configuration mode. In IPC association configuration mode, you configure the details of the association, such as the transport protocol, local port and local IP addresses, and the remote port and remote IP addresses. Valid association IDs range from 1 to 255. There is no default value.
- Step 3** Router(config-ipczone)# **no shutdown**  
Restarts a disabled association and its associated transport protocol. Shutdown of the association is required for any changes to the transport protocol parameters.
- Step 4** Router(config-ipczone-assoc)# **protocol sctp**  
Configures Stream Control Transmission Protocol (SCTP) as the transport protocol for this association and enables SCTP protocol configuration mode.
- Step 5** Router(config-ipc-protocol-sctp)# **local-port** *local\_port\_num*  
Defines the local SCTP port number to use for communication with the redundant peer and enables IPC transport-SCTP local configuration mode. The IPC zone configuration must be distributed to the TCOPs. The TCOPs establish SCTP connection with their peer, so a set of 12 contiguous port numbers from the configured SCTP port number are used for RF or CF purposes.  
Router(config-ipc-protocol-sctp)# **local-port** 5000  
In the above case, port numbers between 5000 and 5011 are used for SCTP communication. If you have enabled autosynchronization feature, configure the SCTP port as:  
Router(config-ipc-protocol-sctp)# **unit1-port** *port\_num*  
Valid port numbers range between 1 and 65535. There is no default value.




---

**Note** Ensure that the local port number and the remote port number on the peer router are identical.

---

- Step 6** Router(config-ipc-local-sctp)# **local ip** *ip\_addr*  
Defines the local IP address that is used to communicate with the redundant peer. The local IP address must match the remote IP address on the peer router.

Router(config-ipc-unit1-sctp)# **unit1-ip** *ip\_addr*

Represents the IP address that is used to communicate with the redundant peer, if autosynchronization is enabled.

**Step 7** Router(config-ipc-local-sctp)# **keepalive** [*period* [*retries*]]

Enables keepalive packets and specifies the number of times that the Cisco IOS software tries to send keepalive packets with a response before bringing down the interface or tunnel protocol for a specific interface.

Valid value for period is an integer value in seconds great than 0. The default is 10. Valid value for retries is an integer value greater than one and less than 355. The default is the previously used value or 5 if there was no value previously specified.

**Step 8** Router(config-ipc-local-sctp)# **retransmit-timeout** *interval*

Configures the message retransmission time. Valid range is 300 to 60000 milliseconds. The minimum default is 1000. The maximum default is 60000.

**Step 9** Router(config-ipc-local-sctp)# **path-retransmit** *number*

Configures the maximum number of keep-alive retries before the corresponding destination address is marked inactive. Valid range is 2 to 10. The default is 5.

**Step 10** Router(config-ipc-local-sctp)# **assoc-retransmit** *number*

Defines the maximum number of retransmissions over all destination addresses before an association is declared failed. Valid range is 2 to 20. The default is 10.

**Step 11** Router(config-ipc-local-sctp)# **exit**

Exits IPC transport - SCTP local configuration mode.

**Step 12** Router(config-ipc-protocol-sctp)# **remote-port** *port\_num*

Defines the remote SCTP port that is used to communicate with the redundant peer and enables IPC Transport-SCTP remote configuration mode. Valid port numbers range from 1 to 65535. There is no default.




---

**Note** The remote port number should be the same as the local port number on the peer device.

---

**Step 13** Router(config-ipc-protocol-sctp)# **unit2-port** *port\_num*

Defines the SCTP port for the unit2, if autosynchronization is enabled.

Router(config-ipc-remote-sctp)# **remote-ip** *ip\_addr*

Defines the remote IP address of the redundant peer that is used to communicate with the local device. All remote IP addresses must refer to the same device. To remove an association configuration, use the **no** form of the command.

Router(config-ipc-unit2-sctp)# **unit2-ip** *ip\_addr*

Defines the unit2 IP address of the redundant peer that is used to communicate with the unit1 device.

---

## Using the Loopback Interface For the PDSN-AAA Server Interface

To ensure that the AAA server views the active and standby units as a single NAS, the same NAS IP address should be used by both the units. Now, the NAS IP address can be configured for the PDSN using the **ip radius source-interface** command. When configured, the IP address of that interface is used as the NAS IP address.

However, the command does not support virtual IP addresses (HSRP). As a result, the only way to ensure that both the units appear as a single NAS is to configure a loopback interface, and use that interface as the source-interface. In short, the CLI command would look something like:

```
ip radius source-interface Loopback1
```

## Configuring Application Tracking to Handle Active-Active Situation

---

**Step 1** Router(config) # **track object-id application pdsn**

Defines a tracking object for PDSN application.

**Step 2** Router(config-if) # **standby track object-id [decrement priority]**

Associates the tracking object defined for PDSN with the HSRP config. HSRP would start tracking the state of this object. The configured **decrement priority** is used to change the HSRP priority based on the state of the tracking object. If the tracking object is “UP”, HSRP will have the configured priority. If the tracking object is “DOWN”, HSRP decrements its priority by the **decrement priority** specified in the **standby track** command.




---

**Note** If preemption is configured, the *priority* value should be greater than the difference in priorities of the active and standby PDSNs

---

# Protocol Layering and RP Connections

Each mobile station has a single PPP connection with the PDSN, and for each PPP connection there is a corresponding R-P connection between the PDSN and the Base Station/ PCF. R-P connection-related information is maintained for the duration of the PPP connection.

Additionally, the PPP connection and the associated HDLC, LCP, CCP and IPCP state information is also maintained for the duration of the packet data session. One SIP flow and several MIP flows can be supported over a single PPP connection.




---

**Note** Closed RP is not supported in Cisco PDSN Release 4.0.

---

## Open RP Interface Connections

An R-P connection represents the logical tunnel between the PDSN and the Base Station/PCF. It enables bearer data for a PPP connection to be transported between the PDSN and the Base Station/PCF. R-P connection state information is maintained at the PDSN for the duration of the PPP connection. During

handoff, the mobile station may connect the PDSN through another Base Station/PCF entity resulting in establishment of another R-P connection between the PDSN and the new Base Station/PCF. This results in the release of the R-P connection between the PDSN and the old Base Station/PCF.

R-P connection state information is maintained at the PDSN even during the dormant phase of the session. When a mobile station transitions to active state, this information allows the PDSN to associate the mobile station with an already available PPP connection. Loss of R-P state information results in the release of the PPP connection by the PDSN. As a result, a mobile station accessing packet data services following the loss of an R-P connection results in the establishment of a new PPP connection, and the reset and restart of user applications. Therefore, the PDSN retains the R-P connection state information to ensure minimal disruption of user applications during transitions between active and dormant session phases.

## PPP Connections

A PPP connection represents the link layer connectivity between the mobile station and the PDSN. It includes the HDLC state, negotiated LCP parameters, negotiated IP address and CCP compression state tables, and so on. Peer PPP entities may re-negotiate LCP and CCP parameters during an active session without compromising continuity of user sessions; however, user identity, authentication-related information and negotiated IP addresses are retained, thus ensuring that applications established over the SimpleIP flow are unaware that renegotiation has occurred. PPP connection state information is retained at the PDSN during dormant phase of the session to ensure minimal disruption of user applications during transitions between active and dormant session phases.

## Application Flows

One SIP and several MIP flow instances can be supported over a single PPP connection. For each SIP flow, the state information includes the associated IP address, NAI and billing related usage data records (UDRs), and other related information. For each MIP flow, the state information includes the MIP visitor list information, NAI and UDRs, and other related information.

## PPPoGRE RP Interface

The PDSN interfaces with the Radio Network/Base Station to provide a transmission path for the user data stream between the packet network and the radio access network. The PDSN interfaces to the Radio Network through the Packet Control Function (PCF) using the PPPoGRE RP interface.

The following list describes the transmission path between the Radio Network and the PDSN:

- The PDSN provides a media-independent physical link that supports IP packet transport capabilities.
- The PPPoGRE RP Interface supports both the signaling channel and the bearer data transport capabilities.

The PPPoGRE RP interface is based on 3GPP2 TIA/EIA/IS-835 standard for the control and bearer data transport capabilities. The following list describes the differences between the 3GPP2 standard and PPPoGRE RP Interface from the PDSN perspective:

- The PCF connecting the PDSN that supports PPPoGRE functionality sends the A11 Registration request with the GRE Protocol Type field set to 0x880B.
- Neither the PDSN, nor the MN requires AHDLC framing or de-framing for the PPPoGRE sessions.

- A10 bearer data packets are sent and received in the GRE Protocol field set to 0x880B (PPPoGRE).

## A11 Session Update

This feature is based on Interoperability Specification (IOS) for *cdma 2000 Access Network Interfaces (Part 7 (A10 and A11 Interfaces) (3G-IOSv4.3) Version 2.0.1 Date: July 2003)* and Interoperability Specification (IOS) for *cdma 2000 Access Network Interfaces (Part 3 Features (3G-IOSv4.3) Version 2.0.1 Date: July 2003 standard)*. An A11 Session Update message is sent from the PDSN to the PCF to add, change, or update session parameters for an A10 connection. The following parameters are sent from the PDSN to PCF in an A11 Session Update message in a session parameters NVSE extension with Application Type 08H (Session Parameter). These session parameters NVSE extension will also be sent by the PDSN in the A11 Registration Reply messages.

- Radio Network Packet Data Inactivity Timer [01H]
  - Application Sub-Type 01H, the Application Data field contains the Radio Network Packet Data Inactivity Timer (RN-PDIT) value in seconds. This field is one octet in length and has range 01H-FFH, corresponding to timer values 1-255 seconds.
  - Supported for Service types SIP, MIP, PMIP, MSID, and VPDN.
- Always On Indicator [02H]
  - For Application Sub Type 02H ((Always-on indicator), the Application Data is zero bytes in length.
  - Supported for Service types SIP and MSID.

As per the standard *cdma 2000® Wireless IP Network Standard TIA-835-C, AUGUST 2003*, the PDSN will download the Always On Indicator VSA and RN-PDIT VSA from the RADIUS server (Visited/Home RADIUS) during the authentication phase. If a user initiates multiple packet data sessions, the PDSN may receive more than one RN PDIT VSA from different home domains. In this case, the largest RN PDIT value received from different home domains is sent from the PDSN to the RN. This update may happen during an ongoing packet data session when the PDSN receives a new RN PDIT value that is greater than the one previously sent to the RN. For Handoff scenario the RN-PDIT and Always-On indicator are sent the PCF in the A11 Registration Reply if the Airlink is not dormant.

## SDB Indicator Marking

This feature supports short data burst (SDB) applications, such as SIP signaling for PTT applications, and proposes the interaction with the PDSN. SIP is used by PTT applications to signal a PTT call. The message is short and needs to be delivered to the end-user. The Short Data Burst support on the RAN can be used to send these to the end-user, especially when the messages are to be terminated to the mobile. This is especially important when the mobile user is actually dormant.

The proposal consists of two parts:

- Signalling of SDB indication, or other indications, on the GRE link between PDSN and PC.
- Identification of data packet suitable for payloads.



### Note

SDB Marking is only supported for service type SIP.

## Signaling of SDB Indication

The SDB indication is based on the 3GPP2 Proposal Contribution (Ericsson/SKT) A30-20030818-006, where one of the reserved bits in the GRE header is used to indicate the SDB packets from the PDSN for dormant sessions. The PDSN definition of dormancy is Airlink Stop record A11 Registration request is received from the PCF and A11 Registration success reply is sent by the PDSN.

The PDSN may set the B bit to “1” if the GRE frame contains an IP packet suitable for transmission over the air interface in a Data Burst Message. In the PCF-to-PDSN direction, and on the A8 interface, the B bit is set to “0”.

## Identification of Data Packets For SDB Indication

SDB indication is required for certain types of data only. Packets destined towards the mobiles that match the policy criteria will be chosen for SDB indication provided the mobile is in dormant mode

The local policy can be considered for an initial phase, if the selection of servers or signaling protocols is limited. For example, if there is only a single SIP server sending out SIP signaling message, a combination of port and source IP address may be used. In addition to this, the PDSN can also be configured with the min and max IP length.

On a PDSN, IOS MQC can be used to apply classification rules for matching packets that require SDB classification. For example, simple classification criteria can include port number, and source IP address range of the server. A more complex classification criterion can include a custom protocol inspection.

If packets pass the classification criteria and the user is dormant, the PDSN will signal SDB indication to the PCF.

To enable the identification of data packets for SDB indication feature, use the following command:

```
cdma pdsn compliance ios4.1 sdb
```

This command enables the PDSN to process an SDB record sent from PCF according to IOS4.1 Standard.

If deep classification is required for certain types of payloads such as RTP, or a custom application, IOS NBAR can be used for inspecting these packets. For a detailed description of how to configure IOS NBAR please refer to the documentation on NBAR.

A sample configuration for the classification function is shown here:

```
class-map match-all sdb-packets
  match packet length min 100 max 300
  match protocol <protocol>
  match access-group <access-group-number>
ip access-list <access-group-number> permit ip 192.0.2.0 0.0.0.255 any
```

(This example of access-list allows matching of a certain protocol from servers whose address range is 192.0.2.0/24)

The protocol and the access-group can be set to match the desired packet stream. The match criteria can also include a custom protocol inspection such as

```
ip nbar custom media_new 8 hex 0x60 dest udp 3001
```

The above statement classifies all packets with a UDP destination of port 3001, and contains the value 0x60 at offset 8. The protocol **media\_new** can now be used in the **match protocol protocol** statement.

```
policy-map sdb-policy
  class sdb-packets
  set qos-group group-number
```

The policy map is then applied to the input interface. The group-number represents the classified match criteria. All packets that are set with the specific group-number will be flagged for SDB usage between the PCF and the PDSN. This is done with the following command:

```
cdma pdsn a11 dormant sdb-indication gre-flags group-number
```

The B bit (SDB indication) would be set for packets matching the sdb-indication group-number.

## SDB Indicator Marking for PPP Control Packets

While data packets can be sent towards the mobile using SDBs as shown above, SDBs can also be used for delivering PPP control packets. This can be particularly helpful for Always-On sessions, where the session is dormant. Basically, with Always On configured, the PDSN sends out LCP echo requests (and waits for LCP echo replies) to keep the session alive. Hence, when such a session goes dormant, a data channel needs to be setup to deliver these LCP echo requests to the MN. The other option is to use SDBs to deliver the LCP echo requests without setting up a data channel.

Configure the following CLI command along with the above CLIs to enable this feature:

```
cdma pdsn a11 dormant sdb-indication match-qos-group group-number ppp-ctrl-pkts
```

## Multiple Service Connections

The PDSN currently maintains one A10 connection and an associated session, and supports multiple flows (one SIP and multiple MIP flows). In this new implementation, the term “Service connection” indicates an A10 connection as defined in IS-835-D. All A10 service connections for a given MS are associated with a single A10 session. The series of packets that share a specific instance of IETF protocol layers are called “IP flows”. Multiple IP flows may use a single service connection. Currently, there is one main service instance only, and all SIP and MIP flows use that single service instance. IP Flows on different flows (SIP or MIP) can be spread across different A10s.

Each A10 connection can support multiple IP flows, as indicated by the RAN in A11 messaging. The TFTs signaled by the MS indicate which applications are mapped to which IP flow.

The mapping of an IP flow to the A10 session is sent by the PCF. Each IP flow is identified using a Flow ID.

Cisco PDSN Release 4.0 supports a maximum of 25,000 sessions with two aux A10s and two IP flows per direction per aux A10.

## Session Creation—A11 Registration Request

### Connection Establishment Call Flow

The PCF sends the initial A11 Registration Request with Service Option 59 for the main service connection. This SR ID is always the main service instance in the A11 Registration Request. This service flow is the default A10 connection, and is used by the Application Flows with ID FFH for both forward and reverse directions. When a MN needs multiple flows, the PCF sends out an A11 Registration Request with non-zero lifetime including Additional Session Information NVSE (which contains details of additional A10 connections to be created). The current implementation supports only SO 64, and not SO 67. Aux connection SO 64 requires PPPoAHDLC.

The RRQ contains the R\_QOS\_SUBBLOB along with the Additional Session Info (GRE Key information), which provides the mapping of A10 to Flow IDs.

All PPP negotiations happen over the main service connection.

### A11 Registration Reply

PDSN sends out a Registration Reply based on the Request received with non-zero lifetime from PCF. On receiving a valid A11 registration request, the PDSN creates the requested A10 connections and acknowledges them to the PCF. If any aux connection is new in the A11 request, then a new A10 connection is created. If the information of any aux connection present on the PDSN is missing in the A11 registration request, then that A10 connection is deleted from the PDSN. If any of the aux connections failed to be created on the PDSN, the PDSN responds with the message: Insufficient Resources.

Each A10 connection is created based on the GRE key in the Additional Session Information NVSE (Application Type 0CH). The application flows defined in the QoS NVSE (Application Type 0DH) (Forward and Reverse) are linked to the corresponding A10 connection based (GRE information NVSE) on SR ID. This registration reply also includes the subscriber QoS policy during authentication (when attributes are downloaded from the AAA server during authentication), and dormant handoff.

Whenever additional session information contains SO other than 64, it is rejected with 8BH (Registration Denied - service option not supported).

Whenever mapping of Flow to A10 is received but SRID does not exist, it is rejected with 8EH (Registration Denied - nonexistent A10 or IP flow).

### Session Refresh

All A11 Reregistrations (A11 Registration request with non-zero lifetime) contain all the A10 connections in the Additional Session NVSE that exist after this reregistration. If there are additional A10 connections in the Additional Session NVSE, they are created. A10 connections that already existed but are absent in the request are released.

During reregistration, it is possible for the mapping of flow IDs to A10 to change. A MN and a PCF might renegotiate the mapping and forward the same to the PDSN. The PDSN accordingly remaps the flow ID to the newly mapped A10.

### Session Deletion

In order to release all the connections from the PCF, an A11 Registration Request is sent by the PCF with a lifetime value of zero. Releasing the main service connection releases all its aux connections as well.

When the PDSN wants to terminate the session, an A11 Registration Update is sent. This occurs when all of the connections need to be brought down. The PDSN cannot initiate a release of a particular connection. There is no change in the packet format of this message. The SRID is always filled with one for HRPD sessions.

### A11 Session Update

An A11 session update is used to pass on the newly downloaded or updated subscriber QoS profile to the PCF. The PDSN does not include the QoS update information as the PDSN does not update the QoS information.

When configured, an A11 Session Update is sent when at least one of the subscriber QoS attributes is downloaded during authentication. During handoff the attributes are sent in a RRP except when the session is dormant. When the session is dormant, a session-update is sent when the session becomes active.

## Configuring Multiple Service Connections

To configure the Multiple Service Connections feature on the PDSN, perform the following tasks:

	Command	Purpose
Step 1	<pre>router# cdma pdsn multiple service-flows [maximum number]</pre>	Enables the multiple flow support feature. The maximum number defines the maximum number of aux A10s that can be created between PDSN and PCF. The default value is 7.

### Example

Here is a sample configuration:

```
router#cdma pdsn multiple service-flows ?
      maximum Maximum limit
      qos       Configure qos parameters
      <cr>

router# cdma pdsn multiple service-flows
router# cdma pdsn multiple service-flows maximum 8
```

## Verifying the Configuration

To verify that the Multiple Service Connections feature is enabled on the PDSN, perform the following tasks:

	Command	Purpose
Step 1	<pre>router# Show cdma pdsn</pre>	<p>In Cisco PDSN Release 4.0, the show output is enhanced to display the following information:</p> <ul style="list-style-type: none"> <li>• The multiple service flow feature is enabled, or disabled.</li> <li>• Maximum number of aux A10s allowed.</li> <li>• Number of sessions active with service flows.</li> <li>• Total number of service flows currently active in the system.</li> </ul>
Step 2	<pre>router# show cdma pdsn session [{service-flows   detail}]</pre>	<p>In Cisco PDSN Release 4.0, the output is enhanced to display the following information:</p> <ul style="list-style-type: none"> <li>• New service flow details.</li> <li>• New IP flow details for both forward and reverse directions.</li> </ul>

	Command	Purpose
Step 3	router# <b>Show cdma pdsn statistics</b>	In Cisco PDSN Release 4.0, new counters are introduced to display the following information: <ul style="list-style-type: none"> <li>• The number of requests (both new requests and reregistration requests) that contained additional session information NVSE and QoS information NVSE.</li> <li>• New reject reasons for requests containing aux connection details like unsupported service option, non-existing A10.</li> <li>• The number of missing connections and the number of remapping flows.</li> </ul>
Step 4	router# <b>show cdma pdsn session brief</b>	In Cisco PDSN Release 4.0, a new column is introduced to display the number of service flows for the session.
Step 5	router# <b>Show cdma pdsn pcf</b>	In Cisco PDSN Release 4.0, new counters are introduced to display the number of aux A10s that exist.
Step 6	router# <b>Show cdma pdsn pcf brief</b>	In Cisco PDSN Release 4.0, a new column is introduced to display the number of aux A10s currently existing on the PCF.

## Examples

Here is an example for Cisco PDSN Release 4.0:

```

router# show cdma pdsn
PDSN software version 4.0, service is enabled

A11 registration-update timeout 1 sec, retransmissions 5
A11 session-update timeout 3 sec, retransmissions 3
Mobile IP registration timeout 300 sec
A10 maximum lifetime allowed 65535 sec
GRE sequencing is on
Maximum PCFs limit not set
Maximum sessions limit set to 10 (default 9950 maximum)
SNMP failure history table size 100
MSID Authentication is disabled
Ingress address filtering is disabled
Sending Agent Adv in case of IPCP Address Negotiation is enabled
Allow CI_ADD option during IPCP Phase is disabled
Aging of idle users disabled
Radius Disconnect Capability disabled
Multiple Service flows enabled
Maximum number of service-flows per MN allowed is 8
Call Admission Control enabled
Police Downstream enabled

Number of pcfs connected 1,
Number of pcfs 3GPP2-RP 1,
Number of sessions connected 1,
Number of sessions 3GPP2-RP 1,
Number of sessions Active 1, Dormant 0,
Number of sessions using HDLCoGRE 1, using PPPoGRE 0
Number of sessions using Auxconnections 1, using Policing 1, using DSCP 1

```

```

Number of service flows 1
  Simple IP flows 1, Mobile IP flows 0,
  PMIP flows 0, VPDN flows 0

```

Here is another example with information about service flows and session details:

**router#show cdm pds session service-flows**

```

Mobile Station ID IMSI 09884708942
PCF IP Address 2.2.2.4, PCF Session ID 1

GRE protocol type is 0x8881
GRE sequence number transmit 17, receive 0
Using interface Virtual-Access2.1
Using AHDLC engine on slot 0, channel ID 1
Service Option EV-DO Flow Discrimination 0 DSCP Included 0
Flow Count forward 0 reverse 0
This session has 1 flow
This session has 1 service flow

Service Flow PCF IP Address 2.2.2.4 SR ID 0x2
  Service Option 0x40 Flow Discrimination 0 DSCP Included 0
  Flow Count forward 2 reverse 2
  GRE protocol type is 0x8881, key 2
  GRE sequence number transmit 0, receive 0
  Using AHDLC engine on slot 0, channel ID 0

```

Here is an example output for the **show cdma pdsn statistics** command for Cisco PDSN Release 4.0:

```

router# show cdma pdsn statistics
Last clearing of "show cdma pdsn statistics" counters never
RP Interface:
  Reg Request rcvd 1524, accepted 1405, denied 2, discarded 117
  Initial Reg Request rcvd 18, accepted 17, denied 1, discarded 0, AuxRequest 1
  Re-registration requests rcvd 1380, accepted 1374, denied 0, discarded 6
Re-registration requests containing Active-Start 15, Active-Stop 16, updated QoS Blob 5
Re-registration requests containing new connections 10, missing connections 12, remapping
flows 1

Handoff requests rcvd 2, accepted 2, denied 0, discarded 0, AuxRequest 1
De-registration rcvd 13, accepted 12, denied 1, discarded 0
De-registration Reg Request with Active-Stop 9
Registration Request Errors:
  Unspecified 0, Administratively prohibited 0
  Resource unavailable 0, Authentication failed 0
  Identification mismatch 1, Poorly formed requests 1
  Unknown PDSN 0, Reverse tunnel mandatory 0
  Reverse tunnel unavailable 0, Bad CVSE 0
  Max Service Flows 0, Unsupported SO 0, Non-existent A10 0,
  Bandwidth unavailable 0

Update sent 52, accepted 9, denied 8, not acked 35
Initial Update sent 14, retransmissions 38
Acknowledge received 17, discarded 0
Update reason lifetime expiry 0, PPP termination 11, other 3
Registration Update Errors:
  Unspecified 0, Identification mismatch 8
  Authentication failed 0, Administratively prohibited 0
  Poorly formed request 0

Handoff statistics:
  Inter PCF handoff active 2, dormant 0
  Update sent 5, accepted 2, denied 2, not acked 1
  Initial Update sent 2, retransmissions 3
  Acknowledge received 4, discarded 0

```

```

De-registration accepted 2, denied 0
Handoff Update Errors:
  Unspecified 0, Identification mismatch 2
  Authentication failed 0, Administratively prohibited 0
  Poorly formed request 0

RP Session Update statistics:
Update sent 0, accepted 0, denied 0, not acked 0
Initial Update sent 0, retransmissions 0
Acknowledge received 0, discarded 0
Sent reasons Always On 0, RN-PDIT 0, Subscriber QoS 0
RP Session Update Errors:
  Unspecified 0, Identification mismatch 0
  Authentication failed 0, Session parameters not updated 0
  Poorly formed request 0

Service Option:
  Unknown (0) success 1405, failure 2

PPP:
Current Connections 0
Connection requests 17, success 17, failure 0, aborted 0
Connection enters stage LCP 17, Auth 6, IPCP 13
Connection success LCP 17, AUTH 6, IPCP 13
Failure reason LCP 0, authentication 0, IPCP 0, other 0
Failure reason lower layer disconnect 0

A10 release before LCP nego by PDSN 0, by PCF 0

LCP Stage
  Failure Reasons Options 0, MaxRetry 0, Unknown 0
  LCP Term Req during LCP nego sent 0, rcvd 0
  A10 release during LCP nego by PDSN 0, by PCF 0

Auth Stage
  CHAP attempt 2, success 2, failure 0, timeout 0
  PAP attempt 4, success 4, failure 0, timeout 0
  MSCHAP attempt 0, success 0, failure 0, timeout 0
  EAP attempt 0, success 0, failure 0
  MSID attempt 0, success 0, failure 0
  AAA timeouts 0, Auth timeouts 0, Auth skipped 11
  LCP Term Req during Auth nego sent 0, rcvd 0
  A10 release during Auth nego by PDSN 0, by PCF 0

IPCP Stage
  Failure Reasons Options 0, MaxRetry 0, Unknown 0
  Options failure reason MN Rejected IP Address 0
  LCP Term Req during IPCP nego sent 0, rcvd 0
  A10 release during IPCP nego by PDSN 0, by PCF 0

CCP Stage
  Connection negotiated compression 0
  Compression type Microsoft 0, Stac 0, other 0
  Connections negotiated MRRU 0, IPX 0, IP 13
  Connections negotiated VJ-Compression 0, BAP 0
  PPP bundles 0
  Connections failed to negotiate compression 0

Renegotiation total 0, by PDSN 0, by Mobile Node 0
Renegotiation success 0, failure 0, aborted 0
Renegotiation reason: address mismatch 0, lower layer handoff 0
  GRE key change 0, other 0

```

Release total 16, by PDSN 14, by Mobile Node 2  
 Release by ingress address filtering 0  
 Release reason: administrative 4, LCP termination 2  
   Idle timeout 3, echo missed 0  
   L2TP tunnel 0, insufficient resources 0  
   Session timeout 0, service unavailable 0  
   De-Reg from PCF 0, lifetime expiry 0, other 7

Echo stats  
 Request sent 0, resent 0, max retransmit timeout 0  
 Response rcvd 0

Discarded Packets  
 Unknown Protocol Errors 424, Bad Packet Length 0

RSVP  
 IEs Parsed 0  
 TFTs Created Success 0, Failure 0  
 TFTs Updated Success 0, Failure 0  
 TFTs Deleted Success 0, Failure 0

Other Failure 0  
 Unknown 0, Unsupported Ie types 0  
 Tft Ipv4 Failure Stats  
   Tft Unauthorized 0, Unsuccessful Processing 0  
   Tft Treatment Unsupported 0, Persistency reached 0  
   Packet Filter Add 0, Replace 0  
   Packet Filter Precedence Contention 0, Unavailable 0  
   Packet Filter Maximum Limit 0, Non-Existent Tft add 0

QoS:  
 Total Profile Download Success 10, Failure 10,  
 Local Profile selected 4  
   Failure Reason DSCP 1, Flow Profile ID 1,  
   Service Option Profile 1, Others 1  
 Total Consolidated Profile 4, DSCP Remarkd 0  
 Total Policing installed 4, failure 5, removed 4

slot 0:  
 AHDLC Engine Type: CDMA HDLC SW ENGINE  
   Engine is ENABLED  
   total channels: 20000, available channels: 20000

Framing input 5306 bytes, 169 paks  
 Framing output 7008 bytes, 169 paks  
 Framing errors 0, insufficient memory 0, queue overflow 0  
   Invalid size 0

Deframing input 1371683974 bytes, 4005798483 paks  
 Defaming output 4948 bytes, 142 paks  
 Deframing errors 0, insufficient memory 0, queue overflow 0  
   Invalid size 64, CRC errors 117817589

RADIUS DISCONNECT:  
 Disconnect Request rcvd 0, accepted 0  
 Disconnect Request Errors:  
   Unsupported Attribute 0, Missing Attribute 0  
   Invalid Request 0, NAS Id Mismatch 0  
   Session Cxt Not Found 0, Administratively Prohibited 0

## Data Plane

### Downstream or Forward Packet Processing

When a packet is received in the forward direction at the PDSN, flow accounting occurs. At this point, the PDSN first identifies the TFT that can be applied based on the destination IP address. The packet is then run through the packet filters to identify the application flow. The A11 RRQ contains the mapping of the application flows to the service flow. With that mapping, the service flow is identified and the packet is marked with the A10 connection information. If the packet is a PPP control packets, the packet is marked with main A10 connection. When the packet later completes AHDLC encapsulation after PPP encapsulation, the corresponding A10 connection is selected and forwarded to the tunnel.

In the A11 RRQ, more specifically in the QoS update, the PCF may specify to use flow discrimination. This means that all bearer packets will contain the flow ID that is encoded in the 3GPP2 header extension for GRE.

### Upstream or Reverse Packet Processing

When a packet is received in the reverse direction, after the PPP encapsulation is removed, the packet is picked up by the PDSN for flow accounting. The packet is first evaluated for the DSCP and actions are taken accordingly. If the packet can then be forwarded, the packet is passed through the TFT (which has the packet filters to identify the flow ID). If packet has the “IP flow” details in the GRE header, the packet is directly accounted for that flow ID, and not passed through TFT. Once the flow is identified, accounting is performed and then forwarded. If there is no packet filter to identify a flow, the default flow ID FF is assumed.

## QoS Signaling

This section discusses Quality of Service (QoS) signaling, and involves the following concepts:

- Handling of traffic flow Templates
  - Handling of RSVP messages that carry the TFT message.
  - Handling of TFT—parsing and installation of packet filters.
- Handling of subscriber QoS profile
  - Downloading the subscriber QoS profile, or using the locally configured subscriber QoS profile.
  - Applying the subscriber QoS profile to the session or flow.
- Handling of data traffic
  - Using the TFT, the IP flow is identified and accounted.
  - Policing the data traffic, if requested, based on the maximum aggregate bandwidth.
  - Applying DSCP marking on the packets in both directions based on the profile applied.

## Traffic Flow Templates

Traffic Flow Templates (TFT) define the IP flows. The TFT contains a set of packet filters that define each IP flow. An IP flow can carry multiple application flows, each of which is identified using packet filters.

The MN determines the flows and sends the packet filters in a TFT as a RSVP message. The RSVP message contains a 3GPP2 object that defines the TFT. There could be only one 3GPP2 object with multiple TFTs sent in one RSVP Message. In HRPD, there is only one persistent TFT per MS IP address. The TFT describes the flow, the packet filters, and the packet treatments. The MN sends 1 TFT per IP address per flow direction. These packet filters are associated with a precedence level. The packet filters are sorted and associated with the session. The flow IDs (which are the IP flow IDs) in these packet filters are matched with the IP flow IDs mentioned in the A11 RRQ to determine the corresponding A10 connection to use. If there is no mapping, the PDSN forwards the packet through the main service instance (which is the default A10 and has a flow ID FF).

In this case, RSVP messages are accounted as data traffic on the session.

### Other Considerations

An HRPD MS only uses Non-Specific TFTs in both the forward and reverse directions.

Each TFT IE contains one or more packet filters that are matched against forward or reverse directions. The PDSN supports 255 packet filters per direction per TFT.

During PPP renegotiation, all of the connection details (like TFTs) are released and reestablished when a fresh request comes for the same.

## Packet Filters

Packet filters describe an IP flow for a particular direction. Packet filters contain sub-type PF0 and PF1. PF0 implies the filter is applied on the Outer IP Header and PF1 implies the filter is applied on the extended headers or transport headers. The initial support on PDSN is only for IPv4 addresses/Port/ToS/Protocol. The only protocol supported in the initial phase is IP and GRE. Each packet filter is associated with a precedence level. When a packet (during data traffic) is given to this TFT to identify the ip flow, the packet is passed through these filters in their order of precedence.

## TFT Installation

When a fresh TFT needs to be installed, the MS sends a TFT with “Create new TFT” attached. The following TFTs are marked with appropriate actions like “Add packet filter to existing TFT”, “Delete existing TFT”, “Replace packet filters in existing TFT”, or “Delete packet filters from existing TFT”.

The PDSN replies affirmatively if the TFT is parsed properly and installed successfully.

The PDSN reports one of the following errors depending on the scenario it encountered:

**Table 22** *TFT Error Messages*

Packet filter add failure	PDSN could not add the requested packet filter due to any reason.
Packet filter unavailable	MS attempted to replace or delete packet filter(s) that is/are not installed in the PDSN.
Unsuccessful TFT processing	PDSN could not parse the TFT for any reason, for example, poorly formatted TFT.
Channel not available	MS attempted to installed a non-persistent TFT (P=0) when the corresponding A10 is not established.
Evaluation precedence contention	Contention in the evaluation precedence value detected.
Treatment not Supported	The MS included a flow or channel treatment value that is not supported by the PDSN.
Packet filter replace failure	The packet filter replace request has some unknown error.

**Table 22** TFT Error Messages (continued)

Unauthorized TFT	The MS attempted to install TFTs with a non-authorized IP address in the MSIP address field.
Max number of Packet Filters for the TFT has been reached	The MS attempted to install more than 255 packet filters for the TFT in any direction.
Attempted to add Packet Filters to non	The MS attempted to add packet filters to a TFT before creating the TFT.

The PDSN processes the request in order of the IEs that are present in the 3GPP2 OBJECT. If processing of all the IEs is successful, the PDSN returns a ResvConf message containing the MS IP address. If processing of an IE fails, the PDSN stops further processing of the Resv message. The PDSN returns a ResvErr message to the MS including the error code and the index of the IE that failed processing. The TFT IE index starts from 1. If processing of an IE fails, the PDSN stops further processing of the Resv message but retains the result of any actions already performed on earlier IEs in the message.

### TFT Update

The MS can update the TFT at any point of time. It might do so when there is any change in the packet filter content, or change of MS IP address.

As a TFT is associated with a MS based on its IP address, when there is a change of MS IP address, the MS sends RSVP messages to delete the old and create a new TFT for the new IP address.

TFTs for a session will be deleted only when either the MS sends a delete TFT message, the session goes down, or during PPP renegotiation.

### Configuring TFTs

To configure the PDSN to include the TFT error extensions, perform the following task:

```
router# cdma pdsn tft reject include error extension
```

Configure this CLI command to include the error extension in the reject message whenever a TFT is rejected.

### Example

Here is an example of the **cdma pdsn tft reject include error extension** command:

```
cdma pdsn tft ?
  reject      Configure CDMA PDSN TFT reject

cdma pdsn tft reject ?
  include     Configure CDMA PDSN TFT reject include

cdma pdsn tft reject include ?
  error       Configure CDMA PDSN TFT reject include error

cdma pdsn tft reject include error ?
  extension   Configure CDMA PDSN TFT reject include error extension

cdma pdsn tft reject include error extension ?
```

## Verifying the Configuration

To verify that the TFT feature is enabled, and to gather information about those TFTs, perform the following tasks:

	Command	Purpose
Step 1	router# <b>show cdma pdsn session {qos tft detail}</b>	In Cisco PDSN Release 4.0, the <b>show cdma pdsn session command</b> adds extensions that display the following information: <ul style="list-style-type: none"> <li>• The subscriber QoS profile</li> <li>• TFTs installed for the session in addition to the existing details</li> </ul>
Step 2	router# <b>show cdma pdsn statistics</b>  router# <b>show cdma pdsn statistics tft</b>	In Cisco PDSN Release 4.0, new counters are introduced to display the following information: <ul style="list-style-type: none"> <li>• Number of TFTs parsed successfully or failed.</li> <li>• New counters to identify the TFT parsing failure reasons.</li> <li>• Number of subscriber QoS profile downloaded from the AAA server or locally installed.</li> <li>• Consolidation of subscriber QoS profile.</li> <li>• Policing installed or uninstalled.</li> <li>• Packets for which the DSCP was remarked based on policy installed.</li> </ul>
Step 3	router# <b>show cdma pdsn redundancy</b>	In Cisco PDSN Release 4.0, this command output is enhanced to show the details of the number of TFTs synchronized to standby.

## Example

Here are some configuration examples:

```

router#show cdma pdsn session tft
Mobile Station ID IMSI 123456789011122
  PCF IP Address 10.1.1.1, PCF Session ID 1
  This session has 1 flow
  This session has 1 Tft
  TFT IP Address 3.1.1.1
  Number of Packet Filters Forward 2, Reverse 1
  Forward Packet Filters
    Packet Filter 1
      Flow Id 10, Precedence 255, PF Type 0
      Source Port 125

    Packet Filter 2
      Flow Id 10, Precedence 255, PF Type 0
      Source Port 125

  Reverse Packet Filters
    Packet Filter 1
      Flow Id 10, Precedence 10, PF Type 0
      Source Port 125

Mobile Station ID IMSI 123456789011123

```

```
PCF IP Address 10.1.1.1, PCF Session ID 2
This session has 1 flow
This session has 1 Tft
```

```
TFT
IP Address 3.1.1.2
Number of Packet Filters Forward 2, Reverse 3
Forward Packet Filters
  Packet Filter 1
    Flow Id 2, Precedence 2, PF Type 0
    Source Ip 5.5.5.5 Mask 255.255.255.0

  Packet Filter 2
    Flow Id 5, Precedence 5, PF Type 0
    Source Ip 1.1.1.1 Mask 255.255.255.0
```

```
Reverse Packet Filters
  Packet Filter 1
    Flow Id 10, Precedence 255, PF Type 0
    Source Port 125

  Packet Filter 2
    Flow Id 10, Precedence 255, PF Type 0
    Source Port 125

  Packet Filter 3
    Flow Id 10, Precedence 255, PF Type 0
    Source Port 125
```

**router#show cdma pdsn statistics**

Last clearing of "show cdma pdsn statistics" counters never

RP Interface:

```
Reg Request rcvd 1524, accepted 1405, denied 2, discarded 117
Initial Reg Request rcvd 18, accepted 17, denied 1, discarded 0, AuxRequest 1
Re-registration requests rcvd 1380, accepted 1374, denied 0, discarded 6
Re-registration requests containing Active-Start 15, Active-Stop 16, updated QoS Blob 5
Re-registration requests containing new connections 10, missing connections 12
Handoff requests rcvd 2, accepted 2, denied 0, discarded 0, remapping flows 1
De-registration rcvd 13, accepted 12, denied 1, discarded 0
De-registration Reg Request with Active-Stop 9
Registration Request Errors:
  Unspecified 0, Administratively prohibited 0
  Resource unavailable 0, Authentication failed 0
  Identification mismatch 1, Poorly formed requests 1
  Unknown PDSN 0, Reverse tunnel mandatory 0
  Reverse tunnel unavailable 0, Bad CVSE 0
  Max Service Flows 0, Unsupported SO 0, Non-existent A10 0,
  Bandwidth unavailable 0
```

```
Update sent 52, accepted 9, denied 8, not acked 35
Initial Update sent 14, retransmissions 38
Acknowledge received 17, discarded 0
Update reason lifetime expiry 0, PPP termination 11, other 3
Registration Update Errors:
  Unspecified 0, Identification mismatch 8
  Authentication failed 0, Administratively prohibited 0
  Poorly formed request 0
```

```
Handoff statistics:
Inter PCF handoff active 2, dormant 0
Update sent 5, accepted 2, denied 2, not acked 1
Initial Update sent 2, retransmissions 3
Acknowledge received 4, discarded 0
De-registration accepted 2, denied 0
```

```

Handoff Update Errors:
  Unspecified 0, Identification mismatch 2
  Authentication failed 0, Administratively prohibited 0
  Poorly formed request 0

RP Session Update statistics:
Update sent 0, accepted 0, denied 0, not acked 0
Initial Update sent 0, retransmissions 0
Acknowledge received 0, discarded 0
Sent reasons Always On 0, RN-PDIT 0, Subscriber QoS 0
RP Session Update Errors:
  Unspecified 0, Identification mismatch 0
  Authentication failed 0, Session parameters not updated 0
  Poorly formed request 0

Service Option:
  Unknown (0) success 1405, failure 2

PPP:
  Current Connections 0
  Connection requests 17, success 17, failure 0, aborted 0
  Connection enters stage LCP 17, Auth 6, IPCP 13
  Connection success LCP 17, AUTH 6, IPCP 13
  Failure reason LCP 0, authentication 0, IPCP 0, other 0
  Failure reason lower layer disconnect 0

  A10 release before LCP nego by PDSN 0, by PCF 0

  LCP Stage
    Failure Reasons Options 0, MaxRetry 0, Unknown 0
    LCP Term Req during LCP nego sent 0, rcvd 0
    A10 release during LCP nego by PDSN 0, by PCF 0

  Auth Stage
    CHAP attempt 2, success 2, failure 0, timeout 0
    PAP attempt 4, success 4, failure 0, timeout 0
    MSCHAP attempt 0, success 0, failure 0, timeout 0
    EAP attempt 0, success 0, failure 0
    MSID attempt 0, success 0, failure 0
    AAA timeouts 0, Auth timeouts 0, Auth skipped 11
    LCP Term Req during Auth nego sent 0, rcvd 0
    A10 release during Auth nego by PDSN 0, by PCF 0

  IPCP Stage
    Failure Reasons Options 0, MaxRetry 0, Unknown 0
    Options failure reason MN Rejected IP Address 0
    LCP Term Req during IPCP nego sent 0, rcvd 0
    A10 release during IPCP nego by PDSN 0, by PCF 0

  CCP Stage
    Connection negotiated compression 0
    Compression type Microsoft 0, Stac 0, other 0
    Connections negotiated MRRU 0, IPX 0, IP 13
    Connections negotiated VJ-Compression 0, BAP 0
    PPP bundles 0
    Connections failed to negotiate compression 0

  Renegotiation total 0, by PDSN 0, by Mobile Node 0
  Renegotiation success 0, failure 0, aborted 0
  Renegotiation reason: address mismatch 0, lower layer handoff 0
    GRE key change 0, other 0

  Release total 16, by PDSN 14, by Mobile Node 2
  Release by ingress address filtering 0

```

```

Release reason: administrative 4, LCP termination 2
  Idle timeout 3, echo missed 0
  L2TP tunnel 0, insufficient resources 0
  Session timeout 0, service unavailable 0
  De-Reg from PCF 0, lifetime expiry 0, other 7

Echo stats
  Request sent 0, resent 0, max retransmit timeout 0
  Response rcvd 0

Discarded Packets
  Unknown Protocol Errors 424, Bad Packet Length 0

RSVP
  TFTs Parsed 0
  TFTs Created Success 0, Failure 0
  TFTs Updated Success 0, Failure 0
  TFTs Deleted Success 0, Failure 0
  TFT Failure Stats
    Tft Unauthorized 0, Unsuccessful Parsing 0
    Tft Treatment Unsupported 0, Persistency reached 0
    Packet Filter Add 0, Replace 0
    Packet Filter Precedence Contention 0, Unavailable 0
    Packet Filter Maximum Limit 0, Non-Existent Tft add 0

router#show cdma pdsn redundancy
CDMA PDSN Redundancy is enabled

CDMA PDSN Session Redundancy system status
  PDSN state = ACTIVE
  PDSN-peer state = STANDBY HOT

CDMA PDSN Session Redundancy Statistics
  Last clearing of cumulative counters never
                Synced to standby      Current
                since peer up          Connected
Sessions                0                0
SIP Flows                0                0
MIP Flows                0                0
PMIP Flows               0                0
TFT                      0                0

```

## Subscriber QoS Policy

While establishing a session with PDSN, during authentication subscriber QoS attributes are downloaded from the AAA server. The following are the attributes downloaded from the AAA server as part of subscriber QoS profile:

- Allowed differentiated services markings.
- Allowed number of persistent TFTs.
- Maximum authorized aggregate bandwidth for best-effort traffic.
- Authorized flow profile IDs for each direction.
- Maximum per flow priority.
- service option profile.
- The inter-user priority for best effort traffic.

The maximum authorized aggregate bandwidth is used for policing and bandwidth allocation on the PDSN.

The first two items in the above list are used by the PDSN for authorizing and applying on the bearer traffic. The remaining five attributes are stored and forwarded to the PCF as part of A11 Registration Reply and A11 Session-Update.

If different profiles are downloaded for a MN with single NAI, the profile in the PDSN is updated.

If there are multiple NAIs per MN, multiple versions of the above attributes will be received. The PDSN consolidates the attributes and forwards them to the PCF. This consolidation process provides the following details:

- The total set of all allowed service options
- The maximum of the maximum number of service instances
- The total set of all allowed Authorized Flow Profile IDs.
- The maximum of the Maximum Authorized Aggregate Bandwidth for Best-Effort Traffic.
- The maximum of the maximum per Flow priority.
- The maximum of the Inter-User priority for best effort traffic.

When the subscriber QoS profile is not downloaded from the AAA server, the locally configured QoS profile is applied.

### Allowed Differentiated Services Marking

The Allowed Differentiated Services Marking attribute consists of three subtypes:

- A,E,O bit flags
- Max-class
- RT marking

The MS may mark the packet and send the traffic. The PDSN monitors it and checks if the marked value is within the allowed marking. If packets contain DSCP greater than the allowed value, the PDSN may remark those packets if a remark DSCP is configured. If this remark DSCP is not configured, the packet is forwarded using best-effort DSCP.

The PDSN validates the DSCP in the following ways:

- If max-class is configured, considering all the defined classes are in the ascending order (AF list, EF and Selector Class, in that order), the PDSN checks if the DSCP in the packet is within the range of Max-class.
- If max-class is not present and the A, E, and O bit flags are present, the PDSN checks the DSCP according to the bits set.
- If both max-class and bit flags are not present, the PDSN remarks it with default class.
- If RT marking is set in the attribute, the packets that are reverse tunneled are also marked with the locally configured value.

### Allowed Number of Persistent TFTs

In HRPD, there can be only one persistent TFT per MS IP address. This attribute is not forwarded to the PCF.

If the number of persistent TFT attributes is not downloaded or configured locally, the TFT is rejected with “Unsuccessful TFT Processing” error.

## Maximum Authorized Aggregate Bandwidth

Maximum Authorized Aggregate Bandwidth is used for downstream policing. This value is considered as the guaranteed bandwidth for the mobile for the session. It is forwarded to PCF.

## Configuring the Subscriber QoS Profile

To configure the subscriber QoS profile feature on the PDSN, perform the following tasks:

	Command	Purpose
Step 1	<code>router# cdma pdsn multiple service-flows qos subscriber profile</code>	Enables you to configure the local subscriber QoS profile. This profile will be used for a MN when subscriber QoS profile is not downloaded from the AAA server.
Step 2	<code>router# cdma pdsn multiple service-flows qos remark-dscp value</code>	Enables you to configure the DSCP remark value used for marking when the data packets from the mobile towards the Internet are do not have a DSCP within the allowed dscp value for that mobile.

Configuring the `cdma pdsn multiple service flows qos subscriber profile` takes you to a submode. The following commands are available to configure various parameters in the local subscriber QoS profile:

	Command	Purpose
Step 1	<code>router# cdma pdsn multiple service-flows qos subscriber profile</code>	
	<code>Bandwidth number</code>	Configures the Maximum Aggregate Bandwidth value. Valid Range: 8000-2000000000.
	<code>inter-user-priority value</code>	Configures the Inter-user priority parameter. Valid Range: 1-4294967295.
	<code>tft-allowed value</code>	Configures the allowed number of Persistent TFTs parameter. Valid range: 1-255.
	<code>link-flow value</code>	Configures the maximum service connection parameter in Service Option profile. Valid range:1-4294967295.
	<code>service-option value</code>	Configures Service option allowed to establish over HRPD. Valid range:1-255. For HRPD, SDB records are not supported
	<code>flow-priority value</code>	Configures the maximum per Flow Priority parameter. Valid range: 1-65535.
	<code>flow-profile direction {forward  reverse  bi-direction} flow-id flow-id</code>	Configures the Authorized Flow Profile IDs for each direction.
	<code>dscp {allowed-class {AF EF O}   max-class value  reverse-marking value}</code>	Configures the Allowed Differentiated Services Markings parameter. Valid range: 1-63.

## Examples

Here are some example configurations:

```

router(config)#cdma pdsn multiple service-flows qos subscriber profile
router(config-qos-profile)#
Eg:
cdma pdsn multiple service-flows qos subscriber profile

router# cdma pdsn multiple service-flows qos remark-dscp AF11

router#(config-qos-profile)#bandwidth ?
<8000-20000000000> Value

router#(config-qos-profile)#bandwidth 9000 ?
<cr>

```

### dscp Command

Here is an example of the **dscp** command:

```

router#(config-qos-profile)#dscp ?
  allowed-class    allowed dscp's classes with which user can mark
packets
  max-class        User may mark packets with a class selector code
point
  reverse-marking  marking level pdsn apply to reverse tunneled packets

router#(config-qos-profile)#dscp allowed-class ?
  AF  User can send packets with AF dscp (A bit)
  EF  User can send packets with EF dscp (E bit)
  0   User can mark packets for experiment or local use (0 bit)

router#(config-qos-profile)#dscp allowed-class AF ?
<cr>
AF11      AF11
AF12      AF12
AF13      AF13
AF21      AF21
AF22      AF22
AF23      AF23
AF31      AF31
AF32      AF32
AF33      AF33
AF41      AF41
AF42      AF42
AF43      AF43
Default   Selector Class 0
EF        EF
class1    Selector Class 1
class2    Selector Class 2
class3    Selector Class 3
class4    Selector Class 4
class5    Selector Class 5
class6    Selector Class 6
class7    Selector Class 7

router(config-qos-profile)#

router(config-qos-profile)#dscp reverse-marking ?
AF11      AF11
AF12      AF12
AF13      AF13
AF21      AF21
AF22      AF22
AF23      AF23
AF31      AF31
AF32      AF32

```

```

AF33      AF33
AF41      AF41
AF42      AF42
AF43      AF43
Default   Selector Class 0
EF        EF
class1    Selector Class 1
class2    Selector Class 2
class3    Selector Class 3
class4    Selector Class 4
class5    Selector Class 5
class6    Selector Class 6
class7    Selector Class 7

```

```
router(config-qos-profile)#
```

### flow-priority Command

Here is an example of the **flow-priority** command:

```

router(config-qos-profile)#flow-priority ?
 <1-4294967295> Value

router(config-qos-profile)#flow-priority 100 ?
 <cr>

```

### flow-profile direction Command

Here is an example of the **flow-profile** direction command:

```

router#(config-qos-profile)#flow-profile ?
 direction Configure direction for flow of packet

router#(config-qos-profile)#flow-profile direction ?
 <1-3> 1-Reverse 2-Forward 3-Bi-direction

router#(config-qos-profile)#flow-profile direction 1 ?
 flow-id defines qos treatment to apply to a packet flow

router(config-qos-profile)#flow-profile direction 1 flow-id ?
 <1-65535> Value
router#(config-qos-profile)#flow-profile direction 1 flow-id 100 ?

```

### inter-user-priority Command

Here is an example of the **inter-user-priority** command:

```

router#(config-qos-profile)#inter-user-priority ?
 <1-4294967295> Value

router#(config-qos-profile)#inter-user-priority 200 ?
 <cr>

```

### link-flow Command

Here is an example of the **link-flow** command:

```

router(config-qos-profile)#link-flow ?
 <1-4294967295> Value

router(config-qos-profile)#link-flow 40 ?
 <cr>

router(config-qos-profile)#

```

**tft Command**

Here is an example of the **tft** command:

```
router(config-qos-profile)#tft-allowed ?
<1-4294967295> Value

router(config-qos-profile)#tft-allowed 1 ?
<cr>

router(config-qos-profile)#tft-allowed 1
```

**subscriber redundancy rate Command**

Here is an example of the **subscriber redundancy rate** command:

```
router(config)# subscriber redundancy rate 250 1
```

## Verifying the Configuration

To verify the subscriber QoS profile feature on the PDSN, perform the following tasks:

	Command	Purpose
Step 1	router# <b>show cdma pdsn session {qos tft detail}</b>	In Cisco PDSN Release 4.0, the <b>show cdma pdsn session command</b> adds extensions that display the following information: <ul style="list-style-type: none"> <li>• The subscriber QoS profile</li> <li>• TFTs installed for the session in addition to the existing details</li> </ul>
Step 2	router# <b>Show cdma pdsn qos local profile</b>	This command displays the locally configured subscriber QoS profile.
Step 3	router# <b>show cdma pdsn</b>	In Cisco PDSN Release 4.0, new counters are introduced to display the number of sessions that have QoS enabled, and policing installed and enabled.
Step 4	router# <b>show cdma pdsn statistics</b>	In Cisco PDSN Release 4.0, new counters are introduced to display the following information: <ul style="list-style-type: none"> <li>• Number of TFTs parsed successfully or failed.</li> <li>• New counters to identify the TFT parsing failure reasons.</li> <li>• Number of subscriber QoS profiles downloaded from the AAA server or locally installed.</li> <li>• Consolidation of subscriber QoS profile.</li> <li>• Policing installed or uninstalled.</li> <li>• Packets for which the DSCP was remarked based on policy installed.</li> </ul>

## Examples

Here is an example of the **show cdma pdsn session tft** command:

```
router# show cdma pdsn session tft
Mobile Station ID IMSI 123456789011122
```

```

PCF IP Address 10.1.1.1, PCF Session ID 1
This session has 1 flow
This session has 1 Tft
TFT IP Address 3.1.1.1
Number of Packet Filters Forward 2, Reverse 1
Forward Packet Filters
  Packet Filter 1
    Flow Id 10, Precedence 255, PF Type 0
    Source Port 125

  Packet Filter 2
    Flow Id 10, Precedence 255, PF Type 0
    Source Port 125

Reverse Packet Filters
  Packet Filter 1
    Flow Id 10, Precedence 10, PF Type 0
    Source Port 125

Mobile Station ID IMSI 123456789011123
PCF IP Address 10.1.1.1, PCF Session ID 2
This session has 1 flow
This session has 1 Tft

TFT IP Address 3.1.1.2
Number of Packet Filters Forward 2, Reverse 3
Forward Packet Filters
  Packet Filter 1
    Flow Id 2, Precedence 2, PF Type 0
    Source Ip 5.5.5.5 Mask 255.255.255.0

  Packet Filter 2
    Flow Id 5, Precedence 5, PF Type 0
    Source Ip 1.1.1.1 Mask 255.255.255.0

Reverse Packet Filters
  Packet Filter 1
    Flow Id 10, Precedence 255, PF Type 0
    Source Port 125

  Packet Filter 2
    Flow Id 10, Precedence 255, PF Type 0
    Source Port 125

  Packet Filter 3
    Flow Id 10, Precedence 255, PF Type 0
    Source Port 125

```

Here is an example of the **show cdma pdsn qos local profile** command:

```

router# show cdma pdsn qos ?
  local      CDMA PDSN local qos information

router# show cdma pdsn qos local ?
  profile    CDMA PDSN local qos profile information

router# show cdma pdsn qos local profile ?
  | Output modifiers
  <cr>

router# show cdma pdsn qos local profile ?
CDMA PDSN LOCAL QOS PROFILE
QoS subscriber profile
  Max Aggregate Bandwidth : 8000

```

```

Inter User Priority : 4321
Maximum Flow Priority : 4
Number of persistent TFT : 10
Total link flow : 2
  Service Option : 59
  Service Option : 61
Flow-profile
  Forward flow-id : 1
  Reverse flow-id : 2
  Bi-direction flow-id : 3
DSCP
  Allowed-class AF
  Max-selector class 4

```

Here is a partial example of the show cdma pdsn statistics command that identifies QoS statistics:

```
router #show cdma pdsn statistics
```

QoS:

```

Total Profile Download Success 10, Failure 10, Local Profile selected 4
Failure Reason DSCP 1, Bandwidth 1, TFT 1, Flow Profile ID 1,
Max per flow 1, IUP 1, Others 4
Total Consolidated Profile 4, DSCP Remarkd 0
Total Policing installed 4, failure 5, removed 4

```

## Other QoS Parameters

The MS sends the QoS parameters for the IP flows in R\_QOS\_SUB\_BLOB to PCF. The PCF, after it grants the QoS, forwards the details to the PDSN in an A11 RRQ. This is just stored and forwarded during accounting, and contains the mapping the definitions of IP flows (FlowID) which are used for A10 connection mapping. This blob also contains an indicator of whether the flow ID needs to be included in the bearer packets. If it is set, the PDSN adds a new GRE header, including the flow ID, in all the bearer packets for that flow.

## Flow Remapping

Many times, even while the session and connections are up, the MS might decide to remap. It may do so when a new application is started. In such cases, QoS is again renegotiated, and the details are forwarded to the PDSN. The PDSN creates or deletes the A10, and also remaps the flows to the corresponding A10 connections.

## Per-flow Accounting

### Connection Setup

In HRPD systems, if a single A11-Registration Request message is used to establish multiple A10 connections, an A10 Connection Setup Airlink record is included for each of the A10 connections to be established. No field in the QoS blob is used or processed in the PDSN other than forwarding the same to the AAA server for accounting.

### Airlink Start

An accounting start is generated under the following conditions:

- For IP flows with ID FFH, when the main A10 connection is associated with the traffic channel or when new parameters are set.

- For all other IP flows, when both of the following become true for that IP flow:
  - the IP flow is in the active state, and its associated link flow is associated with the traffic channel.
- When new parameters are set.

**Note**


---

For IP flows with ID FFH in HRPD systems, accounting is bidirectional. It applies to both forward and reverse IP flows.

---

This record does not include granted QoS parameters.

**Airlink Stop**

An accounting stop will be generated under the following conditions:

- The main A10 connection is disassociated from the traffic channel, or parameter settings are no longer valid.
- For all other IP flows, when the IP flow is in the active state and its associated link flow is associated with the traffic channel, and then one or more of the following occurs:
  - the traffic channel is released,
  - the IP flow is deactivated or removed,
  - its link flow is disassociated with the traffic channel; or
- When parameter settings are no longer valid.

For inter-PCF handoff, the source PCF sends an Active-Stop Airlink record for each activated IP flow to the PDSN, and the target PCF send Active-Start Airlink records for each activated IP flow per direction to the PDSN.

During A11 reregistration, if some connections are missing and the flows are deleted, an accounting stop is sent for those connections and flows. Similarly an accounting start is sent for all those newly added flow-ids.

IP flows with received accounting records are identified by the granted QoS that carries the respective IP flow ID and direction. When remapping of IP flows occurs, the flows get mapped from one A10 to another A10. The PDSN sends an accounting stop for the old A10, and an accounting start for the new A10 for that particular IP flow. In this scenario, an accounting Start and Stop is triggered on receiving an active start and active stop, respectively. When an active start and stop are not received and session is torn down, still the pair of accounting stops for the old A10 and the start for new A10 are sent for the IP flow.

When an IP flow receives an active stop with flow status as inactive, it is moved to inactive state. The IP flow becomes active once an active start is received for the same. The PDSN generates a stop accounting stop record when the IP Flow moves from active to inactive state. The IP flow is moved back to active after it receives an active start, and when it changes from inactive to active an accounting start is sent.

## Configuring Per-Flow Accounting

To configure the Per-flow Accounting feature on the PDSN, perform the following task:

Command	Purpose
<b>Step 1</b> router# <b>cdma pdsn attribute send</b> {f16 f17 f18 f19 f20 f22}	In Cisco PDSN Release 4.0, new options are introduced in the existing CLI command. These new attributes are sent in accounting messages.  (F16) Forward PDCH RC (F17) Forward DCCH Mux Option (F18) Reverse DCCH Mux Option (F19) Forward DCCH RC (F20) Reverse DCCH RC (F22) Reverse PDCH RC

### Example

Here is sample output for Cisco PDSN Release 4.0:

```
cdma pdsn attribute send ?
a1      Attribute Calling Station ID
a2      Attribute ESN, Electronic Serial Number
a3      Attribute MEID, Mobile Equipment Identifier
c5      Service Reference ID
esn-optional  Send ESN in Access Req/accounting records only when received
           from PCF

f11     IP Technology
f15     Attribute f15, always-on
f16    Forward PDCH RC
f17     Forward DCCH MUX
f18     Reverse DCCH MUX
f19     Forward DCCH RC
f20     Reverse DCCH RC
f22     Reverse PDCH RC
f5      Attribute Service Option
g1      Attribute Input Octets
g17     Last known user activity
g2      Attribute Output Octets
is835a  is835a specified attributes (g3 and g8 to g16)
meid-optional Send MEID in Access req/accounting records only when received from PCF.
```

## Verifying Per-Flow Accounting

To verify that the Per-flow Accounting feature is configured on the PDSN, perform the following tasks:

Command	Purpose
<b>Step 1</b> router# <b>Show cdma pdsn accounting [detail]</b>	In Cisco PDSN Release 4.0, the output is enhanced to display the HRPD and IP flow details.

### Example

Here is example output:

```
router#show cdma pdsn accounting detail
UDR for session
session ID: 1
```

Mobile Station ID IMSI 123456789123457

Mobile Station ID (A1) IMSI 123456789123457  
 ESN (A2) 000100020003005  
 MEID (A3)  
 Session Continue (C3) ' ' 0  
 Serving PCF (D3) 2.2.1.1 Base Station ID (D4) 000000000000  
 User Zone (E1) 0000  
 Forward Mux Option (F1) 1 Reverse Mux Option (F2) 2  
 Service Option (F5) 59 Forward Traffic Type (F6) 6  
 Reverse Traffix type (F7) 7 Fundamental Frame size (F8) 8  
 Forward Fundamental RC (F9) 9 Reverse Fundamental RC (F10) 10  
 DCCH Frame Format (F14) 14 Always On (F15) 0  
**Forward PDCH RC (F16) 16 Forward DCCH Mux (F17) 17**  
 Reverse DCCH Mux (F18) 18 Forward DCCH RC (F19) 19  
**Reverse DCCH RC (F20) 20 Reverse PDCH RC (F22) 22**

Bad PPP Frame Count (G3) 0 Active Time (G8) 0  
 Number of Active Transitions (G9) 1  
 SDB Octet Count Terminating (G10) 0  
 SDB Octet Count Originating (G11) 0  
 Number of SDBs Terminating (G12) 0  
 Number of SDBs Originating G13 0  
 Number of HDLC Layer Bytes Received (G14) 225  
 In-Bound Mobile IP Signalling Octet Count (G15) 0  
 Out-bound Mobile IP Signalling Octet Count (G16) 0  
 Last User Activity Time (G17) 0  
 IP Quality of Service (I1) 0  
 Airlink Quality of Service (I4) 0  
 R-P Session ID (Y2) 1

UDR for flow

Mobile Node IP address 20.2.0.0  
 IP Address (B1) 20.2.0.0, Network Access Identifier (B2) mwtcp-sip-basic-user1  
 Account Session ID (C1) 4248  
 Correlation ID (C2) ' ' 240  
 Beginning Session (C4) ' ' 0  
 MIP Home Agent (D1) 0.0.0.0  
 IP Technology (F11) 01 Compulsory Tunnel indicator (F12) 00  
 Release Indicator (F13) 00  
 Data Octet Count Terminating (G1) 0  
 Data Octet Count Originating (G2) 0 Event Time G4:1219295403  
 Rsvp Signaling Inbound Count (G22) 0 Outbound Count (G23) 0  
 Rsvp Signaling Packets In (G24) 0 Packets Out (G25) 0  
 Packets- in:0 out:0

The following are new in Cisco PDSN Release 4.0:

UDR for IPFlow (new: Yes)

Session ID : 2 Flow ID : 0x01 Direction : Forward  
 Account Session ID (C1) 1095 Correlation (C2) 0  
**Service Reference ID (C5) 2 Flow ID (C6) 1**  
 Serving PCF (D3) 2.2.1.1  
 Forward Mux Option (F1) 1 Reverse Mux Option (F2) 2  
 Service Option (F5) 59 Forward Traffic Type (F6) 6  
 Reverse Traffix type (F7) 7 Fundamental Frame size (F8) 8  
 Forward Fundamental RC (F9) 9 Reverse Fundamntal RC (F10) 10  
 DCCH Frame Format (F14) 14 **Forward PDCH RC (F16) 16**  
**Forward DCCH Mux (F17) 17 Reverse DCCH Mux (F18) 18**  
 Forward DCCH RC (F19) 19 Reverse DCCH RC (F20) 20  
**Reverse PDCH RC (F22) 22 Flow Status (F24) Active**  
  
 Data Octet Count Terminating (G1) 0

Data Octet Count Originating (G2) 0 Event Time G4:0  
 Active Time (G8) 0  
 Number of Active Transitions (G9) 1  
 SDB Octet Count Terminating (G10) 0  
 SDB Octet Count Originating (G11) 0  
 Number of SDBs Terminating (G12) 0  
 Number of SDBs Originating G13 0

**Granted Qos (I5):**

Flow direction :0 Flow ID :1  
 Flow Profile ID :0  
 Qos Attribute Set ID :1 Traffic Class :0  
 Peak Rate :1 Bucket Size :100  
 Token Rate :100 Maximum Latency :100  
 Max IP Packet Loss Rate :10

**Packet Size :10 Delay Variance Sensitive :100**

IP Quality of Service (I1) 0  
 Airlink Quality of Service (I4) 0  
 R-P Session ID (Y2) 2

## UDR for session

session ID: 1  
 Mobile Station ID IMSI 987654321098766

Mobile Station ID (A1) IMSI 987654321098766  
 ESN (A2)  
 MEID (A3)  
 Session Continue (C3) ' ' 0  
 Serving PCF (D3) 11.1.1.11 Base Station ID (D4) 123412340000  
 HRPD Subnet (D7) SNL 40  
     SN 000100010002000300000000000000004  
     SID 000300040005000600000000000000007  
 User Zone (E1) 0000  
 Forward Mux Option (F1) 241 Reverse Mux Option (F2) 242  
 Service Option (F5) 59 Forward Traffic Type (F6) 246  
 Reverse Traffix type (F7) 247 Fundamental Frame size (F8) 248  
 Forward Fundamental RC (F9) 249 Reverse Fundamntal RC (F10) 250  
 DCCH Frame Format (F14) 0 Always On (F15) 0  
 Forward PDCH RC (F16) 0 Forward DCCH Mux (F17) 0  
 Reverse DCCH Mux (F18) 0 Forward DCCH RC (F19) 0  
 Reverse DCCH RC (F20) 0 Reverse PDCH RC (F22) 0

Bad PPP Frame Count (G3) 0 Active Time (G8) 0  
 Number of Active Transitions (G9) 0  
 SDB Octet Count Terminating (G10) 0  
 SDB Octet Count Originating (G11) 0  
 Number of SDBs Terminating (G12) 0  
 Number of SDBs Originating G13 0  
 Number of HDLC Layer Bytes Received (G14) 177  
 In-Bound Mobile IP Signalling Octet Count (G15) 0  
 Out-bound Mobile IP Signalling Octet Count (G16) 0  
 Last User Activity Time (G17) 0  
 IP Quality of Service (I1) 0  
 Airlink Quality of Service (I4) 0  
 R-P Session ID (Y2) 1

## UDR for flow

Mobile Node IP address 9.1.1.6  
 IP Address (B1) 9.1.1.6, Network Access Identifier (B2) g7SIP1@xxx.com  
 Account Session ID (C1) 11  
 Correlation ID (C2) ' ' 34  
 Beginning Session (C4) ' ' 0  
 MIP Home Agent (D1) 0.0.0.0  
 IP Technology (F11) 01 Compulsory Tunnel indicator (F12) 00  
 Release Indicator (F13) 00

```

Data Octet Count Terminating (G1) 0
Data Octet Count Originating (G2) 0 Event Time G4:1247463520
Rsvp Signaling Inbound Count (G22) 0 Outbound Count (G23) 0
Rsvp Signaling Packets In (G24) 0 Packets Out (G25) 0
Packets- in:0 out:0

```

## Handoff Scenarios

This section lists various handoff scenarios.

### Inter-PCF handoff - Same PDSN (RevA to RevA)

The PDSN, irrespective of PPP Renegotiation or not, will release all of its existing A10 connections with the old PCF and establish the aux connections afresh for the new PCF.

In this case, the TFTs are not cleared. The flow-IDs are retained and remapped to the new PCF's A10 connections.

### Handoff from 1x to RevA

When a MN hands off from a 1x network to a Rev A PCF, the existing flow is considered the main service connection. The aux service flows and the application flows are then created afresh. When a handoff from 1xRTT to EV-DO occurs, the PDSN sends an accounting start on receiving active start per flow per direction. In this case, there should be a connection setup received for the associated A10 of that IP flow.

### Handoff from Rev A to 1x

When a MN hands off from a Rev A PCF to a 1x PCF, all the service flows and application flows are deleted except the TFTs. The subscriber QoS profile is retained with the session. The policing and DSCP validations continue if already in place. When there is a handoff from EV-DO to 1xRTT, will be sending one accounting stop per IP flow per direction is sent for those IP flows that are active. A pair of Start-Stops are sent for those IP flows that are inactive, since this is the final stop through which to detach from the AAA server context.

## Call Admission Control

As part of the subscriber QoS profile, bandwidth is downloaded from the AAA server. The PDSN needs to make that bandwidth available for the mobile station. This bandwidth helps in case the mobile uses any video services.

There is no specific interface on the PDSN that is considered as egress that defines the maximum available bandwidth. So there is no direct allocation, and the PDSN cannot use generic IOS QoS implementation on allocation failure.

As a solution, a new CLI command is introduced which defines the total bandwidth on the box. This bandwidth could be the Gigabit interface on the SAMI card, or the egress interface on the line card. The maximum available bandwidth could be the minimum of the two.

Whenever a session registers with the PDSN, and the PDSN downloads the bandwidth to allocate, it checks the available bandwidth. If the requested bandwidth is available for use, the session is created successfully and the allotted amount is deducted from the available bandwidth. If it runs out of bandwidth, the call is rejected.

Whenever the session is deleted, the bandwidth is returned to the original pool.

Whenever a different bandwidth is downloaded during reregistration, the old one is returned and then the new one is deducted.

$$\text{BandwidthFactor} = (\text{ConsumedBandwidth} / \text{Total Bandwidth}) * 100$$

The other factors that can be included are memory, CPU, and the session load.

#### **Session Load:**

Currently, the load that is calculated and forwarded to the cluster controller is the ratio of number of sessions active to the total session capacity of the box.

$$\text{SessionFactor} = (\text{Number of Sessions active} / \text{Total session capacity}) * 100$$

#### **Memory:**

Memory factor consists of 2 parts—Processor Memory and IO Memory. The RRQ should be accepted only if 10% of memory is available (both processor and IO Memory).

$$\text{ProcMemoryFactor} = (\text{MemoryConsumed}/\text{TotalMemory}) * 100$$

$$\text{IOMemoryFactor} = (\text{MemoryConsumed}/\text{TotalMemory}) * 100$$

#### **CPU Factor:**

The processor could be loaded due to heavy traffic (high packets/sec), or because of high number of requests or heavy data traffic. To consider this parameter, take the current CPU percentage for computation as well.

$$\text{CPUFactor} = (\text{CPU Percentage})$$

Taking all the four parameters, the new load factor will be the maximum of the four.

If the maximum is memory or CPU, new registration requests are rejected till the value drops below the configured threshold.

If the maximum is because of BandwidthFactor, and if the new request is 1x (not downloading bandwidth), it is allowed. If it is RevA or 1x (downloading bandwidth), the registration proceeds until the bandwidth is downloaded. Then, based on bandwidth availability, the request is either processed or rejected.

If the highest is session count, it proceeds till the maximum is reached.

#### **Controller - Member Calculation**

The member now sends the newly calculated load to the controller as the exact load of the system. The controller performs load-balancing with the load value sent by the member. The controller reject calls once any of the load parameters for all the associated members reach the threshold of 100%. CAC is enabled on the member when the BW and CPU thresholds are configured. Multiple flows are enabled in the controller to support Cisco PDSN Release 4.0. The default memory threshold is 90%.

## Configuring Call Admission Control on the PDSN

To configure the Call Admission Control feature on the PDSN, perform the following tasks:

	Command	Purpose
Step 1	<pre>router# cdma pdsn cac maximum [bandwidth number] cdma pdsn cac maximum [cpu number]</pre>	Enables the Call Admission Control feature. Use the <b>bandwidth</b> keyword to control the maximum CAC bandwidth parameters, and the <b>cpu</b> keyword to control the maximum CPU threshold.
Step 2	<pre>router# cdma pdsn cluster controller member reva-support</pre>	When the members are based on Cisco PDSN Release 4.0, CAC is done based on many parameters. Use this command to make the cluster controller use all the newly introduced parameters to distribute the load.



### Note

The download of bandwidth from the RADIUS server during reregistration for MIP call is currently not handled on PDSN.

## Examples

Here is an example of the configuration commands:

```
router# cdma pdsn cac ?
  maximum          Configure Maximum values for CAC Parameters

cdma pdsn cac maximum ?
  bandwidth        Configure Maximum Bandwidth
  cpu              Configure CPU Threshold parameters

cdma pdsn cac maximum bandwidth ?
  <8000-2000000000> Value

cdma pdsn cac maximum cpu ?
  <30-100> Value
```



### Note

By default, the maximum CPU value is 90.

## Verifying the Configuration

To verify that the CAC feature is enabled, and to gather information regarding the CAC feature, perform the following task:

	Command	Purpose
Step 1	<pre>router# show cdma pdsn cac</pre>	Displays the various call admission control parameters and their status.

## Examples

Here is an example of the **show cdma pdsn cac** command:

```
router# show cdma pdsn cac
Router#sh cdma pdsn cac
```

	Output in Values	Output
in percentage		
Total configured bandwidth	200000000 b	100%
Allocated bandwidth	0 b	0%
Available bandwidth	200000000 b	100%
CPU Threshold		90%
CPU Current		0%
Processor Memory Threshold	813609471	90%
Processor Memory Current	73398292	8%
IO Memory Threshold	60397977	90%
IO Memory Current	45603376	67%
Sessions allocated	0	0%
Max sessions allowed	25000	100%
Router#		

## Resource Management

Resource management defines the mechanism to release packet data session related resources at the network elements like the PDSN and the HA. Resources may be released due to the session handoff or for administrative purposes.

IS-835-C defines two mechanisms for resource management:

- Packet of Disconnect (POD)
- MIP Resource Revocation

While resource management based on Packet of Disconnect is applicable to SIP, MIP and PMIP flows, resource management based on MIP Resource revocation is applicable only to MIP flows.

The PDSN supports resource management based on both Packet of Disconnect and MIP resource revocation.

## Resource Revocation for Mobile IP

Basic MIP resource revocation is an IS-835-C initiative that defines the methods by which a mobility agent (one that provides MIP services to a MN) can notify the other mobility agent of the termination of a registration due to administrative reasons or MIP handoff.

When configured on the PDSN/FA, the Mobility Agent Advertisement extension in the Agent advertisement will have the X bit set, thus advertising support for resource revocation on that link. A PDSN configured to support resource revocation in MIPv4 will include a revocation support extension in all MIP RRQ including reregistrations. If the associated MIP RRP from the HA also includes a valid revocation support extension, then the PDSN will assume the associated registration as revocable.

For a registration that is revocable, if the PDSN/FA needs to terminate the session administratively, the PDSN/FA sends a resource revocation message to the HA and releases the resources held for that registration.

If the resource revocation ACK from the HA is not received within a configurable amount of time, the resource revocation message will be retransmitted.

On receipt of a resource revocation message from HA, and a registration (identified by the home address, care-of address, and HA address) is located, the resources held by that registration are freed, and a resource revocation ACK message is sent back to the HA. If no other MIP registrations are active on the PPP session associated with the revoked binding, then the PDSN will release the associated PPP and R-P sessions for the revoked registration.

## Restrictions for Registration Revocation

The following restrictions for Registration Revocation on the PDSN apply:

- The STC VSA returned from the AAA server in access-accept message during FA-CHAP and HA-CHAP will be ignored, and local configuration on the PDSN and HA will take precedence.
- Revocation extension and messages, even if not protected by FHAE or IPSec, will be accepted and processed by both PDSN and HA. It is recommended that the user takes care of providing the security of the messages by either configuring FA-HA security association or by provisioning IPSec tunnel between the two agents.
- MobileIP MIB is not updated with the Registration revocation information.
- On the PDSN, all the **ip mobile foreign-service** commands need to be configured at the global level and not at the interface level.
- On the PDSN, for the I-bit support the local policy is to always negotiate I-bit and to always set it to 1 in the Revocation messages. Also the provision to set B-bit to 1 in the agent advertisement message while informing MN of the revoked data flow is not provided.
- Resource Revocation and Bind Update cannot be enabled simultaneously. Both are mutually exclusive of each other.

## Packet of Disconnect

RADIUS Disconnect, or Packet of Disconnect (PoD) is a mechanism that allows the RADIUS server to send a RADIUS Disconnect Message to the PDSN to release Session related resources. Resources may be released due to the session handoff, or for administrative purposes. Some of the resources identified include PPP, RP sessions and MIP bindings. Support for RADIUS Disconnect on the PDSN and HA is TIA835C compliant.

The PDSN communicates its resource management capabilities to the Home AAA server in the access-request message (sent for authentication/authorization procedure) by including a 3GPP2 Vendor Specific Session Termination Capability (STC) VSA. The value communicated in the STC VSA is obtained in the configuration. The PDSN also includes a NAS-Identifier attribute containing its Fully Qualified Domain Name (FQDN) in the access-request.

The Home AAA server establishes a relationship between the user and the NAS Identifier/ NAS-IP address to detect a inter-PDSN handoff. If the NAS-Identifier/ NAS IP address received in the access-request is different from the previously stored value (non-zero), an inter-PDSN handoff is detected.

The Disconnect Request contains the NAS-ID and the Username (NAI) attributes. It can optionally contain 3GPP2 Correlation ID Calling station ID (IMSI) and the Framed IP address—some session identification attributes. A Disconnect Reason VSA is included if a inter-PDSN handoff is detected. The session identification attributes supported by the PDSN are 3GPP2 Correlation ID and Calling station ID (IMSI).

If the 3GPP2 Correlation ID and Calling station ID (IMSI) attributes are received in the Disconnect Request, and the PDSN is able to find the session/flow corresponding to them, the PDSN will terminate the associated flow and send a Disconnect ACK message to RADIUS server. If session is not found for

the received attributes, the PDSN will reply back with a Disconnect NACK message with error code “session context not found”. If the Disconnect request has invalid attributes (for example, an 8-digit IMSI), the PDSN will reply with a Disconnect NACK with error code “Invalid Request”.

The PDSN also supports processing Disconnect Requests that only contain the NAI attribute (if configured). In compliance with the standards, the PDSN terminates all sessions corresponding to the Username received.

The Ballot version mentions that a Disconnect Request can be received at the HA, but details on the action to be taken in such an event is not detailed. Hence the approach followed is to terminate a specific binding if Framed-IP-Address attribute is received along with NAI, or terminate all bindings for the NAI, if only NAI attribute is received in the Disconnect Request.

The following restriction is present for this feature:

- All Dormant NVSE are not supported.

The command line interface for this feature will be standard AAA server interfaces. The preferred method to configure POD in Release 2.0 and higher is to use the **aaa server radius dynamic-author** command, which leads to a sub-configuration mode that has options to configure clients, security keys, and other variables.

The following NAS global AAA command is used to enable listening for POD packets:

- **aaa pod server key word**, where *word* is the shared key.

The full syntax for this command is:

- **aaa pod server [clients ipaddr1 [ipaddr2] [ipaddr3] [ipaddr4]] [port port-number] [auth-type {any | all | session-key}] server-key [encryption-type] string**

The following debug command is also available:

- debug aaa pod

### Restrictions for RADIUS Disconnect

- All Dormant NVSE is not supported.
- MIB support is not currently planned.
- Processing of a RADIUS Disconnect message with only NAI present must be configured for compliance to IS 835-C.

## RADIUS Enhancements

Cisco PDSN Release 3.0 includes the following RADIUS enhancements:

- RADIUS server load balancing
- Selection of RADIUS server based on realm.

### RADIUS Server Load Balancing

The RADIUS Load-Balancing (RLB) feature shares the load of RADIUS Authentication and Accounting transactions across a set of RADIUS servers. Without RLB, all transactions are sent to the first server considered to be alive in a server group. When this server stops responding and is marked dead, the PDSN fails over to the next one in the group. Using only one server, despite the presence of other usable servers in the group, limits the overall throughput for call setup/teardown.

RADIUS Server Load Balancing allows the PDSN to distribute the transaction load across multiple servers in a server group. It tracks the slower servers and reduces the transaction load on those servers, and it adapts when a server is marked dead and when it comes back up again.

The transactions are grouped into batches (the size of which is configurable), and each server is assigned a batch to process. The feature then load-balances transactions based on these batches, one batch at a time. When the first transaction is received, the algorithm determines the server with the least outstanding transactions, and this server is assigned the next batch of transactions. Once a batch of transactions has been assigned, the algorithm determines the server with the least outstanding transactions, and this server is assigned the next batch of transactions. Thus, the server with the least outstanding transactions always gets assigned the next batch. This load-balancing scheme can be applied based on a server group. Thus, each server group defined on the IOS platform can have its own load-balancing scheme.

You should exercise care while configuring the batch size. The trade-off in large versus a small batch size is that of throughput versus CPU load. A large batch size results in a lesser amount of computations, and a lower CPU load; however, it may cause a particular server within the server-group to be assigned transactions even though others in the group are idle. For very small batch sizes, the CPU load increases, as it computes outstanding load across servers more often. Lab simulations indicate that a batch size of 25 gives a decent throughput while not adversely affecting the CPU load.

#### **High Latency RADIUS Servers**

The algorithm adapts well to servers of varying response times. Servers that are quick have a lower number of transactions outstanding, and are assigned larger number of the incoming transactions. Slower servers get proportionately lower numbers of transactions.

#### **Server Failovers**

When a transaction fails over to the next server in the group after a failover, its outstanding count is increased. Thus, failed-over transactions are also load-balanced. When the next batch of transactions is assigned, this server's outstanding count will reflect its load accurately—both new and failover transactions will be accounted for in the outstanding transaction count.

#### **Dealing with Server Groups**

Consider the following two server-groups:

Server-group SG1 with servers S1, S2, S3.

Server-group SG2 with servers S3, S4, S5.

Consider that SG1 is configured to be load-balanced, while SG2 is not. When requests are sent to SG2 these requests are assigned to S3, as it is the first server in the group and its outstanding transaction count will increase. When requests are sent to SG1, these requests are load-balanced across these servers. When sending transactions to S3, the outstanding transaction count for the server will be high because SG2 transactions are assigned directly to it. Thus, it will receive a low proportion of transactions in SG1. This is the preferred behavior, since the goal is to send transactions to servers that are quicker and able to handle more load, where the load is the total transactions a server is handling, not just those of the current server-group.

#### **Preferred Servers**

In certain cases, it is desirable to use the same server for all requests for a given session. With RADIUS server load balancing there is no guaranty that this will occur. To avoid such situations a preferred-server indication is introduced in Cisco PDSN Release 3.0.

**Note**


---

This indication is a preference or recommendation only.

---

The preferred server behavior, which is enabled by default, tries to ensure that all the accounting records (Start, Stop, and Interim) for a session are sent to the same RADIUS server. However, authentication and accounting records for the same session may still be sent to different RADIUS servers as determined by the load balancing algorithm.

The following events may cause accounting records for the same session to be sent to different RADIUS servers:

- PPP renegotiation
- Handoff

The PDSN will try to use the server if possible, but if not, it will fall back to other servers in the group based on the load-balancing mechanism.

When this indicator is used, costs are not considered in deciding which server to use. However, it might not be possible to always use the preferred server. The server may have been marked dead. Or the server may not be usable since it is not part of the server-group that was used for a previous transaction during the session (for example, the Accounting server-group may be different from the authentication server-group). In this case, the algorithm is free to select an alternate server, based on the load-balancing scheme.

**Incoming RADIUS Requests**

The RADIUS server load balancing feature is not applicable to incoming RADIUS requests (for example, Packet of Disconnect). POD responses require that the server requesting service be the one that is responded to, thus you should not load-balance these requests across servers.

## Subscriber Authorization Based on Domain

Cisco IOS provides a “Subscriber Authorization” mechanism to authorize subscribers based on their realm. You can find details of this feature at the following URL:

[http://www.cisco.com/en/US/partner/products/ps6350/products\\_configuration\\_guide\\_chapter09186a0080455cf0.html#wp1056463](http://www.cisco.com/en/US/partner/products/ps6350/products_configuration_guide_chapter09186a0080455cf0.html#wp1056463)

## IS-835 Prepaid Support

The Cisco PDSN Release 2.0 provides real-time monitoring and rating of data calls for prepaid users. The prepaid billing solution for the PDSN is based on the RADIUS (AAA) server, and takes advantage of the existing flow-based accounting functionality. The prepaid billing feature requires the RADIUS server to interface with a PBS to relay real-time billing information between the PDSN and the PBS. A third-party PBS controls the real-time rating of data calls and maintains balances in users accounts. Cisco does not supply the PBS.

The following three types of prepaid service are available in Cisco PDSN Release 2.1:

- Volume-based prepaid data service
- Volume-based prepaid data service with tariff switching
- Duration-based prepaid data service

Prepaid functionality is supported on PDSN for the following type of data sessions:

- SIP sessions with authentication and authorization performed at the AAA server.
- VPDN sessions with authentication and authorization for the user performed at the AAA server.
- MIP sessions with FA-CHAP performed for the session or NAI at the AAA server.
- PMIP sessions with authentication and authorization for the user performed at the AAA server.

Prepaid service is also available for sessions opened with MSID-based authentication access.



#### Note

Either Volume-based or Duration-based, but not both options in one prepaid flow, are supported on the PDSN. Multiple flows, each supporting either Volume or Duration based prepaid service, are allowed on the PDSN. The PDSN can be configured to support only Volume-based, or only Duration-based, or either type of prepaid service per flow at any point in time.

Volume-based accounting for prepaid flows other than VPDN will count the bytes present in the PPP payload. For VPDN flows, it will count the bytes present in the PPP packet including the PPP packet header. A session that has multiple flows can have some of the flows with prepaid data service enabled, each either Volume-based or Duration-based, while other flows may not be prepaid enabled.

Tariff-based prepaid service is also supported for volume-based prepaid data service on the PDSN. To support tariff-based prepaid service, the PBS should have the following capabilities:

- Charged by volume—different tariff for different time of day.
- The Billing server allocates a different quota (volume-based) for a user that is determined by a tariff for a different time-of-day (this ensures the two charging rates do not overlap).

### Restrictions for Prepaid Support in Cisco PDSN Release 2.1

- Prepaid for remote address based accounting is not supported.
- Online access-request messages are sent with Service-Type as “outbound” (instead of “Authorize Only”), and user password is included in the message.
- There is no prepaid MIB support in the present release.
- Prepaid for the HA is not supported.

## Prepaid Billing

When a user performs SIP access with the AAA server authentication, or MIP access with FA-CHAP, the prepaid-capable PDSN sends a RADIUS access-request message for authentication and authorization. The prepaid-capable PDSN informs the billing server of its own prepaid capabilities by including a PPAC VSA in the RADIUS access-request message.

The Home RADIUS performs authentication and authorization procedures as usual. If the HAAA identifies that a user is a prepaid user from its user profile, the HAAA interfaces with the billing server to retrieve prepaid related information for the user, and passes on the prepaid related information in the access-request message. The billing server performs prepaid authorization for the user. The prepaid authorization procedure at HAAA and billing server consists of the following steps:

- Checking the PPAC VSA.
- Checking the home network policy.
- Checking the user’s account balance and state.

When the billing server successfully authorizes the user as a valid prepaid user, it notifies the HAAA that it supports prepaid service based on volume, or duration, or both, depending on the configuration at the billing server and capabilities as indicated by the PDSN. The HAAA encodes the information in a PPAC VSA to the PDSN, and indicates that volume-based or duration-based prepaid (or both) service is supported by the billing server.

HAAA sends the authorization response to the prepaid capable PDSN using RADIUS access-accept or reject messages. The authorization response includes a PPAQ VSA in the same RADIUS access-accept message stating an initial quota, quota-id and a threshold value of the quota for the prepaid flow corresponding to the user.

When the PDSN sends online access-request messages to HAAA for prepaid related functionality, it does not set the User-Password (= 2) field in the message, and normal RADIUS message authentication is set and performed with Message Authenticator. Currently, the User-Password is set in online Access Requests to the default value of "cisco".

If the PDSN does not receive the PPAC VSA from the HAAA in the initial RADIUS access-accept message, or the message is included but indicates that "Prepaid Accounting not used", the PDSN will release the user's prepaid flow if the RADIUS access-accept message includes a PPAQ VSA. The PDSN will send an access-request to HAAA to return the quota allocated with update-reason VSA that indicates client service termination.

If the PDSN is capable of supporting prepaid service based on either volume or duration, then the PDSN will enable prepaid service for the flow based on the Billing server-indicated service that applies to the session in PPAC. If the Billing server also indicates that the PDSN can allocate either volume or duration, then the PDSN will enable prepaid service based on the type of quota (volume or duration) present in PPAQ from HAAA. If both types of quota are present in PPAQ, then prepaid flow is not opened on the PDSN.

If the PDSN is capable of supporting prepaid service based on volume, and billing server indicates that it will support prepaid service based on duration, then the PDSN will close the prepaid flow. The PDSN will send an access-request message with update-reason VSA indicating "Client Service Termination". The same logic applies to the PDSN if it supports prepaid based on duration, and billing server returns prepaid service based on volume.

If the PDSN receives an access-accept message containing the PPAC VSA indicating prepaid service supported, but the initial quota is not included in the message, the PDSN will close the flow. Since no quota was received in the access-accept, the PDSN will not send further RADIUS access-request message to HAAA.

To ignore billing server interaction of HAAA for access-requests sent by the PDSN during MIP reregistration for FA-CHAP, the PDSN will include the Session-Continue VSA set to "TRUE" in the online access-request messages.

If multiple flows are present for the session that hosted the prepaid flow, and a prepaid flow was stopped, and if it was the last flow for the session, then the session will be deleted by the PDSN. If one of MIP flows expires and it is not the last flow for the session, then the PDSN will close the flow locally. If the resource revocation mechanism is enabled on PDSN, the relevant resource revocation mechanism will be applied in this case.

If the SIP flow is closed (for example, a PPP session is torn down or quota for the SIP flow expires), then all the other MIP flows, both prepaid and non-prepaid, will also get closed. If SIP flow is closing due to allocated quota expiry, it will send access-request message with update-reason as "Quota Reached". In other cases where the SIP session is closed, the access-request will be sent with update-reason as "Client Service Termination". All other prepaid flows for the PPP session will also send access-request messages to close the prepaid service and return unused quota. The update-reason for all these flows will contain value for "Main SI Released".

When threshold for the quota is reached, the PDSN sends an access-request to HAAA to retrieve more quota for the flow. In case the values of threshold for the quota and the quota allocated are same, then on quota expiry (when Quota = Threshold), the PDSN will treat this as flow as closed, and send an access-request with Update-reason as “Quota reached”.

When the quota expires for the flow, the PDSN sends an online access-request to the HAAA to indicate that the prepaid flow is released. During this time the PDSN marks the flow as deleted, and stops switching any packets for the flow. On receipt of the access-accept from the AAA server for this access-request, the PDSN deletes the prepaid flow for the user and sends an accounting stop.

If resource revocation mechanism is enabled at the PDSN, then the PDSN will send a resource revocation to the HA to clear binding at the HA, and the PDSN will clear the visitor information for the flow.

On receiving a RADIUS Disconnect Request (POD) or MIP revocation messages, the PDSN sends an online RADIUS access-request message containing the used quota and the update-reason sub-type set to “Remote forced disconnect”. The PDSN will delete the flow and send resource revocation message to the HA, and will send the existing RADIUS Accounting-Stop.

## Volume-based Prepaid Data Service Flow

The metric for accounting volume-based prepaid service is total bytes flowing through the user flow in upstream and downstream direction.

---

**Step 1** The prepaid capable PDSN determines that SIP or MIP setup requires a RADIUS access-request message to be sent to the Home RADIUS Server. For SIP sessions, the user has to be authenticated with the AAA server instead of local authentication. In case of MIP users, FA-CHAP authentication is required.

The PDSN includes its own PPAC VSA to inform the HAAA or billing server that it supports prepaid based on volume (value = 1 or 3). If resource revocation is enabled on the PDSN, then it will send a SessionTerminationCapability (STC) attribute indicating that it can support resource revocation for MIP sessions.

The Home RADIUS server performs the regular authentication and authorization of the access-request sent by the user. If the user profile indicates the user is a prepaid subscriber, HAAA interfaces with the billing server, and provides the billing server with the prepaid information for the user as received in the access-request message.

**Step 2** After the billing server receives the user prepaid information, it checks the capabilities of PDSN (sent in the PPAC VSA). The billing server also checks that the user has a valid balance and account status. The billing server then indicates to the PDSN that it supports prepaid packet data service based on volume. It also assigns the initial quota for the user, which is typically a fraction of total available quota for the user. The quota allocated for the user is identified by a quota ID assigned by the billing server for the user for the current quota. The billing server interfaces with HAAA and provides this information to the HAAA.

The HAAA encapsulates the prepaid information received for the user in a RADIUS access-accept message and sends it to the PDSN. The RADIUS message includes:

- A PPAQ VSA that contains the following parameters:
  - Initialized quota for the user flow specified in VolumeQuota parameter
  - Quota ID for the quota allocated
  - A threshold value for the quota allocated in VolumeThreshold parameter
- A PPAC VSA indicating prepaid service is based on volume.

After the PDSN receives the access-accept message from the AAA server, it parses the RADIUS packet and retrieves the attributes inside it. The PDSN stores the information present in the packet regarding the quota allocated for the flow and the threshold corresponding to the allocated flow. It also stores the Quota-ID allocated in the user flow present in the message. Once the flow for the user comes up (IP address assigned for SIP, or MIP RRP received from the HA and sent to the MS), the PDSN starts metering the user's traffic over the flow against the allocated quota.

**Step 3** User data (IP datagrams) that flow through each prepaid flow is accounted in both upstream and downstream directions. The bytes consumed are checked against the quota allocated for the flow by the billing server.

**Step 4** Once the volume threshold value reaches the allocated quota for the prepaid flow, the PDSN sends an access-request message to the AAA server to refresh quota for the user. This RADIUS packet contains a PPAQ VSA, which includes following parameters:

- Update-Reason Sub-Type that is set to indicate "Threshold reached" (= 3)
- Quota ID previously received
- Used volume in the VolumeQuota Sub-Type

HAAA authenticates the RADIUS packet and if authentication is successful, forwards the prepaid-related information present in the packet to the billing server.

**Step 5** The billing server updates its database with the amount of quota the user utilizes. Since the user indicates quota renewal, the billing server apportion a fraction of prepaid account balance of the user. It also assigns a new quota ID for the current allocated quota and a corresponding threshold value for the assigned quota. This information is passed on to HAAA.

The HAAA sends the information received from the billing server into a RADIUS access-accept message to be sent to PDSN. The attributes that are encapsulated into a PPAQ VSA include:

- Quota ID
- Allocated quota into VolumeQuota parameter
- Threshold corresponding to the assigned quota into VolumeThreshold parameter.

After the PDSN receives the access-accept message from the AAA server, it parses the RADIUS packet and retrieves the attributes inside it. The PDSN stores the information present in the packet and updates the quota allocated for the flow and the current threshold value corresponding to the allocated flow. It also stores the new Quota-ID allocated for the current quota.

**Step 6** User data (IP datagrams) continues to flow through the prepaid flow, and is accounted in both upstream and downstream directions. The bytes consumed are checked against the quota allocated for the flow.

**Step 7** The PDSN decides to close the prepaid flow based on the following criteria:

- The access-request message was sent to renew the quota and the corresponding access-accept message was not received from the AAA server after a configurable time value. This time is the same as the RADIUS message timeout configured on the PDSN.
- An access-accept was sent to retrieve quota and before access-accept can be received, the remaining VolumeQuota is consumed. This is when the VolumeQuota value and the VolumeThreshold values become same.

In this case, PDSN sends an access-request message containing the PPAQ VSA that includes:

- Update-Reason Sub-Type to indicate 'Quota reached' (= 4)
- Amount of quota used by the user in VolumeQuota attribute.

At this time, the PDSN marks the prepaid flow as being marked for deleted, such that it does not switch any packets through it for the prepaid flow. It does not delete the prepaid flow immediately and waits for the response of the access-request or timeout of the access-request message.

**Step 8** The billing server does not allocate a new quota when the user indicates “Quota reached” for the prepaid flow. The billing server terminates the prepaid flow and indicates the same to the HAAA. The HAAA sends an access-accept message to the PDSN acknowledging the termination of the prepaid packet data session by encapsulating update-reason sub-type as “Quota is reached” inside PPAQ VSA.

After the PDSN receives the access-accept message, it deletes the user flow for the prepaid session. As part of the usual offline accounting procedures, the PDSN sends an offline RADIUS Accounting-Stop message on successful release of the appropriate resources (normal operation).

## Duration-based Prepaid Data Service Flow

The metric for accounting duration-based prepaid service is session duration in seconds.

**Step 1** The prepaid capable PDSN determines that SIP or MIP setup requires a RADIUS access-request message to be sent to the Home RADIUS Server. For SIP sessions, user authentication has to be performed with the AAA server rather than local authentication. In the case of MIP users, FA-CHAP is required for authentication.

The PDSN includes its own PPAC VSA to inform the HAAA or billing server that it supports prepaid based on duration (value = 2 or 3). If resource revocation is enabled on the PDSN, the PDSN will send a SessionTerminationCapability (STC) attribute indicating that it can support resource revocation for MIP sessions. The Event\_Time attribute (G4, value = 55) will be included in the RADIUS access-request message.

The Home RADIUS server performs the regular authentication and authorization of the access-request sent by the user. If the user profile indicates the user is a prepaid subscriber, the HAAA interfaces with the billing server and provides the billing server with the prepaid related information for the user as received in the access-request message.

**Step 2** After the billing server receives the user’s prepaid information, it checks the capabilities of the PDSN (sent in the PPAC VSA). The billing server also checks that the user has a valid balance and account status. The billing server informs the PDSN that it supports prepaid packet data service that is based on Duration. It also assigns the initial quota for the user, which is typically a fraction of total available quota for the user. The quota allocated for the user is identified by a quota ID assigned by the billing server for that user for the current quota. The billing server interfaces with the HAAA and provides this information to the HAAA.

The HAAA encapsulates the prepaid information received for the user in a RADIUS access-accept message and sends it to the PDSN. The RADIUS message includes:

A PPAQ VSA that contains the following parameters:

- Initialized quota for the user flow specified in DurationQuota parameter
- Quota ID for the quota allocated
- A threshold value for the quota allocated in DurationThreshold parameter

A PPAC VSA that indicates prepaid service is based on duration.

For duration based prepaid packet data service, the Event\_Time attribute is used for DurationQuota/DurationThreshold allocation by the billing server.

After the PDSN receives the access-accept message from the AAA server, it parses the RADIUS packet and retrieves the attributes inside it. The PDSN stores information in the packet regarding the quota allocated for the flow, and threshold corresponding to the allocated flow. It also stores the Quota-ID allocated corresponding to the quota.

Once the flow for the user comes up (for example, an IP address assigned for SIP or MIP RRP received from the HA and sent to the MS), the PDSN starts the timer corresponding to the duration threshold value and duration quota value.

Once the timer expires for the threshold value of the allocated quota for the prepaid flow, the PDSN sends an access-request message to the AAA server to refresh quota for the prepaid flow. This access-request message contains a PPAQ VSA, which includes the following parameters:

- Update-Reason Sub-Type that is set to indicate 'Threshold reached' (= 3)
- Quota ID previously received
- Used duration in the DurationQuota Sub-Type

The HAAA authorizes the RADIUS packet and, if successful, forwards the prepaid-related information in the packet to the billing server.

**Step 3** The billing server updates its database with the amount of quota used by the user. Since the user indicates quota renewal, the billing server apportions a fraction of prepaid account balance of the user. It also assigns a new Quota ID for the current allocated quota and a corresponding threshold value for the assigned quota. This information is passed on to the HAAA.

The HAAA sends the information received from the billing server into a RADIUS access-accept message to be sent to the PDSN. The attributes that are encapsulated into a PPAQ VSA include:

- Quota ID
- Allocated quota into DurationQuota parameter
- Threshold corresponding to the assigned quota into DurationThreshold parameter.

After the PDSN receives the access-accept message from the AAA server, it parses the RADIUS packet and retrieves the attributes inside it. The PDSN stores the information in the packet, updates it with the quota allocated for the flow and the current threshold value corresponding to the allocated flow. The PDSN restarts the duration quota timer with the new value received in the Accept-Accept message, and starts the threshold timer with the new threshold value received corresponding to the current quota. It also stores the new Quota-ID allocated for the current quota.

**Step 4** The PDSN closes the prepaid flow based on following criteria:

- An access-request message was sent to renew the quota, and the corresponding access-accept message was not received from the AAA server after a configurable time value. This time value is the same as the RADIUS message timeout configured on the PDSN.
- An access-accept was sent to retrieve quota and before the access-accept can be received, and the remaining DurationQuota is consumed and the timer corresponding to it expires. This event is when the DurationQuota value and the DurationThreshold values become the same.

If this event occurs, the PDSN sends an access-request message containing the PPAQ VSA that includes:

- Update-Reason Sub-Type to indicate 'Quota reached' (= 4)
- Amount of quota used by the user in DurationQuota attribute.

The PDSN marks the prepaid flow for deletion, and does not switch any packets through it for the prepaid flow. The PDSN does not delete the prepaid flow immediately, and waits for the response of the access-request or timeout of the access-request message.

**Step 5** The billing server does not allocate a new quota when the user indicates "Quota reached" for the prepaid flow. The billing server terminates the prepaid flow and indicates the same to the HAAA. HAAA sends an access-accept message to the PDSN acknowledging the termination of the prepaid packet data session by encapsulating update-reason sub-type as "Quota is reached" inside PPAQ VSA.

When the PDSN receives the access-accept message, it clears the user flow for the prepaid session. As part of the usual offline accounting procedures, the PDSN sends an offline RADIUS Accounting-Stop message on successful release of the appropriate resources.

## Volume-based Prepaid Data Service with Tariff Switching

The PDSN and the billing server support tariff switch, volume-based, prepaid packet data service. The tariff switch trigger is controlled at the billing server. To support this capability, a new sub-Type PrepaidTariffSwitch (PTS) VSA attribute is sent by HAAA to PDSN. This attribute contains following key sub-types:

- QuotaId: Quota Id is same as present in PPAQ.
- VolumeUsedAfterTariffSwitch (VUATS): Volume switched after Tariff Switch
- TariffSwitchInterval (TSI): Interval in seconds between the time stamp (G4) of the corresponding online RADIUS access-request message and the next tariff switch condition

The following sequence describes the functionality of prepaid data service when Tariff Switching is enabled.

- 
- Step 1** The prepaid capable PDSN determines that SIP or MIP setup requires a RADIUS access-request message to be sent to the Home RADIUS Server. For SIP sessions, authentication of the user with the AAA server has to be done instead of local authentication. In case of MIP users, authentication via FA-CHAP is required.
- PDSN includes its own PPAC VSA to inform the HAAA or billing server that it supports prepaid based on volume (value = 1 or 3). If resource revocation is enabled on the PDSN, then it will send a SessionTerminationCapability (STC) attribute indicating that it can support resource revocation for MIP sessions.
- The Home RADIUS server performs the regular authentication and authorization of the access-request sent by the user. If the user profile indicates the user is a prepaid subscriber, HAAA interfaces with the billing server and provides the billing server with the prepaid related information for the user as received in the access-request message.
- Step 2** After the billing server receives the user prepaid information, it checks the capabilities of the PDSN that were sent in the PPAC VSA. It also checks that the user has a valid balance and account status. The billing server notifies the PDSN that it will support prepaid packet data service that is based on volume. The billing server also assigns the initial quota for the user, which is typically fraction of total available quota for the user. The quota allocated for the user is identified by a quota ID assigned by billing server for the user. The billing server interfaces with the HAAA and provides this information to the HAAA.
- The billing server that supports tariff switching indicates the time (in seconds) remaining for the next tariff switch point, and passes the information to the HAAA server. Optionally, it can include the time after tariff switch point that the PDSN will send access-request to the HAAA, if the threshold value for the assigned quota is not reached.
- The HAAA encapsulates the prepaid information received for the user from billing server in a RADIUS access-accept message and sends it to the PDSN. The RADIUS message includes:
- A PPAQ VSA that contains the following parameters:
    - Initialized quota for the user flow specified in VolumeQuota parameter
    - Quota ID for the quota allocated
    - A threshold value for the quota allocated in VolumeThreshold parameter

- A PTS VSA that contains the following parameters:
  - QuotaID as in PPAQ VSA attribute
  - TariffSwitchInterval indicating the time in seconds remaining before which the tariff switch condition will trigger
  - TimeIntervalafterTariffSwitchUpdate indicating the duration after tariff switch point when PDSN will send an online access-request if threshold point is not reached.
- A PPAC VSA indicating prepaid service is based on Volume.

After the PDSN receives the access-accept message from the AAA server, it parses the RADIUS packet and retrieves the attributes inside it. It stores the information present in the packet regarding the quota allocated for the flow and threshold corresponding to the allocated flow. The PDSN also stores the Quota-ID allocated in the user flow present in the message.

Once the flow for the user comes up (the IP address assigned for SIP, or MIP RRP received from the HA and sent to the MS), the PDSN starts metering user's traffic over the flow against the allocated quota. It also starts the timer corresponding to the value received in TariffSwitchInterval attribute so that it is aware when the tariff switch condition is hit. The timer is started by the PDSN only if the timestamp of the access-request + Tariff Switch Interval is more than the timestamp of the access-accept message.

QuotaId present in the PTS attribute should be equal to the QuotaId present inside PPAQ. If the 2 values are unequal, the prepaid flow is closed by PDSN.

**Step 3** User data (IP datagrams) that flows through each prepaid flow is accounted in both upstream and downstream directions. The bytes consumed are checked against the quota allocated for the flow by the billing server.

**Step 4** Once the VolumeThreshold value is reached for the allocated quota for the prepaid flow, the PDSN sends an access-request message to the AAA server to refresh quota for the user. This RADIUS packet contains a PPAQ VSA, which includes following parameters:

- Update-Reason Sub-Type that is set to indicate 'Threshold reached' (= 3)
- Quota ID previously received
- Used volume in the VolumeQuota Sub-Type

The HAAA authorizes the RADIUS packet and if authorization is successful, forwards the prepaid-related information present in the packet to the billing server.

**Step 5** The billing server updates its database with the amount of quota used by the user. As the user indicates quota renewal, the billing server apportions a fraction of prepaid account balance of the user. It also assigns a new quota ID for the current allocated quota and a corresponding threshold value for the assigned quota. This information is passed on to HAAA.

The billing server also indicates to the HAAA, the time remaining in seconds for the next tariff switch trigger point.

The HAAA sends the information received from the billing server into a RADIUS access-accept message to be sent to the PDSN. The attributes that are encapsulated into a PPAQ VSA include:

- Quota ID
- Allocated quota into VolumeQuota parameter
- Threshold corresponding to the assigned quota into VolumeThreshold parameter

The Attributes encapsulated inside PTS attribute includes:

- QuotaID, same as the PPAQ attribute
- TariffSwitchInterval that indicates the time (in seconds) remaining before which the tariff switch condition will trigger.

- `TimeIntervalAfterTariffSwitchUpdate` that indicates the duration after tariff switch point when the PDSN will send an online access-request if threshold point is not reached.

After the PDSN receives the access-accept message from the AAA server, it parses the RADIUS packet and retrieves the attributes inside it. It stores the information present in the packet updating with the quota allocated for the flow and the current threshold value corresponding to the allocated flow. It also stores the new Quota-ID allocated for the current quota.

Additionally, the PDSN re-starts the timer indicated in `TariffSwitchInterval` attribute. This time indicates the time remaining in seconds before the next tariff switch condition will be hit.

- Step 6** User data (IP datagrams) continues to flow through the prepaid flow, and is accounted in both upstream and downstream directions. The bytes consumed are checked against the quota allocated for the flow.
- Step 7** The timer for the tariff switch interval expires, and indicates the tariff switch point for the flow is hit. The PDSN continues to count the total number of octets flowing through the session in upstream and downstream direction, and also the number of bytes switched by the PDSN after the tariff switch trigger point. If `TimeIntervalAfterTariffSwitchUpdate` was sent by the AAA server, then the PDSN starts a timer with this value after the tariff switch point is reached.
- Step 8** User data (IP datagrams) that flows through each prepaid flow continues to be accounted in both upstream and downstream directions until the next threshold point is reached. The PDSN counts the total number of bytes switched till last quota update, and also the total number of bytes switched by PDSN after the Tariff Switch trigger point is hit. The bytes consumed are checked against the quota allocated for the flow.
- Step 9** Once the `VolumeThreshold` value is reached for the quota allocated in `VolumeQuota` value for the flow or timer corresponding to `TimeIntervalAfterTariffSwitchUpdate` expires, the PDSN sends quota update information in an access-request Message to the AAA server and the billing server. This online RADIUS access-request message contains following attributes in the PPAQ VSA:
- `Update-Reason Sub-Type` that is set to indicate “Threshold reached” (= 3) if threshold is reached. Otherwise, it is set to indicate “Tariff Switch Update” (=9) if `TimeIntervalAfterTariffSwitchUpdate` expires
  - The Quota ID previously received
  - The utilized volume in the `VolumeQuota Sub-Type`
- The PTS attribute contains following subtypes:
- Quota ID previously received
  - `VolumeUsedAfterTariffSwitch (VUATS)` attribute, that contains the total number of octets being switched by the PDSN after tariff switch trigger point.

The HAAA authorizes the RADIUS packet and, if authorization is successful, forwards the prepaid-related information present in the packet to the billing server.

The billing server updates its database with the amount of quota utilized by the user. Since the user indicates quota renewal, the billing server apportions a fraction of prepaid account balance of the user. It also assigns a new Quota ID for the current allocated quota and a corresponding threshold value for the assigned quota. This information is passed on to the HAAA.

The billing server also indicates to the HAAA the time remaining in seconds for the next Tariff Switch trigger point.

The HAAA sends the information received from the billing server into a RADIUS access-accept message to be sent to PDSN. The attributes that are encapsulated into a PPAQ VSA include:

- New Quota ID for the current quota
- Allocated quota into `VolumeQuota` parameter

- Threshold corresponding to the assigned quota into VolumeThreshold parameter

The PTS attribute contains following subtypes:

- Quota ID previously received
- TariffSwitchInterval that indicates the time (in seconds) remaining before which the tariff switch condition will trigger.
- Optionally TimeIntervalafterTariffSwitchUpdate that indicates the duration after the tariff switch point when the PDSN will send an online access-request if threshold point is not reached.

After the PDSN receives the access-accept message from the AAA server, it parses the RADIUS packet and retrieves the attributes inside it. The PDSN stores the information present in the packet, and updates it with the quota allocated for the flow and the current threshold value corresponding to the allocated flow. It also stores the new Quota-ID allocated for the current quota.

Additionally, the PDSN re-starts the timer indicated in TariffSwitchInterval attribute. The PDSN starts the timer only if the timestamp of the access-request + Tariff Switch Interval is more than the timestamp of the access-accept message. This time indicates the time remaining in seconds before the next tariff switch condition will be hit.

## Support for G17 Attribute in Acct-Stop and Interim Records

The G17 attribute is required to bill users based on when the last activity was detected rather than when the user is de-registered. The following scenario briefly describes on how the attribute is used and how the AAA server identifies the last user activity.

G17 is defined as last user activity to indicate the time when the last activity was detected by the user. The G17 attribute is sent in acct-stop and interim accounting update messages, and has the following usage guidelines:

- Configure support for the G17 attribute by issuing the **cdma pdsn attribute send g17** command
- The attribute is not included in acct-start record and included only in accounting stop/interim-update.
- The attribute is set to 0 when an airlink start record arrives.
- The attribute is set to the current time when airlink active stop arrives.
- The attribute is set to 0 once the acct-stop record is sent out.

The G17 attribute is useful under the following conditions:

- When the **cdma pdsn accounting send start-stop** command is not configured.
  - A session goes dormant. G17 is recorded with the current time. As the above CLI command is not configured, there is no accounting stop generated.
  - The PDSN will continue to send interim update accounting records for this session. These messages will contain G17 with the value recorded with time when airlink-stop was received.
  - When the mobile finally deregisters (and receives an A11 RRQ with lft = 0, and w/o an airlink STOP), the PDSN sends an accounting stop with the G17 attribute that was recorded earlier when airlink-stop was received. This gives the real value of time when last user activity was detected.
- When the **cdma pdsn accounting send start-stop** command is configured.
  - The PDSN will generate an accounting stop when an airlink-stop is received from the PCF. This acct-stop will contain the G17 recorded with time when airlink-stop was received.

- G17 is reset once the acct-stop is sent out. finally when the session ends, the accounting stop would have G17 as 0.
- AAA server needs to use the previous value of G17 to find out the last user activity.

## Home Area, Maximum Authorized Aggregate Bandwidth, and Inter-user Priority Attributes Downloaded from AAA Server

The home-area, inter-user priority, and maximum authorized aggregate bandwidth attributes are received by the PDSN, and are forwarded to the PCF as part of subscriber QoS profile (NVSE) structure. Local configurations of these attributes are not supported in Cisco PDSN Release 3.5.

The subscriber QoS profile is carried to the PCF in the following messages from the PDSN:

- A11 session update when a session is newly created.
- A11 Registration reply during inter-PCF handoff.

All of these attributes are synchronized to the standby in session redundancy

### Basic Operation

- If any home-area, inter-user priority, or maximum authorized aggregate bandwidth attributes are downloaded from the AAA server, and parsed successfully, they are stored on the PDSN and forwarded to the PCF as part of subscriber QoS profile structure.
- The home-area attribute is sent to the PCF only if the **cdma pdsn pcf PCF IP\_ address [ending IP\_ address] vendor-id NVSE vendor\_ID** command is configured.
- The vendor-specific attributes that are added in subscriber QoS profile are based on the configuration.
- The subscriber QoS profile is sent to the PCF in either A11 RRP or A11 session update messages.
- If the maximum authorized aggregate bandwidth attribute is downloaded then bandwidth policing for the session based on this attribute is applied on the PDSN.
- When a user session is created these attributes are sent to PCF through A11 session update message.
- In case of inter PCF handoff these attributes are sent in an A11 session update message, or in an A11 RRP message.
- The A11 messages with subscriber QoS profile included are sent to the PCF from PDSN only if the **cdma pdsn a11 session-update qos** command is configured.
- Bandwidth policing based on the maximum authorized aggregate bandwidth is applied only if the **cdma pdsn a10 police downstream** command is configured.
- If the AAA server attributes received are of invalid length, then the access-accept is dropped and session creation fails on PDSN.
- If the attribute values received at the PDSN are not in the given range then the attributes are ignored.
- If an unknown attribute is received the attribute is ignored.
- If multiple instances of the same attribute are downloaded, the maximum value of the downloaded attribute is taken.
- Local configuration of the subscriber QoS profile is not supported in Cisco PDSN Release 3.5.
- When new or multiple values of the given attributes as received in access-accept, the values on the PDSN are updated as follows:
  - The home area attribute downloaded for last flow is maintained.

- The maximum of the maximum authorized aggregate bandwidth and inter-user priority attributes are maintained.
- In case of PPP renegotiation, the values of the attributes maintained in the session are reset and the values received in the access-accept are applied.
- Traffic exceeding or violating the downloaded bandwidth is not accounted for in the session.

## Subscriber QoS Profile

Subscriber QoS profile consists of the following attributes that are downloaded from the AAA server:

- Maximum authorized aggregate bandwidth
- Home area defined by Lucent.
- Inter-user priority

These attributes are stored in the PDSN, and are forwarded to the PCF as part of subscriber QoS profile. The A11 registration reply, or A11 session-update, carries the subscriber QoS profile to PCF.

The subscriber QoS profile, carried in A11 messages to the PCF, is packed as an NVSE with the attributes as RADIUS VSAs.

## Bandwidth Policing

During authentication of the mobile with the AAA server, the maximum authorized aggregate bandwidth attribute may be downloaded from the AAA server as part of an access-accept. If this attribute is downloaded, the PDSN creates a policy internally and associates it with the session. The traffic to the mobile is then policed based on the value downloaded. When the session goes down, the policy is also removed.

## Session Redundancy

The downloaded attributes are always synchronized to the standby PDSN using the existing Session Redundancy infrastructure whenever the flow is created, or during handoff.

When the switchover happens, the policing starts over in the newly active box because fresh tokens are allocated in the bucket.

## Configuring Subscriber QoS Profile to PCF

To enable the PDSN to send subscriber QoS profiles to the PCF through session updates, perform the following task:

	Command	Purpose
Step 1	<code>router(config)# cdma pdsn a11 session-update qos</code>	Enables you to send the subscriber QoS profile to the PCF through a Session Update. The existing timeout and retransmit a11 session-update configurations apply to this command too.

## Configuring Bandwidth Policing

To configure policing of down stream data traffic for the session, perform the following task:

	Command	Purpose
Step 1	<code>router(config)#[no] <b>cdma pdsn a10 police downstream</b></code>	Enables you to police downstream data traffic for the session. This command is configured based on maximum authorized aggregate bandwidth value downloaded from the AAA server.

## Configuring VSAs in Subscriber QoS Profiles

To configure the sending of vendor-specific attributes in subscriber QoS profile, perform the following task:

	Command	Purpose
Step 1	<code>router(config)# <b>cdma pdsn pcf</b> PCF IP_address ending IP_address <b>vendor-id</b> NVSE Vendor_id</code>	<p>Enables you to send a subscriber QoS profile through A11 session-update and A11 RRP.</p> <ul style="list-style-type: none"> <li>• <i>PCF IP_address</i>—Single or starting PCF IP address</li> <li>• <i>Ending PCF IP_address</i>—Ending PCF IP address</li> <li>• <i>NVSE Vendor_Id</i>—Radius vendor ID of PCF</li> </ul>



### Note

This configuration is not required for 3gpp or 3gpp2 attributes.

Here is a sample configuration:

```
cdma pdsn virtual-template 1
cdma pdsn a10 max-lifetime 65535
cdma pdsn a10 ahdlc engine 0 usable-channels 8000
cdma pdsn a10 police downstream
cdma pdsn all session-update qos
cdma pdsn pcf 10.1.1.1 10.1.1.50 vendor-id 3729
cdma pdsn timeout mobile-ip-registration 10
cdma pdsn timeout all-session-update 3
cdma pdsn send-agent-adv
cdma pdsn debug show-conditions
cdma pdsn secure pcf 150.1.4.1 spi 100 key ascii cisco
cdma pdsn secure pcf 150.1.4.10 150.1.4.18 spi 100 key ascii cisco
cdma pdsn secure pcf 150.1.4.25 spi 100 key ascii cisco
cdma pdsn secure pcf 150.1.4.123 spi 100 key ascii cisco
cdma pdsn secure pcf 150.1.4.223 spi 100 key ascii cisco
cdma pdsn secure pcf 150.1.4.224 spi 100 key ascii cisco
cdma pdsn compliance is835a handoff
```

## Verifying the Configuration

To verify that these various attributes are sent, perform the following tasks:

	Command	Purpose
Step 1	router# <b>show cdma pdsn</b>	Displays the status and current configuration of the PDSN.
Step 2	router# <b>show cdma pdsn session</b>	Displays the session information on the PDSN.
Step 3	router# <b>show cdma pdsn statistics</b>	Displays VPDN, PPP, RP interface, Closed-RP interface and error statistics for the PDSN

Here are some examples:

```

router# show cdma pdsn
PDSN software version 3.5, service is enabled

All registration-update timeout 1 sec, retransmissions 5
Mobile IP registration timeout 10 sec
A10 maximum lifetime allowed 65535 sec
GRE sequencing is on
Maximum PCF's limit set to 2000
Maximum sessions limit not set (default 974 maximum)
SNMP failure history table size 100
MSID Authentication is disabled
Ingress address filtering is disabled
Sending Agent Adv in case of IPCP Address Negotiation is enabled
Allow CI_ADD option during IPCP Phase is disabled
Aging of idle users disabled
Radius Disconnect Capability enabled

Number of pcfs connected 0,
Number of pcfs 3GPP2-RP 0,
Number of sessions connected 0,
Number of sessions 3GPP2-RP 0,
Number of sessions Active 0, Dormant 0,
Number of sessions using HDLCoGRE 0, using PPPoGRE 0

router# show cdma pdsn session
Mobile Station ID IMSI 123456789123457
PCF IP Address 5.1.1.46, PCF Session ID 1
A10 connection time 119:19:10, registration lifetime 1800 sec
Number of successful A11 reregistrations 357
Remaining session lifetime 650 sec
Always-On not enabled for the user
Current Access network ID 0005-0101-2E
Last airlink record received is Unknown, airlink is active
GRE protocol type is 0x8881
GRE sequence number transmit 9, receive 7
Using interface Virtual-Access2.1, status OPN
Using AHDLC engine on slot 0, channel ID 4381
Service Option Ev-DO
Police Downstream CIR(bps) 8000,
  Normal Burst(bytes) 1500, Excess Burst(bytes) 3000
  Packets Conformed 0 Exceeded 0 Dropped packets 0
This session has 1 flow
Session Airlink State Active
QoS Parameters:
  Max Aggregate Bandwidth: 8000
  Home Area                : 10

```

```

Inter User Priority      : 15

Flow service Simple, NAI NAI gSIP1@xxx.com
Mobile Node IP address 32.1.35.203
Packets in 0, bytes in 0
Packets out 0, bytes out

router# show cdma pdsn statistics
Bandwidth policing:
Policing installed 0 failure 0 uninstalled 0

```

## Mobile IP Call Processing Per Second Improvements

In previous Cisco PDSN Releases, the MIP CPS rate was approximately 40—comparatively low to that of SIP CPS which around 125. MIP CPS was low because some of the MIP configurations are interface specific. When these configurations are applied to the virtual-template interface (which is typical for the PDSN software), it takes considerable time to clone the virtual-access from the Virtual-Template because of the presence of the MIP configuration, and this directly affects the CPS for MIP service. The virtual-access is cloned when the calls are setup. To reduce virtual-access cloning time, Cisco PDSN Release 2.1 supports commonly used per-interface configurations in global configuration mode, and supports per-interface for backward compatibility.

## Always On Feature

The PDSN supports always-on service to maintain the subscriber's packet data session in the local network. The always-on support ensures that the PDSN will not release a subscriber's packet data session due to PPP idle timer expiry unless the PDSN determines the user is no longer reachable.

The always-on service maintains a subscriber's packet data session irrespective of PPP inactivity timer value for the user. At the same time, by making use of a finite PPP inactivity timer value, this feature provides a way to keep a session only as long as the user is reachable. The PDSN uses LCP Echos (as per RFC 1661 and IS835B) to determine if the user is reachable.

The always-on service is enabled for a user only when the F15 "Always On" attribute is received and set to a value of **1** in the access-accept message from the AAA server.

The PDSN supports the ability to configure the Echo-Reply-Timeout timer and Echo-Request-Attempts counter. There is no extra configuration required on the PDSN to enable the Always On feature itself; however, you can disable the feature by configuring the Echo-Request-Attempts to zero. The PPP inactivity timer is started for a session entering IPCP open state, if is configured or retrieved from the AAA server, for the user.

For always-on users:

1. On expiration of the inactivity timer, the Echo-Request-Attempts counter is initialized to the configured value.
2. If the Echo-Request-Attempts counter is zero, the PPP session is torn down. If the Echo-Request-Attempts counter is nonzero, an LCP Echo-Request message is sent, the Echo-Request-Attempts counter is decremented, and the Echo-Reply-Timeout timer is started.
3. On receipt of the corresponding LCP Echo-Reply message, Echo-Reply-Timeout timer is stopped and the PPP inactivity timer is restarted.
4. On expiration of Echo-Reply-Timeout timer, repeat including step 2 and step 3 above.

This feature is not supported for VPDN users, and is not applicable to MIP users.

For always-on users, a value of “1” will be sent for F15 attribute in the accounting start or stop or interim records. For non-always-on users, the F15 attribute will only be sent in the accounting records if configured.

### Restrictions for the Always On Feature:

- The always-on implementation follows the IS835B standard; the IS835C specific additions are not available in this release of PDSN.
- Echo-Reply is the only packet that will stop always-on timer.  
Basically it means even if there is upstream or downstream data received, the session will be teared down unless the echo-reply received within configured number of retries and configured time interval.
- The always-on feature is not applicable for mobile IP users.
- The always-on feature is not supported for VPDN users.
- Aging of Dormant PPP sessions feature works independent of always-on users. The aging of dormant PPP sessions feature does not care for the always-on property of a session.

## PDSN MIB Enhancements

The following new objects are created as part of the Cisco PDSN 4.0 software release:

### SystemInfo - Global level on the PDSN

- PolicingEnabled - Boolean indicating Policing is enabled or not.
- SessionsWithAuxiliaryConnectionsTotal - Number of sessions with aux connections.
- TotalBandwidth - Total bandwidth of the box as configured through CLI command.
- AvailableBandwidth - Remaining bandwidth available for new sessions.
- ccpCdmaExtAllocatedBandwidth - Specifies the allocated bandwidth.
- SessionMaxAuxConnectionsAllowed-Number of aux connections supported by PDSN per session
- SessionServiceFlowsTotal-Number of A10 service flows currently established with the PDSN.
- AuxSessionTotal- Number of sessions with aux sessions currently established with the PDSN.
- PolicingSessionTotal - Number of sessions with policing enabled currently established with the PDSN.
- PDSNIpAddress- An IPv4 address identifying a PDSN. You can only access this object through notification.
- DSCPSession-Number of sessions with DSCP enabled currently established with the PDSN.
- ccpCdmaExtLoadHighReachedNotifEnabled - Indicates if trap is enabled, or not.
- SessionAuxConnectionsEnabled - Boolean indicating whether the PDSN system supports aux A10 connections for the session.

### Pcf Based Table:

- SessionsWithAuxiliaryConnectionsTotal - Number of sessions with aux connections associated with the PCF.
- NewAuxConnections - Number of A11 registration messages received per PCF at PDSN to establish new aux A10 connections.

- `ccpCdmaExtPcfSoRpRegStatsBwUnavailableSess` -
- `ReRegNewAuxConnections` - Number of A11 reregistration messages received per PCF at PDSN to establish new aux a10 connections.
- `RemapFlows` - Number of A11 registration or reregistration messages received per PCF at PDSN, indicating a change of a10 connection to flow-id mapping for the session.
- `CloseAuxConnections` -Number of A11 reregistration messages received per PCF at PDSN indicating removal of A10 connections (missing a10 aux connections existing for the session).
- `SessionUpdSubscriberQos` -Number of A11 session update messages per PCF received at PDSN
- `RegReqMaxServiceFlows` - Number of A11s that were rejected per PCF because the maximum number of aux connections per session was reached
- `RegReqUnSupportedSO` - Number of A11s that were rejected per PCF because additional session NVSE contained unsupported Service Option
- `RegReqNonExistA10` - Number of A11s that were rejected per PCF because IP flow mapping contained a mapping to a non-existent A10.
- `ccpCdmaExtPDSNIpAddrType` - access via notify
- `ccpCdmaExtPDSNIpAddress` - access via notify
- `ccpCdmaExtNotifReason` - access via notify
- `ccpCdmaExtNotifReasonCurrentValue` - access via notify

Here is an example of these objects:

Due to CPU Low Reason:

=====

```
Received SNMPv2c Trap:
Community: public
From: 9.11.51.83
sysUpTime.0 = 20545
snmpTrapOID.0 = ciscoCdmaExtLoadLowReachedNotif
ccpCdmaExtPDSNIpAddrType.0 = ipv4(1)
ccpCdmaExtPDSNIpAddress.0 = 03 04 53 67
ccpCdmaExtNotifReason.0 = cputhreshold(2)
ccpCdmaExtNotifReasonCurrentValue.0 = 27
```

### Bandwidth Policies

- `ccpCdmaExtBandwidthPolicyInstallSuccesses` - bandwidth installed to the session.
- `ccpCdmaExtBandwidthPolicyInstallFailures` - bandwidth installed failure to the session.
- `ccpCdmaExtBandwidthPolicyRemoves` - removal of bandwidth installation from the session by clearing the session.

### RPErrors

- `BandwidthUnavailable` - Number of A11s that were rejected because bandwidth was not available.
- `RegReqMaxServiceFlows` - Number of A11s that were rejected because the maximum aux connections per session was reached.
- `RegReqUnSupportedSO` - Number of A11s that were rejected because additional session NVSE contained unsupported Service Option.
- `RegReqNonExistA10` - Number of A11s that were rejected because IP flow mapping contained a mapping to a non-existent A10.

**RPSessUpdates**

- SessionUpdSubscriberQos-Number of A11 session update messages sent from PDSN to PCF.

**RSVPStats**

- TFTCreationSuccesses -Number of TFTs created successfully
- TFTCreationFailure -Number of TFTs creation failed
- TFTPacketFilterAddFailure-Number of packet filters not added to requested TFT.
- TFTPacketFilterUnavailable -Number of packet filters not available on requested TFT.
- TFTPacketFilterReplace -Number of packet filters replaced on existing TFT.
- TFTPacketFilterAddBeforeCreation -Number of packet filters added to persistent TFT.
- TFTUnableToParse -Number of TFTs unable to parse on PDSN.
- TFTUnauthorized - Number of unauthorized TFTs received on PDSN
- TFTPrecedenceContention -Number of TFTs that have contention in the packet filter evaluation precedence value.
- TFTTreatmentUnsupported - Number of TFTs that have received MS flows treatment values that are not supported on PDSN.
- TFTMaxPacketFiltersReached - Number of TFTs that have reached maximum allowed number of packet filters.

**QOSStats**

- QOSSuccess -Number Qos profiles that have been successfully applied on sessions.
- QOSFailure -Number Qos profiles failed to be applied on sessions.
- QOSDscpRemarked-Number of packets remarked at the PDSN.

**RpStats**

- NewAuxConnections- Number of A11 registration messages received at PDSN to establish new aux a10 connections.
- ReRegNewAuxConnections-Number of A11 reregistration messages received at PDSN to establish new aux a10 connections.
- RemapFlows- Number of A11 registration or reregistration messages received at PDSN, indicating a change of a10 connection to flow ID mapping for the session.
- CloseAuxConnections-Number of A11 reregistration messages received at PDSN indicating removal of A10 connections (missing a10 aux connections existing for the session).
- SessionUpdSubscriberQos-Number of A11 session update messages received at PDSN.

**CAC**

The following NotificationObjects are introduced as part of Call Admission Control

- LoadThresholdHighReached-PDSN has reached the maximum load.
- LoadThresholdLowReached-PDSN has reached the minimum load.

**PPP Counters in Cisco PDSN Release 3.0**

Objects have been added under the following existing MIB subgroups:

- cCdmaPppSetupStats

- cCdmaPppReNegoStats
- cCdmaPppAuthStats
- cCdmaPppReleaseStats
- cCdmaPppMiscStats

Table 23 describes the list of PPP counters that have been added in Cisco PDSN Release 3.0.

**Table 23** PPP Counters in Cisco PDSN Release 3.0

CDMA PPP MIB Subgroup	Counter Description
cCdmaPppSetupStats	
PPP stats - LCP Failure - option issue	Total number of PPP calls failed by LCP option negotiation failure.
PPP stats - IPCP failure option-issue	Total number of PPP calls failed by IPCP option negotiation failure.
PPP stats - Authentication aborted	Total number of PPP calls failed by authentication max-retry.
Session Disc - no remote-ip address:	Total number of sessions released because MN rejects IP address allocated by PDSN.
PPP stats - Lower layer disconnected:	Total number of calls released by RP layer.
PPP stats - TermReq-From-MN-IPCP:	LCP Term-Req received from MS During IPCP
PPP stats - TermReq-From-PDSN-IPCP:	LCP Term-Req Sent from PDSN During IPCP
PPP stats - TermReq-From-PDSN-Auth:	LCP Term-Req Sent from PDSN During Authentication
PPP stats - TermReq-From-MN-Auth:	LCP Term-Req received from MS During Authentication
PPP stats - TermReq-From-PDSN-LCP:	LCP Term-Req Sent from PDSN During LCP
PPP stats - TermReq-From-MN-LCP:	LCP Term-Req received from MS During LCP
PPP stats - A10Release-PCF-preLCP :	A10 Released by PCF before LCP stage
PPP stats - A10Release-PDSN-preLCP :	A10 Release by PDSN before LCP stage
PPP stats - A10Release-PCF-LCP :	A10 Released by PCF During LCP stage without LCP Term-Req
PPP stats - A10Release-PDSN-LCP :	A10 Released by PDSN During LCP stage without LCP Term-Req
PPP stats - A10Release-PCF-Auth:	A10 Released by PCF During Authentication without LCP Term-Req
PPP stats - A10Release-PDSN-Auth	A10 Released by PDSN During Authentication without LCP Term-Req
PPP stats - A10Release-PCF-IPCP :	A10 Released by PCF During IPCP stage without LCP Term-Req
PPP stats - A10Release-PDSN-IPCP :	A10 Released by PDSN During IPCP stage without LCP Term-Req
PPP stats - LCP - success :	PPP connections that finished LCP successfully
PPP stats - auth - success :	PPP connections that finished AUTH successfully

**Table 23** *PPP Counters in Cisco PDSN Release 3.0 (continued)*

<b>CDMA PPP MIB Subgroup</b>	<b>Counter Description</b>
PPP stats - IPCP - success :	PPP connections that finished IPCP successfully
cCdmaPppReNegoStats	
Session Reneg - Lower layer handoff:	Total number of sessions renegotiated due to PANID/CANID comparison during handoff.
cCdmaPppAuthStats	
Session Authen- CHAP auth timeout:	MN does not respond for CHAP request.
Session Authen- PAP auth timeout:	PDSN does not receive PAP request from MN.
Session Authen- MSCHAP auth timeout:	MN does not respond for MSCHAP request.
Session Authen- sessions skipped PPP Auth:	Total number of sessions skipped PPP authentication.
cCdmaPppReleaseStats	
PPP stats - release - pcf deregister:	PPP connections released as PCF sends deregistration
PPP stats - release - lifetime expiry:	PPP connections released due to life timer expiry
cCdmaPppMiscStats	
Session Data Compress - CCP negotiation failures:	Total number of sessions failed CCP negotiation.
LCP Echo Stats - total LCP Echo Req. sent:	Total transmission of LCP Echo Request.
LCP Echo Stats - LCP Echo Req. resent:	Total retransmission of LCP Echo Request.
LCP Echo Stats - LCP Echo Reply received:	Total received LCP Echo Reply.
LCP Echo Stats - LCP Echo Request timeout:	Total LCP Echo Request timeout.
Receive Errors - unknown protocol errors:	Total packets which protocol value cannot be identified out of packets received at PPP stack.
Receive Errors - bad pkt length:	Total bytes discarded with reasons above.

### RP Counters in Cisco PDSN Release 3.0

The following list identifies new MIB subgroups in Cisco PDSN Release 3.0:

- cCdmaRPreReqErrors
- cCdmaRPreUpdAckErrors
- cCdmaRPSessUpdAckErrors
- cCdmaRPreReplyErrors
- cCdmaRPreUpdErrors
- cCdmaRPSessUpdErrors
- cCdmaRpSessUpdStats
- cCdmaPcfSoRpSessUpdStats

The following list identifies existing MIB subgroups, under which objects are added:

- cCdmaTrafficStats

- cCdmaPcfSoRpRegStats
- cCdmaPcfSoRpUpdStats
- cCdmaSystemInfo
- cCdmaRpRegStats

Table 24 indicates the additional RP counters supported in Cisco PDSN Release 3.0:

**Table 24** *RP Counters Supported in Cisco PDSN Release 3.0*

CDMA PPP MIB Subgroup	Counter Description
cCdmaSystemInfo	
sysInfo - PPPoGREsessions	The total number of PPPoGRE sessions currently established with this system.
sysInfo-HDLC-GREsessions	The total number of HDLCoGRE sessions currently established with this system.
sysInfo-totalSessions	The total number of sessions established since system was last restarted.
sysInfo-totalReleases	The total number of sessions released since system was last restarted.
sysInfo-totalMSIDFlow	The total number of flows currently using MSID service.
sysInfo-totalVPDNFlow	The total number of flows currently using VPDN service.
cCdmaRpRegStats	
RegStats-Req	The number of Initial A11 Registration requests received since system was last restarted.
RegStats-Disc	The number of Initial A11 Registration requests silently discarded since system was last restarted.
RegStats-ReregReqs	The number of A11 Reregistration requests received since system was last restarted.
RegStats-ReregDisc	The number of A11 Reregistration requests silently discarded since system was last restarted.
RegStats-DeregReqs	The number of A11 Deregistration requests received since system was last restarted.
RegStats-DeregDisc	The number of A11 Deregistration requests silently discarded since system was last restarted.
RegStats-HandoffReqs	The number of A11 Handoff Registration requests received since system was last restarted.
RegStats-HandoffAccepted	Total number of accepted handoff A11 Registration Requests meant for already existing session, since the system was last restarted.
RegStats-HandoffDenied	Total number of denied handoff A11 Registration Requests meant for already existing session, since the system was last restarted.

**Table 24** *RP Counters Supported in Cisco PDSN Release 3.0 (continued)*

<b>CDMA PPP MIB Subgroup</b>	<b>Counter Description</b>
RegStats-HandoffDisc	The number of handoff A11 Registration requests silently discarded since system was last restarted.
RegStats-ReregAirlinkStart	The number of A11 Reregistration requests containing Airlink Start since system was last restarted.
RegStats-ReregAirlinkStop	The number of A11 Reregistration requests containing Airlink Stop since system was last restarted.
RegStats-DeregAirlinkStop	The number of Inter PCF active handoff since system was last restarted.
RegStats-HandoffInterPCFActive	The number of A11 Deregistration requests containing Airlink Stop since system was last restarted.
RegStats-HandoffInterPCFDormant	The number of Inter PCF dormant handoff since system was last restarted.
cCdmaRpSessUpdStats	
SessUpdStats-TransReqs	Total number of A11 Session Updates transmitted since system was last restarted.
SessUpdStats-AcceptedReqs	Total number of A11 Session Update Acknowledgements received with the Status field set to zero (indicating that the corresponding Registration Update was accepted), since system was last restarted.
SessUpdStats-DeniedReqs	Total number of A11 Session Update Acknowledgements received with the Status field set to non-zero indicating that the corresponding Registration Update was denied, since system was last restarted.
SessUpdStats-NotAckedReqs	Total number of A11 Session Update Updates sent, for which no corresponding A11 Registration Acknowledgements received, since system was last restarted.
SessUpdStats-TransReqs	Total number of initial A11 Session Updates sent, excluding the re-transmitted A11 Registration Updates, since system was last restarted.
SessUpdStats-RetransReqs	Total number of re-transmitted A11 Session Updates, since system was last restarted.
SessUpdStats-RecAcks	Total number of A11 Session Update Acknowledgements received, since system was last restarted.
SessUpdStats-DiscAcks	Total number of A11 Session Update Acknowledgements discarded, since system was last restarted.

**Table 24** *RP Counters Supported in Cisco PDSN Release 3.0 (continued)*

<b>CDMA PPP MIB Subgroup</b>	<b>Counter Description</b>
SessUpdStats-AlwaysON	Total number of initial A11 Session Updates sent due to Always On since system was last restarted. Note that this count does not include any retransmissions.
SessUpdStats-RNPDIT	Total number of initial A11 Registration Updates sent due to RNPDIT value downloaded, since system was last restarted. Note that this count does not include any retransmissions.
SessUpdStats-UnSpecFail	The number of session update registrations failed for unspecified reason since system was last restarted.
SessUpdStats-ParamNotUpd	The number of session update registrations failed for session parameters not updated reason since system was last restarted.
SessUpdStats-MNAuthenFail	The number of session update registrations failed due to MN authentication failure since system was last restarted.
SessUpdStats-IdentMismatchFail	The number of session update registrations failed due to registration identity mismatch since system was last restarted.
SessUpdStats-BadReqsFail	The number of session update registrations failed due to poorly formed request since system was last restarted.
cCdmaTrafficStats	
trafficStats-SDBPaks	Total number of SDB marked data packets sent to PCF from PDSN since system was last restarted.
trafficStats-SDBOctets	Total number of SDB marked data octets sent to PCF from PDSN since system was last restarted.
cCdmaPcfSoRpRegStats	
PcfSoRegStats-InitRegReqs	The number of Initial A11 Registration requests received since system was last restarted.
PcfSoRegStats-InitRegDisc	The number of Initial A11 Registration requests silently discarded since system was last restarted.
PcfSoRegStats-RegReqs	The number of A11 Reregistration requests received since system was last restarted.
PcfSoRegStats-ReregDisc	The number of A11 Reregistration requests silently discarded since system was last restarted.
PcfSoRegStats-DeregReqs	The number of A11 Deregistration requests received since system was last restarted.
PcfSoRegStats-DiscardedReqs	The number of A11 Deregistration requests silently discarded since system was last restarted.
PcfSoRegStats-RcvdReqs	The number of A11 Handoff Registration requests received since system was last restarted.

Table 24 RP Counters Supported in Cisco PDSN Release 3.0 (continued)

CDMA PPP MIB Subgroup	Counter Description
PcfSoRegStats-AcptdReqs	Total number of accepted handoff A11 Registration Requests meant for already existing session, since the system was last restarted.
PcfSoRegStats-DeniedReqs	Total number of denied handoff A11 Registration Requests meant for already existing session, since the system was last restarted.
PcfSoRegStats-Disc	The number of handoff A11 Registration requests silently discarded since system was last restarted.
PcfSoRegStats-ReregAirlinkStart	The number of A11 Reregistration requests containing Airlink Start since system was last restarted.
PcfSoRegStats-ReregAirlinkStop	The number of A11 Reregistration requests containing Airlink Stop since system was last restarted.
PcfSoRegStats-DeregAirlinkStop	The number of A11 Deregistration requests containing Airlink Stop since system was last restarted.
cCdmaPcfSoRpUpdStats	
PcfSoHandoffUpdStats	The number of update registrations sent as a result of inter PCF handoffs, since system was last restarted.
PcfSoHandoffUpdStats-NotAckedReqs	Total number of A11 Registration Updates (sent as the result of inter PCF handoffs), for which no corresponding A11 Registration Acknowledgements received, since system was last restarted.
PcfSoHandoffUpdStats-RecAcks	Total number of A11 Registration Acknowledgements received for the A11 Registration Updates sent as the result of inter PCF handoffs, since system was last restarted.
PcfSoHandoffUpdStats-AcceptReqs	Total number of A11 Registration Acknowledgements received with the Status field set to zero (indicating that the corresponding Registration Update was accepted), since system was last restarted.
PcfSoHandoffUpdStats-DeniedReqs	Total number of A11 Registration Acknowledgements received with the Status field set to non-zero indicating that the corresponding Registration Update was denied, since system was last restarted.
PcfSoHandoffUpdStats-DiscAcks	Total number of A11 Registration Acknowledgements discarded, since system was last restarted.

**Table 24** *RP Counters Supported in Cisco PDSN Release 3.0 (continued)*

<b>CDMA PPP MIB Subgroup</b>	<b>Counter Description</b>
PcfSoHandoffUpdStats-TxdReqs	Total number of initial A11 Registration Updates sent as the result of inter PCF handoffs, excluding the re-transmitted A11 Registration Updates, since system was last restarted.
PcfSoHandoffUpdStats-RetxdReqs	Total number of re-transmitted A11 Registration Updates as the initial Registration Update (sent as a result of inter PCF handoffs) was not acked or denied, since system was last restarted.
PcfSoHandoffUpdStats-UnknownFail	The number of update registrations failed for unspecified reason since system was last restarted. The update is sent as a result of inter PCF handoff.
PcfSoHandoffUpdStats-AdminProhibitFail	The number of update registrations failed due to administrative prohibition since system was last restarted. The update is sent as a result of inter PCF handoff.
PcfSoHandoffUpdStats-MNAuthenFail	The number of update registrations failed due to MN authentication failure since system was last restarted. The update is sent as a result of inter PCF handoff.
PcfSoHandoffUpdStats--IdMismatch	The number of registrations failed due to registration identity mismatch since system was last restarted. The update is sent as a result of inter PCF handoff.
PcfSoHandoffUpdStats-BadReqs	The number of update registrations failed due to poorly formed request since system was last restarted. The update is sent as a result of inter-PCF handoff.
cCdmaRPRegReqErrors	
RegReqErr-PakLen	Invalid Registration request packet length while parsing since system was last restarted.
RegReqErr-Protocol	Invalid Protocol value in the Registration Request Session Specific Extension since system was last restarted.
RegReqErr-Flags	Invalid Flags value in the Registration Request since system was last restarted.
RegReqErr-MHAEKey	Invalid Authentication key in the Registration Request Mobile-Home Authentication extension since system was last restarted.
RegReqErr-SPIMismatch	Mismatch in SPI in the Registration Request Mobile-Home Authentication extension since system was last restarted.
RegReqErr-SPI	Invalid SPI in the Registration Request Mobile-Home Authentication extension since system was last restarted.

**Table 24** *RP Counters Supported in Cisco PDSN Release 3.0 (continued)*

<b>CDMA PPP MIB Subgroup</b>	<b>Counter Description</b>
RegReqErr-ConnId	Invalid Connection ID in the Registration Request since system was last restarted.
RegReqErr-MNID	Invalid MN ID in the Registration Request since system was last restarted.
RegReqErr-MNIDType	Invalid MN ID type in the Registration Request since system was last restarted.
RegReqErr-MSIDLen	Invalid MSID length in the Registration Request since system was last restarted.
RegReqErr-SSE	Session Specific extension missing in the Registration Request since system was last restarted.
RegReqErr-MHAE	Mobile-Home Authentication extension missing in the Registration Request since system was last restarted.
RegReqErr-Order	Invalid order of the extensions in the Registration Request since system was last restarted.
RegReqErr-VSE	Invalid vendor-specific extensions in the Registration Request since system was last restarted.
RegReqErr-AppType	Invalid Application type in vendor-specific extensions in the Registration Request since system was last restarted.
RegReqErr-DupAppType	Duplicate Application type in vendor-specific extensions in the Registration Request since system was last restarted.
RegReqErr-AppSubType	Invalid Sub Application type in vendor-specific extensions in the Registration Request since system was last restarted.
RegReqErr-VendorId	Invalid Vendor ID in vendor-specific extensions in the Registration Request since system was last restarted.
RegReqErr-CVSE	Duplicate Critical Vendor extension in the Registration Request since system was last restarted.
RegReqErr-UnknownAttr	Unknown Accounting attribute in the Registration Request since system was last restarted.
RegReqErr-LenAttr	Invalid accounting attribute length in the Registration Request since system was last restarted.
RegReqErr-DupAttr	Duplicate accounting attribute received in the Registration Request since system was last restarted.

**Table 24** *RP Counters Supported in Cisco PDSN Release 3.0 (continued)*

<b>CDMA PPP MIB Subgroup</b>	<b>Counter Description</b>
RegReqErr-AcctRecRetrans	Same accounting sequence number and record type in the Registration Requests airlink record not updated since system was last restarted.
RegReqErr-SeqNum	Invalid sequence number in the airlink accounting record Registration Requests silently discarded since system was last restarted.
RegReqErr-DupGREKey	Duplicate GRE Key received in the Registration Request for different MSID from the same PCF since system was last restarted.
RegReqErr-SameGREKey	Same GRE Key and Airlink setup received in the Registration Request for existing session since system was last restarted.
RegReqErr-GREKeyChangeNoSetup	GRE changed without airlink setup received in the Registration Request for existing session since system was last restarted.
RegReqErr-InitNoSetup	Airlink Setup record not received in the Initial Registration Request since system was last restarted.
RegReqErr-StartBeforeSetup	Airlink Start record received before the Airlink setup in the Registration Request since system was last restarted.
RegReqErr-StartOnClose	Airlink Start record received in the Deregistration Request since system was last restarted.
RegReqErr-StartOnActive	Airlink Start record received in the Registration Request for already active session since system was last restarted.
RegReqErr-StopOnDormant	Airlink Stop record received in the Registration Request for already dormant session since system was last restarted.
RegReqErr-InitStop	Airlink Stop record received in the Initial Registration Request since system was last restarted.
RegReqErr-InitSDB	Airlink SDB received in the Initial Registration Request since system was last restarted.
RegReqErr-airlinkRec	Invalid Accounting Airlink record type in the Registration Request since system was last restarted.
RegReqErr-DeregNoSession	Deregistration Request for non-existing session registration request is discarded since system was last restarted.
RegReqErr-ReregInDisc	Reregistration Request received for the session in the disconnecting or deleting state, therefore the registration request is discarded since system was last restarted.

**Table 24** *RP Counters Supported in Cisco PDSN Release 3.0 (continued)*

<b>CDMA PPP MIB Subgroup</b>	<b>Counter Description</b>
RegReqErr-Memfail	Registration Request discarded due to memory allocation failure during processing since system was last restarted.
RegReqErr-MaxSessions	Registration request rejected because of maximum limit or configured number of session reached since system was last restarted.
cCdmaRPRegUpdAckErrors	
RegUpdAckErr-PakLen	Invalid Registration Update Ack packet length while parsing since system was last restarted.
RegUpdAckErr-Protocol	Invalid Protocol value in the Registration Update Ack Session Specific Extension since system was last restarted.
RegUpdAckErr-RUAEKey	Invalid Authentication key in the Registration Update Ack Registration Update Authentication extension since system was last restarted.
RegUpdAckErr-SPI	Invalid SPI in the Registration Update Ack Registration Update Authentication extension since system was last restarted.
RegUpdAckErr-ConnId	Invalid Connection ID in the Registration Update Ack since system was last restarted.
RegUpdAckErr-MNID	Invalid MN ID in the Registration Update Ack since system was last restarted.
RegUpdAckErr-MNIDType	Invalid MN ID type in the Registration Update Ack since system was last restarted.
RegUpdAckErr-MSIDLen	Invalid MSID length in the Registration Update Ack since system was last restarted.
RegUpdAckErr-SSE	Session Specific extension missing in the Registration Update Ack since system was last restarted.
RegUpdAckErr-RUAE	Registration Update Authentication extension missing in the Registration Update Ack since system was last restarted.
RegUpdAckErr-Order	Invalid order of the extensions in the Registration Update Ack since system was last restarted.
RegUpdAckErr-VSE	Invalid vendor-specific extensions in the Registration Update Ack since system was last restarted.
RegUpdAckErr-NoSession	Deregistration Update Ack for non existing session Registration Update Ack is discarded since system was last restarted.
RegUpdAckErr-MemFail	Registration Update Ack discarded due to memory allocation failure during processing since system was last restarted.

**Table 24** *RP Counters Supported in Cisco PDSN Release 3.0 (continued)*

<b>CDMA PPP MIB Subgroup</b>	<b>Counter Description</b>
cCdmaRPSessUpdAckErrors	
SessUpdAckErr-PakLen	Invalid Session Update Ack packet length while parsing since system was last restarted.
SessUpdAckErr-Protocol	Invalid Protocol value in the Session Update Ack Session Specific Extension since system was last restarted.
SessUpdAckErr-RUAEKey	Invalid Authentication key in the Session Update Ack Registration Update Authentication extension since system was last restarted.
SessUpdAckErr-SPI	Invalid SPI in the Session Update Ack Session Update Authentication extension since system was last restarted.
SessUpdAckErr-ConnId	Invalid Connection ID in the Session Update Ack since system was last restarted.
SessUpdAckErr-MSID	Invalid MN ID in the Session Update Ack since system was last restarted.
SessUpdAckErr-MSIDType	Invalid MN ID type in the Session Update Ack since system was last restarted.
SessUpdAckErr-MSIDLen	Invalid MSID length in the Session Update Ack since system was last restarted.
SessUpdAckErr-SSE	Session Specific extension missing in the Session Update Ack since system was last restarted.
SessUpdAckErr-RUAE	Session Update Authentication extension missing in the Session Update Ack since system was last restarted.
SessUpdAckErr-Order	Invalid order of the extensions in the Session Update Ack since system was last restarted.
SessUpdAckErr-VSE	Invalid vendor-specific extensions in the Session Update Ack since system was last restarted.
SessUpdAckErr-NoSession	De-Session Update Ack for non existing session Session Update Ack is discarded since system was last restarted.
SessUpdAckErr-MemFail	Session Update Ack discarded due to memory allocation failure during processing since system was last restarted.
cCdmaRPRegReplyErrors	
RegRplyErr-Internal	Registration reply not sent due to internal error during processing since system was last restarted.
RegRplyErr-MemFail	Registration reply not sent due to memory allocation failure during processing since system was last restarted.

**Table 24** *RP Counters Supported in Cisco PDSN Release 3.0 (continued)*

<b>CDMA PPP MIB Subgroup</b>	<b>Counter Description</b>
RegRplyErr-NoSecOrParse	Cannot send Reply to PCF because security association not found for the PCF or Parse error of Request since system was last restarted.
cCdmaRPRegUpdErrors	
RegUpdErr-Internal	Registration update not sent due to internal error during processing since system was last restarted.
RegUpdErr-MemFail	Registration update not sent due to memory allocation failure during processing since system was last restarted.

The following MIB enhancements are included in the Cisco PDSN Release 2.1:

PPP Counter Objects have been added under the following existing MIB subgroups:

- cCdmaPppSetupStats
- cCdmaPppReNegoStats
- cCdmaPppAuthStats
- cCdmaPppReleaseStats
- cCdmaPppMiscStats

#### **CDMA PDSN System Information**

ccpcEnabled OBJECT-TYPE

::= { ccpcSystemInfo 1 }

ccpcSessionTotal OBJECT-TYPE

::= { ccpcSystemInfo 2 }

#### **CDMA PDSN Closed RP Registration Statistics per PCF**

The PDSN PCF table maintains reference about the PCF in the RAN currently interacting with the PDSN.

An entry is created when an L2TP tunnel is established with the PCF. An entry is deleted when the tunnel is deleted.

Statistics Objects maintained per PCF include the following:

ccpcPcfIpAddressType OBJECT-TYPE

“Represents the type of the address specified by ccpcPcfIpAddress.”

::= { ccpcPcfPerfStatsEntry 1 }

ccpcPcfIpAddress OBJECT-TYPE

“The IP address of the PCF that serves the mobile node.”

::= { ccpcPcfPerfStatsEntry 2 }

ccpcPcfRcvdIcrqs OBJECT-TYPE

“Total number of Incoming-Call-Requests received to establish a L2TP session since the L2TP tunnel was established with PCF.”

::= { ccpcPcfPerfStatsEntry 3 }

ccpcPcfAcptdIcrqs OBJECT-TYPE

“Total number of Incoming-Call-Requests accepted since the L2TP tunnel was established with PCF.”

::= { ccpcPcfPerfStatsEntry 4 }

ccpcPcfDroppedIcrqs OBJECT-TYPE

“Total number of Incoming-Call-Requests denied since the L2TP tunnel was established with PCF.”

::= { ccpcPcfPerfStatsEntry 5 }

ccpcPcfSentIcrps OBJECT-TYPE

“Total number of Incoming-Call-Replies sent since the L2TP tunnel was established with PCF.”

::= { ccpcPcfPerfStatsEntry 6 }

ccpcPcfRcvdIccns OBJECT-TYPE

“Total number of Incoming-Call-Connected messages received since the L2TP tunnel was established with PCF.”

::= { ccpcPcfPerfStatsEntry 7 }

ccpcPcfAcptdIccns OBJECT-TYPE

“Total number of Incoming-Call-Connected messages accepted since the L2TP tunnel was established with PCF.”

::= { ccpcPcfPerfStatsEntry 8 }

ccpcPcfDroppedIccns OBJECT-TYPE

“Total number of Incoming-Call-Connected messages accepted since the L2TP tunnel was established with PCF.”

::= { ccpcPcfPerfStatsEntry 9 }

ccpcPcfRcvdCdns OBJECT-TYPE

“Total number of Call-Disconnect-Notify messages received to tear down L2TP session since the L2TP tunnel was established with PCF.”

::= { ccpcPcfPerfStatsEntry 10 }

ccpcPcfSentCdns OBJECT-TYPE

“Total number of Call-Disconnect-Notify messages sent to PCF to tear down L2TP session since the L2TP tunnel was established with PCF.”

::= { ccpcPcfPerfStatsEntry 11 }

ccpcPcfDroppedCdns OBJECT-TYPE

“Total number of Call-Disconnect-Notify messages dropped since the L2TP tunnel was established with PCF.”

::= { ccpcPcfPerfStatsEntry 12 }

ccpcPcfRcvdZlbs OBJECT-TYPE

“Total number of Zero-Length-Buffer messages received since the L2TP tunnel was established with PCF.”

```
 ::= { ccpcPcfPerfStatsEntry 13 }
```

ccpcPcfSentZlbs OBJECT-TYPE

“Total number of Zero-Length-Buffer messages sent since the L2TP tunnel was established with PCF.”

```
 ::= { ccpcPcfPerfStatsEntry 14 }
```

In Cisco PDSN Release 2.0 and later releases, the MIB CISCO-CDMA-PDSN-MIB module is modified to provide the following statistics by PCF plus Service Option:

- PCF and Service Option based RP Registration Statistics
- PCF and Service Option based RP Update Statistics
- PCF and Service Option based PPP Statistics

#### PCF/Service Option-based RP Statistics

In Release 1.2, the PDSN MIB provided RP registration statistics that offer box level information. These statistics are defined under the group “cCdmaRpRegStats.” In Release 2.0 and higher, in addition to box level information, the PCF/SO-based RP statistics will also be provided, and the MIB objects pertaining to these statistics is defined under the following group:

```
cCdmaPcfSoRpRegStats  OBJECT IDENTIFIER
 ::= { cCdmaPerformanceStats 10 }
```

#### PCF/Service Option-based RP Update Statistics

The Release 1.2 MIB provides RP update statistics at box level; the MIB objects pertaining to these statistics are defined under the group cCdmaRpUpdStats. In addition to these statistics, the Release 2.0 MIB will provide PCF/SO based RP update statistics. These new MIB objects are defined under the following group.

```
cCdmaPcfSoRpUpdStats  OBJECT IDENTIFIER
 ::= { cCdmaPerformanceStats 11 }
```

#### PCF/Service Option-based PPP Statistics

In Release 1.2, the MIB object defined under the group “cCdmaPppStats” provides box level information about PPP negotiation between the PDSN and the MN. In Release 2.0, the MIB will provide the following PPP stats based on PCF/SO.

```
cCdmaPcfSoPppCurrentConns,
cCdmaPcfSoPppConnInitiateReqs,
cCdmaPcfSoPppConnSuccesses,
cCdmaPcfSoPppConnFails,
cCdmaPcfSoPppConnAborts
```

These objects are grouped under the following MIB group.

```
cCdmaPcfSoPppSetupStats  OBJECT IDENTIFIER
 ::= { cCdmaPerformanceStats 12 }
```

As with previous releases, you can manage the PDSN with CiscoWorks 2000 network management system using SNMP. In addition to the standard 6500 MIBS, the Cisco CDMA PDSN MIB (CISCO\_CDMA\_PDSN\_MIB.my) is part of the PDSN solution. The PDSN MIB continues to support the following features:

- Statistics groups
  - Handoff statistics: include inter-PCF success and failure, inter-PDSN handoff
  - Service option based success and failure statistics
  - Flow type based failure statistics
  - MSID authentication statistics
  - Addressing scheme statistics: static or dynamic MIP or SIP
- A TRAP threshold group to support different severity levels. Agent generates notifications only if the severity level of the affected service is higher than the configured severity level. The severity level can be configured using the following methods:
  - The CLI command using the **cdma pdsn mib trap level 1-4**, or by
  - Using SNMP, set the object cCdmaNotifSeverityLevel.

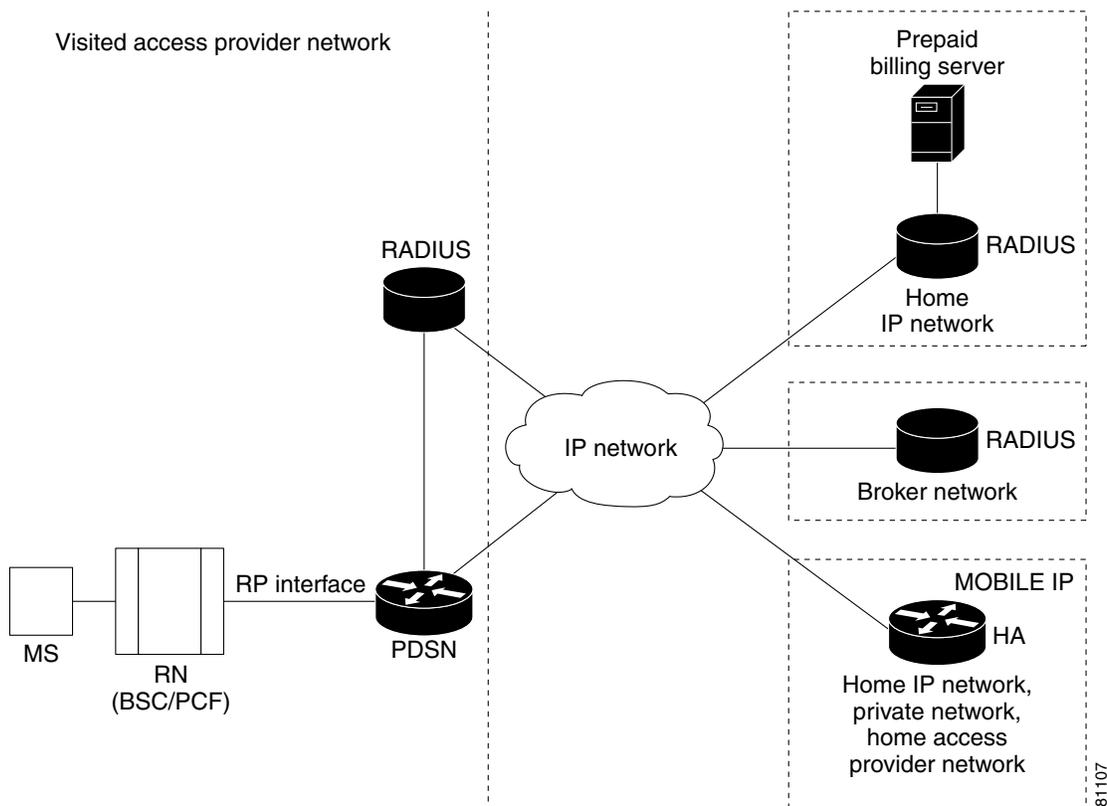
## Cisco Proprietary Prepaid Billing

Cisco PDSN Release 2.1 supports Cisco proprietary prepaid billing features, that provide the following services:

- SIP-based service metering in real time. See the [“Prepaid Simple IP Call Flow” section on page 97](#) for more information.
- Undifferentiated MIP service in real-time, with support for multiple MIP flows per user. See the [“Prepaid Mobile IP Call Flow” section on page 98](#) for more information.
- Rating based on per-flow data volume, octet or packet count, and call duration.

[Figure 6](#) shows the network reference architecture for prepaid service. The PBS resides in the mobile station's home network and is accessed by the home RADIUS server. A Cisco Access Registrar (AR) with prepaid functionality can be used as the home RADIUS server to provide service to prepaid and non-prepaid users.

**Figure 6 PDSN Prepaid Billing Architecture**



For roaming users, the local RADIUS server in the visited network forwards the AAA server requests to the home RADIUS server, using a broker RADIUS server if required. For roaming prepaid users, this requires that the local and broker AAA servers forward the new vendor-specific prepaid accounting attributes transparently to the home RADIUS server.

In existing networks, where the home RADIUS server does not support the interface to the PBS, AR can be placed in front of the home RADIUS server to act as a proxy. In this case AR forwards all authorization and accounting messages to or from the home RADIUS server and communicates with the PBS. This scenario is relevant if you already have a RADIUS server.

While this architecture does impose some additional requirements on the RADIUS server, the interface towards the PDSN does not change.

It is possible that you may want to use an existing WIN or IN-based prepaid billing server. In this situation, the PBS will interface to the external prepaid billing server.

### Accounting Records

The PDSN will continue to generate per flow accounting records in the same way as it does for non-prepaid users. However, the last accounting stop request for a flow will contain the new prepaid Vendor Specific Attributes (VSAs) for reporting the final usage.

## How Prepaid Works in PDSN

When a prepaid mobile user makes a data service call, the MS establishes a Point-to-Point Protocol (PPP) link with the PDSN. The PDSN authenticates the mobile station by communicating with the AAA server. The AAA server verifies that the user is a valid prepaid subscriber, determines what services are available for the user, and tracks usage for billing.

The methods used to assign an IP address and the nature of the connection are similar to those discussed in the [“How PDSN Works” section on page 5](#).

The following sections describe the IP addressing and communication levels in the prepaid environment for each respective topic:

- [Prepaid Simple IP Call Flow](#)
- [Prepaid Mobile IP Call Flow](#)

### Prepaid Simple IP Call Flow

In the following scenario, the prepaid user has sufficient credit and makes a SIP data call. The user disconnects at the end of the call.

- 
- Step 1** The MS originates a call by sending an origination message. A traffic channel is assigned, and the MS is authenticated using CHAP.
- Step 2** The PDSN determines that a SIP flow is requested and sends an access-request to the RADIUS server.
- Step 3** The RADIUS Server looks up the user’s profile and determines that user has prepaid service. It sends an initial authentication request to the billing server.
- Step 4** The billing server checks that the user has sufficient quota to make a call, and returns the result.
- Step 5** The RADIUS Server sends an access-accept message to PDSN indicating that this is a prepaid user.
- Step 6** The PDSN completes the PPP connection, and an IP address is assigned to the MS.
- Step 7** PDSN sends an Accounting Request (Start) as normal, and sends an access-request to AR for initial quota authorization. The request contains the Service Id VSA that indicates the call is SIP.
- Step 8** The RADIUS Server, knowing that this is a prepaid user, sends an initial quota authorization request to the billing server, which returns the quota information to the RADIUS Server. The RADIUS Server includes the quota information in the access-accept message and sends it to the PDSN.
- Step 9** The PDSN saves the received quota information and monitors user data against this. When the quota is used up, the PDSN sends an access-request to AR indicating the usage and reason “Quota Depleted.”
- Step 10** The RADIUS Server then sends a re-authorization request to PBS, which updates the user’s account, allocates additional quota, and returns the new quota information to the RADIUS Server.
- Step 11** The RADIUS Server includes the new quota information in the access-accept message and sends it to the PDSN. The PDSN updates the new quota information in its tables, and adjusts the usage to allow for quota that was used since the access-request was sent. The PDSN then continues to monitor the user data. Steps 9 - 11 are repeated as long as the user has sufficient quota.
- Step 12** When the user disconnects, the MS initiates release of the call and the traffic channel is released. The PDSN clears the session and sends an Accounting Request Stop record. The record includes the prepaid VSAs to report final usage.

- Step 13** The RADIUS Server updates its own records and sends final usage report to PBS. The PBS updates the user's account and replies to the AR. And the AR sends the Accounting Response to PDSN.
- 

## Prepaid Mobile IP Call Flow

In the following scenario, the prepaid user makes a MIP data call. The user runs out of quota during the MIP data session and the PDSN disconnects the call. The call flow shows a single MIP flow; however, additional flows are established and handled in a similar manner when the MS sends additional MIP Registration Requests.

- 
- Step 1** The MS originates a call by sending an origination message. A traffic channel is assigned, but the MS skips CHAP.
- Step 2** The PDSN completes the PPP connection. As the MS skips IP address assignment during IPCP, the PDSN assumes MIP.
- Step 3** The PDSN sends an agent advertisement with a FA-CHAP challenge, and the MS begins a MIP registration request with FA-CHAP response.
- Step 4** The PDSN sends the access-request with FA-CHAP to the AR. The AR looks up the user's profile and determines that if the user has prepaid service. It then sends an authentication request to the billing server.
- Step 5** The billing server checks that the user has sufficient quota to make a call and returns an **ok**. The RADIUS server sends an access-accept message to the PDSN that indicates a prepaid user.
- Step 6** The PDSN forwards the MIP registration request to the HA and receives a registration reply. The PDSN forwards the reply to the MS.
- Step 7** The PDSN sends an access-request for initial quota authorization. The request contains the service ID VSA that indicates this is a MIP call. The AR, knowing that this is a prepaid user, sends the initial quota authorization request to the PBS. The billing server returns the quota information to the AR, which includes the quota information in the access-accept message and sends it to the PDSN.
- Step 8** The PDSN saves the received quota information and monitors the user data against this. When the quota is used up, the PDSN sends an access-request to AR indicating the usage and reason as "Quota Depleted."
- Step 9** The AR sends a re-authorization request to the PBS, which updates the user's account, allocates additional quota, and returns the new quota information to the AR.
- Step 10** The AR includes the new quota information in the access-accept message and sends it to the PDSN. The PDSN updates the new quota information in its tables, and adjusts usage to allow for quota used since the access-request was sent. The PDSN then continues to monitor the user data. Steps 8-10 are repeated as long as the user has sufficient funds.
- Step 11** If the PDSN requests an additional quota but the user has run out, the PBS rejects the request with reason "Exceeded Balance", and the AR sends an access-reject to PDSN.
- Step 12** The PDSN deletes the MIP flow, determines that this is the last flow, and requests release of the A10 connection by sending A11-Registration Update to the PCF. The PCF sends an ack message and initiates release of the traffic channel.
- Step 13** The PDSN clears the session and sends an accounting request stop record. The record includes the prepaid VSAs to report final usage.
- Step 14** The AR updates its own records and sends the final usage report to PBS, which updates the user's account and replies to the AR.

**Step 15** The AR finally sends the accounting response to the PDSN.

**Note**

This feature is a variant of Cisco PDSN Release 2.1. See the [PDSN Feature Matrix](#) section to see which features are available on the image of Cisco PDSN Release 2.0.

## 3DES Encryption

The PDSN include 3DES encryption, which supports IPSec on PDSN. IPSec on the MWAM platform requires you to use a Cisco VPN Acceleration Module.

This feature allows VPDN traffic and MIP traffic (between the PDSN HA) to be encrypted. In this release the PDSN requires you to configure the parameters for each HA before a MIP data traffic tunnel is established between the PDSN and the HA.

**Note**

This feature is only available with hardware support.

**Note**

This feature is a variant of the PDSN software. See the [PDSN Feature Matrix](#) to see which features are available on a specific image of PDSN.

## Mobile IP IPSec

The Internet Engineering Task Force (IETF) has developed a framework of open standards called IP Security (IPSec) that provides data confidentiality, data integrity, and data authentication between participating peers. IPSec provides these security services at the IP layer; it uses Internet Key Exchange (IKE) to handle negotiation of protocols and algorithms based on local policy, and to generate the encryption and authentication keys to be used by IPSec. IPSec can be used to protect one or more data flows between a pair of hosts, between a pair of security gateways, or between a security gateway and a host.

IS-835-B specifies three mechanisms for providing IPSec security:

- Certificates
- Dynamically distributed pre-shared secret
- Statically configured pre-shared secret.

**Note**

IS-835-B Statically configured pre-shared secret is not supported in Cisco PDSN Release 1.2. Only CLI-configured, statically configured pre-shared secret of IKE will be implemented and supported.

## Hardware IPSec Acceleration Using IPSec Acceleration Module—Static IPSec



### Note

The Cisco PDSN Release 3.0 on the Cisco 6500 and 7600 platforms requires the support of the Cisco IPSec Services Module (VPNSM), a blade that runs on the Catalyst 6500 Series Switch and the Cisco 7600 Series Router. VPNSM does not have any physical WAN or LAN interfaces, and uses VLAN selectors for its VPN policy. For more information on Catalyst 6500 Security Modules visit <http://wwwin.cisco.com/issg/isbu/products/6000/6500security.shtml>. For more information on the Cisco 7600 Series Router, visit <http://wwwin.cisco.com/rtg/routers/products/7600/techttools/index.shtml>.

IPSec-based security may be applied on tunnels between the PDSN and the HA depending on parameters received from Home AAA server. A single tunnel may be established between each PDSN-HA pair. It is possible for a single tunnel between the PDSN-HA pair to have three types of traffic streams: Control Messages, Data with IP-in-IP encapsulation, and Data with GRE-in-IP encapsulation. All Traffic carried in the tunnel will have the same level of protection provided by IPSec.

IS-835-B defines Mobile IP service as described in RFC 2002; the PDSN provides MIP service and PMIP service.

In Proxy Mobile service, the Mobile-Node is connected to the PDSN/FA through SIP, and the PDSN/FA acts as MIP Proxy for the MN to the HA.

Once Security Associations (SAs, or tunnels) are established, they remain active until there is traffic on the tunnel, or the lifetime of the SAs expire.



### Note

This feature is a variant of the PDSN software. See the [PDSN Feature Matrix](#) section to see which features are available on a specific image of PDSN.

## Conditional Debugging Enhancements

In Cisco PDSN Release 4.1, debugs are displayed while parsing the attributes and sending them in an accounting request.

- debug aaa authentication
- debug aaa authorization
- debug radius
- debug aaa per-user
- debug ppp negotiation

### Debugs from Access Accept

```
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: Service-Type [6] 6 Framed
[2]
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: Framed-IP-Pool [88] 11 "test-pool"
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: Vendor, 3GPP2 [26] 20
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: cdma-dns-server-ip-[117] 14
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: 01 06 01 02 03 04 02 06 05 06 07 08
[????????????]
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: Vendor, Cisco [26] 27
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: Cisco AVpair [1] 21
"ip:vrf-id=test-pdsn"
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: Vendor, Cisco [26] 34
```

```

SAMI 5/3: Aug 4 10:16:07.859: RADIUS: Cisco AVpair [1] 28
"ip:ip-unnumbered=Loopback0"
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: Vendor, CNCTC [26] 17
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: cnctc-served-mdn [100] 11
SAMI 5/3: Aug 4 10:16:07.859: RADIUS: 74 65 73 74 2D 70 64 73 6E
[test-pdsn]

```

### Debugs in IPCP

```

SAMI 5/3: Aug 4 10:16:07.863: Vi2.1 IPCP: O CONFNAK [REQsent] id 1 len 22
SAMI 5/3: Aug 4 10:16:07.863: Vi2.1 IPCP: Address 2.1.1.1 (0x030602010101)
SAMI 5/3: Aug 4 10:16:07.863: Vi2.1 IPCP: PrimaryDNS 1.2.3.4 (0x810601020304)
SAMI 5/3: Aug 4 10:16:07.863: Vi2.1 IPCP: SecondaryDNS 5.6.7.8 (0x830605060708)
SAMI 5/3: Aug 4 10:16:07.863: Vi2.1 IPCP: I CONFACK [REQsent] id 1 len 10
SAMI 5/3: Aug 4 10:16:07.863: Vi2.1 IPCP: Address 51.1.1.10 (0x03063301010A)
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 IPCP: I CONFREQ [ACKrcvd] id 2 len 22
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 IPCP: Address 2.1.1.1 (0x030602010101)
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 IPCP: PrimaryDNS 1.2.3.4 (0x810601020304)
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 IPCP: SecondaryDNS 5.6.7.8 (0x830605060708)
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 AAA/AUTHOR/IPCP: primary dns server 1.2.3.4
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 AAA/AUTHOR/IPCP: secondary dns server 5.6.7.8
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 IPCP: O CONFACK [ACKrcvd] id 2 len 22
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 IPCP: Address 2.1.1.1 (0x030602010101)
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 IPCP: PrimaryDNS 1.2.3.4 (0x810601020304)
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 IPCP: SecondaryDNS 5.6.7.8 (0x830605060708)
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 IPCP: State is Open
SAMI 5/3: Aug 4 10:16:07.867: AAA/AUTHOR: Processing PerUser AV vrf-id
SAMI 5/3: Aug 4 10:16:07.867: AAA/AUTHOR: Processing PerUser AV ip-unnumbered
SAMI 5/3: Aug 4 10:16:07.867: AAA/BIND(000000DE): Bind i/f
SAMI 5/3: Aug 4 10:16:07.867: Vi2.1 IPCP: Install route to 2.1.1.1
SAMI 5/3: Aug 4 10:16:07.867: RADIUS/ENCODE(000000DE):Orig. component type = PDSN

```

### Debugs in Accounting Request

```

SAMI 5/3: Aug 4 10:16:07.867: RADIUS: Framed-IP-Address [8] 6 2.1.1.1
SAMI 5/3: Aug 4 10:16:07.867: RADIUS: Vendor, CNCTC [26] 17
SAMI 5/3: Aug 4 10:16:07.867: RADIUS: cnctc-served-mdn [100] 11
SAMI 5/3: Aug 4 10:16:07.867: RADIUS: 74 65 73 74 2D 70 64 73 6E [test-pdsn]

```

### Trace Functionality in Cisco PDSN Release 3.0

While conditional debugging has been a useful tool to limit the displayed debugs to a particular user, the output can still be a bit misleading if a few users are traced together. Therefore, the following capabilities are added in Cisco PDSN Release 3.0:

- The PDSN currently supports display of the MNID or username with every line printed from the CDMA debugs. A similar mechanism is also added for a few other subsystems, like MIP, PPP, and AAA. Some of the commonly used debugs that are enhanced with the trace functionality are:
  - debug ppp negotiation
  - debug aaa id
  - debug aaa accounting
  - debug aaa authentication
  - debug aaa authorization
  - debug ip mobile
  - debug cdma pdsn all events
  - debug cdma pdsn accounting

- debug cdma pdsn service-selection
- debug cdma pdsn session events
- cdma pdsn redundancy debugs
- When the debug conditions match, every line of the debug message is pre-pended with either the username or the IMSI (not both), depending on the condition set.




---

**Note** Pre-pending of Username/IMSI is not supported for a11 cluster debugs.

---




---

**Note** Pre-pending of Username/IMSI is not supported for **cdma pdsn redundancy** debugs.

---




---

**Note** GRE debugs are not pre-pended with IMSI for the first few lines.

---




---

**Note** **debug cdma pdsn a11 errors** are not printed for matching conditions.

---




---

**Note** **debug aaa accounting** does not get pre-pended with username.

---

- The above behavior is controlled through the **cdma pdsn debug show-condition** and **ip mobile debug include username** commands. If conditional debugging is enabled without these CLI commands being configured, the username or IMSI will not be displayed in the debugs. However, if the above CLIs are configured without configuring conditional debugging, the username or IMSI is printed along with the debugs.

## Enhancements in Releases Earlier Than Cisco PDSN 3.0

Cisco PDSN Release 2.1 supports additional conditional debugging for MIP components. MIP conditional debugging is supported based on NAI as well as the MN's home address.

Currently, when multiple conditional debugging is enabled, the debug output does not individually display the condition for which the debugs are printed for all the CDMA related debugs.

### Check Condition

A condition is set using the **debug condition username** command.

### Delete Condition

The debugging conditions can be removed using the following commands:

- **no debug condition username**—removes all the conditions based on **username**
- **no debug condition username *username***—removes the condition for the specified *username*

When a condition is removed using the above CLI command, the IOS Conditional Debugging Subsystem, which maintains a list of conditions and the TRUE conditions, resets the flag. When all the conditions are removed, the debugging information will appear without any filter applied.

The PDSN software also utilizes conditional debugging based on the Mobile Subscriber ID (MSID) into the CDMA subsystem by using the existing IOS debug condition of the CLI command. The calling option of the CLI command is used to specify the MSID (for example, debug condition calling 00000000011124).

The following debug commands are supported for conditional debugging based on NAI. The NAI is a name like foo@bar.com.

- **debug ip mobile**
- **debug ip mobile host**
- **debug ip mobile proxy**

The following debug commands are not impacted by NAI-based conditional debugging:

- **debug ip mobile local-area**
- **debug ip mobile router**

This release provides conditional debugging support for the following PDSN CLI commands:

- **debug cdma pdsn accounting**
- **debug cdma pdsn accounting flow**
- **debug cdma pdsn session [errors | events]**
- **debug ip mobile**
- **debug condition username**

The all debugs additionally support msid-based debugging using the following individual CLI commands:

- **debug cdma pdsn a11 events mnid**
- **debug cdma pdsn a11 errors mnid**
- **debug cdma pdsn a11 packet mnid**

Conditional debugging is an IOS feature, and the following CLI commands are available across all images.

```
router# debug condition ?
  application  Application
  called       called number
  calling      calling
  glbp         interface group
  interface    interface
  ip           IP address
  mac-address  MAC address
  match-list   apply the match-list
  standby      interface group
  username     username
  vcid        VC ID
```

The options **calling**, **username**, and **ip** are used by the CDMA or MIP subsystems.

```
PDSN#debug condition username ?
  WORD Username for debug filtering
```

```
PDSN#debu condition calling ?
  WORD Calling number
```

```
PDSN#debu condition ip ?
  A.B.C.D IP address
```

See the debug commands in the *Command Reference for the Cisco PDSN 2.1 Release for Cisco IOS Release 12.3(11)YF* for more information about conditional debugging in Cisco PDSN Release 2.1.

## Electronic Serial Number in Billing

The Electronic Serial Number (ESN) is a unique identifier for a piece of equipment, such as of a mobile device, and is used during the authentication process. The ESN is parameter a2 of the R-P Session Setup airlink record, and parameter A2 in the PDSN Usage Data Record (UDR). Both parameters are introduced in this release.

The PDSN accepts the parameter a2, and puts it as A2 into a Usage Data Record.

This feature is supported in the Cisco Access Registrar.

## Support for Mobile Equipment Identifier

The Mobile Equipment Identifier (MEID) is a new attribute introduced in IS-835D, and will eventually replace the ESN AVP. In the interim period, both attributes are supported on the PDSN.

To include the MEID in access-request, FA-CHAP, or MIP RRQ, use the **cdma pdsn attribute send a3** command.

## 1xEV-DO Support

The PDSN supports Evolution-Data Optimized (1xEV-DO) telecommunications standard. 1xEV-DO offers high-performance, high-speed, high-capacity wireless Internet connectivity, and is optimized for packet data services. It can transport packet data traffic at forward peak rates of 2.4 Mbps, which is much higher than the current 1xRTT peak rate of 144 kbps.

PDSN support for 1xEV-DO technology includes the following enhancements:

- PDSN recognizes a new Service Option value of 59 (decimal) for 1xEV-DO in Active Start Airlink Record.
- The PDSN CLI commands are enhanced to show sessions—**show cdma pdsn session**—so that packet service options are displayed (1xRTT, 1xEV-DO, or undefined).

## Integrated Foreign Agent

The FA is an essential component to mobility, because it allows a mobile station to remotely access services provided by the station's home network. The PDSN provides an integrated FA. The FA communicates with any standard HA, including the Cisco IOS-based HA.

## AAA Server Support

The PDSN provides an authentication client that communicates with any standard AAA server, including Cisco Access Registrar, to authenticate the mobile station. It uses the mobile stations' name (NAI) to authenticate the user with the local AAA server.

- The PDSN supports the following AAA services for SIP:

- Password Authentication Protocol (PAP) and CHAP authentication.
- Accounting information.
- IP address allocation for the mobile user.



**Note** The PDSN supports the assignment of IP addresses and the mapping of MSID to NAI for special configuration users. Typically, this includes MSID-based access users who skip the authentication process during the PPP establishment and prefer the SIP routing service.

- The PDSN supports the following AAA services for VPDN:
  - PAP and CHAP authentication.
  - Accounting information.
- The PDSN supports the following AAA services for PMIP:
  - PAP and CHAP authentication.
  - Accounting information.
  - Assignment of IP address (as received from HA, in the Registration Reply message) during the IPCP phase.
- The PDSN supports the following AAA services for MIP:
  - Optionally skip authentication during PPP on receiving REJ from the mobile station.
  - FA Challenge or Response as defined in TIA/EIA/IS-835-B through MIP registration.
  - FA-HA and FA-mobile station authentications as described under [PDSN Mobile IP](#) section.
  - Verification of the FA challenge response in a MIP registration request corresponding to a recent advertisement.

The PDSN also supports service provisioning using AAA servers and a user service profile. This profile is defined by the user's home network. It is referenced by the NAI. It is typically stored on the AAA server in the user's home network, along with the user authentication information, and is retrieved as part of authorization reply.

In Cisco PDSN Release 4.0, the following AAA server attributes (see [Table 25](#)) are added.



**Note**

In [Table 25](#), the following conditions apply:

- No—This attribute must not be present in the packet.
- Yes —Zero or one instance of this attribute may be present in the packet.

**Table 25** AAA Attributes in Cisco PDSN Release 4.0

Attribute	Type	Access-Request	Access-Accept	Accounting Messages		Interim
				Accounting Start	Accounting Stop	
Differentiated Services Class Option	26/05	No	Yes	No	No	No

**Table 25 AAA Attributes in Cisco PDSN Release 4.0**

Allowed Differentiated Services Marking	26/73	No	Yes	No	No	No
Maximum Authorized Aggregate Bandwidth for Best-Effort Traffic	26/130	No	Yes	No	No	No
Authorized Flow Profile IDs for the User	26/131	No	Yes	No	No	No
Granted QoS Parameters	26/132	No	No	Yes	Yes	Yes
Maximum Per Flow Priority for the User	26/133	No	Yes	No	No	No
FLOW_ID Parameter	26/144	No	No	No	Yes	No
Flow Status	26/145	No	No	No	Yes	No
RSVP Inbound Octet Count	26/162	No	No	No	Yes	Yes
RSVP Outbound Octet Count	26/163	No	No	No	Yes	Yes
RSVP Inbound Packet Count	26/164	No	No	No	Yes	Yes
RSVP Outbound Packet Count	26/165	No	No	No	Yes	Yes

## Packet Transport for VPDN

The PDSN supports the transport of VPDN packets. If you offer VPDN services, the mobile station can securely access private resources through a public Internet or dedicated links. The VPDN tunnel extends from the PDSN/FA to the home IP network. The home IP network is the IP network associated with the NAI.

## Proxy Mobile IP

With PMIP as part of the PPP link initiation, the PDSN registers with a HA on behalf of the mobile station. It obtains an address from the HA and forwards that address to the mobile station as part of IPCP during PPP initialization.

## Multiple Mobile IP Flows

The PDSN allows multiple IP access points from the same mobile station, as long as each IP flow registers individually (each IP flow requires a unique NAI). This enables multiple IP hosts to communicate through the same mobile access device and share a single PPP connection to your network. For accounting purposes, it is important that the PDSN generate separate usage data records (UDRs) for each flow to the AAA server.

## Redundancy and Load Balancing

This section provides information about Intelligent PDSN Selection and Load Balancing for the Controller - Member cluster model.

## PDSN Cluster Controller / Member Architecture

The PDSN Controller member architecture was designed to support 8 members with redundant active or standby controllers. This controller-member mode designates certain nodes as controllers responsible for performing PDSN selection, and for maintaining the global session tables. Each member node maintains information only about the sessions that are terminated on that node. Controllers can be redundant with all session information synchronized between them, and they monitor the state of all nodes to detect the failure of a member or another controller.

When a PDSN cluster operates in the controller-member mode, controllers are dedicated to the PDSN selection function, and do not terminate bearer sessions.

Cisco PDSN Release 2.1 supports the following enhancements:

- Cluster scalability to support 48 members with bulk-update of session information
- Conditional debugging support for MSID under clustering feature
- Controller Show command enhancements
- Clear command under clustering feature to clear clustering statistics

When a Registration Request (RRQ) arrives from the PCF to the active controller, the controller uses the MSID as an index to look up the session-table. If a session record entry is present, the controller forwards the RRQ to the PDSN that hosts the session for the MSID. If the session entry is not present in the controller session-table, the controller chooses a member based on a configured selection algorithm, and replies to the PCF with an RRP that suggests the member IP address in the message.

When the session comes up, the member sends a Session-Up message from the member for that session (MSID) to the controller. On receipt of this message from the member, the controller creates the Session Record for that MSID in the controller to establish MSID-member association on the controller. On receipt of Session-Down message from member, the controller flushes the Session Record from the controller.

The controller does not create a Session Record for the MSID when it redirects the RRQ, but only on the receipt of a Session-Up message from the member on which the session has come up

To support a large number of members (28~48) per Controller, processing overhead is reduced when members send one bulk-update packet to the controller for every configured periodic update time interval with multiple pairs of Session-Up/Session-Down. The packet contains concatenated multiple MSIDs with one Session-Up/Session-Down flag, thereby saving bytes in the packet. The controller will process these bulk-update packets and send a bulk-update-ack packet to the members.

### Conditional Debugging Support Under Clustering Feature

Cisco PDSN Release 2.0 clustering feature adds additional support for the conditional debugging with the following clustering debug command on both controller and member:

- **debug cdma pdsn cluster controller message {event | error | packet }**



#### Note

PDSNs in controller-member mode and peer-to-peer mode cannot co-exist in the same cluster. They are mutually exclusive.

## PDSN Controller-Member Clustering

In Controller-Member clustering, a controller maintains load and session (such as A10 connection) information for each member in the cluster, and performs member selection for load-balancing or inter-PDSN handoff avoidance. The controller identifies the operational state of each member and detects the failure of a member, or the failure of another controller. A member notifies the controller about its load and session information.

**Note**

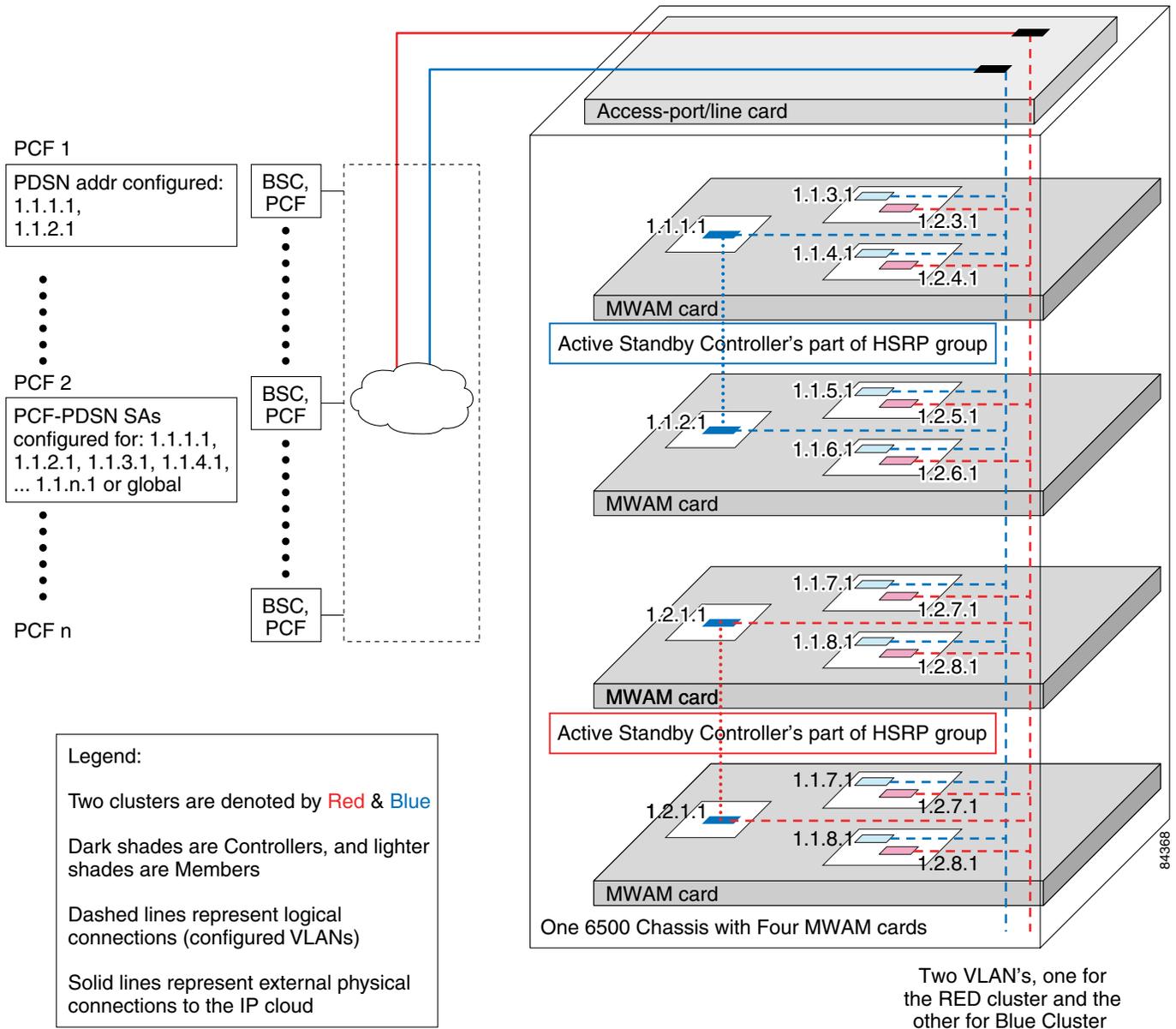
---

The new PDSN Controller-Member clustering feature is only available on the **-c6is-mz**, and **-c6ik9s-mz** images.

---

[Figure 7](#) illustrates the Controller-Member architecture on the 6500 or 7600-based MWAM platform. This illustration depicts two PDSN clusters with two primary and two backup controllers, and their corresponding members.

Figure 7 PDSN Controller -Member Architecture for MWAM on the Catalyst 6500



PDSNs that are designated as controllers, perform member PDSN selection and load balancing. The following list describes the major functions of the controllers:

- Controllers maintain the load information for all members—they obtain the load information by seeking the cluster members. Alternatively, the members send the load value at configurable intervals inside a session origination or termination message. Controllers synchronize by exchanging information as needed.
- The link on which controllers exchange information is an HSRP-based state information exchange (HA redundancy is based on this type of implementation).
- The link on which the active controller and members exchange information is a unicast HSRP address for the active controller, but must be configured on the members.

- The actual PDSN selection and load-balancing procedures are similar to the Release 1.1 implementation; however, different record tables are used.
- Auto configuration of a new PDSN controller added to the cluster—The new controller must be configured as such, and must be configured as a member of the HSRP group of routers. As a consequence, the new controller (standby) automatically downloads member and session records from the active controller. The active controller updates the standby as needed, so that records are synchronized.
- Auto configuration of the controllers when a new member is added to the cluster—The new member registers with the active controller, which updates the standby controller.
- Redundancy—All controllers in the cluster maintain session and load information for all members. This provides redundancy for availability, and, in case of a controller failure, session and load-balancing information is not lost.

## Redundancy

Cluster redundancy is based on the premise that only one PDSN might fail at any given time. Two controllers are configured as an HSRP group: One controller is active, the other standby. Controllers have redundancy and members have load sharing.

## Load Sharing

Cluster member loadsharing is an N+1 scheme. If a member fails, the established sessions will be lost, but the overall group capacity allows sessions to be re-established with the other group members. Additionally, redundancy is also enhanced because cluster members no longer have to be network neighbors.

Controllers exchange information over an ethernet link. Controllers and members exchange information over a unicast interface link where members address messages to the HSRP group address of the controllers. The members in a PDSN cluster do not need to be network neighbors; they can be attached anywhere in the IP network.

Adding an additional controller to a cluster is simplified by auto configuration of the controller in the cluster. This is possible by configuring the additional controller for HSRP. The newly-added controller will automatically synchronize with the active controller, by enabling autosynchronization feature. Similarly, when a new member is added to the cluster, auto configuration for the member occurs in all cluster controllers.

## PDSN Cluster Member Selection

Selection of a cluster member by the controller is based on a *load factor*. Load factor is a computed value by session load and CPU load on a member. The controller attempts to assign sessions to a member that has smallest load factor so that data connections are evenly distributed over members in the cluster as much as possible.

If an A11 Registration Request is received indicating a handoff, a member that is already serving the session is selected by the controller.

## Load Balancing

A controller maintains load information for all members in the cluster in order to perform PDSN Cluster Member selection. This load information is transferred from the members to the controller under the following conditions:

- at periodic intervals.
- when a session is established or dismantled in a member. In this case, the periodic timer is restarted.
- requested from the members by the controller.

The session and member records are synchronized between the active and standby controllers as needed. Since both active and standby controller maintain session and load information for all the members of that cluster, failure of a controller does not result in the loss of any session or load information.

## Upgrading the Member PDSN Software from Cisco PDSN Release 1.2 to Release 2.0 and Higher

To upgrade a member PDSN to Cisco PDSN Release 2.0 or later, perform the following tasks:

- 
- Step 1** Separate a member PDSN out of the cluster by configuring the following command on the member PDSN:
- ```
config# cdma pdsn cluster member prohibit administratively
```
- The status of the member will be updated to the controller in a subsequent periodic keepalive reply message that the member sends to the controller. The controller, on reception of this message, does not select this member for any of the new incoming calls.
- Step 2** Display the member PDSNs which are prohibited administratively by issuing the following command:
- ```
# show cluster controller member prohibited administratively
```
- The calls, which are already connected to the member, will be alive until the MN disconnects the call. Alternatively, the calls can be forcibly cleared on the prohibited member using the following command:
- ```
# clear cdma pdsn session all
```
- Step 3** When all the calls are brought down, upgrade the software to Cisco PDSN Release 2.0 and higher, or shutdown this member without disrupting the operation of the PDSN cluster. When the member comes online you can configure it to rejoin the cluster by issuing the following command:
- ```
config# no cdma pdsn cluster member prohibit administratively
```
- Once the controller is updated with the status the new member PDSN will be selected for new incoming calls.
- Step 4** Configure the following command to use the scalable bulk-synchronization mechanism of session information between controller and member PDSN:
- ```
config# cdma pdsn cluster member periodic-update 300
```
-

## Scalability

In this release the PDSN uses a new scalability feature that allows PPP sessions to run on virtual-access subinterfaces that can support up to 175,000 sessions.


**Note**

When using the virtual-access subinterfaces, not more than 20 percent (or a maximum of 4000) of the sessions should be compression sessions.


**Note**

If you are using the PDSN with a AAA server, ensure that the attribute “compression=none” is not present in your user profiles. If it is, the PDSN uses the full virtual access interface instead of the virtual-access sub-interface.


**Note**

To increase the call setup performance, use the **no virtual-template snmp** global configuration command. This prevents the virtual-access subinterfaces from being registered with the SNMP functionality of the router, and reduces the amount of memory used.

## High Availability

### Overview

High availability allows you to minimize the switchover time from the active supervisor engine to the standby supervisor engine if the active supervisor engine fails.

Prior to this feature, fast switchover ensured that a switchover to the standby supervisor engine happened quickly. However, with fast switchover, because the state of the switch features before the switchover was unknown, you had to re-initialize and restart all the switch features when the standby supervisor engine assumed the active role.

High availability removes this limitation; high availability allows the active supervisor engine to communicate with the standby supervisor engine, keeping feature protocol states synchronized. Synchronization between the supervisor engines allows the standby supervisor engine to take over in the event of a failure.

In addition, high availability provides a versioning option that allows you to run different software images on the active and standby supervisor engines.

For high availability, a system database is maintained on the active supervisor engine and updates are sent to the standby supervisor engine for any change of data in the system database. The active supervisor engine communicates and updates the standby supervisor engine when any state changes occur, ensuring that the standby supervisor engine knows the current protocol state of supported features. The standby supervisor engine knows the current protocol states for all modules, ports, and VLANs; the protocols can initialize with this state information and start running immediately.

The active supervisor engine controls the system bus (backplane), sends and receives packets to and from the network, and controls all modules. Protocols run on the active supervisor engine only.

The standby supervisor engine is isolated from the system bus and does not switch packets. But it does receive packets from the switching bus to learn and populate its Layer 2 forwarding table for Layer 2-switched flows. The standby supervisor engine also receives packets from the switching bus to learn and populate the Multilayer Switching (MLS) table for Layer 3-switched flows. The standby supervisor engine does not participate in forwarding any packets and does not communicate with any modules.

If you enable high availability when the standby supervisor engine is running, image version compatibility is checked and if found compatible, the database synchronization starts. High availability compatible features continue from the saved states on the standby supervisor engine after a switchover.

When you disable high availability, the database synchronization is not done and all features must restart on the standby supervisor engine after a switchover.

If you change high availability from enabled to disabled, synchronization from the active supervisor engine is stopped and the standby supervisor engine discards all current synchronization data.

If you change high availability from disabled to enabled, synchronization from the active to standby supervisor engine is started (provided the standby supervisor engine is present and its image version is compatible).

NVRAM synchronization occurs irrespective of high availability being enabled or disabled (provided there are compatible NVRAM versions on the two supervisor engines).

If you do not install a standby supervisor engine during system bootup, the active supervisor engine detects this and the database updates are not queued for synchronization. Similarly, when you reset or remove the standby supervisor engine, the synchronization updates are not queued and any pending updates in the synchronization queue are discarded. When you hot insert or restart a second supervisor engine that becomes the standby supervisor engine, the active supervisor engine downloads the entire system database to the standby supervisor engine. Only after this global synchronization is completed, the active supervisor engine queues and synchronizes the individual updates to the standby supervisor engine.


**Note**

When you hot insert or restart a second supervisor engine, it might take a few minutes for the global synchronization to complete.

For more information about High Availability, including configuration details, and information about power management, refer to the [PDSN Controller-Member Clustering](#) section, as well as the documents at the following urls:

- *Catalyst 6500 Series Software Configuration Guide* (6.1.1a), with special attention to the “Configuring Redundancy” chapter at:
  - <http://www.cisco.com/en/US/docs/switches/lan/catalyst6500/catos/8.x/configuration/guide/redund.html>
- *Cisco Catalyst 6000 Series Switches Configuration Guides*:
  - [http://www.cisco.com/en/US/products/hw/switches/ps700/products\\_installation\\_and\\_configuration\\_guides\\_list.html](http://www.cisco.com/en/US/products/hw/switches/ps700/products_installation_and_configuration_guides_list.html)

## Related Features and Technologies

- MIP
- PPP (Point-to-Point Protocol)
- AAA (Authentication, Authorization, and Accounting)
- VPDN (Virtual Private Data Network) using L2TP
- RADIUS (Remote Authentication Dial-In User Service)

## Related Documents

For additional information about the Cisco PDSN Release 2.1 software, refer to *Release Notes for the Cisco PDSN 2.1 Feature in Cisco IOS Release 12.3(11)YF*.

For more information about:

- MWAM hardware and software information, refer to the *Cisco Multi-processor WAN Application Module Installation and Configuration Note*.
- The IP Sec configuration commands included in this document, refer to the “IP Security and Encryption” section in the *Cisco IOS Security Configuration Guide*.
- The AAA server configuration commands included in this document, refer to the Cisco IOS Release 12.3 documentation modules *Cisco IOS Security Command Reference* and *Cisco IOS Security Configuration Guide*.
- The PPP and RADIUS configuration commands included in this document, refer to the Cisco IOS Release 12.3 documentation module *Cisco IOS Dial Services Command Reference*.
- MIP, refer to the Cisco Release 12.3 documentation modules *Cisco IOS IP Command Reference* and *Cisco IOS IP Configuration Guide*.
- Virtual Private Networks, refer to the Cisco IOS Release 12.3 documentation modules *Cisco IOS Dial Services Configuration Guide*, *Network Services* and *Cisco IOS Dial Services Command Reference*.

## Supported Platforms

Cisco PDSN 4.0 release is a special release that is developed on Cisco IOS 12.4 for the SAMI card on the Cisco 6500 Catalyst Switch and 7600 Series Router, and the Cisco NPE-G1 Router.

A SAMI card with 2 GB of memory is recommended for Cisco PDSN Release 4.0. See the *Release Notes for the Cisco PDSN 4.0 Feature in Cisco IOS Release 12.4(15)xx* for information about the supported platforms.

## Supported Standards, MIBs, and RFCs

### Standards

- TIA/EIA/IS-835-B, Wireless IP Network Standard
- TIA/EIA/IS-2001-B, Interoperability Specification (IOS) for CDMA 2000 Access Network Interfaces (Also known as 3GPP2 TSG-A and as TR45.4)
- TIA/EIA/TSB-115, Wireless IP Network Architecture Based on IETF Protocols

### MIBs

- CISCO\_CDMA\_PDSN\_MIB.my
- CISCO\_PROCESS\_MIB.my
- CISCO\_MOBILE\_IP\_MIB.my
- CISCO\_AHDLC\_MIB.my
- CISCO\_AAA\_CLIENT\_MIB.my

- CISCO\_AAA\_SERVER\_MIB.my
- CISCO\_VPDN\_MGMT\_MIB.my
- CISCO\_VPDN\_MGMT\_EXT\_MIB.my

For descriptions of supported MIBs and how to use MIBs, see the Cisco MIB web site on CCO at <http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>.

#### RFCs

- RFC 791, *Internet Protocol*
- RFC 1144, *Compressing TCP/IP Headers for Low-speed Serial Links*
- RFC 1332, *The PPP Internet Protocol Control Protocol (IPCP)*
- RFC 1334, *PPP Authentication Protocols*
- RFC 1661, *The Point-to-Point Protocol (PPP)*
- RFC 1662, *PPP in HDLC-like Framing*
- RFC 1962, *The PPP Compression Control Protocol (CCP)*
- RFC 1974, *PPP Stac LZS Compression Protocol*
- RFC 1994, *PPP Challenge Handshake Authentication Protocol (CHAP)*
- RFC 2002, *IP Mobility Support*
- RFC 2003, *IP Encapsulation within IP*
- RFC 2005, *Applicability Statement for IP Mobility Support*
- RFC 2006, *The Definitions of Managed Objects for IP Mobility Support using SMIv2*
- RFC 2118, *Microsoft Point-To-Point Compression (MPPC) Protocol*
- RFC 2344, *Reverse Tunneling for Mobile IP*
- RFC 2401, *Security Architecture for the Internet Protocol*
- RFC 2402, *IP Authentication Header*
- RFC 2406, *IP Encapsulating Security Payload (ESP)*
- RFC 3012, *Mobile IPv4 Challenge/Response Extension*

## Configuration Tasks

This section describes the steps for configuring the Cisco PDSN software on the MWAM platform. Prior to configuring instances of the PDSN on MWAM application cards, you must create a base Catalyst 6500 or 7600 configuration. See the *Cisco Multi-processor WAN Application Module Installation and Configuration Note* for more information.

# System Requirements

This section describes the system requirements for Cisco IOS Release 12.4(15)XR1:

- [Memory Requirements, page 258](#)
- [Hardware Supported, page 258](#)
- [Software Compatibility, page 259](#)
- [Determining the Software Version, page 259](#)
- [Configuring the PDSN Image, page 259](#)
- [Configuring PDSN Session Redundancy Infrastructure, page 263](#)

## Memory Requirements

Table 26 shows the memory requirements for the PDSN Software Feature Set that supports the SAMI card on the Cisco 7600 Series Router. The table also lists the memory requirements for the IP Standard Feature Set (for the PDSN).

**Table 26** Memory Requirements for the SAMI Blade on the Cisco 7600 Series Router

| Platform                 | Software Feature Set      | Image Name                                                            | Flash Memory Required | DRAM Memory Required | Runs From |
|--------------------------|---------------------------|-----------------------------------------------------------------------|-----------------------|----------------------|-----------|
| Cisco 7600 Series Router | PDSN Software Feature Set | 12.4(15)XR-c7svcsami-c6ik9s-mz.124-15.XR<br>(This is a bundled image) | 128 MB                | 2048 MB              | RAM       |

## Hardware Supported

Cisco IOS Release 12.4(15)XR1 is optimized for the SAMI Card on the Cisco 7600 Series Router.

A Hardware-Software Compatibility Matrix is available on Cisco.com for users with CCO accounts. This matrix allows users to search for supported hardware components by entering a Cisco platform and IOS Release. The Hardware-Software Compatibility Matrix tool is available at the following URL: <http://www.cisco.com/cgi-bin/front.x/Support/HWSWmatrix/hwswwmatrix.cgi>

Cisco PDSN 4.0 release is a special release that is developed on Cisco IOS 12.4 for the SAMI card on the Cisco 7600 Series Router, and the Cisco NPE-G1 Router.

A SAMI card with 2 GB of memory is recommended for Cisco PDSN Release 4.0.

For user migration, one of the processors on the SAMI must act as a standby to an active MWAM processor that hosts the PDSN application. Through systems synchronization, ensure that the standby SAMI processor gets all session and flow information from the active MWAM processor. For user migration, the correlation will be 5 to 5 from a processor standpoint, since the 6th processor on MWAM blade is not used for synchronization. After the synchronization is complete, perform the switchover and take the active MWAM offline. The SAMI now becomes active, and user sessions are preserved with no loss of data.

The steps to setup up the SAMI and HSRP to make it the standby to MWAM are similar to those related to MWAM redundancy.

A Hardware-Software Compatibility Matrix is available on CCO for users with CCO login accounts. This matrix allows users to search for supported hardware components by entering a Cisco platform and IOS Release. The Hardware-Software Compatibility Matrix tool is available at the following URL:

<http://www.cisco.com/cgi-bin/front.x/Support/HWSWmatrix/hwswmatrix.cgi>

## Software Compatibility

Cisco IOS Release 12.4(15)XR1 is a special release that is developed on Cisco IOS Release 12.4.

Cisco IOS Release 12.4(15)XR1 supports the same features that are in Cisco IOS Release 12.4, with the addition of the PDSN feature.

## Determining the Software Version

To determine the version of Cisco IOS software running on your router, log in to the router and enter the **show version EXEC** command:

```
Router# show version
Cisco IOS Software, MWAM Software (MWAM-C6IS-M), Version 12.4(15)XN , RELEASE SOFTWARE
Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Tue 11-Dec-07 15:44 by jsomiram

ROM: System Bootstrap, Version 12.2(11)YS2 RELEASE SOFTWARE

PDSN-S2000-BAL uptime is 4 minutes
System returned to ROM by bus error at PC 0x2033D804, address 0x283 at 06:56:44 PDT Mon
Dec 3 2007
System restarted at 03:29:24 PDT Tue Dec 11 2007
System image file is "svcmwam-c6is-mz.xn"

Cisco MWAM (MWAM) processor with 997376K/32768K bytes of memory.
SB-1 CPU at 700MHz, Implementation 1025, Rev 0.2

Last reset from power-on
1 Gigabit Ethernet interface
511K bytes of non-volatile configuration memory.

Configuration register is 0x4

Router#
```

## Upgrading to a New Software Release

For information on upgrading to a new software release, see the product bulletin *Cisco IOS Software Upgrade Ordering Instructions* located at:

[http://www.cisco.com/warp/public/cc/pd/iosw/prodlit/957\\_pp.htm](http://www.cisco.com/warp/public/cc/pd/iosw/prodlit/957_pp.htm)

## Configuring the PDSN Image

The PDSN can provide four classes of user services: SIP, SIP with VPDN, MIP, and PMIP. The following sections describe the configuration tasks for implementing PDSN. Each category of tasks indicates whether the tasks are optional or required.

**R-P Interface Configuration Tasks (Required for all classes of user services)**

The following tasks establish the R-P interface, also referred to as the A10/A11 interface.

To configure the R-P interface, complete the following tasks:

- [Enabling PDSN Services](#)
- [Creating the CDMA Ix Interface](#)
- [Creating a Loopback Interface](#)
- [Creating a Virtual Template Interface and Associating it with the PDSN Application](#)
- [Enabling R-P Interface Signaling](#)

**User Session Configuration Tasks (Optional)**

To configure the user session, complete the following task.

- [Configuring User Session Parameters](#)

**Session Redundancy Configuration Tasks**

To configure Session Redundancy on the PDSN, complete the following tasks:

- [Configuring HSRP](#)
- [Enabling HSRP and Configuring an HSRP Master Group](#)
- [Configuring Follow Groups](#)
- [Enabling Inter-Device Redundancy](#)
- [Configuring the Inter-Device Communication Transport](#)
- [Using the Loopback Interface For the PDSN-AAA Server Interface](#)

**AAA and RADIUS Configuration Tasks (Required for All Scenarios)**

To configure the AAA server and RADIUS in the PDSN environment, complete the following tasks.

- [Configuring AAA Server in the PDSN Environment](#)
- [Configuring RADIUS in the PDSN Environment](#)

**Prepaid Configuration Tasks**

- [Configuring Prepaid in the PDSN Environment](#)

**VPDN Configuration Tasks (Required for Simple IP with VPDN Scenario)**

To configure the VPDN in the PDSN environment, complete the following task:

- [Enabling VPDN in a PDSN Environment](#)

**Mobile IP Configuration Tasks (Required for Mobile IP)**

To configure MIP on the PDSN, complete the following task:

- [Configuring the Mobile IP FA](#)
- [Configuring Mobile IP Security Associations](#)
- [Enabling Network Management](#)

**PDSN Selection Configuration Tasks (Optional)**

To configure PDSN selection, complete the following tasks:

- [Configuring PDSN Cluster Controller](#)
- [Configuring PDSN Cluster Member](#)

### Network Management Configuration Tasks (Required for Network Management in Any Scenario)

To configure network management, complete the following task:

- [Enabling Network Management](#)

### Other Configuration Tasks

The following tasks are optional on the PDSN:

- [Configuring Always On Service](#)
- [Configuring A11 Session Updates](#)
- [Configuring SDB Indicator Marking](#)
- [Configuring SDB Indicator Marking for PPP Control Packets](#)
- [Configuring PoD on the PDSN](#)
- [Configuring Mobile IP Resource Revocation on the PDSN](#)
- [Note](#)You will also have [VPDN configuration tasks](#), [Layer 2 Tunneling Protocol \(L2TP\) tunnel configuration tasks](#), and [Load Balancing configuration tasks](#) to perform. Please refer to the appropriate documentation for more specific information.
- [Configuring Short Data Burst Flagging](#)
- [Configuring PDSN Accounting Events](#)
- [Configuring CDMA RADIUS Attributes](#)

### Tuning, Verification, and Monitoring Tasks (Optional)

To tune, verify, and monitor PDSN elements, complete the following tasks:

- [Monitoring and Maintaining the PDSN](#)

## Enabling PDSN Services

To enable PDSN services, use the following commands in global configuration mode:

| Command                                  | Purpose                |
|------------------------------------------|------------------------|
| Router(config)# <b>service cdma pdsn</b> | Enables PDSN services. |

## Creating the CDMA Ix Interface

To create the CDMA Ix interface, use the following commands in global configuration mode:

| Command                                              | Purpose                                                                                                                                |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>interface cdma-Ix1</b>            | Defines the CDMA virtual interface for the R-P interface.                                                                              |
| Router(config-if)# <b>ip address ip-address mask</b> | Assigns an IP address and mask to the CDMA-Ix virtual interface. This IP address will be used by the RAN to communicate with the PDSN. |

## Creating a Loopback Interface

We recommend that you create a loopback interface and then associate the loopback interface IP address to the virtual template, rather than directly configuring an IP address on the virtual template.

To create a loopback interface, use the following commands in global configuration mode:

| Command                                                     | Purpose                                                                                      |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Router(config)# <b>interface loopback</b> <i>number</i>     | Creates a loopback interface. A loopback interface is a virtual interface that is always up. |
| Router(config-if)# <b>ip address</b> <i>ip-address mask</i> | Assigns an IP address to the loopback interface.                                             |

## Creating a Virtual Template Interface and Associating it with the PDSN Application

Creating a virtual template interface allows you to establish an interface configuration and apply it dynamically.

To create a virtual template interface that can be configured and applied dynamically, use the following commands in global configuration mode:

| Command                                                                       | Purpose                                                                               |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Router(config)# <b>interface virtual-template</b> <i>number</i>               | Creates a virtual template interface.                                                 |
| Router(config-if)# <b>ip unnumbered loopback</b> <i>number</i>                | Assigns the previously defined loopback IP address to the virtual template interface. |
| Router(config-if)# <b>ppp authentication chap pap optional</b>                | Enables PPP authentication.                                                           |
| Router(config-if)# <b>ppp accounting none</b>                                 | Disables PPP accounting to enable 3GPP2 accounting.                                   |
| Router(config-if)# <b>ppp accm</b> <i>0</i>                                   | Specifies the transmit ACCM table value. The value must be specified as 0.            |
| Router(config-if)# <b>ppp timeout idle</b> <i>value</i>                       | Specifies the PPP idle timeout.                                                       |
| Router(config-if)# <b>exit</b>                                                | Exit interface configuration mode.                                                    |
| Router(config)# <b>cdma pdsn virtual-template</b> <i>virtual-template-num</i> | Associates a virtual template with the PDSN application.                              |

## Enabling R-P Interface Signaling

To enable the R-P interface signaling, use the following commands in global configuration mode:

| Command                                                                                                                                                       | Purpose                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn secure pcf</b> <i>lower_addr [upper_addr] spi {spi_val   [inbound in_spi_val outbound out_spi_val]} key {ascii   hex} string</i> | Defines the PCF security association on the PDSN.                                                                                                                   |
| Router(config)# <b>cdma pdsn a10 max-lifetime</b> <i>seconds</i>                                                                                              | Specifies the maximum lifetime the PDSN accepts in A11 registration requests from the PCF.                                                                          |
| Router(config)# <b>cdma pdsn a10 gre sequencing</b>                                                                                                           | Enables inclusion of per-session Generic Routing Encapsulation (GRE) sequence numbers in the outgoing packets on the A10 interface. (This is the default behavior.) |

| Command                                                              | Purpose                                                                                                       |
|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn retransmit a11-update</b> <i>number</i> | Specifies the maximum number of times an A11 Registration Update message will be re-transmitted.              |
| Router(config)# <b>cdma pdsn timeout a11-update</b> <i>seconds</i>   | Specifies A11 Registration Update message timeout value.                                                      |
| Router(config)# <b>cdma pdsn maximum pcf</b> <i>number</i>           | Specifies the maximum number of packet control functions (PCF) that can be connected to the PDSN at one time. |

## Configuring User Session Parameters

To configure user session parameters, use the following commands in global configuration mode:

| Command                                                                                                                                                             | Purpose                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn maximum sessions</b> <i>maxsessions</i>                                                                                                | Specifies the maximum number of mobile sessions allowed on a PDSN.                                                  |
| Router(config)# <b>cdma pdsn ingress-address-filtering</b>                                                                                                          | Enables ingress address filtering.                                                                                  |
| Router(config)# <b>cdma pdsn msid-authentication</b> [ <i>imsi number</i> ] [ <i>min number</i> ] [ <i>irm number</i> ] [ <b>profile-password</b> <i>password</i> ] | Enables provision of SIP service using MSID-based authentication.                                                   |
| Router(config)# <b>cdma pdsn timeout mobile-ip-registration</b> <i>timeout</i>                                                                                      | Specifies the number of seconds before which MIP registration should occur for a user who skips PPP authentication. |

## Configuring PDSN Session Redundancy Infrastructure

The PDSN-SR feature uses the Cisco IOS Check-point Facility (CF) to send stateful data over Stream Control Transmission Protocol (SCTP) to a redundant PDSN. Additionally, in conjunction with Cisco IOS HSRP, the PDSN uses the Cisco IOS Redundancy Facility (RF) to monitor and report transitions on active and standby PDSNs.

Before configuring PDSN-SR, you need to configure the inter-device redundancy infrastructure.

### Configuring HSRP

The HSRP provides high network availability because it routes IP traffic from hosts on networks without relying on the availability of any single router. HSRP is used in a group of routers for selecting an active router and a standby router. HSRP monitors both the inside and outside interfaces so that if any interface goes down, the whole device is deemed to be down and the standby device becomes active and takes over the responsibilities of an active device.

When configuring HSRP, note that the following recommendation and restrictions apply:

- At minimum, HSRP must be enabled and an HSRP a “master” group defined on one interface per PDSN instance. A “follow” group can be configured on all other PDSN interfaces using the **standby interface** configuration command with the **follow** keyword option specified. The advantages of using follow groups are:
  - The follow group feature enables all interfaces on which it is configured to share the HSRP parameters of the master group.

- Interfaces that share the same group will follow the state of master interface and will use same priority as master interface. This will ensure that all interfaces are in the same HSRP state. Otherwise there is a possibility of one or more interfaces to assume another role than the master HSRP interface.
- This optimizes HSRP group number and minimizes the configuration and maintenance overhead when having large configurations.
- It eliminates unnecessary network traffic over all interfaces by eliminating HSRP Hello messages from follow groups, if configured.

**Note**

Do not configure a preemption delay on the standby PDSN using the **standby preempt** interface configuration command.

- When the **standby use-bia** command is not used to allow bridge and gateways to learn the virtual MAC address, for optimization purposes, configure the **standby mac-refresh** command to a value greater than the default (hello messages are sent every 10 seconds) under the main interface (gig0/0). This value is used as the hello message interval.

**Note**

If **standby use-bia** is configured, then there will be no hello messages sent out of follow group interfaces. It is recommended to use **standby use-bia** unless explicitly required not to configure.

- An ARP multicast packet is sent out when there is a HSRP state change to active. ARP requests for follow group virtual IP address are responded if HSRP state is active. Also an ARP multicast is sent on the follow group VLAN when a slave virtual IP address is configured and if the master group is active.

Use the same group number for each PDSN follow group as is defined for the primary group. Using the same group number for the primary and follow groups facilitates HRSP group setup and maintenance in an environment that contains a large number of PDSN interfaces and HRSP groups.

More information on HSRP configuration and HSRP groups can be found here:

[http://www.cisco.com/en/US/partner/tech/tk648/tk362/tk321/tsd\\_technology\\_support\\_sub-protocol\\_home.html](http://www.cisco.com/en/US/partner/tech/tk648/tk362/tk321/tsd_technology_support_sub-protocol_home.html)

and

[http://www.cisco.com/en/US/partner/tech/tk648/tk362/technologies\\_configuration\\_example09186a0080094e90.shtml](http://www.cisco.com/en/US/partner/tech/tk648/tk362/technologies_configuration_example09186a0080094e90.shtml)

## Enabling HSRP and Configuring an HSRP Master Group

To enable HSRP on an interface and configure the primary group, use the following commands in interface configuration mode:

| Command                                                                      | Purpose                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config-if)# <b>standby</b> [group-number] ip [ip-address] [secondary] | Enables the HSRP on the interface.                                                                                                                                                                                                                                                                                                            |
| Router(config-if)# <b>standby</b> [group-number] priority priority           | Sets the Hot Standby priority used in choosing the active router. The priority value range is from 1 to 255, where 1 denotes the lowest priority and 255 denotes the highest priority. Specify that, if the local router has priority over the current active router, the local router should attempt to take its place as the active router. |
| Router(config-if)# <b>standby</b> [group-number] name name                   | Specifies the name of the standby group.                                                                                                                                                                                                                                                                                                      |
| Router(config-if)# <b>standby use-bia</b> [scope interface]                  | (Optional) Configures HSRP to use the burned-in address of an interface as its virtual MAC address instead of the preassigned MAC address.                                                                                                                                                                                                    |

## Configuring Follow Groups

HSRP follow groups are configured to share the HSRP parameters of the primary group by defining a follow group on the interface using the standby interface configuration command with the follow keyword option specified. Interfaces that share a group track states together and have the same priority.

To configure an interface to follow a primary group, use the following commands in interface configuration mode:

| Command                                                              | Purpose                                                                                                                                                                                                          |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config-if)# <b>standby</b> group-number follow group-name     | Specifies the number of the follow group and the name of the primary group to follow and share status.<br><b>Note</b> It is recommended that the group number specified is the same as the primary group number. |
| Router(config-if)# <b>standby</b> group-number ip virtual-ip-address | Specifies the group number and virtual IP address of the follow group.<br><b>Note</b> The group number specified above should be same as the master group number.                                                |

## Enabling Inter-Device Redundancy

To enable inter-device redundancy, use the following commands beginning in global configuration mode:

| Command                                                                            | Purpose                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>redundancy inter-device</b>                                     | Configures redundancy and enters inter-device configuration mode.<br><br>To remove all inter-device configuration, use the <b>no</b> form of the command.                                                                                                                                                                            |
| Router(config-red-interdevice)# <b>scheme standby</b><br><i>standby-group-name</i> | Defines the redundancy scheme that is to be used. Currently, <b>standby</b> is the only supported scheme.<br><br><i>standby-group-name</i> -Must match the standby name specified in the standby name interface configuration command (see the “Configuring HSRP” section). Also, the standby name should be the same on both PDSNs. |
| Router(config-red-interdevice)# <b>exit</b>                                        | Returns to global configuration mode.                                                                                                                                                                                                                                                                                                |

## Configuring the Inter-Device Communication Transport

Inter-device redundancy requires a transport for communication between the redundant PDSNs. This transport is configured using Interprocess Communication (IPC) commands.

To configure the inter-device communication transport between the two PDSNs, use the following commands beginning in global configuration mode:

| Command                                            | Purpose                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>ipc zone default</b>            | Configures the Inter-device Communication Protocol (IPC) and enters IPC zone configuration mode.<br><br>Use this command to initiate the communication link between the active device and the standby device.                                                                                                                                                                         |
| Router(config-ipczone)# <b>association 1</b>       | Configures an association between two devices and enters IPC association configuration mode.<br><br>In IPC association configuration mode, you configure the details of the association, such as the transport protocol, local port and local IP addresses, and the remote port and remote IP addresses.<br><br>Valid association IDs range from 1 to 255. There is no default value. |
| Router(config-ipczone)# <b>no shutdown</b>         | Restarts a disabled association and its associated transport protocol.<br><br><b>Note</b> Shutdown of the association is required for any changes to the transport protocol parameters.                                                                                                                                                                                               |
| Router(config-ipczone-assoc)# <b>protocol sctp</b> | Configures Stream Control Transmission Protocol (SCTP) as the transport protocol for this association and enables SCTP protocol configuration mode.                                                                                                                                                                                                                                   |

| Command                                                                | Purpose                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>Router(config-ipc-protocol-sctp)# local-port local_port_num</pre> | <p>Defines the local SCTP port number to use for communication with the redundant peer and enables IPC transport-SCTP local configuration mode.</p> <p>Valid port numbers range from 1 to 65535. There is no default value.</p> <p><b>Note</b> The local port number must be identical to the remote port number on the peer router.</p>                                                                                                                                                               |
| <pre>Router(config-ipc-protocol-sctp)# unit1-port port_num</pre>       | <p>If autosynchronization feature is enabled, configure the SCTP port.</p>                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <pre>Router(config-ipc-local-sctp)# local ip ip_addr</pre>             | <p>Defines the local IP address that communicates with the redundant peer. The local IP address must match the remote IP address on the peer router.</p>                                                                                                                                                                                                                                                                                                                                               |
| <pre>Router(config-ipc-unit1-sctp)# unit1-ip ip_addr</pre>             | <p>Represents the IP address that communicates with the redundant pair, if the autosynchronization feature is enabled.</p>                                                                                                                                                                                                                                                                                                                                                                             |
| <pre>Router(config-ipc-local-sctp)# keepalive [period [retries]]</pre> | <p>Enables keepalive packets and specifies the number of times that the Cisco IOS software tries to send keepalive packets with a response before bringing down the interface or tunnel protocol for a specific interface.</p> <p>Valid value for period is an integer value in seconds great than 0. The default is 10. Valid value for retries is an integer value greater than one and less than 355. The default is the previously used value or 5 if there was no value previously specified.</p> |
| <pre>Router(config-ipc-local-sctp)# retransmit-timeout interval</pre>  | <p>Configures the message retransmission time.</p> <p>Valid range is 300 to 60000 milliseconds. The minimum default is 1000. The maximum default is 60000.</p>                                                                                                                                                                                                                                                                                                                                         |
| <pre>Router(config-ipc-local-sctp)# path-retransmit number</pre>       | <p>Configures the maximum number of keep-alive retries before the corresponding destination address is marked inactive.</p> <p>Valid range is 2 to 10. The default is 5.</p>                                                                                                                                                                                                                                                                                                                           |
| <pre>Router(config-ipc-local-sctp)# assoc-retransmit number</pre>      | <p>Defines the maximum number of retransmissions over all destination addresses before an association is declared failed.</p> <p>Valid range is 2 to 20. The default is 10.</p>                                                                                                                                                                                                                                                                                                                        |
| <pre>Router(config-ipc-local-sctp)# exit</pre>                         | <p>Exits IPC transport - SCTP local configuration mode.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                            |

| Command                                                              | Purpose                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config-ipc-protocol-sctp)# <b>remote-port</b> <i>port_num</i> | Defines the remote SCTP port that communicates with the redundant peer and enables IPC transport-SCTP remote configuration mode.<br><br>Valid port numbers range from 1 to 65535. There is no default.<br><br><b>Note</b> The remote port number must be identical to the local port number on the peer device. |
| config-ipc-protocol-sctp)# <b>unit2-port</b> <i>port_num</i>         | Defines the SCTP port for the unit2, if autosynchronized feature is enabled.                                                                                                                                                                                                                                    |
| Router(config-ipc-remote-sctp)# <b>remote-ip</b> <i>ip_addr</i>      | Defines the remote IP address of the redundant peer communicates with the local device. All remote IP addresses must refer to the same device.<br><br>To remove an association configuration, use the <b>no</b> form of the command.                                                                            |
| Router(config-ipc-unit2-sctp)# <b>unit2-ip</b> <i>ip_addr</i>        | Defines the unit2 IP address of the redundant peer that is used to communicate with the unit1 device.                                                                                                                                                                                                           |

### Using the Loopback Interface For the PDSN-AAA Server Interface

To ensure that the AAA server views the active and standby units as a single NAS, the same NAS IP address should be used by both the units. Now, the NAS IP address can be configured for the PDSN using the **ip radius source-interface** command. When configured, the IP address of that interface is used as the NAS IP address.

However, the CLI command does not support virtual IP addresses (HSRP). As a result, the only way to ensure that both the units appear as a single NAS is to configure a loopback interface, and use that interface as the source-interface. The command is **ip radius source-interface Loopback1**.

### Configuring Application Tracking to Handle active-active Situation

| Command                                                                | Purpose                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>track object-id application pdsn</b>                | Defines a tracking object for PDSN application.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Router(config-if)# <b>standby track object-id [decrement priority]</b> | Associates the tracking object defined for PDSN with the HSRP config. HSRP would start tracking the state of this object. The configured decrement priority is used to change HSRP priority based on the state of the tracking object. If the tracking object is "UP", HSRP will have the configured priority. When the tracking object is "DOWN", HSRP decrements its priority by the <b>decrement priority</b> specified in the <b>standby track</b> command. |

## Configuring AAA Server in the PDSN Environment

Access control is the way you manage who is allowed access to the network server and the services they are allowed to use. AAA network security services provide the primary framework through which you set up access control on your router or access server. For detailed information about the AAA server configuration options, see the “Configuring Authentication,” and “Configuring Accounting” chapters in the *Cisco IOS Security Configuration Guide*.

To configure the AAA server in the PDSN environment, use the following commands in global configuration mode:

| Command                                                                                | Purpose                                                                                                                                                                              |
|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>aaa new-model</b>                                                   | Enables the AAA server access control.                                                                                                                                               |
| Router(config)# <b>aaa authentication ppp default group radius</b>                     | Enables authentication of PPP users using RADIUS.                                                                                                                                    |
| Router(config)# <b>aaa authorization configuration default group radius</b>            | Enables Network Access Identifier (NAI) construction in the absence of CHAP.                                                                                                         |
| Router(config)# <b>aaa authorization config-commands</b>                               | Re-establishes the default created when the <b>aaa authorization commands level method1</b> command was issued.                                                                      |
| Router(config)# <b>aaa authorization network if-authenticated default group radius</b> | Restricts network access to a user. Runs authorization for all network-related service requests. Uses the group RADIUS authorization method as the default method for authorization. |
| Router(config)# <b>aaa accounting update periodic minutes</b>                          | Enables an interim accounting record to be sent periodically to the accounting server. The recommended period of time is 60 minutes.                                                 |
| Router(config)# <b>aaa accounting network pdsn start-stop group radius</b>             | Enables the AAA server accounting of requested services for billing or security purposes when you use RADIUS.                                                                        |

## Configuring RADIUS in the PDSN Environment

RADIUS is a method for defining the exchange of the AAA server information in the network. In the Cisco implementation, RADIUS clients run on Cisco routers and send authentication requests to a RADIUS server that contains all user authentication and network server access information. For detailed information about RADIUS configuration options, refer to the “Configuring RADIUS” chapter in the *Cisco IOS Security Configuration Guide*.

To configure RADIUS in the PDSN environment, use the following commands in global configuration mode:

| Command                                                            | Purpose                                                                                                                                                                            |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>radius-server host ip-addr key sharedsecret</b> | Specifies the IP address of the RADIUS server host and specifies the shared secret text string used between the router and the RADIUS server.                                      |
| Router(config)# <b>radius-server vsa send accounting 3gpp2</b>     | Enables the use of vendor-specific attributes (VSA) as defined by RADIUS IETF attribute 26. Limits the set of recognized vendor-specific attributes to only accounting attributes. |

| Command                                                               | Purpose                                                                                                                                                                                |
|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>radius-server vsa send authentication 3gpp2</b>    | Enables the use of vendor-specific attributes (VSA) as defined by RADIUS IETF attribute 26. Limits the set of recognized vendor-specific attributes to only authentication attributes. |
| Router(config)# <b>radius-server attribute 55 include-in-acct-req</b> | Enables sending G4 (Event Time) Accounting-Start from PDSN.                                                                                                                            |

## Configuring Prepaid in the PDSN Environment

For the 1.2 release of Cisco PDSN software, to configure prepaid, ensure that you include `crb-entity-type=1` in the user profile.

In Cisco PDSN Release 2.0 and higher, to configure IS835C prepaid, use the following commands in global configuration mode:

| Command                                                                                                        | Purpose                                                                                                             |
|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| router (config)# <b>cdma pdsn accounting prepaid ?</b><br><b>duration</b><br><b>threshold</b><br><b>volume</b> | Prepaid service based on duration.<br>Configure threshold percentage per quota.<br>Prepaid service based on volume. |

## Enabling VPDN in a PDSN Environment

To configure VPDN in the PDSN environment, use the following commands in global configuration mode:

| Command                                           | Purpose                                                    |
|---------------------------------------------------|------------------------------------------------------------|
| Router(config)# <b>vpdn enable</b>                | Enables VPDN.                                              |
| Router(config)# <b>vpdn authen-before-forward</b> | Specifies to authenticate a user locally before tunneling. |

For more information about VPDNs, refer to the Cisco IOS Release 12.3 documentation modules *Cisco IOS Dial Services Configuration Guide: Network Services* and *Cisco IOS Dial Services Command Reference*.

## Configuring the Mobile IP FA

MIP operation (as specified by TR-45.6) requires the ability to authenticate a mobile station through a challenge/response mechanism between the PDSN (acting as an FA) and the mobile station.

To configure the MIP FA, use the following commands in global and interface configuration modes:

| Command                                                                                                  | Purpose                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>router mobile</b>                                                                     | Enables MIP.<br>This and other MIP commands are used here to enable R-P signaling. They are required regardless of whether you implement SIP or MIP. |
| Router(config)# <b>cdma pdsn send-agent-adv</b>                                                          | Enables agent advertisements to be sent over a newly formed PPP session with an unknown user class that negotiates IPCP address options.             |
| Router(config) <b>interface virtual-template</b> <i>number</i>                                           | Creates a virtual template interface.                                                                                                                |
| Router(config-if)# <b>cdma pdsn mobile-advertisement-burst</b> <b>{[number value]   [interval msec]}</b> | Configures the number of FA advertisements to send and the interval between them when a new PPP session is created.                                  |
| Router(config-if)# <b>ip mobile foreign-service challenge</b> <b>{[timeout value]   [window num]}</b>    | Configure the challenge timeout value and the number of valid recently-sent challenge values.                                                        |
| Router(config-if)# <b>ip mobile foreign-service challenge forward-mfce</b>                               | Enables the FA to send mobile foreign challenge extensions (MFCE) and MN-AAA authentication extensions (MNAE) to the HA in registration requests.    |
| Router(config-if)# <b>ip mobile registration-lifetime</b> <i>seconds</i>                                 | Configures the maximum MIP registration lifetime.                                                                                                    |
| Router(config-if)# <b>ip mobile foreign-service [reverse-tunnel [mandatory]]</b>                         | Enables MIP FA service on this interface.                                                                                                            |
| Router(config-if)# <b>ip mobile foreign-service registration</b>                                         | Sets the R bit in an Agent Advertisement.                                                                                                            |

To reduce the virtual-access cloning time in order to increase the CPS rate on a standalone PDSN on a Cisco router, use the following per interface configurations in global configuration mode:

| Command                                                                                                                                           | Purpose                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>Router(config)# ip mobile foreign-service      ip mobile prefix-length  ip mobile registration-lifetime</pre>                                | <p>Enables foreign agent service on an interface if care-of addresses are configured</p> <p>Appends the prefix-length extension to the advertisement.</p> <p>Sets the registration lifetime value advertised.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <pre>Router(config)# ip mobile foreign-service challenge      home-access allowed      limit      registration-required      reverse-tunnel</pre> | <p>(Optional) Configures the foreign agent challenge parameters.</p> <p>(Optional) Controls which HA addresses mobile nodes can be used to register. The access list can be a string or number from 1 to 99.</p> <p>(Optional) Number of visitors allowed on the interface. The Busy (B) bit will be advertised when the number of registered visitors reaches this limit.</p> <p>(Optional) Solicits registration from the MN even if it uses collocated care-of addresses. The Registration-required (R) bit will be advertised.</p> <p>(Optional) Enables reverse tunneling on the foreign agent. For releases prior to 12.3T, you cannot use this keyword when you enable foreign agent service on a sub-interface.</p> |

The CPS on a standalone PDSN on a Cisco Router should improve to 100 CPS from the current number of 40.

## Configuring Proxy Mobile IP Attributes Locally

As an alternative to true MIP, which is not supported by all mobile devices, you can configure the Cisco PDSN to provide many of the benefits of MIP through the use of PMIP. All PMIP attributes can be retrieved from the AAA server. To configure PMIP attributes locally, use the following command in global configuration mode:

| Command                                                                                                                                                  | Purpose                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| <pre>Router(config)# ip mobile proxy-host nai username@realm [flags rrq-flags] [ha homeagent] [homeaddr address] [lifetime value] [local-timezone]</pre> | <p>Specifies PMIP attributes locally on the PDSN.</p> |

## Configuring Mobile IP Security Associations

To configure security associations for mobile hosts, FAs, and HAs, use one of the following commands in global configuration mode:

| Command                                                                                                                                                                                                                                                                                  | Purpose                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| Router(config)# <b>ip mobile secure</b> {aaa-download   visitor   home-agent   proxy-host} {lower-address [upper-address]   nai string} {inbound-spi spi-in outbound-spi spi-out   spi spi} <b>key</b> {hex   ascii} string [replay timestamp [number] algorithm md5 mode prefix-suffix] | Specifies the security associations for IP mobile users. |
| Router(config)# <b>ip mobile secure proxy-host nai</b> string spi spi <b>key</b> {ascii   hex} string                                                                                                                                                                                    | Specifies the security associations for PMIP users.      |

## Configuring PDSN Cluster Controller

To configure the PDSN cluster controller attributes locally, use the following commands in global configuration mode.


**Note**

These commands have no effect if the router supports PDSN member functionality from a prior configuration.

| Command                                                                                                 | Purpose                                                                                                                                |
|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn secure cluster default spi</b> spi number [ <b>key</b> ascii   hex value ] | Configures one common security association for all PDSNs in a cluster.                                                                 |
| Router# <b>cdma pdsn cluster controller interface</b> interface name                                    | Enables the controller functionality for PDSN Controller/Member clustering, and specifies which interface to send messages to and from |
| Router# <b>cdma pdsn cluster controller standby</b> cluster-name                                        | Configures the PDSN to operate as a cluster controller in standby.                                                                     |

## Configuring PDSN Cluster Member

To configure the PDSN Cluster Member attributes locally, use the following commands in global configuration mode:


**Note**

These commands have no effect if the router supports PDSN member functionality from a prior configuration.

| Command                                                                                               | Purpose                                                                |
|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn secure cluster default spi</b> spi_index [ <b>key</b> ascii   hex value] | Configures one common security association for all PDSNs in a cluster. |
| Router(config)# <b>cdma pdsn cluster member controller</b> ipaddr                                     | Configures the PDSN to operate as a cluster member.                    |
| Router(config)# <b>cdma pdsn cluster member interface</b> interface name                              | Configures the PDSN to operate as a cluster member.                    |

## Enabling Network Management

To enable SNMP network management for the PDSN, use the following commands in global configuration mode:

| Command                                                                                                                                                       | Purpose                                                                                                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>snmp-server community</b> <i>string</i> [ <b>ro</b>   <b>rw</b> ]                                                                          | Specifies the community access string to permit access to the SNMP protocol.                                                                                                                          |
| Router(config)# <b>snmp-server enable traps cdma</b>                                                                                                          | Enables network management traps for CDMA.                                                                                                                                                            |
| Router(config)# <b>snmp-server host</b> <i>host-addr</i> <b>traps version</b> { <b>1</b>   <b>2</b>   <b>3</b> [ <b>auth</b>   <b>noauth</b>   <b>priv</b> ]} | Specifies the recipient of an SNMP notification operation.                                                                                                                                            |
| Router(config)# <b>cdma pdsn failure-history entries</b>                                                                                                      | Specifies the maximum number of entries that can be maintained in the SNMP session failure table.                                                                                                     |
| Router(config)# <b>no virtual-template snmp</b>                                                                                                               | Prevents the virtual-access subinterfaces from being registered with the SNMP functionality of the router and reduces the amount of memory being used, thereby increasing the call setup performance. |

## Configuring Always On Service

Always On service maintains the subscriber's packet data session in the local network. The PDSN will not initiate release of the subscriber's packet data session due to PPP idle timer expiry, unless the PDSN determines the user is no longer reachable. The Always On feature is enabled by default. To change the default parameters related to this feature, use following command:

| Command                                                                                                                                                     | Purpose                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn a10 always-on keepalive</b> { <b>interval</b> <i>1-65535</i> [ <b>attempts</b> <i>0-255</i> ]   <b>attempts</b> <i>0-255</i> } | <p>Configures always-on service parameters on the PDSN.</p> <p>The <b>keepalive interval</b> is the duration in seconds, for which the PDSN waits for the LCP echo response from peer before sending next LCP echo. The default value is 3seconds. The <b>no</b> form of this command will return to the default value.</p> <p><b>attempts</b> is the number of times LCP echo must be sent before declaring an always-on user is not reachable for tearing down the session after the idle timer expires. The default value is 3. Configuring this variable to 0 is similar to ignoring the always-on property for the user.</p> |

## Configuring A11 Session Updates

A11 Session Update messages are sent from the PDSN to the PCF to add, change, or update session parameters for an A10 connection. To enable the A11 Session Update feature, perform the following tasks:

| Command                                                                                                   | Purpose                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn a11 session-update</b> {[ <b>always-on</b> ] 1-10<br>[ <b>rn-pdit</b> ] 0-9} | Enables the A11 Session update feature on the PDSN, and sends an A11 session update for either the Always On, RNPDI, or both attributes that are downloaded from the AAA server during the authentication phase.<br><br>The default timeout value is 3 seconds. The default retransmit number is 3. |
| Router# <b>cdma pdsn retransmit a11-update</b> number                                                     | Specifies the maximum number of times an A11 Registration Update message is retransmitted. Possible values are 0 through 9. The default is 5 retransmissions.                                                                                                                                       |

## Configuring SDB Indicator Marking

This feature supports short data burst applications, such as SIP signaling for PTT applications, and proposes the interaction with the PDSN. SIP is used by PTT applications to signal a PTT call. The message is short and needs to be delivered to the end-user. The Short Data Burst support on the RAN can be used to send these to the end-user, especially when the messages are to be terminated to the mobile. This is especially important when the mobile user is actually dormant. Use the following command to configure SDB Indicator Marking:

| Command                                                                                      | Purpose                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn a11 dormant sdb-indication gre-flags</b><br><i>group-number</i> | The <i>group-number</i> represents the classified match criteria. All packets that are set with the specific group-number will be flagged for SDB usage between the PCF and the PDSN.<br><br>The B bit (SDB indication) would be set for packets matching the sdb-indication group-number. |

## Configuring SDB Indicator Marking for PPP Control Packets

While data packets can be sent towards the mobile using SDBs as described in the previous section, SDBs can also be used for delivering PPP control packets. This can be particularly helpful for Always-On sessions, where the session is dormant. Basically, with Always On configured, the PDSN sends out LCP echo requests (and waits for LCP echo replies) to keep the session alive. Hence, when such a session goes dormant, a data channel needs to be setup to deliver these LCP echo requests to the MN. The other option is to use SDBs to deliver the LCP echo requests without setting up a data channel.

Use the following CLI command in conjunction of the above CLI command to enable this feature:

| Command                                                                                                | Purpose                                                           |
|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn all dormant sdb-indication match-qos-group group-number ppp-ctrl-pkts</b> | The <i>group-number</i> represents the classified match criteria. |

## Configuring PoD on the PDSN

To enable the Packet of Disconnect (RADIUS Disconnect) feature on the PDSN, perform the following tasks:

| Command                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Purpose                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn radius disconnect</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Enables the RADIUS disconnect feature on the PDSN.                                                      |
| Router(config)# <b>aaa pod server</b> [ <b>clients</b> <i>ipaddr1</i> [ <i>ipaddr2</i> ] [ <i>ipaddr3</i> ] [ <i>ipaddr4</i> ]] [ <b>port</b> <i>port-number</i> ] [ <b>auth-type</b> { <b>any</b>   <b>all</b>   <b>session-key</b> }] <b>server-key</b> [ <i>encryption-type</i> ] <i>string</i>                                                                                                                                                                                                                                                                                                | Enables listening for POD packets on the AAA server.                                                    |
| Router(config)# <b>aaa server radius dynamic-author</b><br>Router(config-locsvr-radius)#?<br>RADIUS Application commands:<br><b>auth-type</b> Specify the server authorization type<br><b>client</b> Specify a RADIUS client<br><b>default</b> Set a command to its defaults<br><b>exit</b> Exit from RADIUS application configuration mode<br><b>ignore</b> Override behavior to ignore certain parameters<br><b>no</b> Negate a command or set its defaults<br><b>port</b> Specify port on which local RADIUS server listens<br><b>server-key</b> Encryption key shared with the RADIUS clients | Enters RADIUS application configuration mode, and presents the user with several configuration options. |

## Configuring Mobile IP Resource Revocation on the PDSN

To enable resource revocation support on PDSN, perform the following task:

| Command                                                                                                        | Purpose                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>Router(config)# ip mobile foreign-service revocation [timeout value] [retransmit value] [timestamp]</pre> | <p><b>timeout value</b> is the time interval in seconds between re-transmission of resource revocation message. The wait time is between 0-100, and the default value is 3 seconds.</p> <p><b>retransmit value</b> is the number of maximum re-transmissions of MIPv4 resource revocation messages.</p> <p>The number of retries for a transaction is 0-100. The default value is 3.</p> <p><b>Note</b> All foreign-service configurations should be done globally and not under the virtual-template interface.</p> <p><b>Timestamp</b> specifies the unit of timestamp field for revocation. The unit of timestamp value for revocation is in milliseconds.</p> |



### Note

You will also have VPDN configuration tasks, Layer 2 Tunneling Protocol (L2TP) tunnel configuration tasks, and Load Balancing configuration tasks to perform. Please refer to the appropriate documentation for more specific information.

For information regarding VPDN configuration details, please refer to the following URL:

[http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps5207/products\\_command\\_reference\\_chapter09186a00801a7e8f.html#wp1167095](http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps5207/products_command_reference_chapter09186a00801a7e8f.html#wp1167095)

For information regarding Layer 2 Tunneling Protocol (L2TP) tunnel configuration details, please refer to the following URL:

[http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps5207/products\\_command\\_reference\\_chapter09186a00801a7e90.html](http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps5207/products_command_reference_chapter09186a00801a7e90.html)

For information regarding IOS Server Load Balancing, please refer to the following URL:

[http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps5012/products\\_feature\\_guide09186a008020b9f3.html#wp3601032](http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps5012/products_feature_guide09186a008020b9f3.html#wp3601032)

## Configuring Short Data Burst Flagging

This feature adds support for short data burst applications such as SIP signaling for PTT applications, and proposes the interaction with PDSN. SIP is used by PTT applications to signal a PTT call. The message is short and needs to be delivered to the end-user. The Short Data Burst support on the RAN can be used to send these over to the end-user, especially when the messages are to be terminated to the mobile.

To configure SDB on the PDSN so that all packets that are set with the specific group-number will be flagged for SDB usage between the PCF and the PDSN, use the following command in global configuration:

| Command                                                                            | Purpose                                                                                                                                    |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn a11 dormant sdb-indication gre-flags group-number</b> | Configures SDB so that all packets that are set with the specific group-number will be flagged for SDB usage between the PCF and the PDSN. |

## Configuring PDSN Accounting Events

To configure attributes of PDSN accounting events, use the following commands in global configuration mode:

| Command                                                                  | Purpose                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router(config)# <b>clock timezone zone hours-offset [minutes-offset]</b> | Sets the time zone for display purposes.                                                                                                                                                                                                                                |
| Router(config)# <b>cdma pdsn accounting local-timezone</b>               | Sets the local time stamp for PDSN accounting events.                                                                                                                                                                                                                   |
| Router(config)# <b>cdma pdsn accounting time-of-day</b>                  | Sets triggers for accounting information for different times of day.                                                                                                                                                                                                    |
| Router(config)# <b>cdma pdsn accounting send start-stop</b>              | Enables the PDSN to send: <ul style="list-style-type: none"> <li>An accounting stop record when it receives an active stop airlink record (dormant state)</li> <li>An accounting start record when it receives an active start airlink record (active state)</li> </ul> |

## Configuring CDMA RADIUS Attributes

To configure both authentication and accounting requests on the PDSN, perform the following tasks:

| Command                                                                                                                                                                                                                                                                                                  | Purpose                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Router(config)# <b>cdma pdsn attribute send {a1 { fa-chap   mip-rrq}   a2 {auth-req   fa-chap   mip-rrq}   a3 {auth-req   fa-chap   mip-rrq}   {c5 {acct-reqs}   f15 {acct-reqs}   f16 {acct-reqs}   f5 {fa-chap}   g1 {acct-start}   g2 {acct-start}   g17   esn-optional   meid-optional   is835a}</b> | Enables both authentication and accounting requests on the PDSN. |

# Monitoring and Maintaining the PDSN

To monitor and maintain the PDSN, use the following commands in privileged EXEC mode:

| Command                                                                                                                                                   | Purpose                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Router# <b>clear cdma pdsn cluster controller session records</b><br><b>age days</b>                                                                      | Clears session records of a specified age.                                                                           |
| Router# <b>clear cdma pdsn cluster controller session record all</b>                                                                                      | Clears all the session records of the PDSN cluster controller.                                                       |
| Router# <b>clear cdma pdsn cluster controller statistics</b>                                                                                              | Clears PDSN cluster controller statistics.                                                                           |
| Router# <b>clear cdma pdsn cluster member statistics</b>                                                                                                  | Clears PDSN cluster member statistics.                                                                               |
| Router# <b>clear cdma pdsn session</b> {all   pcf ip-addr   msid<br>octet-stream} {send {all-update   termreq}}                                           | Clears the session.                                                                                                  |
| Router# <b>clear cdma pdsn statistics</b>                                                                                                                 | Clears the RAN-to-PDSN interface (RP) or PPP statistics on the PDSN.                                                 |
| Router# <b>clear ip mobile binding</b> {all [load<br>standby-group-name]   ip-address   nai string ip_address}                                            | Removes mobility bindings.                                                                                           |
| Router# <b>clear ip mobile visitor</b> [ip-address   nai string<br>ip_address]                                                                            | Clears visitor information.                                                                                          |
| Router# <b>clear vpdn tunnel l2tp ?</b><br>all All L2TP tunnels<br>hostname Based on the hostnames<br>id Based on the tunnel ID<br>ip Based on IP address | Clears VPDN L2TP Tunnel information for the Closed-PR feature.                                                       |
| Router# <b>show cdma pdsn</b>                                                                                                                             | Displays the status and current configuration of the PDSN gateway.                                                   |
| Router# <b>show cdma pdsn accounting</b>                                                                                                                  | Display the accounting information for all sessions and the corresponding flows.                                     |
| Router# <b>show cdma pdsn accounting detail</b>                                                                                                           | Displays detailed accounting information for all sessions and the corresponding flows.                               |
| Router# <b>show cdma pdsn accounting session msid</b>                                                                                                     | Displays the accounting information for the session identified by the msid.                                          |
| Router# <b>show cdma pdsn accounting session msid detail</b>                                                                                              | Displays the accounting information (the counter names) for the session identified by the msid.                      |
| Router# <b>show cdma pdsn accounting session msid flow</b><br>{mn-ip-address IP_address}                                                                  | Displays the accounting information for a specific flow that is associated with the session identified by the msid.  |
| Router# <b>show cdma pdsn accounting session msid flow user</b><br><b>username</b>                                                                        | Displays accounting information for a flow with username that is associated with the session identified by the msid. |
| Router# <b>show cdma pdsn ahdlc slot_number channel</b> [channel_id]                                                                                      | Displays AHDLC engine information.                                                                                   |
| Router# <b>show cdma pdsn cluster controller</b> [configuration  <br><b>statistics]</b>                                                                   | Displays configuration and statistics for the PDSN cluster controller.                                               |

| Command                                                                                                                                                                                                                    | Purpose                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Router# <b>show cdma pdsn cluster controller config</b>                                                                                                                                                                    | Displays the IP addresses of the members that are registered with a specific controller.                                                                                                                |
| Router# <b>show cdma pdsn cluster controller member</b> [load   time   <i>ipaddr</i> ]                                                                                                                                     | Displays either the load reported by every PDSN cluster member, or the time until (or past) the seek time of the member, or for detailed information related to the member of the specified ip address. |
| Router# <b>show cdma pdsn cluster controller queueing</b>                                                                                                                                                                  | Displays statistics associated with controller queueing feature.                                                                                                                                        |
| Router# <b>show cdma pdsn cluster member queueing</b>                                                                                                                                                                      | Displays statistics associated with member queueing feature.                                                                                                                                            |
| Router# <b>show cdma pdsn cluster controller session</b> [count [age days]   <b>oldest</b> [more 1-20 records]   <b>imsi BCDs</b> [more 1-20 records]]                                                                     | Displays session count, or count by age, or one or a few oldest session records, or session records corresponding to the IMSI entered.                                                                  |
| Router# <b>show cdma pdsn cluster controller statistics</b>                                                                                                                                                                | Displays the IP addresses of the members that are registered with a specific controller.                                                                                                                |
| Router# <b>show cdma pdsn cluster member</b> [configuration   <b>statistics</b> ]                                                                                                                                          | Displays configuration and statistics for the PDSN cluster member.                                                                                                                                      |
| Router# <b>show cdma pdsn flow</b> { <b>mn-ip-address</b> <i>ip_address</i>   <b>msid string</b>   <b>service-type</b>   <b>user string</b> }                                                                              | Displays flow-based summary of active sessions, and the flows and IP addresses assigned to the mobile numbers in each session.                                                                          |
| Router# <b>show cdma pdsn pcf</b> [brief   <i>ip-addr</i> ]                                                                                                                                                                | Displays the PCF information for those PCFs that have R-P tunnels to this PDSN.                                                                                                                         |
| Router# <b>show cdma pdsn pcf secure</b>                                                                                                                                                                                   | Displays security associations for all PCFs configured on this PDSN.                                                                                                                                    |
| Router# <b>show cdma pdsn resource</b> [ <i>slot_number</i> [ <b>ahdlc-channel</b> [ <i>channel_id</i> ]]]                                                                                                                 | Displays AHDLC resource information.                                                                                                                                                                    |
| Router# <b>show cdma pdsn session</b> [brief   dormant   <b>mn-ip-address</b> <i>address</i>   <b>msid</b> <i>msid</i>   <b>user</b> <i>nai</i> ]                                                                          | Displays the session information on the PDSN.                                                                                                                                                           |
| Router# <b>show cdma pdsn statistics</b> [ <b>ahdlc</b>   <b>rp</b> [ <b>pcf</b> <i>ip_address</i> ]   <b>closed-rp</b> [ <b>pcf</b> <i>ip_address</i> ]   <b>error</b> ] [ <b>ppp</b> [ <b>pcf</b> <i>ip_address</i> ] ]] | Displays VPDN, PPP, RP interface, Closed-RP interface, prepaid, RADIUS, and error statistics for the PDSN.                                                                                              |
| Router# <b>show compress detail-ccp</b>                                                                                                                                                                                    | Displays the compression information for all users.                                                                                                                                                     |
| Router# <b>show diag</b> [ <i>slot</i> ]                                                                                                                                                                                   | Displays diagnostic information about the controller, interface processor, and port adapters associated with a specified slot of a Cisco router.                                                        |
| Router# <b>show interfaces virtual-access</b> <i>number</i>                                                                                                                                                                | Displays a description of the configuration of the vaccess interface.                                                                                                                                   |
| Router# <b>show ip mobile cdma ipsec profile</b>                                                                                                                                                                           | Displays the configured IPsec profiles.                                                                                                                                                                 |
| Router# <b>show ip mobile cdma ipsec security-level</b>                                                                                                                                                                    | Displays a list of FAs and their security levels.                                                                                                                                                       |
| Router# <b>show ip mobile globals</b>                                                                                                                                                                                      | Displays MIPv4 Registration Revocation support in MIP subsystem.                                                                                                                                        |
| Router# <b>show ip mobile proxy</b> [host [ <i>nai string</i> ]   <b>registration</b>   <b>traffic</b> ]                                                                                                                   | Displays information about a PMIP host.                                                                                                                                                                 |
| Router# <b>show ip mobile secure</b>                                                                                                                                                                                       | Displays mobility security associations for MIP.                                                                                                                                                        |

| Command                                                                                         | Purpose                                                                                       |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Router# <b>show ip mobile traffic</b>                                                           | Displays MIPv4 Registration Revocation message related statistics                             |
| Router# <b>show ip mobile visitor</b>                                                           | Displays a list of visitors.                                                                  |
| Router# <b>show ip mobile violation</b>                                                         | Displays information about security violations.                                               |
| Router# <b>show mwam module slot_num port_num</b>                                               | Displays connectivity information regarding the individual processors on the MWAM card.       |
| Router# <b>show tech-support cdma pdsn</b>                                                      | Displays PDSN information that is useful to Cisco Customer Engineers for diagnosing problems. |
| Router# <b>show vpdn</b><br>Router# <b>show vpdn session</b><br>Router# <b>show vpdn tunnel</b> | Displays VPDN information relevant to the Closed-RP Interface.                                |

## Configuration Examples

This section provides the following configuration examples:

- [Cisco PDSN Standalone Configuration](#)
- [Cisco PDSN Session Redundancy Configuration](#)
- [Cisco PDSN Cluster Configuration](#)
- [Cisco PDSN Configuration for Simple IP](#)
- [Cisco PDSN Configuration for Simple IP with VPDN](#)
- [Cisco PDSN Configuration for Mobile IP](#)
- [Combined Configuration for Cisco PDSN](#)
- [Simple IPv6 Configuration Example](#)

### Cisco PDSN Standalone Configuration

This section provides an example of Cisco PDSN standalone configuration.

```

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
service internal
service cdma pdsn
boot-start-marker
boot-end-marker
!
!
hostname PDSN-standalone
!
logging message-counter syslog
logging buffered 2000000
!
!
!
aaa new-model
!

```

```

!
aaa group server radius auth_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa group server radius acct_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa authentication login default local none
aaa authentication ppp default group auth_server_group_1
aaa authorization network default group auth_server_group_1
aaa authorization configuration default group auth_server_group_1
aaa accounting update periodic 300
aaa accounting network pdsn
  action-type start-stop
  group acct_server_group_1
!
aaa accounting system default
  action-type start-stop
  broadcast
  group acct_server_group_1
!
!
!
aaa session-id common
aaa memory threshold authentication reject 15
aaa memory threshold accounting disable 10

memory-size iomem 256

/* default pool cache size is 10 , recommended cache size is 50 */
sami pool-cache 50
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
ip source-route
ip cef
!
!
no ip domain lookup
no ipv6 cef
vpdn enable
vpdn authen-before-forward
!

!
multilink bundle-name authenticated
!
!
memory lite
archive
  log config
  hidekeys
!
!
!
!
!
!
!
interface Loopback0

```

```

    ip address 40.1.33.103 255.255.0.0
    !
interface Loopback1
    ip address 171.1.33.103 255.255.0.0
    !
interface Loopback2
    ip address 51.1.33.103 255.255.0.0
    !
interface CDMA-Ix1
    ip address 30.1.33.103 255.255.0.0
    tunnel source 30.1.33.103
    tunnel key 46
    tunnel sequence-datagrams
    !
interface GigabitEthernet0/0
    mtu 1600
    no ip address
    load-interval 30
    no keepalive
    !
    !
    !
interface GigabitEthernet0/0.20
    description RP-interface
    encapsulation dot1Q 20
    ip address 20.1.33.103 255.255.0.0
    !
interface GigabitEthernet0/0.50
    description PDSN-HA Connectivity
    encapsulation dot1Q 50
    ip address 50.1.33.103 255.255.0.0
    ip mtu 1500
    !
interface GigabitEthernet0/0.60
    description ReverseDirection Connectivity
    encapsulation dot1Q 60
    ip address 60.1.33.103 255.255.0.0
    ip mtu 1500
    !
interface GigabitEthernet0/0.170
    description LAAA Connectivity
    encapsulation dot1Q 170
    ip address 170.1.33.103 255.255.0.0
    ip mtu 1500
    !
interface Virtual-Template1
    ip unnumbered Loopback0
    peer default ip address pool sip-addr-33-pool1
    no keepalive
    ppp accm 0
    ppp authentication pap chap optional
    ppp accounting none
    ppp direction callin
    ppp timeout ncp 30
    ppp timeout authentication 60
    ppp timeout idle 7200
    !
router mobile
    !
ip local pool sip-addr-33-pool1 100.33.1.1 100.33.254.254 recycle delay 30
ip local pool sip-addr-33-pool1 100.34.1.1 100.34.254.254
ip local pool sip-addr-33-pool1 100.35.1.1 100.35.254.254
ip local pool msid-sip-addr-33-pool1 140.33.1.1 140.33.254.254 recycle delay 30
ip local pool msid-sip-addr-33-pool1 140.34.1.1 140.34.254.254

```

```

ip local pool msid-sip-addr-33-pool1 140.35.1.1 140.35.254.254

ip forward-protocol nd

ip route 11.1.0.0 255.255.0.0 20.1.2.100
ip route 12.1.0.0 255.255.0.0 60.1.2.100
ip route 21.1.0.0 255.255.0.0 20.1.2.100
ip route 70.1.0.0 255.255.0.0 50.1.112.102
!
!
no ip http server
no ip http secure-server
ip mobile debug include username
ip mobile foreign-agent care-of GigabitEthernet0/0.50
ip mobile foreign-agent reverse-tunnel private-address
ip mobile foreign-agent skip-aaa-reauthentication
ip mobile secure home-agent 50.1.112.102 spi FFFFFFFF key ascii cisco algorithm md5 mode
prefix-suffix
ip mobile foreign-service revocation
ip mobile foreign-service challenge forward-mfce
ip mobile foreign-service registration-required reverse-tunnel mandatory
ip mobile proxy-host nai @cisco.com flags 42
ip mobile proxy-registration lifetime 1800
!
ip radius source-interface Loopback1
logging main-cpu 4000 emergencies

snmp-server community public RW
snmp-server enable traps cdma
!
!
radius-server attribute 8 include-in-access-req
radius-server dead-criteria time 50 tries 5
radius-server host 170.1.4.201 auth-port 1645 acct-port 1646 key 7 045802150C2E
radius-server retransmit 5
radius-server timeout 10
radius-server deadtime 1
radius-server vsa send accounting
radius-server vsa send authentication
radius-server vsa send accounting 3gpp2
radius-server vsa send authentication 3gpp2
!
control-plane
!
cdma pdsn radius disconnect nai
cdma pdsn accounting send start-stop
cdma pdsn tft reject include error extension

cdma pdsn virtual-template 1
cdma pdsn a10 max-lifetime 1800
cdma pdsn a11 session-update always-on rn-pdit qos
cdma pdsn timeout mobile-ip-registration 100
cdma pdsn timeout a11-update 5
cdma pdsn timeout a11-session-update 5
cdma pdsn msid-authentication
cdma pdsn send-agent-adv
cdma pdsn debug show-conditions
cdma pdsn secure pcf default spi 100 key ascii testtesttesttest local-timezone replay 255
cdma pdsn secure pcf 20.1.32.1 20.1.32.7 spi 100 key ascii cisco

cdma pdsn compliance is835c account ipmobile control-packets
!
line con 0
  exec-timeout 0 0

```

```

line aux 0
  exec-timeout 0 0
line vty 0 4
  exec-timeout 0 0
  password 7 151E0A0E
!
exception data-corruption buffer truncate
ntp server 127.0.0.51 burst iburst
end

```

## Cisco PDSN Session Redundancy Configuration

This section provides an example of a Cisco PDSN session redundancy configuration for an active PDSN:

```

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
service internal
service cdma pdsn
!
hostname PDSN-B
!
boot-start-marker
boot-end-marker
!
!
redundancy inter-device
  scheme standby PDSN-redundancy
!
!
!
redundancy
  no keepalive-enable
logging message-counter syslog
!
!
ipc zone default
  association 1
  no shutdown
  protocol sctp
  local-port 5000
  local-ip 20.1.23.203
  remote-port 5000
  remote-ip 20.1.33.103
!
aaa new-model
!
!
aaa group server radius auth_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa group server radius acct_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa authentication login default local none
aaa authentication ppp default group auth_server_group_1
aaa authorization network default group auth_server_group_1
aaa authorization configuration default group auth_server_group_1
aaa accounting update periodic 300
aaa accounting network pdsn

```

```

    action-type start-stop
    group acct_server_group_1
    !
aaa accounting system default
    action-type start-stop
    broadcast
    group acct_server_group_1
    !
    !
    !
aaa session-id common
aaa memory threshold authentication reject 15
aaa memory threshold accounting disable 10
memory-size iomem 256
sami pool-cache 50
    !
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
ip source-route
ip cef
    !
    !
no ip domain lookup
subscriber redundancy rate 250 1
no ipv6 cef
vpdn enable
vpdn authen-before-forward
    !
multilink bundle-name authenticated
    !
    !
archive
    log config
    hidekeys
    !
    !
    !
    !
    !
    !
    !
interface Loopback0
    ip address 40.1.33.103 255.255.0.0
    !
interface Loopback1
    ip address 171.1.33.103 255.255.0.0
    !
interface Loopback2
    ip address 51.1.33.103 255.255.0.0
    !
interface CDMA-Ix1
    ip address 30.1.33.103 255.255.0.0
    tunnel source 30.1.33.103
    tunnel key 46
    tunnel sequence-datagrams
    !
interface GigabitEthernet0/0
    mtu 1600
    no ip address
    load-interval 30
    no keepalive

```

```

!
interface GigabitEthernet0/0.20
  description RP-interface
  encapsulation dot1Q 20
  ip address 20.1.23.203 255.255.0.0
  standby delay minimum 30 reload 30
  standby version 2
  standby 20 ip 20.1.33.254
  standby 20 priority 110
  standby 20 name PDSN-redundancy
!
interface GigabitEthernet0/0.50
  description PDSN-HA Connectivity
  encapsulation dot1Q 50
  ip address 50.1.23.203 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 50 ip 50.1.33.254
  standby 50 follow PDSN-redundancy
!
interface GigabitEthernet0/0.60
  description ReverseDirection Connectivity
  encapsulation dot1Q 60
  ip address 60.1.23.203 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 60 ip 60.1.33.254
  standby 60 follow PDSN-redundancy
!
interface GigabitEthernet0/0.170
  description LAAA Connectivity
  encapsulation dot1Q 170
  ip address 170.1.23.203 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 170 ip 170.1.33.254
  standby 170 follow PDSN-redundancy
!
interface Virtual-Templatel
  ip unnumbered Loopback0
  peer default ip address pool sip-addr-33-pool1
  no keepalive
  ppp accm 0
  ppp authentication pap chap optional
  ppp accounting none
  ppp direction callin
  ppp timeout ncp 30
  ppp timeout authentication 60
  ppp timeout idle 7200
!
router mobile
!
ip local pool sip-addr-33-pool1 100.33.1.1 100.33.254.254 recycle delay 30
ip local pool sip-addr-33-pool1 100.34.1.1 100.34.254.254
ip local pool sip-addr-33-pool1 100.35.1.1 100.35.254.254
ip local pool msid-sip-addr-33-pool1 140.33.1.1 140.33.254.254 recycle delay 30
ip local pool msid-sip-addr-33-pool1 140.34.1.1 140.34.254.254
ip local pool msid-sip-addr-33-pool1 140.35.1.1 140.35.254.254
ip forward-protocol nd
ip route 11.1.0.0 255.255.0.0 20.1.2.100
ip route 12.1.0.0 255.255.0.0 60.1.2.100
ip route 21.1.0.0 255.255.0.0 20.1.2.100
ip route 70.1.0.0 255.255.0.0 50.1.112.102
!

```

```

!
no ip http server
no ip http secure-server
ip mobile debug include username
ip mobile foreign-agent care-of GigabitEthernet0/0.50
ip mobile foreign-agent reverse-tunnel private-address
ip mobile foreign-agent skip-aaa-reauthentication
ip mobile secure home-agent 50.1.112.102 spi FFFFFFFF key ascii cisco algorithm md5 mode
prefix-suffix
ip mobile foreign-service revocation
ip mobile foreign-service challenge forward-mfce
ip mobile foreign-service registration-required reverse-tunnel mandatory
ip mobile proxy-host nai @cisco.com flags 42
ip mobile proxy-registration lifetime 1800
!
ip radius source-interface Loopback1
logging main-cpu 4000 emergencies
snmp-server community public RW
snmp-server enable traps cdma
!
!
radius-server attribute 8 include-in-access-req
radius-server dead-criteria time 50 tries 5
radius-server host 170.1.4.201 auth-port 1645 acct-port 1646 key 7 045802150C2E
radius-server retransmit 5
radius-server timeout 10
radius-server deadtime 1
radius-server vsa send accounting
radius-server vsa send authentication
radius-server vsa send accounting 3gpp2
radius-server vsa send authentication 3gpp2
!
control-plane
!
cdma pdsn radius disconnect nai
cdma pdsn accounting send start-stop
cdma pdsn tft reject include error extension
cdma pdsn virtual-template 1
cdma pdsn all session-update always-on rn-pdit qos
cdma pdsn timeout mobile-ip-registration 100
cdma pdsn timeout all-update 5
cdma pdsn timeout all-session-update 5
cdma pdsn msid-authentication
cdma pdsn send-agent-adv
cdma pdsn debug show-conditions
cdma pdsn secure pcf default spi 100 key ascii testtesttesttest local-timezone replay 255
cdma pdsn secure pcf 20.1.32.1 20.1.32.7 spi 100 key ascii cisco
cdma pdsn compliance is835c account ipmobile control-packets
cdma pdsn redundancy
!
line con 0
  exec-timeout 0 0
line aux 0
  exec-timeout 0 0
line vty 0 4
  exec-timeout 0 0
  password 7 151E0A0E
!
exception data-corruption buffer truncate
ntp server 127.0.0.51 burst iburst
end

```

## Cisco PDSN session redundancy configuration example for a standby PDSN:

```

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
service internal
service cdma pdsn
!
hostname PDSN-A
!
boot-start-marker
boot-end-marker
!
!
redundancy inter-device
  scheme standby PDSN-redundancy
!
!
!
redundancy
  no keepalive-enable
logging message-counter syslog
!
!
ipc zone default
  association 1
  no shutdown
  protocol sctp
  local-port 5000
  local-ip 20.1.33.103
  remote-port 5000
  remote-ip 20.1.23.203
!
aaa new-model
!
!
aaa group server radius auth_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa group server radius acct_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa authentication login default local none
aaa authentication ppp default group auth_server_group_1
aaa authorization network default group auth_server_group_1
aaa authorization configuration default group auth_server_group_1
aaa accounting update periodic 300
aaa accounting network pdsn
  action-type start-stop
  group acct_server_group_1
!
aaa accounting system default
  action-type start-stop
  broadcast
  group acct_server_group_1
!
!
!
aaa session-id common
aaa memory threshold authentication reject 15
aaa memory threshold accounting disable 10
memory-size iomem 256
sami pool-cache 50

```

```

!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
ip source-route
ip cef
!
!
no ip domain lookup
subscriber redundancy rate 250 1
no ipv6 cef
vpdn enable
vpdn authen-before-forward
!
multilink bundle-name authenticated
!
!
archive
  log config
  hidekeys
!
!
!
!
!
!
!
!
interface Loopback0
  ip address 40.1.33.103 255.255.0.0
!
interface Loopback1
  ip address 171.1.33.103 255.255.0.0
!
interface Loopback2
  ip address 51.1.33.103 255.255.0.0
!
interface CDMA-Ix1
  ip address 30.1.33.103 255.255.0.0
  tunnel source 30.1.33.103
  tunnel key 46
  tunnel sequence-datagrams
!
interface GigabitEthernet0/0
  mtu 1600
  no ip address
  load-interval 30
  no keepalive
!
interface GigabitEthernet0/0.20
  description RP-interface
  encapsulation dot1Q 20
  ip address 20.1.33.103 255.255.0.0
  standby delay minimum 30 reload 30
  standby version 2
  standby 20 ip 20.1.33.254
  standby 20 name PDSN-redundancy
!
interface GigabitEthernet0/0.50
  description PDSN-HA Connectivity
  encapsulation dot1Q 50
  ip address 50.1.33.103 255.255.0.0
  ip mtu 1500

```

```

standby version 2
standby 50 ip 50.1.33.254
standby 50 follow PDSN-redundancy
!
interface GigabitEthernet0/0.60
description ReverseDirection Connectivity
encapsulation dot1Q 60
ip address 60.1.33.103 255.255.0.0
ip mtu 1500
standby version 2
standby 60 ip 60.1.33.254
standby 60 follow PDSN-redundancy
!
interface GigabitEthernet0/0.170
description LAAA Connectivity
encapsulation dot1Q 170
ip address 170.1.33.103 255.255.0.0
ip mtu 1500
standby version 2
standby 170 ip 170.1.33.254
standby 170 follow PDSN-redundancy
!
interface Virtual-Template1
ip unnumbered Loopback0
peer default ip address pool sip-addr-33-pool1
no keepalive
ppp accm 0
ppp authentication pap chap optional
ppp accounting none
ppp direction callin
ppp timeout ncp 30
ppp timeout authentication 60
ppp timeout idle 7200
!
router mobile
!
ip local pool sip-addr-33-pool1 100.33.1.1 100.33.254.254 recycle delay 30
ip local pool sip-addr-33-pool1 100.34.1.1 100.34.254.254
ip local pool sip-addr-33-pool1 100.35.1.1 100.35.254.254
ip local pool msid-sip-addr-33-pool1 140.33.1.1 140.33.254.254 recycle delay 30
ip local pool msid-sip-addr-33-pool1 140.34.1.1 140.34.254.254
ip local pool msid-sip-addr-33-pool1 140.35.1.1 140.35.254.254
ip forward-protocol nd
ip route 11.1.0.0 255.255.0.0 20.1.2.100
ip route 12.1.0.0 255.255.0.0 60.1.2.100
ip route 21.1.0.0 255.255.0.0 20.1.2.100
ip route 70.1.0.0 255.255.0.0 50.1.112.102
!
!
no ip http server
no ip http secure-server
ip mobile debug include username
ip mobile foreign-agent care-of GigabitEthernet0/0.50
ip mobile foreign-agent reverse-tunnel private-address
ip mobile foreign-agent skip-aaa-reauthentication
ip mobile secure home-agent 50.1.112.102 spi FFFFFFFF key ascii cisco algorithm md5 mode
prefix-suffix
ip mobile foreign-service revocation
ip mobile foreign-service challenge forward-mfce
ip mobile foreign-service registration-required reverse-tunnel mandatory
ip mobile proxy-host nai @cisco.com flags 42
ip mobile proxy-registration lifetime 1800
!
ip radius source-interface Loopback1

```

```

logging main-cpu 4000 emergencies
snmp-server community public RW
snmp-server enable traps cdma
!
!
radius-server attribute 8 include-in-access-req
radius-server dead-criteria time 50 tries 5
radius-server host 170.1.4.201 auth-port 1645 acct-port 1646 key 7 045802150C2E
radius-server retransmit 5
radius-server timeout 10
radius-server deadtime 1
radius-server vsa send accounting
radius-server vsa send authentication
radius-server vsa send accounting 3gpp2
radius-server vsa send authentication 3gpp2
!
control-plane
!
cdma pdsn radius disconnect nai
cdma pdsn accounting send start-stop
cdma pdsn tft reject include error extension
cdma pdsn virtual-template 1
cdma pdsn all session-update always-on rn-pdit qos
cdma pdsn timeout mobile-ip-registration 100
cdma pdsn timeout all-update 5
cdma pdsn timeout all-session-update 5
cdma pdsn msid-authentication
cdma pdsn send-agent-adv
cdma pdsn debug show-conditions
cdma pdsn secure pcf default spi 100 key ascii testtesttesttest local-timezone replay 255
cdma pdsn secure pcf 20.1.32.1 20.1.32.7 spi 100 key ascii cisco
cdma pdsn compliance is835c account ipmobile control-packets
cdma pdsn redundancy
!
line con 0
  exec-timeout 0 0
line aux 0
  exec-timeout 0 0
line vty 0 4
  exec-timeout 0 0
  password 7 151E0A0E
!
exception data-corruption buffer truncate
ntp server 127.0.0.51 burst iburst
end

```

The show command output for Cisco PDSN session redundancy configuration are as follows:

```

PDSN-B# show redundancy states
      my state = 13 -ACTIVE
      peer state = 8  -STANDBY HOT
      Mode = Duplex
      Unit ID = 0

Maintenance Mode = Disabled
Manual Swact = Enabled
Communications = Up

      client count = 12
      client_notification_TMR = 30000 milliseconds
      RF debug mask = 0x0
PDSN-B#

PDSN-A# show redundancy states

```

```

        my state = 8 -STANDBY HOT
        peer state = 13 -ACTIVE
            Mode = Duplex
            Unit ID = 0

Maintenance Mode = Disabled
Manual Swact = Enabled
Communications = Up

client count = 12
client_notification_TMR = 30000 milliseconds
RF debug mask = 0x0

PDSN-A#

```

## Cisco PDSN Redundancy Configuration (Auto Synchronization Enabled)

Cisco PDSN session redundancy configuration example when autosynchronization is enabled:

```

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
service internal
service cdma pdsn
boot-start-marker
boot-end-marker
!
!
redundancy inter-device
  scheme standby PDSN-redundancy
!
!
redundancy unit1 slot 8 unit2 slot 9
!
redundancy unit1 hostname PDSN-A unit2 hostname PDSN-B
!
redundancy
  no keepalive-enable
logging message-counter syslog
!
auto-sync all
!
ipc zone default
  association 1
  no shutdown
  protocol sctp
    unit2-port 5000
    unit2-ip 20.1.23.203
    unit1-port 5000
    unit1-ip 20.1.33.103
!
aaa new-model
!
!
aaa group server radius auth_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa group server radius acct_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa authentication login default local none

```

```

aaa authentication ppp default group auth_server_group_1
aaa authorization network default group auth_server_group_1
aaa authorization configuration default group auth_server_group_1
aaa accounting update periodic 300
aaa accounting network pdsn
  action-type start-stop
  group acct_server_group_1
!
aaa accounting system default
  action-type start-stop
  broadcast
  group acct_server_group_1
!
!
!
aaa session-id common
aaa memory threshold authentication reject 15
aaa memory threshold accounting disable 10
memory-size iomem 256
sami pool-cache 50
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
ip source-route
ip cef
!
!
no ip domain lookup
subscriber redundancy rate 250 1
no ipv6 cef
vpdn enable
vpdn authen-before-forward
!
multilink bundle-name authenticated
!
!
archive
  log config
  hidekeys
!
!
!
!
!
!
!
interface Loopback0
  ip address 40.1.33.103 255.255.0.0
!
interface Loopback1
  ip address 171.1.33.103 255.255.0.0
!
interface Loopback2
  ip address 51.1.33.103 255.255.0.0
!
interface CDMA-Ix1
  ip address 30.1.33.103 255.255.0.0
  tunnel source 30.1.33.103
  tunnel key 46
  tunnel sequence-datagrams
!

```

```

interface GigabitEthernet0/0
  mtu 1600
  no ip address
  load-interval 30
  no keepalive
!
interface GigabitEthernet0/0.20
  description RP-interface
  encapsulation dot1Q 20
  redundancy ip address unit1 20.1.33.103 255.255.0.0 unit2 20.1.23.203 255.255.0.0
  standby delay minimum 30 reload 30
  standby version 2
  standby 20 ip 20.1.33.254
  standby 20 name PDSN-redundancy
!
interface GigabitEthernet0/0.50
  description PDSN-HA Connectivity
  encapsulation dot1Q 50
  redundancy ip address unit1 50.1.33.103 255.255.0.0 unit2 50.1.23.203 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 50 ip 50.1.33.254
  standby 50 follow PDSN-redundancy
!
interface GigabitEthernet0/0.60
  description ReverseDirection Connectivity
  encapsulation dot1Q 60
  redundancy ip address unit1 60.1.33.103 255.255.0.0 unit2 60.1.23.203 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 60 ip 60.1.33.254
  standby 60 follow PDSN-redundancy
!
interface GigabitEthernet0/0.170
  description LAAA Connectivity
  encapsulation dot1Q 170
  redundancy ip address unit1 170.1.33.103 255.255.0.0 unit2 170.1.23.203 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 170 ip 170.1.33.254
  standby 170 follow PDSN-redundancy
!
interface Virtual-Template1
  ip unnumbered Loopback0
  peer default ip address pool sip-addr-33-pool1
  no keepalive
  ppp accm 0
  ppp authentication pap chap optional
  ppp accounting none
  ppp direction callin
  ppp timeout ncp 30
  ppp timeout authentication 60
  ppp timeout idle 7200
!
router mobile
!
ip local pool sip-addr-33-pool1 100.33.1.1 100.33.254.254 recycle delay 30
ip local pool sip-addr-33-pool1 100.34.1.1 100.34.254.254
ip local pool sip-addr-33-pool1 100.35.1.1 100.35.254.254
ip local pool msid-sip-addr-33-pool1 140.33.1.1 140.33.254.254 recycle delay 30
ip local pool msid-sip-addr-33-pool1 140.34.1.1 140.34.254.254
ip local pool msid-sip-addr-33-pool1 140.35.1.1 140.35.254.254
ip forward-protocol nd
ip route 11.1.0.0 255.255.0.0 20.1.2.100

```

```

ip route 12.1.0.0 255.255.0.0 60.1.2.100
ip route 21.1.0.0 255.255.0.0 20.1.2.100
ip route 70.1.0.0 255.255.0.0 50.1.112.102
!
!
no ip http server
no ip http secure-server
ip mobile debug include username
ip mobile foreign-agent care-of GigabitEthernet0/0.50
ip mobile foreign-agent reverse-tunnel private-address
ip mobile foreign-agent skip-aaa-reauthentication
ip mobile secure home-agent 50.1.112.102 spi FFFFFFFF key ascii cisco algorithm md5 mode
prefix-suffix
ip mobile foreign-service revocation
ip mobile foreign-service challenge forward-mfce
ip mobile foreign-service registration-required reverse-tunnel mandatory
ip mobile proxy-host nai @cisco.com flags 42
ip mobile proxy-registration lifetime 1800
!
ip radius source-interface Loopback1
logging main-cpu 4000 emergencies
snmp-server community public RW
snmp-server enable traps cdma
!
!
radius-server attribute 8 include-in-access-req
radius-server dead-criteria time 50 tries 5
radius-server host 170.1.4.201 auth-port 1645 acct-port 1646 key 7 045802150C2E
radius-server retransmit 5
radius-server timeout 10
radius-server deadtime 1
radius-server vsa send accounting
radius-server vsa send authentication
radius-server vsa send accounting 3gpp2
radius-server vsa send authentication 3gpp2
!
control-plane
!
cdma pdsn radius disconnect nai
cdma pdsn accounting send start-stop
cdma pdsn tft reject include error extension
cdma pdsn virtual-template 1
cdma pdsn all session-update always-on rn-pdit qos
cdma pdsn timeout mobile-ip-registration 100
cdma pdsn timeout all-update 5
cdma pdsn timeout all-session-update 5
cdma pdsn msid-authentication
cdma pdsn send-agent-adv
cdma pdsn debug show-conditions
cdma pdsn secure pcf default spi 100 key ascii testtesttesttest local-timezone replay 255
cdma pdsn secure pcf 20.1.32.1 20.1.32.7 spi 100 key ascii cisco
cdma pdsn compliance is835c account ipmobile control-packets
cdma pdsn redundancy
!
line con 0
  exec-timeout 0 0
line aux 0
  exec-timeout 0 0
line vty 0 4
  exec-timeout 0 0
  password 7 151E0A0E
!
exception data-corruption buffer truncate
ntp server 127.0.0.51 burst iburst

```

```
end
```

The show command output for Cisco PDSN redundancy configuration (auto synchronization enabled):

```
PDSN-B# show redundancy states
    my state = 13 -ACTIVE
    peer state = 8  -STANDBY HOT
        Mode = Duplex
        Unit ID = 0

Maintenance Mode = Disabled
Manual Swact = Enabled
Communications = Up

    client count = 12
    client_notification_TMR = 30000 milliseconds
        RF debug mask = 0x0

PDSN-B#

PDSN-A#          show redundancy states
    my state = 8  -STANDBY HOT
    peer state = 13 -ACTIVE
        Mode = Duplex
        Unit ID = 0

Maintenance Mode = Disabled
Manual Swact = Enabled
Communications = Up

    client count = 12
    client_notification_TMR = 30000 milliseconds
        RF debug mask = 0x0

PDSN-A#
```

## Cisco PDSN Cluster Configuration

This section provides an example of Cisco PDSN cluster configuration.

### Cisco PDSN Member Configuration

The Cisco PDSN Release 5.1 member is interoperable with Cisco PDSN Releases 5.0, 4.0, and 3.0 controllers without requiring any changes in the controller configuration.



#### Note

Cisco PDSN Release 5.1 member reports load in terms of weight. The maximum weight is in the scale of 100 rather than session count.

```
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
service internal
service cdma pdsn
boot-start-marker
boot-end-marker
```

```

!
!
hostname PDSN-Cluster-Mem
!
logging message-counter syslog
logging buffered 2000000
!
!
!
aaa new-model
!
!
aaa group server radius auth_server_group_1
 server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa group server radius acct_server_group_1
 server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa authentication login default local none
aaa authentication ppp default group auth_server_group_1
aaa authorization network default group auth_server_group_1
aaa authorization configuration default group auth_server_group_1
aaa accounting update periodic 300
aaa accounting network pdsn
 action-type start-stop
 group acct_server_group_1
!
aaa accounting system default
 action-type start-stop
 broadcast
 group acct_server_group_1
!
!
!
aaa session-id common
aaa memory threshold authentication reject 15
aaa memory threshold accounting disable 10
!
memory-size iomem 256

/* default pool cache size is 10 , recommended cache size is 50 */
sami pool-cache 50
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
ip source-route
ip cef
!
!
no ip domain lookup
no ipv6 cef
vpdn enable
vpdn authen-before-forward
!

!
multilink bundle-name authenticated
!
!
memory lite
archive
 log config

```

```

hidekeys
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 40.1.33.103 255.255.0.0
!
interface Loopback1
 ip address 171.1.33.103 255.255.0.0
!
interface Loopback2
 ip address 51.1.33.103 255.255.0.0
!
interface CDMA-Ix1
 ip address 30.1.33.103 255.255.0.0
 tunnel source 30.1.33.103
 tunnel key 46
 tunnel sequence-datagrams
!
interface GigabitEthernet0/0
 mtu 1600
 no ip address
 load-interval 30
 no keepalive
!
!
!
interface GigabitEthernet0/0.20
 description RP-interface
 encapsulation dot1Q 20
 ip address 20.1.33.103 255.255.0.0
!
interface GigabitEthernet0/0.50
 description PDSN-HA Connectivity
 encapsulation dot1Q 50
 ip address 50.1.33.103 255.255.0.0
 ip mtu 1500
!
interface GigabitEthernet0/0.60
 description ReverseDirection Connectivity
 encapsulation dot1Q 60
 ip address 60.1.33.103 255.255.0.0
 ip mtu 1500
!

interface GigabitEthernet0/0.170
 description LAAA Connectivity
 encapsulation dot1Q 170
 ip address 170.1.33.103 255.255.0.0
 ip mtu 1500
!
interface Virtual-Template1
 ip unnumbered Loopback0
 peer default ip address pool sip-addr-33-pool1
 no keepalive
 ppp accm 0
 ppp authentication pap chap optional
 ppp accounting none

```

```

ppp direction callin
ppp timeout ncp 30
ppp timeout authentication 60
ppp timeout idle 7200
!
router mobile
!
ip local pool sip-addr-33-pool1 100.33.1.1 100.33.254.254 recycle delay 30
ip local pool sip-addr-33-pool1 100.34.1.1 100.34.254.254
ip local pool sip-addr-33-pool1 100.35.1.1 100.35.254.254
ip local pool msid-sip-addr-33-pool1 140.33.1.1 140.33.254.254 recycle delay 30
ip local pool msid-sip-addr-33-pool1 140.34.1.1 140.34.254.254
ip local pool msid-sip-addr-33-pool1 140.35.1.1 140.35.254.254

ip forward-protocol nd

ip route 11.1.0.0 255.255.0.0 20.1.2.100
ip route 12.1.0.0 255.255.0.0 60.1.2.100
ip route 21.1.0.0 255.255.0.0 20.1.2.100
ip route 70.1.0.0 255.255.0.0 50.1.112.102
!
!
no ip http server
no ip http secure-server
ip mobile debug include username
ip mobile foreign-agent care-of GigabitEthernet0/0.50
ip mobile foreign-agent reverse-tunnel private-address
ip mobile foreign-agent skip-aaa-reauthentication
ip mobile secure home-agent 50.1.112.102 spi FFFFFFFF key ascii cisco algorithm md5 mode
prefix-suffix
ip mobile foreign-service revocation
ip mobile foreign-service challenge forward-mfce
ip mobile foreign-service registration-required reverse-tunnel mandatory
ip mobile proxy-host nai @cisco.com flags 42
ip mobile proxy-registration lifetime 1800
!
ip radius source-interface Loopback1
logging main-cpu 4000 emergencies

snmp-server community public RW
snmp-server enable traps cdma
!
!
radius-server attribute 8 include-in-access-req
radius-server dead-criteria time 50 tries 5
radius-server host 170.1.4.201 auth-port 1645 acct-port 1646 key 7 045802150C2E
radius-server retransmit 5
radius-server timeout 10
radius-server deadtime 1
radius-server vsa send accounting
radius-server vsa send authentication
radius-server vsa send accounting 3gpp2
radius-server vsa send authentication 3gpp2
!
control-plane
!
cdma pdsn radius disconnect nai
cdma pdsn accounting send start-stop
cdma pdsn tft reject include error extension

cdma pdsn virtual-template 1
cdma pdsn a10 max-lifetime 1800
cdma pdsn a11 session-update always-on rn-pdit qos
cdma pdsn timeout mobile-ip-registration 100

```

```

cdma pdsn timeout all-update 5
cdma pdsn timeout all-session-update 5
cdma pdsn msid-authentication
cdma pdsn send-agent-adv
cdma pdsn debug show-conditions
cdma pdsn secure pcf default spi 100 key ascii testtesttesttest local-timezone replay 255
cdma pdsn secure pcf 20.1.32.1 20.1.32.7 spi 100 key ascii cisco
cdma pdsn secure cluster default spi 101 key ascii Cisco
cdma pdsn compliance is835c account ipmobile control-packets
cdma pdsn cluster member controller 20.1.33.103
cdma pdsn cluster member interface GigabitEthernet0/0.20
cdma pdsn cluster member timeout 120
!
line con 0
  exec-timeout 0 0
line aux 0
  exec-timeout 0 0
line vty 0 4
  exec-timeout 0 0
  password 7 151E0A0E
!
exception data-corruption buffer truncate
ntp server 127.0.0.51 burst iburst
end

```

The show command output for Cisco PDSN cluster configuration is as follows:

```

PDSN-Cluster-Mem# show cdma pdsn cluster controller configuration
cluster interface GigabitEthernet0/0.20 (collocated)
no R-P signaling proxy
timeout to seek member = 120 seconds
window to seek member is 2 timeouts in a row if no reply (afterwards the member is
declared offline)
default: spi 101, Timestamp +/- 0, key ascii cisco
this PDSN cluster controller is configured

Controller maximum number of load units = 100
PDSN-Cluster-Mem#

```

## Cisco PDSN Controller Configuration

This section provides an example of Cisco PDSN controller configuration.

The Cisco PDSN Release 5.1 cluster controller is interoperable with Cisco PDSN Releases 5.0, 4.0, and 3.0 members without requiring any changes in the member configuration.

```

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
service internal
service cdma pdsn
boot-start-marker
boot-end-marker
!
!
hostname PDSN-Cluster-Cntrl
!
logging message-counter syslog
logging buffered 2000000
!
!

```



```

!
!
interface Loopback0
 ip address 40.1.33.103 255.255.0.0
!
interface Loopback1
 ip address 171.1.33.103 255.255.0.0
!
interface Loopback2
 ip address 51.1.33.103 255.255.0.0
!
interface CDMA-Ix1
 ip address 30.1.33.103 255.255.0.0
 tunnel source 30.1.33.103
 tunnel key 46
 tunnel sequence-datagrams
!
interface GigabitEthernet0/0
 mtu 1600
 no ip address
 load-interval 30
 no keepalive
!
!
!
interface GigabitEthernet0/0.20
 description RP-interface
 encapsulation dot1Q 20
 ip address 20.1.33.103 255.255.0.0
!
interface GigabitEthernet0/0.50
 description PDSN-HA Connectivity
 encapsulation dot1Q 50
 ip address 50.1.33.103 255.255.0.0
 ip mtu 1500
!
interface GigabitEthernet0/0.60
 description ReverseDirection Connectivity
 encapsulation dot1Q 60
 ip address 60.1.33.103 255.255.0.0
 ip mtu 1500
!
interface GigabitEthernet0/0.170
 description LAAA Connectivity
 encapsulation dot1Q 170
 ip address 170.1.33.103 255.255.0.0
 ip mtu 1500
!
interface Virtual-Template1
 ip unnumbered Loopback0
 no peer default ip address
 no keepalive
 ppp accm 0
 ppp authentication pap chap optional
 ppp accounting none
 ppp direction callin
 ppp timeout ncp 30
 ppp timeout authentication 60
 ppp timeout idle 7200
!
router mobile
!
ip forward-protocol nd

```

```

ip route 11.1.0.0 255.255.0.0 20.1.2.100
ip route 12.1.0.0 255.255.0.0 60.1.2.100
ip route 21.1.0.0 255.255.0.0 20.1.2.100
ip route 70.1.0.0 255.255.0.0 50.1.112.102
!
!
no ip http server
no ip http secure-server
ip mobile debug include username
ip mobile foreign-agent care-of GigabitEthernet0/0.50
ip mobile foreign-agent reverse-tunnel private-address
ip mobile foreign-agent skip-aaa-reauthentication
ip mobile secure home-agent 50.1.112.102 spi FFFFFFFF key ascii cisco algorithm md5 mode
prefix-suffix
ip mobile foreign-service revocation
ip mobile foreign-service challenge forward-mfce
ip mobile foreign-service registration-required reverse-tunnel mandatory
ip mobile proxy-host nai @cisco.com flags 42
ip mobile proxy-registration lifetime 1800
!
ip radius source-interface Loopback1
logging main-cpu 4000 emergencies

snmp-server community public RW
snmp-server enable traps cdma
!
!
radius-server attribute 8 include-in-access-req
radius-server dead-criteria time 50 tries 5
radius-server host 170.1.4.201 auth-port 1645 acct-port 1646 key 7 045802150C2E
radius-server retransmit 5
radius-server timeout 10
radius-server deadtime 1
radius-server vsa send accounting
radius-server vsa send authentication
radius-server vsa send accounting 3gpp2
radius-server vsa send authentication 3gpp2
!
control-plane
!
cdma pdsn radius disconnect nai
cdma pdsn accounting send start-stop
cdma pdsn tft reject include error extension

cdma pdsn virtual-template 1
cdma pdsn a10 max-lifetime 1800
cdma pdsn all session-update always-on rn-pdit qos
cdma pdsn timeout mobile-ip-registration 100
cdma pdsn timeout all-update 5
cdma pdsn timeout all-session-update 5
cdma pdsn msid-authentication
cdma pdsn imsi-min-equivalence
cdma pdsn send-agent-adv
cdma pdsn debug show-conditions
cdma pdsn secure pcf default spi 100 key ascii testtesttesttest local-timezone replay 255
cdma pdsn secure pcf 20.1.32.1 20.1.32.7 spi 100 key ascii cisco
cdma pdsn secure cluster default spi 101 key ascii Cisco
cdma pdsn compliance is835c account ipmobile control-packets
cdma pdsn cluster controller interface GigabitEthernet0/0.20
cdma pdsn cluster controller timeout 120
!
line con 0
  exec-timeout 0 0
line aux 0

```

```

exec-timeout 0 0
line vty 0 4
  exec-timeout 0 0
  password 7 151E0A0E
!
exception data-corruption buffer truncate
ntp server 127.0.0.51 burst iburst
end

```

The show command output for Cisco PDSN controller configuration is as follows:

```

PDSN-Cluster-Cntrl# show cdma pdsn cluster controller configuration
cluster interface GigabitEthernet0/0.20
no R-P signaling proxy
timeout to seek member = 120 seconds
window to seek member is 2 timeouts in a row if no reply (afterwards the member is
declared offline)
default: spi 101, Timestamp +/- 0, key ascii cisco
this PDSN cluster controller is configured

Controller maximum number of load units = 100
PDSN-Cluster-Cntrl#

```

## Cisco PDSN Controller Collocated Member with Redundancy

This section provides an example of Cisco PDSN controller collocated member with redundancy configuration.

### Active Mode

```

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
service internal
service cdma pdsn
!
hostname PDSN-B
!
boot-start-marker
boot-end-marker
!
!
redundancy inter-device
  scheme standby PDSN-redundancy
!
!
!
redundancy
  no keepalive-enable
logging message-counter syslog
!
!
ipc zone default
  association 1
  no shutdown
  protocol sctp
  local-port 5000
  local-ip 20.1.23.203
  remote-port 5000
  remote-ip 20.1.33.103
!

```

```

aaa new-model
!
!
aaa group server radius auth_server_group_1
 server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa group server radius acct_server_group_1
 server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa authentication login default local none
aaa authentication ppp default group auth_server_group_1
aaa authorization network default group auth_server_group_1
aaa authorization configuration default group auth_server_group_1
aaa accounting update periodic 300
aaa accounting network pdsn
 action-type start-stop
 group acct_server_group_1
!
aaa accounting system default
 action-type start-stop
 broadcast
 group acct_server_group_1
!
!
!
aaa session-id common
aaa memory threshold authentication reject 15
aaa memory threshold accounting disable 10
memory-size iomem 256
sami pool-cache 50
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
ip source-route
ip cef
!
!
no ip domain lookup
subscriber redundancy rate 250 1
no ipv6 cef
vpdn enable
vpdn authen-before-forward
!
multilink bundle-name authenticated
!
!
archive
 log config
  hidekeys
!
!
!
!
!
!
!
interface Loopback0
 ip address 40.1.33.103 255.255.0.0
!
interface Loopback1
 ip address 171.1.33.103 255.255.0.0

```

```

!
interface Loopback2
 ip address 51.1.33.103 255.255.0.0
!
interface CDMA-Ix1
 ip address 30.1.33.103 255.255.0.0
 tunnel source 30.1.33.103
 tunnel key 46
 tunnel sequence-datagrams
!
interface GigabitEthernet0/0
 mtu 1600
 no ip address
 load-interval 30
 no keepalive
!
interface GigabitEthernet0/0.20
 description RP-interface
 encapsulation dot1Q 20
 ip address 20.1.23.203 255.255.0.0
 standby delay minimum 30 reload 30
 standby version 2
 standby 20 ip 20.1.33.254
 standby 20 priority 110
 standby 20 name PDSN-redundancy
!
interface GigabitEthernet0/0.50
 description PDSN-HA Connectivity
 encapsulation dot1Q 50
 ip address 50.1.23.203 255.255.0.0
 ip mtu 1500
 standby version 2
 standby 50 ip 50.1.33.254
 standby 50 follow PDSN-redundancy
!
interface GigabitEthernet0/0.60
 description ReverseDirection Connectivity
 encapsulation dot1Q 60
 ip address 60.1.23.203 255.255.0.0
 ip mtu 1500
 standby version 2
 standby 60 ip 60.1.33.254
 standby 60 follow PDSN-redundancy
!
interface GigabitEthernet0/0.170
 description LAAA Connectivity
 encapsulation dot1Q 170
 ip address 170.1.23.203 255.255.0.0
 ip mtu 1500
 standby version 2
 standby 170 ip 170.1.33.254
 standby 170 follow PDSN-redundancy
!
interface Virtual-Templat1
 ip unnumbered Loopback0
 peer default ip address pool sip-addr-33-pool1
 no keepalive
 ppp accm 0
 ppp authentication pap chap optional
 ppp accounting none
 ppp direction callin
 ppp timeout ncp 30
 ppp timeout authentication 60
 ppp timeout idle 7200

```

```

!
router mobile
!
ip local pool sip-addr-33-pool1 100.33.1.1 100.33.254.254 recycle delay 30
ip local pool sip-addr-33-pool1 100.34.1.1 100.34.254.254
ip local pool sip-addr-33-pool1 100.35.1.1 100.35.254.254
ip local pool msid-sip-addr-33-pool1 140.33.1.1 140.33.254.254 recycle delay 30
ip local pool msid-sip-addr-33-pool1 140.34.1.1 140.34.254.254
ip local pool msid-sip-addr-33-pool1 140.35.1.1 140.35.254.254
ip forward-protocol nd
ip route 11.1.0.0 255.255.0.0 20.1.2.100
ip route 12.1.0.0 255.255.0.0 60.1.2.100
ip route 21.1.0.0 255.255.0.0 20.1.2.100
ip route 70.1.0.0 255.255.0.0 50.1.112.102
!
!
no ip http server
no ip http secure-server
ip mobile debug include username
ip mobile foreign-agent care-of GigabitEthernet0/0.50
ip mobile foreign-agent reverse-tunnel private-address
ip mobile foreign-agent skip-aaa-reauthentication
ip mobile secure home-agent 50.1.112.102 spi FFFFFFFF key ascii cisco algorithm md5 mode
prefix-suffix
ip mobile foreign-service revocation
ip mobile foreign-service challenge forward-mfce
ip mobile foreign-service registration-required reverse-tunnel mandatory
ip mobile proxy-host nai @cisco.com flags 42
ip mobile proxy-registration lifetime 1800
!
ip radius source-interface Loopback1
logging main-cpu 4000 emergencies
snmp-server community public RW
snmp-server enable traps cdma
!
!
radius-server attribute 8 include-in-access-req
radius-server dead-criteria time 50 tries 5
radius-server host 170.1.4.201 auth-port 1645 acct-port 1646 key 7 045802150C2E
radius-server retransmit 5
radius-server timeout 10
radius-server deadtime 1
radius-server vsa send accounting
radius-server vsa send authentication
radius-server vsa send accounting 3gpp2
radius-server vsa send authentication 3gpp2
!
control-plane
!
cdma pdsn radius disconnect nai
cdma pdsn accounting send start-stop
cdma pdsn tft reject include error extension
cdma pdsn virtual-template 1
cdma pdsn all session-update always-on rn-pdit qos
cdma pdsn timeout mobile-ip-registration 100
cdma pdsn timeout all-update 5
cdma pdsn timeout all-session-update 5
cdma pdsn msid-authentication
cdma pdsn send-agent-adv
cdma pdsn debug show-conditions
cdma pdsn secure pcf default spi 100 key ascii testtesttesttest local-timezone replay 255
cdma pdsn secure pcf 20.1.32.1 20.1.32.7 spi 100 key ascii cisco
cdma pdsn secure cluster default spi 101 key ascii Cisco
cdma pdsn compliance is835c account ipmobile control-packets

```

```

cdma pdsn cluster controller interface GigabitEthernet0/0.20
cdma pdsn cluster controller standby PDSN-redundancy
cdma pdsn cluster controller timeout 120
cdma pdsn cluster member controller 20.1.33.254
cdma pdsn cluster member interface GigabitEthernet0/0.20
cdma pdsn cluster member timeout 120
cdma pdsn redundancy
!
line con 0
  exec-timeout 0 0
line aux 0
  exec-timeout 0 0
line vty 0 4
  exec-timeout 0 0
  password 7 151E0A0E
!
exception data-corruption buffer truncate
ntp server 127.0.0.51 burst iburst

```

## Standby Mode

```

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
service internal
service cdma pdsn
!
hostname PDSN-A
!
boot-start-marker
boot-end-marker
!
!
redundancy inter-device
  scheme standby PDSN-redundancy
!
!
!
redundancy
  no keepalive-enable
logging message-counter syslog
!
!
ipc zone default
  association 1
  no shutdown
  protocol sctp
  local-port 5000
  local-ip 20.1.33.103
  remote-port 5000
  remote-ip 20.1.23.203
!
aaa new-model
!
!
aaa group server radius auth_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa group server radius acct_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!

```

```

aaa authentication login default local none
aaa authentication ppp default group auth_server_group_1
aaa authorization network default group auth_server_group_1
aaa authorization configuration default group auth_server_group_1
aaa accounting update periodic 300
aaa accounting network pdsn
  action-type start-stop
  group acct_server_group_1
!
aaa accounting system default
  action-type start-stop
  broadcast
  group acct_server_group_1
!
!
!
aaa session-id common
aaa memory threshold authentication reject 15
aaa memory threshold accounting disable 10
memory-size iomem 256
sami pool-cache 50
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
ip source-route
ip cef
!
!
no ip domain lookup
subscriber redundancy rate 250 1
no ipv6 cef
vpdn enable
vpdn authen-before-forward
!
multilink bundle-name authenticated
!
!
archive
  log config
  hidekeys
!
!
!
!
!
!
!
!
interface Loopback0
  ip address 40.1.33.103 255.255.0.0
!
interface Loopback1
  ip address 171.1.33.103 255.255.0.0
!
interface Loopback2
  ip address 51.1.33.103 255.255.0.0
!
interface CDMA-Ix1
  ip address 30.1.33.103 255.255.0.0
  tunnel source 30.1.33.103
  tunnel key 46
  tunnel sequence-datagrams

```

```

!
interface GigabitEthernet0/0
  mtu 1600
  no ip address
  load-interval 30
  no keepalive
!
interface GigabitEthernet0/0.20
  description RP-interface
  encapsulation dot1Q 20
  ip address 20.1.33.103 255.255.0.0
  standby delay minimum 30 reload 30
  standby version 2
  standby 20 ip 20.1.33.254
  standby 20 name PDSN-redundancy
!
interface GigabitEthernet0/0.50
  description PDSN-HA Connectivity
  encapsulation dot1Q 50
  ip address 50.1.33.103 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 50 ip 50.1.33.254
  standby 50 follow PDSN-redundancy
!
interface GigabitEthernet0/0.60
  description ReverseDirection Connectivity
  encapsulation dot1Q 60
  ip address 60.1.33.103 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 60 ip 60.1.33.254
  standby 60 follow PDSN-redundancy
!
interface GigabitEthernet0/0.170
  description LAAA Connectivity
  encapsulation dot1Q 170
  ip address 170.1.33.103 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 170 ip 170.1.33.254
  standby 170 follow PDSN-redundancy
!
interface Virtual-Template1
  ip unnumbered Loopback0
  peer default ip address pool sip-addr-33-pool1
  no keepalive
  ppp accm 0
  ppp authentication pap chap optional
  ppp accounting none
  ppp direction callin
  ppp timeout ncp 30
  ppp timeout authentication 60
  ppp timeout idle 7200
!
router mobile
!
ip local pool sip-addr-33-pool1 100.33.1.1 100.33.254.254 recycle delay 30
ip local pool sip-addr-33-pool1 100.34.1.1 100.34.254.254
ip local pool sip-addr-33-pool1 100.35.1.1 100.35.254.254
ip local pool msid-sip-addr-33-pool1 140.33.1.1 140.33.254.254 recycle delay 30
ip local pool msid-sip-addr-33-pool1 140.34.1.1 140.34.254.254
ip local pool msid-sip-addr-33-pool1 140.35.1.1 140.35.254.254
ip forward-protocol nd

```

```

ip route 11.1.0.0 255.255.0.0 20.1.2.100
ip route 12.1.0.0 255.255.0.0 60.1.2.100
ip route 21.1.0.0 255.255.0.0 20.1.2.100
ip route 70.1.0.0 255.255.0.0 50.1.112.102
!
!
no ip http server
no ip http secure-server
ip mobile debug include username
ip mobile foreign-agent care-of GigabitEthernet0/0.50
ip mobile foreign-agent reverse-tunnel private-address
ip mobile foreign-agent skip-aaa-reauthentication
ip mobile secure home-agent 50.1.112.102 spi FFFFFFFF key ascii cisco algorithm md5 mode
prefix-suffix
ip mobile foreign-service revocation
ip mobile foreign-service challenge forward-mfce
ip mobile foreign-service registration-required reverse-tunnel mandatory
ip mobile proxy-host nai @cisco.com flags 42
ip mobile proxy-registration lifetime 1800
!
ip radius source-interface Loopback1
logging main-cpu 4000 emergencies
snmp-server community public RW
snmp-server enable traps cdma
!
!
radius-server attribute 8 include-in-access-req
radius-server dead-criteria time 50 tries 5
radius-server host 170.1.4.201 auth-port 1645 acct-port 1646 key 7 045802150C2E
radius-server retransmit 5
radius-server timeout 10
radius-server deadtime 1
radius-server vsa send accounting
radius-server vsa send authentication
radius-server vsa send accounting 3gpp2
radius-server vsa send authentication 3gpp2
!
control-plane
!
cdma pdsn radius disconnect nai
cdma pdsn accounting send start-stop
cdma pdsn tft reject include error extension
cdma pdsn virtual-template 1
cdma pdsn all session-update always-on rn-pdit qos
cdma pdsn timeout mobile-ip-registration 100
cdma pdsn timeout all-update 5
cdma pdsn timeout all-session-update 5
cdma pdsn msid-authentication
cdma pdsn send-agent-adv
cdma pdsn debug show-conditions
cdma pdsn secure pcf default spi 100 key ascii testtesttesttest local-timezone replay 255
cdma pdsn secure pcf 20.1.32.1 20.1.32.7 spi 100 key ascii cisco
cdma pdsn secure cluster default spi 101 key ascii Cisco
cdma pdsn compliance is835c account ipmobile control-packets
cdma pdsn cluster controller interface GigabitEthernet0/0.20
cdma pdsn cluster controller standby PDSN-redundancy
cdma pdsn cluster controller timeout 120
cdma pdsn cluster member controller 20.1.33.254
cdma pdsn cluster member interface GigabitEthernet0/0.20
cdma pdsn cluster member timeout 120
cdma pdsn redundancy
!
line con 0
  exec-timeout 0 0

```

```

line aux 0
  exec-timeout 0 0
line vty 0 4
  exec-timeout 0 0
  password 7 151E0A0E
!
exception data-corruption buffer truncate
ntp server 127.0.0.51 burst iburst
end

```

The show command output for Cisco PDSN cluster controller and member configurations are as follows:

```

PDSN-B# show cdma pdsn cluster controller configuration
cluster interface GigabitEthernet0/0.20 (collocated)
no R-P signaling proxy
timeout to seek member = 120 seconds
window to seek member is 2 timeouts in a row if no reply (afterwards the member is
declared offline)
default: spi 101, Timestamp +/- 0, key ascii Cisco
this PDSN cluster controller is configured

controller redundancy:
  database in-sync or no need to sync
  group: PDSN-redundancy
Controller maximum number of load units = 100
PDSN-B#

```

```

PDSN-B# show cdma pdsn cluster member configuration
cluster interface GigabitEthernet0/0.20
IP address of controller is 20.1.33.254 (collocated)
no prohibit administratively
timeout to resend status or seek controller = 120 sec or less, randomized
resend a msg for 2 timeouts sequentially if no reply, then inform operator
default: spi 101, Timestamp +/- 0, key ascii Cisco
this PDSN cluster member is configured
PDSN-B#

```

```

PDSN-A# show cdma pdsn cluster controller configuration
cluster interface GigabitEthernet0/0.20 (collocated)
no R-P signaling proxy
timeout to seek member = 120 seconds
window to seek member is 2 timeouts in a row if no reply (afterwards the member is
declared offline)
default: spi 101, Timestamp +/- 0, key ascii Cisco
this PDSN cluster controller is configured

controller redundancy:
  database in-sync or no need to sync
  group: PDSN-redundancy
Controller maximum number of load units = 100
PDSN-A#

```

```

PDSN-A# show cdma pdsn cluster member configuration
cluster interface GigabitEthernet0/0.20
IP address of controller is 20.1.33.254 (collocated)
no prohibit administratively
timeout to resend status or seek controller = 120 sec or less, randomized
resend a msg for 2 timeouts sequentially if no reply, then inform operator
default: spi 101, Timestamp +/- 0, key ascii Cisco
this PDSN cluster member is configured
PDSN-A#

```

## Cisco PDSN Controller Collocated Member (Redundancy with Auto Synchronization Enabled)

This section provides an example of Cisco PDSN controller collocated member (redundancy with autosynchronization enabled) configuration.

```

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
service internal
service cdma pdsn
boot-start-marker
boot-end-marker
!
!
redundancy inter-device
  scheme standby PDSN-redundancy
!
!
redundancy unit1 slot 8 unit2 slot 9
!
redundancy unit1 hostname PDSN-Cntrl-A unit2 hostname PDSN-Cntrl-B
!
redundancy
  no keepalive-enable
logging message-counter syslog
!
auto-sync all
!
ipc zone default
  association 1
    no shutdown
    protocol sctp
    unit2-port 5000
    unit2-ip 20.1.23.203
    unit1-port 5000
    unit1-ip 20.1.33.103
!
aaa new-model
!
!
aaa group server radius auth_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa group server radius acct_server_group_1
  server 170.1.4.201 auth-port 1645 acct-port 1646
!
aaa authentication login default local none
aaa authentication ppp default group auth_server_group_1
aaa authorization network default group auth_server_group_1
aaa authorization configuration default group auth_server_group_1
aaa accounting update periodic 300
aaa accounting network pdsn
  action-type start-stop
  group acct_server_group_1
!
aaa accounting system default
  action-type start-stop
  broadcast
  group acct_server_group_1
!
!
!

```

```

aaa session-id common
aaa memory threshold authentication reject 15
aaa memory threshold accounting disable 10
memory-size iomem 256
sami pool-cache 50
!
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
ip source-route
ip cef
!
!
no ip domain lookup
subscriber redundancy rate 250 1
no ipv6 cef
vpdn enable
vpdn authen-before-forward
!
multilink bundle-name authenticated
!
!
archive
  log config
  hidekeys
!
!
!
!
!
!
!
!
interface Loopback0
  ip address 40.1.33.103 255.255.0.0
!
interface Loopback1
  ip address 171.1.33.103 255.255.0.0
!
interface Loopback2
  ip address 51.1.33.103 255.255.0.0
!
interface CDMA-Ix1
  ip address 30.1.33.103 255.255.0.0
  tunnel source 30.1.33.103
  tunnel key 46
  tunnel sequence-datagrams
!
interface GigabitEthernet0/0
  mtu 1600
  no ip address
  load-interval 30
  no keepalive
!
interface GigabitEthernet0/0.20
  description RP-interface
  encapsulation dot1Q 20
  redundancy ip address unit1 20.1.33.103 255.255.0.0 unit2 20.1.23.203 255.255.0.0
  standby delay minimum 30 reload 30
  standby version 2
  standby 20 ip 20.1.33.254
  standby 20 name PDSN-redundancy
!

```

```

interface GigabitEthernet0/0.50
  description PDSN-HA Connectivity
  encapsulation dot1Q 50
  redundancy ip address unit1 50.1.33.103 255.255.0.0 unit2 50.1.23.203 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 50 ip 50.1.33.254
  standby 50 follow PDSN-redundancy
!
interface GigabitEthernet0/0.60
  description ReverseDirection Connectivity
  encapsulation dot1Q 60
  redundancy ip address unit1 60.1.33.103 255.255.0.0 unit2 60.1.23.203 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 60 ip 60.1.33.254
  standby 60 follow PDSN-redundancy
!
interface GigabitEthernet0/0.170
  description LAAA Connectivity
  encapsulation dot1Q 170
  redundancy ip address unit1 170.1.33.103 255.255.0.0 unit2 170.1.23.203 255.255.0.0
  ip mtu 1500
  standby version 2
  standby 170 ip 170.1.33.254
  standby 170 follow PDSN-redundancy
!
interface Virtual-Template1
  ip unnumbered Loopback0
  peer default ip address pool sip-addr-33-pool1
  no keepalive
  ppp accm 0
  ppp authentication pap chap optional
  ppp accounting none
  ppp direction callin
  ppp timeout ncp 30
  ppp timeout authentication 60
  ppp timeout idle 7200
!
router mobile
!
ip local pool sip-addr-33-pool1 100.33.1.1 100.33.254.254 recycle delay 30
ip local pool sip-addr-33-pool1 100.34.1.1 100.34.254.254
ip local pool sip-addr-33-pool1 100.35.1.1 100.35.254.254
ip local pool msid-sip-addr-33-pool1 140.33.1.1 140.33.254.254 recycle delay 30
ip local pool msid-sip-addr-33-pool1 140.34.1.1 140.34.254.254
ip local pool msid-sip-addr-33-pool1 140.35.1.1 140.35.254.254
ip forward-protocol nd
ip route 11.1.0.0 255.255.0.0 20.1.2.100
ip route 12.1.0.0 255.255.0.0 60.1.2.100
ip route 21.1.0.0 255.255.0.0 20.1.2.100
ip route 70.1.0.0 255.255.0.0 50.1.112.102
!
!
no ip http server
no ip http secure-server
ip mobile debug include username
ip mobile foreign-agent care-of GigabitEthernet0/0.50
ip mobile foreign-agent reverse-tunnel private-address
ip mobile foreign-agent skip-aaa-reauthentication
ip mobile secure home-agent 50.1.112.102 spi FFFFFFFF key ascii cisco algorithm md5 mode
prefix-suffix
ip mobile foreign-service revocation
ip mobile foreign-service challenge forward-mfce

```

```

ip mobile foreign-service registration-required reverse-tunnel mandatory
ip mobile proxy-host nai @cisco.com flags 42
ip mobile proxy-registration lifetime 1800
!
ip radius source-interface Loopback1
logging main-cpu 4000 emergencies
snmp-server community public RW
snmp-server enable traps cdma
!
!
radius-server attribute 8 include-in-access-req
radius-server dead-criteria time 50 tries 5
radius-server host 170.1.4.201 auth-port 1645 acct-port 1646 key 7 045802150C2E
radius-server retransmit 5
radius-server timeout 10
radius-server deadtime 1
radius-server vsa send accounting
radius-server vsa send authentication
radius-server vsa send accounting 3gpp2
radius-server vsa send authentication 3gpp2
!
control-plane
!
cdma pdsn radius disconnect nai
cdma pdsn accounting send start-stop
cdma pdsn tft reject include error extension
cdma pdsn virtual-template 1
cdma pdsn all session-update always-on rn-pdit qos
cdma pdsn timeout mobile-ip-registration 100
cdma pdsn timeout all-update 5
cdma pdsn timeout all-session-update 5
cdma pdsn msid-authentication
cdma pdsn send-agent-adv
cdma pdsn debug show-conditions
cdma pdsn secure pcf default spi 100 key ascii testtesttesttest local-timezone replay 255
cdma pdsn secure pcf 20.1.32.1 20.1.32.7 spi 100 key ascii cisco
cdma pdsn secure cluster default spi 101 key ascii Cisco
cdma pdsn compliance is835c account ipmobile control-packets
cdma pdsn cluster controller interface GigabitEthernet0/0.20
cdma pdsn cluster controller standby PDSN-redundancy
cdma pdsn cluster controller timeout 120
cdma pdsn cluster member controller 20.1.33.254
cdma pdsn cluster member interface GigabitEthernet0/0.20
cdma pdsn cluster member timeout 120
cdma pdsn redundancy
!
line con 0
  exec-timeout 0 0
line aux 0
  exec-timeout 0 0
line vty 0 4
  exec-timeout 0 0
  password 7 151E0A0E
!
exception data-corruption buffer truncate
ntp server 127.0.0.51 burst iburst
end

```

The show command outputs for Cisco PDSN controller collocated member (redundancy with autosynchronization enabled) are given below:

```

PDSN-Cntrl-B# show cdma pdsn cluster controller configuration
cluster interface GigabitEthernet0/0.20 (collocated)

```

```
no R-P signaling proxy
timeout to seek member = 120 seconds
window to seek member is 2 timeouts in a row if no reply (afterwards the member is
declared offline)
default: spi 101, Timestamp +/- 0, key ascii Cisco
this PDSN cluster controller is configured
```

```
controller redundancy:
  database in-sync or no need to sync
  group: PDSN-redundancy
Controller maximum number of load units = 100
PDSN-Cntrl-B#
```

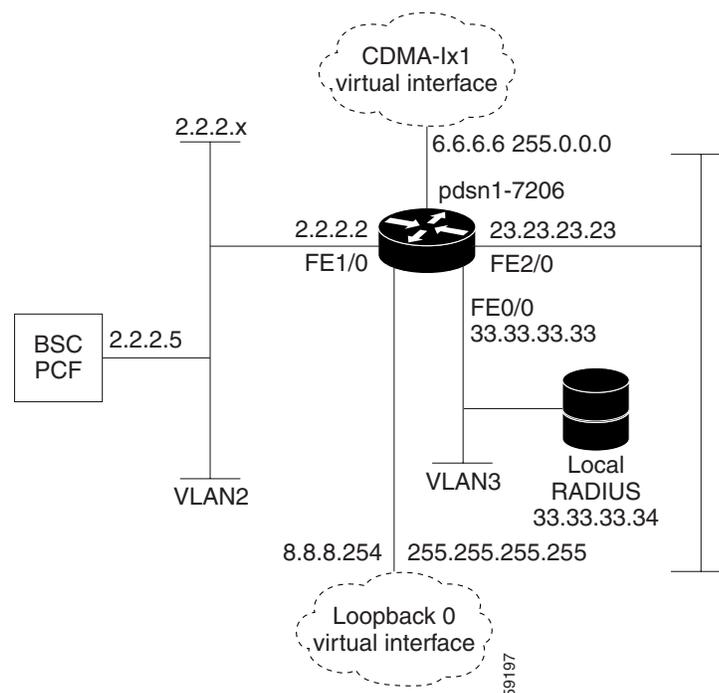
```
PDSN-Cntrl-B# show cdma pdsn cluster member configuration
cluster interface GigabitEthernet0/0.20
IP address of controller is 20.1.33.254 (collocated)
no prohibit administratively
timeout to resend status or seek controller = 120 sec or less, randomized
resend a msg for 2 timeouts sequentially if no reply, then inform operator
default: spi 101, Timestamp +/- 0, key ascii Cisco
this PDSN cluster member is configured
```

```
PDSN-Cntrl-B#
```

## Cisco PDSN Configuration for Simple IP

Figure 8 and the information that follows is an example of PDSN architecture for SIP and its accompanying configuration.

**Figure 8** PDSN for Simple IP—A Network Map



```

service cdma pdsn
!
hostname PDSN1-7206
!
aaa new-model
aaa authentication ppp default group radius
aaa authorization config-commands

aaa authorization network default group radius
aaa authorization configuration default group radius
aaa accounting update periodic 60
aaa accounting network pdsn start-stop group radius
!
no ip gratuitous-arps
!
interface Loopback0
ip address 8.8.8.254 255.255.255.255
!
interface CDMA-Ix1
ip address 6.6.6.6 255.0.0.0
!
interface FastEthernet0/0
! Interface for communication with RADIUS server and NMS
ip address 33.33.33.33 255.255.255.0
!
!
!

```

```

interface FastEthernet1/0
! Interface to PCF - R-P
ip address 2.2.2.2 255.255.255.0
half-duplex
no cdp enable
!
interface FastEthernet2/0
! Interface to external network - Pi
ip address 23.23.23.23 255.255.0.0
!
!
!
interface Virtual-Template1
ip unnumbered Loopback0
peer default ip address pool pdsn-pool
ppp accm 0
ppp authentication chap pap optional
ppp accounting none
ppp timeout idle 2000
!
ip local pool pdsn-pool 8.8.8.1 8.8.8.253
ip classes
!
!
radius-server host 33.33.33.34 auth-port 1645 acct-port 1646 key cisco
radius-server retransmit 3
radius-server vsa send authentication 3gpp2
radius-server vsa send accounting 3gpp2
cdma pdsn virtual-template 1
cdma pdsn maximum sessions 16000
cdma pdsn a10 max-lifetime 36000
cdma pdsn msid-authentication
cdma pdsn secure pcf 2.2.2.5 spi 100 key ascii cisco
!
!
!
end

```

## Cisco PDSN Configuration for Simple IP with VPDN

The configuration SIP with VPDN is identical to the configuration for SIP with two additional lines:

```

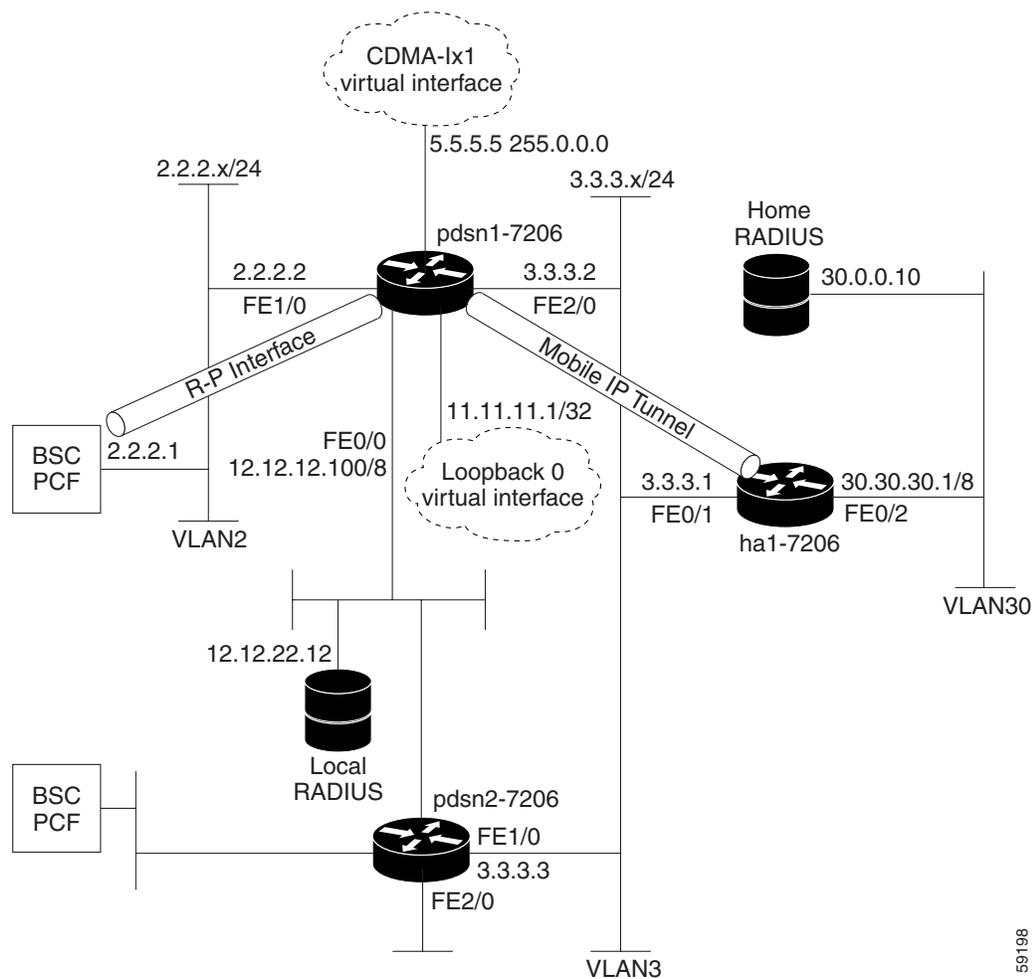
vpdn enable
vpdn authen-before-forward

```

## Cisco PDSN Configuration for Mobile IP

Figure 9 and the information that follows is an example of PDSN architecture for MIP service and its accompanying configuration. The example shows the configuration of PDSN1.

Figure 9 PDSN for Mobile IP—A Network Map



```

service cdma pdsn
!
hostname PDSN1-7206
!
aaa new-model
aaa authentication login default group radius
aaa authentication login CONSOLE none
aaa authentication ppp default group radius
aaa authorization config-commands
aaa authorization network default group radius
!
interface Loopback0
ip address 11.11.11.1 255.255.255.255
!
interface CDMA-Ix1

```

```

ip address 5.5.5.5 255.0.0.0
!
interface FastEthernet0/0
description AAA NMS interface
ip address 12.12.12.100 255.0.0.0
!
interface FastEthernet1/0
description R-P interface
ip address 2.2.2.2 255.255.255.0
full-duplex
!
!
interface FastEthernet2/0
description Pi interface
ip address 3.3.3.2 255.255.255.0
full-duplex
!
interface Virtual-Template1
ip unnumbered loopback0
no ip route-cache
no keepalive
ppp authentication chap pap optional
ppp timeout idle 2000
!
router mobile
!
ip classless
no ip http server
ip mobile foreign-agent care-of FastEthernet2/0
ip mobile foreign-service challenge forward-mfce timeout 10 window 10
ip mobile foreign-service reverse-tunnel
radius-server host 12.12.22.12 auth-port 1645 acct-port 1646 key ascii cisco
!
radius-server host 12.12.22.12 auth-port 1645 acct-port 1646 key ascii cisco
radius-server retransmit 3
radius-server vsa send authentication 3gpp2
radius-server vsa send accounting 3gpp2
cdma pdsn secure pcf 2.2.2.1 spi 100 key ascii cisco
cdma pdsn virtual-template 1
cdma pdsn msid-authentication
!
!
end

```

## Combined Configuration for Cisco PDSN

The following example illustrates a PDSN configured for all scenarios: SIP, SIP with VPDN, MIP, and PMIP.

```

service cdma pdsn
!
hostname PDSN1
!
aaa new-model
aaa authentication ppp default group radius
aaa authorization config-commands
aaa authorization network default group radius
aaa authorization configuration default group radius
aaa accounting update periodic 60
aaa accounting network pdsn start-stop group radius
!
vpdn enable

```

```

vpdn authen-before-forward
virtual-profile aaa
username HA password 0 rosebud
username LNS password 0 cisco
username PDSN password 0 cisco
no ip gratuitous-arps
!
interface Loopback0
ip address 8.8.8.254 255.255.255.255
!
interface CDMA-Ix1
ip address 6.6.6.6 255.0.0.0
!
interface FastEthernet0/0
! Interface for communication with RADIUS server and NMS
ip address 33.33.33.33 255.255.255.0
!
!
!
interface FastEthernet1/0
! Interface to PCF - R-P
ip address 2.2.2.2 255.255.255.0
!
interface FastEthernet2/0
! Interface to external network - Pi
ip address 23.23.23.23 255.255.0.0
!
!
!
interface Virtual-Templat1
ip unnumbered Loopback0
no keepalive
peer default ip address pool pdsn-pool
ppp accm 0
ppp authentication chap pap optional
ppp accounting none
ppp timeout idle 2000
!
router mobile
!
ip local pool pdsn-pool 8.8.8.1 8.8.8.253
ip classless
ip mobile foreign-agent care-of FastEthernet2/0
ip mobile foreign-service challenge forward-mfce timeout 10 window 10
ip mobile foreign-service reverse-tunnel
radius-server host 12.12.22.12 auth-port 1645 acct-port 1646 key ascii cisco
!
!
radius-server host 33.33.33.34 auth-port 1645 acct-port 1646 key cisco
radius-server retransmit 3
radius-server vsa send authentication 3gpp2
radius-server vsa send accounting 3gpp2
cdma pdsn virtual-template 1
cdma pdsn maximum sessions 16000
cdma pdsn a10 max-lifetime 36000
cdma pdsn msid-authentication
cdma pdsn secure pcf 2.2.2.5 spi 100 key ascii cisco
cdma pdsn secure cluster default spi 100 key ascii cisco
!
!
!
end

```

## Simple IPv6 Configuration Example

```

PDSN:
pdsn2#sh run
Building configuration...

Current configuration : 4595 bytes
!
version 12.4
no service pad
service timestamps debug datetime
service timestamps log datetime
no service password-encryption
service cdma pdsn
!
hostname mwtcc21-pdsn2
!
boot-start-marker
boot-end-marker
!
!
redundancy inter-device
  scheme standby pdsn-sr0
!
!
redundancy
no logging queue-limit
enable password lab
!
aaa new-model
!
!
aaa authentication ppp default local group radius
aaa authorization config-commands
aaa authorization network default group radius
aaa authorization configuration default group radius
aaa accounting update periodic 1
aaa accounting network pdsn start-stop group radius
!
!
aaa session-id common
!
resource manager
!
!
ipc zone default
  association 1
  no shutdown
  protocol sctp
  local-port 5000
  local-ip 4.0.0.103
  remote-port 5000
  remote-ip 4.0.0.101
!
ip subnet-zero
!
!
ip cef
ip cef accounting per-prefix non-recursive
ip domain name cisco.com
no ip dhcp use vrf connected
ip dhcp ping packets 0
!

```

```

!
ipv6 unicast-routing
ipv6 cef
!
no virtual-template snmp
!
!
username pdsn2 password 0 cisco
!
!
interface Loopback0
 ip address 6.0.0.1 255.0.0.0
!
interface Loopback2
 ip address 77.0.0.1 255.0.0.0
!
interface Loopback3
 ip address 3.0.0.1 255.0.0.0
!
interface CDMA-Ix1
 ip address 5.0.0.1 255.0.0.0
 tunnel source 5.0.0.1
 tunnel key 1
 tunnel sequence-datagrams
!
interface FastEthernet0/0
 ip address 10.77.154.236 255.255.255.192
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 86.0.0.2 255.0.0.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 ip address 22.22.22.3 255.0.0.0
 duplex full
 no cdp enable
!
interface FastEthernet2/0
 ip address 88.0.0.4 255.0.0.0
 duplex half
 standby delay minimum 30 reload 60
 standby 12 ip 88.0.0.251
 standby 12 name pdsn-sr2
!
interface FastEthernet3/0
 ip address 4.0.0.103 255.0.0.0
 duplex auto
 speed auto
 standby delay minimum 30 reload 60
 standby 10 ip 4.0.0.254
 standby 10 name pdsn-sr0
!
interface FastEthernet3/1
 ip address 7.0.0.4 255.0.0.0
 duplex auto
 speed auto
 standby delay minimum 30 reload 60
 standby 11 ip 7.0.0.254
 standby 11 name pdsn-sr1
!
interface Ethernet4/0

```

```

no ip address
duplex half
ipv6 enable
!
interface Ethernet4/1
ip address 66.0.0.2 255.0.0.0
duplex half
ipv6 address 2001::1/64
ipv6 enable
!
interface Ethernet4/2
no ip address
shutdown
duplex half
!
interface Ethernet4/3
no ip address
shutdown
duplex half
!
interface Virtual-Template1
ip unnumbered Loopback0
ipv6 enable
ipv6 nd ra-interval 1000
ipv6 nd ra-lifetime 5000
no ipv6 nd suppress-ra
no keepalive
compress stac
ppp authentication chap pap optional
ppp accounting none
!
router mobile
!

ip default-gateway 10.77.154.193
ip classless
ip route 9.0.0.2 255.255.255.255 86.0.0.1
ip route 15.0.0.0 255.0.0.0 7.0.0.2
ip route 19.0.0.0 255.0.0.0 7.0.0.2
ip route 17.19.21.34 255.255.255.255 88.0.0.3
ip mobile foreign-agent care-of Loopback2
ip mobile foreign-service challenge forward-mfce timeout 10
ip mobile foreign-service reverse-tunnel
ip mobile registration-lifetime 60000
!
no ip http server
no ip http secure-server
!
!
ip radius source-interface Loopback3
!
!
radius-server host 9.0.0.2 auth-port 1645 acct-port 1646 key cisco
radius-server vsa send accounting
radius-server vsa send accounting 3gpp2
cdma pdsn accounting send start-stop
cdma pdsn virtual-template 1
cdma pdsn a10 max-lifetime 65535
cdma pdsn a10 ahdhc engine 0 usable-channels 8000
cdma pdsn timeout mobile-ip-registration 300
cdma pdsn send-agent-adv
cdma pdsn secure pcf 4.0.0.1 spi 100 key ascii cisco
cdma pdsn secure pcf 4.0.0.2 spi 100 key ascii cisco
cdma pdsn ipv6

```

```

cdma pdsn redundancy
cdma pdsn redundancy accounting update-periodic
!
control-plane
!
!
gatekeeper
 shutdown
!
alias dhcp hu util ma hi
alias dhcp lu util ma lo
alias dhcp o30 origin dhcp subnet size initial /30 autogrow /30
alias dhcp o29 origin dhcp subnet size initial /29 autogrow /29
alias dhcp sp30 subnet prefix-length 30
alias dhcp sp subnet prefix-length
alias dhcp sp29 subnet prefix-length 29
alias dhcp sp28 subnet prefix-length 28
alias configure nopl no ip dhcp pool ispabc-odappool
alias configure cpool ip dhc poo ispabc-odappool
alias configure cpl ip dhc poo ispabc-odappool
alias exec shpl sh ip dhc poo
alias exec shb sh ip dhc bin
!
line con 0
  exec-timeout 0 0
  stopbits 1
line aux 0
  stopbits 1
line vty 5 15
!
!
end

```

## PDSN Accounting

The CDMA 2000 packet accounting model is divided into radio specific parameters collected by the radio network elements, and the IP network specific parameters collected by the serving PDSN. In conformance with the packet accounting procedures specified in TIA/EIA/IS-835-D, the PDSN merges the radio specific parameters for a given user session with the IP network specific ones to form a Usage Data Record (UDR). After merging the parameters, the PDSN sends the UDR to the local RADIUS server at trigger events specified. The PDSN maintains the UDR until it receives positive acknowledgment from the RADIUS server indicating that the RADIUS server has correctly received the UDR.

## Flow-based Accounting

The Cisco PDSN supports multiple user sessions per mobile station. Each of these user sessions is termed a flow. For each mobile station, one SIP-based flow and one or more MIP-based flows can be supported. Each flow is identified by a unique IP address. Accounting procedures for generating a separate UDR for each flow is called flow based accounting.

The Cisco PDSN supports flow based accounting. As per TIA/EIA/IS-835-D specifications, each flow is identified by a unique Correlation-ID. Accounting start/stop message pair for each flow is correlated by unique Accounting-Session-ID.

While creating UDRs for flow based accounting, radio specific accounting parameters are common to all flows. IP network specific parameters, such as uplink and downlink octet counts are specific to each flow and are identified by the unique IP address assigned to that flow. The PDSN creates UDR for each flow by merging the radio specific parameters and the IP network specific parameters. These UDRs are forwarded to the RADIUS server via accounting-request (start, stop, interim) messages.

The following RADIUS attributes are contained in the UDR sent by the PDSN.

**Table 27** *In Accounting Start Record*

| Attribute Name      | TIA/EIA/IS-835-B | Type/Subtype |
|---------------------|------------------|--------------|
| NAS-IP-Address      | D2               | 4            |
| NAS-Port            |                  | 5            |
| NAS-Port-Type       |                  | 61           |
| User-Name           | B2               | 1            |
| Calling-Station-Id  | A1               | 31           |
| Acct-Status-Type    |                  | 40           |
| Acct-Delay-Time     |                  | 41           |
| Acct-Authentic      |                  | 45           |
| Service-Type        |                  | 6            |
| Acct-Session-Id     | C1               | 44           |
| Framed-Protocol     |                  | 7            |
| Framed-IP-Address   | B1               | 8            |
| Event-Timestamp     | G4               | 55           |
| CDMA-Correlation-ID | C2               | 26/44        |
| CDMA-HA-IP-Addr     | D1               | 26/7         |
| CDMA-PCF-IP-Addr    | D3               | 26/9         |
| CDMA-BS-MS-Add      | D4               | 26/10        |
| CDMA-HRPD Subnet    | D7               | 26/108       |
| CDMA-User-ID        | E1               | 26/11        |
| CDMA-Forward-Mux    | F1               | 26/12        |
| CDMA-Reverse-Mux    | F2               | 26/13        |
| CDMA-Forward-Rate   | F3               | 26/14        |
| CDMA-Reverse-Rate   | F4               | 26/15        |
| CDMA-Service-Option | F5               | 26/16        |
| CDMA-Forward-Type   | F6               | 26/17        |
| CDMA-Reverse-Type   | F7               | 26/18        |
| CDMA-Frame-Size     | F8               | 26/19        |
| CDMA-Forward-RC     | F9               | 26/20        |
| CDMA-Reverse-RC     | F10              | 26/21        |
| CDMA-IP-Tech        | F11              | 26/22        |
| CDMA-Comp-Flag      | F12              | 26/23        |

**Table 27** *In Accounting Start Record (continued)*

| <b>Attribute Name</b>        | <b>TIA/EIA/IS-835-B</b> | <b>Type/Subtype</b> |
|------------------------------|-------------------------|---------------------|
| CDMA-Forward PDCH RC         | F16                     |                     |
| CDMA-Forward DCCH Mux Option | F17                     |                     |
| CDMA-Reverse DCCH Mux Option | F18                     |                     |
| CDMA-Forward DCCH RC         | F19                     |                     |
| CDMA-Reverse DCCH RC         | F20                     |                     |
| CDMA-Reverse PDCH RC         | F22                     |                     |
| CDMA-Num-Active              | G9                      | 26/30               |
| CDMA-IP-QoS                  | I1                      | 26/36               |
| CDMA-Airlink-QoS             | I4                      | 26/39               |
| CDMA-Granted QoS             | I5                      |                     |
| CDMA-RP-Session-ID           | Y2                      | 26/41               |
| CDMA-ESN                     | A2                      | 26/52               |
| CDMA-MEID                    | A3                      | 26/116              |

**Table 28** *In Accounting Stop Record*

| <b>Attribute Name</b>        | <b>TIA/EIA/IS-835-B</b> | <b>Type/Subtype</b> |
|------------------------------|-------------------------|---------------------|
| NAS-IP-Address               | D2                      | 4                   |
| NAS-Port                     |                         | 5                   |
| NAS-Port-Type                |                         | 61                  |
| User-Name                    | B2                      | 1                   |
| Calling-Station-Id           | A1                      | 31                  |
| Acct-Status-Type             |                         | 40                  |
| Acct-Delay-Time              |                         | 41                  |
| Acct-Authentic               |                         | 45                  |
| Service-Type                 |                         | 6                   |
| Acct-Session-Id              | C1                      | 44                  |
| Framed-Protocol              |                         | 7                   |
| Flow ID                      | C6                      |                     |
| CDMA-Forward PDCH RC         | F16                     |                     |
| CDMA-Forward DCCH Mux Option | F17                     |                     |
| CDMA-Reverse DCCH Mux Option | F18                     |                     |
| CDMA-Forward DCCH RC         | F19                     |                     |
| CDMA-Reverse DCCH RC         | F20                     |                     |
| CDMA-Reverse PDCH RC         | F22                     |                     |

**Table 28** *In Accounting Stop Record (continued)*

| <b>Attribute Name</b>                    | <b>TIA/EIA/IS-835-B</b> | <b>Type/Subtype</b> |
|------------------------------------------|-------------------------|---------------------|
| Flow Status                              | F24                     |                     |
| Framed-IP-Address                        | B1                      | 8                   |
| Event-Timestamp                          | G4                      | 55                  |
| Acct-Output-Octets                       | G1                      | 43                  |
| Acct-Input-Octets                        | G2                      | 42                  |
| Acct-Input-Packets                       |                         | 47                  |
| Acct-Output-Packets                      |                         | 48                  |
| Acct-Session-Time                        |                         | 46                  |
| Acct-Input-Giga-Words                    |                         | 52                  |
| Acct-Output-Giga-Words                   |                         | 53                  |
| DHHC-Frame-Format                        | F14                     | 26/50               |
| CDMA-Active-Time                         | G8                      | 26/49               |
| CDMA-Correlation-ID                      | C2                      | 26/44               |
| CDMA-HA-IP-Addr                          | D1                      | 26/7                |
| CDMA-PCF-IP-Addr                         | D3                      | 26/9                |
| CDMA-BS-MS-Add                           | D4                      | 26/10               |
| CDMA-User-ID                             | E1                      | 26/11               |
| CDMA-Forward-Mux                         | F1                      | 26/12               |
| CDMA-Reverse-Mux                         | F2                      | 26/13               |
| CDMA-Forward-Rate                        | F3                      | 26/14               |
| CDMA-Reverse-Rate                        | F4                      | 26/15               |
| CDMA-Service-Option                      | F5                      | 26/16               |
| CDMA-Forward-Type                        | F6                      | 26/17               |
| CDMA-Reverse-Type                        | F7                      | 26/18               |
| CDMA-Frame-Size                          | F8                      | 26/19               |
| CDMA-Forward-RC                          | F9                      | 26/20               |
| CDMA-Reverse-RC                          | F10                     | 26/21               |
| CDMA-IP-Tech                             | F11                     | 26/22               |
| CDMA-Comp-Flag                           | F12                     | 26/23               |
| CDMA-Num-Active                          | G9                      | 26/30               |
| CDMA-IP-QoS                              | I1                      | 26/36               |
| CDMA-Mobile-IP-Signaling-In-Bound Count  | G15                     | 26/46               |
| CDMA-Mobile-IP-Signaling-Out-Bound-Count | G16                     | 26/47               |
| CDMA-Airlink-QoS                         | I4                      | 26/39               |
| CDMA-RP-Session-ID                       | Y2                      | 26/41               |
| CDMA-Bad-Frame-Count                     | G3                      | 26/25               |

**Table 28** *In Accounting Stop Record (continued)*

| <b>Attribute Name</b>           | <b>TIA/EIA/IS-835-B</b> | <b>Type/Subtype</b> |
|---------------------------------|-------------------------|---------------------|
| CDMA-HDLC-Layer-Bytes-In        | G14                     | 26/43               |
| CDMA-SDB-Input-Octets           | G10                     | 26/31               |
| CDMA-SDB-Output-Octets          | G11                     | 26/32               |
| CDMA-NumSDB-Input               | G12                     | 26/33               |
| CDMA-NumSDB-Output              | G13                     | 26/34               |
| CDMA-last-user-activity         | G17                     |                     |
| RSVP Signaling Octets Inbound   | G22                     |                     |
| RSVP Signaling Octets Outbound  | G23                     |                     |
| RSVP Signaling Packets Inbound  | G24                     |                     |
| RSVP Signaling Packets Outbound | G25                     |                     |
| CDMA-Reason-Ind                 | F13                     | 26/24               |
| CDMA-Session-Continue           | C3                      | 26/48               |
| CDMA-ESN                        | A2                      | 26/52               |
| CDMA-MEID                       | A3                      | 26/116              |

The following list identifies the prepaid VSAs that can be included in the RADIUS attributes contained in the accounting stop record:

- crb-auth-reason
- crb-duration
- crb-total-volume
- crb-uplink-volume
- crb-downlink-volume
- crb-total-packets
- crb-uplink-packets
- crb-downlink-packets
- crb-session-id

**Table 29** *In Interim-accounting Record*

| <b>Attribute Name</b> | <b>TIA/EIA/IS-835-B</b> | <b>Type/Subtype</b> |
|-----------------------|-------------------------|---------------------|
| NAS-IP-Address        | D2                      | 4                   |
| NAS-Port              |                         | 5                   |
| NAS-Port-Type         |                         | 61                  |
| User-Name             | B2                      | 1                   |
| Calling-Station-Id    | A1                      | 31                  |
| Acct-Status-Type      |                         | 40                  |
| Acct-Delay-Time       |                         | 41                  |

**Table 29** *In Interim-accounting Record (continued)*

| <b>Attribute Name</b>           | <b>TIA/EIA/IS-835-B</b> | <b>Type/Subtype</b> |
|---------------------------------|-------------------------|---------------------|
| Acct-Authentic                  |                         | 45                  |
| Service-Type                    |                         | 6                   |
| Acct-Session-Id                 | C1                      | 44                  |
| Framed-Protocol                 |                         | 7                   |
| Framed-IP-Address               | B1                      | 8                   |
| Event-Timestamp                 | G4                      | 55                  |
| Acct-Output-Octets              | G1                      | 43                  |
| Acct-Input-Octets               | G2                      | 42                  |
| Acct-Input-Packets              |                         | 47                  |
| Acct-Output-Packets             |                         | 48                  |
| Acct-Input-Giga-Words           |                         | 52                  |
| Acct-Output-Giga-Words          |                         | 53                  |
| CDMA-Active-Time                | G8                      | 26/49               |
| CDMA-Correlation-ID             | C2                      | 26/44               |
| CDMA-HA-IP-Addr                 | D1                      | 26/7                |
| CDMA-PCF-IP-Addr                | D3                      | 26/9                |
| CDMA-BS-MS-Add                  | D4                      | 26/10               |
| CDMA-User-ID                    | E1                      | 26/11               |
| CDMA-Forward-Mux                | F1                      | 26/12               |
| CDMA-Granted QoS                | I5                      |                     |
| CDMA-HRPD Subnet                | D7                      | 26/108              |
| CDMA-Reverse-Mux                | F2                      | 26/13               |
| CDMA-Forward-Rate               | F3                      | 26/14               |
| CDMA-Reverse-Rate               | F4                      | 26/15               |
| CDMA-Service-Option             | F5                      | 26/16               |
| CDMA-Forward-Type               | F6                      | 26/17               |
| CDMA-Reverse-Type               | F7                      | 26/18               |
| CDMA-Frame-Size                 | F8                      | 26/19               |
| CDMA-Forward-RC                 | F9                      | 26/20               |
| CDMA-Reverse-RC                 | F10                     | 26/21               |
| CDMA-IP-Tech                    | F11                     | 26/22               |
| CDMA-Comp-Flag                  | F12                     | 26/23               |
| CDMA-Forward PDCH RC            | F16                     |                     |
| CDMA-Forward DCCH Mux<br>Option | F17                     |                     |
| CDMA-Reverse DCCH Mux<br>Option | F18                     |                     |

**Table 29** *In Interim-accounting Record (continued)*

| Attribute Name                  | TIA/EIA/IS-835-B | Type/Subtype |
|---------------------------------|------------------|--------------|
| CDMA-Forward DCCH RC            | F19              |              |
| CDMA-Reverse DCCH RC            | F20              |              |
| CDMA-Reverse PDCH RC            | F22              |              |
| CDMA-Num-Active                 | G9               | 26/30        |
| CDMA-IP-QoS                     | I1               | 26/36        |
| CDMA-Airlink-QoS                | I4               | 26/39        |
| CDMA-RP-Session-ID              | Y2               | 26/41        |
| CDMA-HDLC-Layer-Bytes-In        | G14              | 26/43        |
| CDMA-Bad-Frame-Count            | G3               | 26/25        |
| CDMA-SDB-Input-Octets           | G10              | 26/31        |
| CDMA-SDB-Output-Octets          | G11              | 26/32        |
| CDMA-NumSDB-Input               | G12              | 26/33        |
| CDMA-NumSDB-Output              | G13              | 26/34        |
| CDMA-last-user-activity         | G17              |              |
| Flow ID                         | C6               |              |
| Flow Status                     | F24              |              |
| RSVP Signaling Octets Inbound   | G22              |              |
| RSVP Signaling Octets Outbound  | G23              |              |
| RSVP Signaling Packets Inbound  | G24              |              |
| RSVP Signaling Packets Outbound | G25              |              |

## AAA Server Authentication and Authorization Profile

This section describes user profiles to be configured at the AAA server for authentication and authorization of users for various service types (SIP, MIP, and so on). It also describes the minimal configuration required for the profiles.

1. Client router must be authorized to access Cisco Access Registrar.

The client profile contains the IP address of the router and the shared key. The following example illustrates a client profile:

```
[ //localhost/Radius/Clients/username ]
  Name = username
  Description =
  IPAddress = 9.15.68.7
  SharedSecret = lab
  Type = NAS
  Vendor =
```

```
IncomingScript~ =
OutgoingScript~ =
UseDNIS = FALSE
DeviceName =
DevicePassword =
```

2. A user should have a profile configured at the AAA server (this is applicable to an NAI as well in the case of MIP).

A user profile contains the username, password, and the base profile where attributes retrieved during authorization can be configured.

The following example illustrates a user profile:

```
[ //localhost/Radius/UserLists/Default/username ]
  Name = username
  Description =
  Password = <encrypted>
  AllowNullPassword = FALSE
  Enabled = TRUE
  Group~ =
  BaseProfile~ = username-sip
  AuthenticationScript~ =
  AuthorizationScript~ =
  UserDefined1 =
```

3. A Base Profile contains attributes applied for the user during authorization.

The following example illustrates a base profile :

```
[ //localhost/Radius/Profiles/username-sip ]
  Name = username-sip
  Description =
  Attributes/
```

4. cd attributes

```
[ //localhost/Radius/Profiles/username-sip/Attributes ]
  CDMA-IP-Technology = x
```

## AAA Server Profiles for Various Service Types

The following examples document the AAA server profiles for various service types such as SIP, MIP, and others. The mandatory and optional attributes, and the attributes required to be configured for enabling different features, are specified.

### Simple IP

CDMA-IP-Technology = x

The following attributes are optional and are needed only for specific scenarios:

- IP address assignment is done through the AAA server:  
Framed-IP-Address = 8.1.0.2
- Download pool name:  
cisco-avpair = ip:addr-pool=pdsn-pool
- Enable compression:

```
cisco-avpair = "lcp:interface-config=compress stac"
cisco-avpair = "lcp:interface-config=compress mppc"
cisco-avpair = "lcp:interface-config=compress predictor"
```

- Other Optional Parameters

```
Framed-Protocol = PPP
Framed-Routing = None
Service-Type = Framed
```

### VPDN

```
cisco-avpair = vpdn:tunnel-type=l2tp
cisco-avpair = vpdn:ip-addresses=5.5.5.1
cisco-avpair = vpdn:l2tp-tunnel-password=cisco
```

The following configuration is optional at the AAA server contacted by LNS:

```
cisco-avpair = ip:addr-pool=pdsn-pool
```

### MSID based Authentication

- (a) Simple IP case :

```
cisco-avpair = cdma:cdma-realm=cisco.com
CDMA-IP-Technology = x
```

- (b) PMIP Case :

```
cisco-avpair = lcp:cdma-user-class=3
cisco-avpair = cdma:cdma-realm=cisco.com
cisco-avpair = "lcp:spi#0 = spi 100 key ascii cisco"
cisco-avpair = lcp:cdma-ha-ip-addr=5.5.5.1
```

### Proxy Mobile IP

```
cisco-avpair = lcp:cdma-ha-ip-addr=5.5.5.1
cisco-avpair = "lcp:spi#0 = spi 100 key ascii cisco"
cisco-avpair = lcp:cdma-user-class=3
```

### Mobile IP

- cisco-avpair = lcp:cdma-user-class=2

The following attributes are optional, and are only needed for specific scenarios:

- Dynamic HA Assignment :

```
CDMA-HA-IP-Addr = 6.0.0.2
```

- Download Security Association and static IP addresses (at HA):

```
cisco-avpair = "mobileip:spi#0=spi 100 key ascii cisco"
```

```
cisco-avpair = "mobileip:static-ip-addresses=20.0.0.1 20.0.0.2 20.0.0.3 20.0.0.4"
```

- Download Static ip pool name (at HA):

```
cisco-avpair = "mobileip:spi#0=spi 100 key ascii cisco"
```

cisco-avpair = “mobileip:static-ip-pool=mypool”

**Prepaid (Optional)**

- cisco-avpair = “crb-entity-type=1”

# Attributes

This section lists several of the various Accounting and Authentication attributes for the Cisco PDSN.

## Authentication and Authorization RADIUS Attributes

The PDSN, HA, and the RADIUS server support RADIUS attributes are listed in [Table 32](#) for accounting services. The authentication and authorization RADIUS attributes are listed in [Table 30](#).

**Table 30 Authentication and Authorization AVPs For Packet Data Services**

| Authentication and Authorization AVPs Supported By Cisco IOS Name | Type | Vendor | Length              | Format     | Description                                                                                                                                                                                             | Allowed In     |               |
|-------------------------------------------------------------------|------|--------|---------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------|
|                                                                   |      |        |                     |            |                                                                                                                                                                                                         | Access Request | Access Accept |
| User-Name                                                         | 1    | —      | 64                  | string     | User name for authentication and authorization.                                                                                                                                                         | Yes            | No            |
| User-Password                                                     | 2    | —      | >=18<br>&&<br><=130 | string     | Password for authentication.                                                                                                                                                                            | Yes            | No            |
| CHAP-Password                                                     | 3    | —      | 19                  | string     | CHAP password.                                                                                                                                                                                          | Yes            | No            |
| NAS-IP-Address                                                    | 4    | —      | 4                   | IP address | IP address of the PDSN interface used for communicating with RADIUS server.                                                                                                                             | Yes            | No            |
| Service Type                                                      | 6    | —      | 4                   | integer    | Type of service the user is getting.<br><br>Supported values: <ul style="list-style-type: none"> <li>• Outbound for MSID based user access.</li> <li>• Framed for other type of user access.</li> </ul> | Yes            | Yes           |
| Framed-Protocol                                                   | 7    | —      | 4                   | integer    | Framing protocol user is using.<br><br>Supported value is PPP.                                                                                                                                          | Yes            | Yes           |
| Framed-IP-Address                                                 | 8    | —      | 4                   | integer    | IP address assigned to user.                                                                                                                                                                            | Yes            | Yes           |
| Vendor-Specific                                                   | 26   | —      |                     |            | Vendor-specific Attributes.                                                                                                                                                                             | Yes            | Yes           |
| Session-Time-out                                                  | 27   | —      | 4                   | integer    | Maximum number of seconds service is to be provided to the user before session terminates.<br><br>This attribute value becomes the per-user “absolute time-out”.                                        | No             | Yes           |

Table 30 Authentication and Authorization AVPs For Packet Data Services (continued)

| Authentication and Authorization AVPs Supported By Cisco IOS Name | Type | Vendor | Length | Format  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Allowed In     |               |
|-------------------------------------------------------------------|------|--------|--------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------|
|                                                                   |      |        |        |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Access Request | Access Accept |
| Idle-Time-out                                                     | 28   | —      | 4      | integer | Maximum number of consecutive seconds of idle connection allowed to the user before the session terminates.<br><br>This attribute value becomes the per-user “idle-time-out”.                                                                                                                                                                                                                                                                                                                       | No             | Yes           |
| Calling-Station-ID                                                | 31   | 15     | —      | string  | MSID identifier of the mobile user.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Yes            | No            |
| CHAP-Challenge (optional)                                         | 60   | —      | >=7    | string  | CHAP Challenge                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Yes            | No            |
| Tunnel-Type                                                       | 64   | —      | 6      | —       | VPN tunneling protocol(s) used.<br><br>Supported values: <ul style="list-style-type: none"> <li>• 1 for PPTP (not supported)</li> <li>• 3 for L2TP</li> </ul>                                                                                                                                                                                                                                                                                                                                       | No             | Yes           |
| Tunnel-Medium- Type                                               | 65   | —      | —      | —       | Transport medium type to use for the tunnel.                                                                                                                                                                                                                                                                                                                                                                                                                                                        | No             | Yes           |
| Tunnel-Client- Endpoint                                           | 66   | —      | 4      | ip-addr | Address of the client end of the tunnel.                                                                                                                                                                                                                                                                                                                                                                                                                                                            | No             | Yes           |
| Tunnel-Server- Endpoint                                           | 67   | —      | 4      | ip-addr | Address of the server end of the tunnel.                                                                                                                                                                                                                                                                                                                                                                                                                                                            | No             | Yes           |
| Tunnel-Password                                                   | 69   | —      | >=5    | string  | Password to be used for authenticating remote server.                                                                                                                                                                                                                                                                                                                                                                                                                                               | No             | Yes           |
| Tunnel-Assignment- ID                                             | 82   | —      | >=3    | string  | Indicates to the initiator of the tunnel, identifier of the tunnel to which the session is assigned.                                                                                                                                                                                                                                                                                                                                                                                                | No             | Yes           |
| addr-pool                                                         | 26/1 | Cisco  | >=3    | string  | Name of a local pool from which to obtain address. Used with service=ppp and protocol=ip.<br><br>“addr-pool” works in conjunction with local pooling. It specifies the name of a local pool (which must have been pre-configured locally).<br><br>Use the ip-local pool command for configuring local pools. For example: <ul style="list-style-type: none"> <li>• ip address-pool local</li> <li>• ip local pool boo 10.0.0.1 10.0.0.10</li> <li>• ip local pool moo 10.0.0.1 10.0.0.20</li> </ul> | No             | Yes           |

Table 30 Authentication and Authorization AVPs For Packet Data Services (continued)

| Authentication and Authorization AVPs Supported By Cisco IOS Name | Type | Vendor | Length | Format | Description                                                                                                                                                                                                                                                                                                                        | Allowed In Access Request | Access Accept |
|-------------------------------------------------------------------|------|--------|--------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|---------------|
| Inacl#<n>                                                         | 26/1 | Cisco  | >=3    | string | <p>ASCII access list identifier for an input access list to be installed and applied to an interface for the duration of the current connection.</p> <p>Used with service=ppp and protocol=ip, and service service=ppp and protocol =ipx.</p> <p><b>Note</b> Per-user access lists do not currently work with ISDN interfaces.</p> | No                        | Yes           |
| Inacl                                                             | 26/1 | Cisco  | >=3    | string | <p>ASCII identifier for an interface input access list.</p> <p>Used with service=ppp and protocol=ip.</p> <p>Contains an IP output access list for SLIP or PPP/IP (for example, intacl=4).</p> <p>The access list itself must be pre-configured on the router.</p>                                                                 | No                        | Yes           |
| outacl#<n>                                                        | 26/1 | Cisco  | >=3    | string | <p>ASCII access list identifier for an interface output access list to be installed and applied to an interface for the duration of the current connection.</p> <p>Used with service=ppp and protocol=ip, and service service=ppp and protocol=ipx.</p>                                                                            | No                        | Yes           |
| outacl                                                            | 26/1 | Cisco  | >=3    | string | <p>ASCII identifier for an interface output access list.</p> <p>Used with service=ppp and protocol=ip, and service service=ppp and protocol=ipx.</p> <p>Contains an IP output access list for SLIP or PPP/IP (for example, outacl=4).</p> <p>The access list itself must be pre-configured on the router.</p>                      | No                        | Yes           |
| interface-config                                                  | 26/1 | Cisco  | >=3    | string | <p>User-specific AAA server interface configuration information with Virtual Profiles.</p> <p>The information that follows the equal sign (=) can be any Cisco IOS interface configuration command.</p>                                                                                                                            | No                        | Yes           |

Table 30 Authentication and Authorization AVPs For Packet Data Services (continued)

| Authentication and Authorization AVPs Supported By Cisco IOS Name | Type       | Vendor | Length | Format  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Allowed In     |               |
|-------------------------------------------------------------------|------------|--------|--------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------|
|                                                                   |            |        |        |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Access Request | Access Accept |
| spi                                                               | 26/1       | Cisco  | >=3    | string  | Carries authentication information needed by the HA for authenticating a mobile user during MIP registration.<br><br>Provides the Security Parameter Index (SPI), key, authentication algorithm, authentication mode, and replay protection timestamp range.<br><br>The information is in the same syntax as the <b>ip mobile secure host addr</b> configuration command. Essentially, it contains the rest of the configuration command that follows that string, verbatim. | —              | —             |
| IP-Pool-Definition                                                | 26/21<br>7 | Cisco  | >=3    | string  | Defines a pool of addresses using the format: X a.b.c Z; where X is the pool index number, a.b.c is the pool's starting IP address, and Z is the number of IP addresses in the pool.<br><br>For example, 3 10.0.0.1 5 allocates 10.0.0.1 through 10.0.0.5 for dynamic assignment.                                                                                                                                                                                            | No             | Yes           |
| Assign-IP-Pool                                                    | 26/21<br>8 | Cisco  | 4      | integer | Assign an IP address from the identified IP pool.                                                                                                                                                                                                                                                                                                                                                                                                                            | No             | Yes           |
| Link-Compression                                                  | 26/23<br>3 | Cisco  | 4      | integer | Link compression protocol to be used.<br><br>Supported values are: <ul style="list-style-type: none"> <li>• 0: None</li> <li>• 1: Stac</li> <li>• 2: Stac-LZS</li> <li>• 3: MS-Stac</li> </ul>                                                                                                                                                                                                                                                                               | No             | Yes           |
| Network-PMIP-NAI                                                  | 26/19<br>2 | 3GPP2  | >=9    | string  | Specifies the NAI to be used by the AGW for Network PMIP binding between AGW and HA.                                                                                                                                                                                                                                                                                                                                                                                         | No             | Yes           |
| PMIP-Based-Mobility-Capability                                    | 26/19<br>3 | 3GPP2  | 6      | integer | Indicates that the AGW supports Network PMIP to the AAA server.                                                                                                                                                                                                                                                                                                                                                                                                              | Yes            | Yes           |
| PMIP-HA-Info-IPv4-Service                                         | 26/19<br>4 | 3GPP2  | 14     | —       | Specifies the Network PMIP4 HA or PMIP6 LMA-related information that is used for IPv4 services.                                                                                                                                                                                                                                                                                                                                                                              | No             | Yes           |
| 3GPP2-BSID                                                        | 26/10      | 3GPP2  | 12     | string  | Base station ID.                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Yes            | No            |
| 3GPP2-PCF-IP-Addr                                                 | 26/9       | 3GPP2  | 4      | ip-addr | IP address of the serving PCF.                                                                                                                                                                                                                                                                                                                                                                                                                                               | Yes            | No            |

**Table 30 Authentication and Authorization AVPs For Packet Data Services (continued)**

| Authentication and Authorization AVPs Supported By Cisco IOS Name | Type  | Vendor | Length | Format  | Description                                                                  | Allowed In     |               |
|-------------------------------------------------------------------|-------|--------|--------|---------|------------------------------------------------------------------------------|----------------|---------------|
|                                                                   |       |        |        |         |                                                                              | Access Request | Access Accept |
| NAS-Port                                                          | 5     | —      | 4      | integer | Port number on the Cisco PDSN used for communicating with the RADIUS server. | Yes            | No            |
| 3GPP2-User-Zone-ID                                                | 26/11 | 3GPP2  | 4      | integer | Tiered services user zone.                                                   | Yes            | No            |
| Framed-IP Address                                                 | 8     | —      | 4      | ip-addr | IP address assigned to the user.                                             | Yes            | No            |

**Table 31 Authentication and Authorization AVPs For Packet Data Services**

| Authentication and Authorization AVPs Supported By Cisco IOS Name | Type | Vendor | Length | Format | Description                                                                                                                            | Allowed In     |               |
|-------------------------------------------------------------------|------|--------|--------|--------|----------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------|
|                                                                   |      |        |        |        |                                                                                                                                        | Access Request | Access Accept |
| mobileip-mn-lifetime                                              | 26/1 | Cisco  | >=3    | string | Defines lifetime used in Proxy MIP RRQ                                                                                                 | No             | Yes           |
| mobileip-mn-ipaddr                                                | 26/1 | Cisco  | >=3    | string | MN IP address for static address assignment. If this attribute is present, this address is used in Proxy MIP RRQ                       | No             | Yes           |
| mobileip-mn-flags                                                 | 26/1 | Cisco  | >=3    | string | Defines Flags used in Proxy MIP RRQ.                                                                                                   | No             | Yes           |
| static-ip-addresses                                               | 26/1 | Cisco  | >=3    | string | IP address list for static addresses for same NAI but multiple flows. <ul style="list-style-type: none"> <li>Used at HA</li> </ul>     | No             | Yes           |
| static-ip-pool                                                    | 26/1 | Cisco  | >=3    | string | IP address pool name for static address for same NAI with multiple flows. <ul style="list-style-type: none"> <li>Used at HA</li> </ul> | No             | Yes           |
| ip-addresses                                                      | 26/1 | Cisco  | >=3    | string | IP address list used for dynamic address assignment. <ul style="list-style-type: none"> <li>Used at HA</li> </ul>                      | No             | Yes           |
| ip-pool                                                           | 26/1 | Cisco  | >=3    | string | IP address pool name used for dynamic address assignment. <ul style="list-style-type: none"> <li>Used at the HA</li> </ul>             | No             | Yes           |

**Table 31 Authentication and Authorization AVPs For Packet Data Services (continued)**

|                            |       |       |                   |            |                                                                                                                                                                                                                                                                                                         |     |     |
|----------------------------|-------|-------|-------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| CDMA-Realm                 | 26/34 | Cisco | >=3<br>&&<br><=64 | string     | For MSID based access, “realm” information for construction of user name in the form MSID@realm. User name so constructed is used for accounting purposes only.<br><br>Format of realm information is:<br><ul style="list-style-type: none"> <li>• ASCII string specifying “realm” of user’s</li> </ul> | No  | Yes |
| CDMA-User-Class            | 26/35 | Cisco | 1                 | integer    | Type of service user is subscribed to.<br><br>Supported values are:<br><ul style="list-style-type: none"> <li>• 1 for SIP</li> <li>• 2 for MIP</li> </ul>                                                                                                                                               | No  | Yes |
| 3GPP2-Reverse-Tunnel-Spec  | 26/4  | 3GPP2 | 4                 | integer    | Indicates whether reverse tunneling is required or not.<br><br>Supported values are:<br><ul style="list-style-type: none"> <li>• 0 for reverse tunneling not required.</li> <li>• 1 for reverse tunneling required.</li> </ul>                                                                          | No  | Yes |
| 3GPP2-Home-Agent-Attribute | 26/7  | 3GPP2 | 4                 | ip address | Address of the HA                                                                                                                                                                                                                                                                                       | Yes | Yes |
| 3GPP2-IP-Technology        | 26/22 | 3GPP2 | 4                 | integer    | Indicates type of service user is subscribed to.<br><br>Supported values are:<br><ul style="list-style-type: none"> <li>• 1 for SIP</li> <li>• 2 for MIP</li> </ul>                                                                                                                                     | No  | Yes |
| 3GPP2-Correlation-Id       | 26/44 | 3GPP2 | 8                 | string     | Identifies all accounting records generated for a particular user flow.                                                                                                                                                                                                                                 | Yes | Yes |
| 3GPP2-Always-On            | 26/78 | 3GPP2 | 4                 | integer    | Indicates Always On Service.<br><br>Supported values are:<br><ul style="list-style-type: none"> <li>• 0 for non always on users</li> <li>• 1for always on users</li> </ul>                                                                                                                              | No  | Yes |

## Accounting Services RADIUS Attributes

Table 32 lists the PDSN and the RADIUS server support the RADIUS attributes for accounting services. The inclusion of the various attributes in each of the accounting messages is detailed in the table. The inclusion, or not, of attributes in a message is not configurable.

**Table 32** Accounting AVPs For Packet Data Services

| Name               | 3GPP2 Type | AVP Type | Vendor | Length | Format  | Description                                                                                                                                                                                           | Reference Specs | Attribute Present In |      |         |
|--------------------|------------|----------|--------|--------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------|---------|
|                    |            |          |        |        |         |                                                                                                                                                                                                       |                 | start                | stop | interim |
| User-Name          | B2         | 1        | —      | 64     | string  | Network Access Identifier (NAI) of the mobile user.                                                                                                                                                   | RFC 2865        | Yes                  | Yes  | Yes     |
| NAS-IP-Address     | D2         | 4        | —      | 4      | IP addr | PDSN/FA address                                                                                                                                                                                       | RFC 2865        | Yes                  | Yes  | Yes     |
| NAS-Port           | —          | 5        | —      | 4      | integer | Port number on the PDSN used for communicating with the RADIUS server                                                                                                                                 | RFC 2865        | Yes                  | Yes  | Yes     |
| Service-Type       | —          | 6        | —      | 4      | integer | Type of service the user is getting.<br>Supported values: <ul style="list-style-type: none"> <li>• “Outbound” for MSID based user access</li> <li>• “Framed” for other type of user access</li> </ul> | RFC 2865        | Yes                  | Yes  | Yes     |
| Framed-Protocol    | —          | 7        | —      | 4      | integer | Framing protocol user is using.<br>Supported values: <ul style="list-style-type: none"> <li>• PPP</li> </ul>                                                                                          | RFC 2865        | Yes                  | Yes  | Yes     |
| Framed-IP-Address  | B1         | 8        | —      | 4      | IP addr | IP address assigned to the user.                                                                                                                                                                      | RFC 2865        | Yes                  | Yes  | Yes     |
| Calling-Station-Id | A1         | 31       | —      | 15     | string  | MSID identifier of the mobile user.                                                                                                                                                                   | RFC 2865        | Yes                  | Yes  | Yes     |

Table 32 Accounting AVPs For Packet Data Services (continued)

| Name                | 3GPP2 Type | AVP Type | Vendor | Length | Format  | Description                                                                                                                                                                                                                      | Reference Specs | Attribute Present In |      |         |
|---------------------|------------|----------|--------|--------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------|---------|
|                     |            |          |        |        |         |                                                                                                                                                                                                                                  |                 | start                | stop | interim |
| Acct-Status-Type    | —          | 40       | —      | 4      | integer | Accounting record type<br>Supported Values: <ul style="list-style-type: none"> <li>• 1 for Start</li> <li>• 2 for Stop</li> <li>• 3 for Interim-Update</li> <li>• 7 for Accounting-On</li> <li>• 8 for Accounting-Off</li> </ul> | RFC 2866        | Yes                  | Yes  | Yes     |
| Acct-Delay-Time     | —          | 41       | —      | 4      | integer | Number of seconds PDSN has been trying to send this accounting record.                                                                                                                                                           | RFC 2866        | Yes                  | Yes  | Yes     |
| Acct-Input-Octets   | G2         | 42       | —      | 4      | integer | Total number of octets in IP packets send by the mobile user (verify)                                                                                                                                                            | RFC 2866        | Yes                  | Yes  | Yes     |
| Acct-Output-Octets  | G1         | 43       | —      | 4      | integer | Total number of octets in IP packets send to the mobile user (verify)                                                                                                                                                            | RFC 2866        | Yes                  | Yes  | Yes     |
| Acct-Session- Id    | C1         | 44       | —      | 4      | string  | A unique accounting ID created by the PDSN that allows stop and start records to be matched in a log file.                                                                                                                       | RFC 2866        | Yes                  | Yes  | Yes     |
| Acct- Authentic     | —          | 45       | —      | 4      | integer | Method of authenticating the user<br>Supported values: <ul style="list-style-type: none"> <li>• 1 for RADIUS</li> <li>• 2 for local</li> <li>• 3 for remote</li> </ul>                                                           | RFC 2866        | Yes                  | Yes  | Yes     |
| Acct-Session Time   | —          | 46       | —      | 4      | integer | Number of seconds user has received service.                                                                                                                                                                                     | RFC 2866        | Yes                  | Yes  | Yes     |
| Acct-Input-Packets  | —          | 47       | —      | 4      | integer | Number of packets sent from the mobile user (verify).                                                                                                                                                                            | RFC 2866        | Yes                  | Yes  | Yes     |
| Acct-Output-Packets | —          | 48       | —      | 4      | integer | Number of packets sent to the mobile user (verify).                                                                                                                                                                              | RFC 2866        | Yes                  | Yes  | Yes     |

Table 32 Accounting AVPs For Packet Data Services (continued)

| Name                     | 3GPP2 Type | AVP Type | Vendor | Length | Format      | Description                                                                                                                                                                                                                                             | Reference Specs | Attribute Present In |      |         |
|--------------------------|------------|----------|--------|--------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------|---------|
|                          |            |          |        |        |             |                                                                                                                                                                                                                                                         |                 | start                | stop | interim |
| EventTime stamp          | G4         | 55       | —      | 4      | integer     | Indicates start of accounting session or stop of accounting session if part of a RADIUS start message or stop message, respectively. It is also used in a RADIUS interim message to indicate the time of the event which triggered the interim message. | RFC 2869        | Yes                  | Yes  | Yes     |
| NAS-Port- Type           | —          | 61       | —      | 4      | integer     | Type of physical port on the PDSN.                                                                                                                                                                                                                      | RFC 2865        | Yes                  | Yes  | Yes     |
| Source IPv6 Prefix       | B#         | 97       | —      | 4-20   | IPv6-prefix | Carries the IPv6 prefix of the MS. The length includes the reserved byte as well as the prefix length field byte (see RFC 3162, section 2.3).                                                                                                           | RFC 3162        | Yes                  | Yes  | Yes     |
| IPv6 Interface ID        | B4         | 96       | —      | 10     | string      | Interface ID of the mobile flow                                                                                                                                                                                                                         | RFC 3162        | Yes                  | Yes  | Yes     |
| 3GPP2-ESN                | A2         | 26/52    | 3GPP2  | 15     | string      | ASCII string of ESN                                                                                                                                                                                                                                     | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-MEID               | A3         | 26/116   | 3GPP2  | 14     | string      | ASCII string of MEID                                                                                                                                                                                                                                    | IS-835-D        | Yes                  | Yes  | Yes     |
| 3GPP2-HA-IP-Addr         | D14        | 26/7     | 3GPP2  | 4      | ip-addr     | IP address of the HA                                                                                                                                                                                                                                    | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-PCF-IP-Addr        | D3         | 26/9     | 3GPP2  | 4      | ip-addr     | IP address of the serving PCF                                                                                                                                                                                                                           | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-BSID               | D4         | 26/10    | 3GPP2  | 12     | string      | Base station ID                                                                                                                                                                                                                                         | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2IS-835-D (005-D)    | D7         | 26/108   | 3GPP2  | 37     | string      | The subnet for HRPD system                                                                                                                                                                                                                              | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-User-Zone-ID       | E1         | 26/11    | 3GPP2  | 4      | integer     | Tiered services user zone                                                                                                                                                                                                                               | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Forward-Mux-Option | F1         | 26/12    | 3GPP2  | 4      | integer     | Forward direction multiplex option                                                                                                                                                                                                                      | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Reverse-Mux-Option | F2         | 26/13    | 3GPP2  | 4      | integer     | Reverse direction multiplex option                                                                                                                                                                                                                      | IS-835-B        | Yes                  | Yes  | Yes     |

**Table 32 Accounting AVPs For Packet Data Services (continued)**

| Name                         | 3GPP2 Type | AVP Type | Vendor | Length | Format  | Description                                                                                                                                                                                                                                                                              | Reference Specs | Attribute Present In |      |         |
|------------------------------|------------|----------|--------|--------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------|---------|
|                              |            |          |        |        |         |                                                                                                                                                                                                                                                                                          |                 | start                | stop | interim |
| 3GPP2-Service-Option         | F5         | 26/16    | 3GPP2  | 4      | integer | CDMA air interface service option<br>Supported values: <ul style="list-style-type: none"> <li>• 07H,</li> <li>• 0fH,</li> <li>• 1007H,</li> <li>• 016H,</li> <li>• 017H,</li> <li>• 018H,</li> <li>• 019H, 25 decimal</li> <li>• 021H, 33 decimal</li> <li>• 03BH, 59 decimal</li> </ul> | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Forward-Traffic-Type   | F6         | 26/17    | 3GPP2  | 4      | integer | Forward traffic type<br>Supported values: <ul style="list-style-type: none"> <li>• 0 for Primary</li> <li>• 1 for Secondary</li> </ul>                                                                                                                                                   | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Reverse-Traffic-Type   | F7         | 26/18    | 3GPP2  | 4      | integer | Forward traffic type<br>Supported values: <ul style="list-style-type: none"> <li>• 0 for Primary</li> <li>• 1 for Secondary</li> </ul>                                                                                                                                                   | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Fundamental-Frame-Size | F8         | 26/19    | 3GPP2  | 4      | integer | Fundamental channel Frame Size<br>Supported values: <ul style="list-style-type: none"> <li>• 0 for No Fundamental</li> <li>• 1 for 5ms frame</li> <li>• 2 for 20ms frame</li> </ul>                                                                                                      | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Forward-Fundamental-RC | F9         | 26/20    | 3GPP2  | 4      | integer | Forward Fundamental RC<br>Use is not yet specified in the specs.                                                                                                                                                                                                                         | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Reverse-Fundamental-RC | F10        | 26/21    | 3GPP2  | 4      | integer | Reverse Fundamental RC.<br>Use is not yet specified in the specs.                                                                                                                                                                                                                        | IS-835-B        | Yes                  | Yes  | Yes     |

**Table 32 Accounting AVPs For Packet Data Services (continued)**

| Name                      | 3GPP2 Type | AVP Type | Vendor | Length | Format  | Description                                                                                                                                                                                                                                                                                                                    | Reference Specs | Attribute Present In |      |         |
|---------------------------|------------|----------|--------|--------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------|---------|
|                           |            |          |        |        |         |                                                                                                                                                                                                                                                                                                                                |                 | start                | stop | interim |
| 3GPP2-IP-Technology       | F11        | 26/22    | 3GPP2  | 4      | integer | Specifies SIP, MIP, or other technology<br>Supported values:<br><ul style="list-style-type: none"> <li>• 1 for SIP</li> <li>• 2 for MIP</li> </ul> Other values are configurable, but the defaults are as follows:<br><ul style="list-style-type: none"> <li>• 2 for PMIP</li> <li>• 1 for VPDN</li> </ul>                     | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Comp-Tunnel-Flag    | F12        | 26/23    | 3GPP2  | 4      | integer | Indicator of invocation of compulsory tunnel established on behalf of MS for providing private network and/or ISP access during a single packet data connection.<br>Supported values:<br><ul style="list-style-type: none"> <li>• 0 for no tunnel</li> <li>• 1 for non-secure tunnel</li> <li>• 2 for secure tunnel</li> </ul> | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Release-Indicator   | F13        | 26/24    | 3GPP2  | 4      | integer | Specifies reason for sending a Stop record.<br>Supported values:<br><ul style="list-style-type: none"> <li>• 0 for unknown</li> <li>• 1 for PPP/service time-out</li> <li>• 2 for Handoff</li> <li>• 3 for PPP termination</li> <li>• 4 for MIP registration failure</li> </ul>                                                | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Bad-PPP-Frame-Count | G3         | 26/25    | 3GPP2  | 4      | integer | Number of PPP frames from the mobile station dropped by PDSN due to un-correctable errors.                                                                                                                                                                                                                                     | IS-835-B        | Yes                  | Yes  | Yes     |

**Table 32 Accounting AVPs For Packet Data Services (continued)**

| Name                                   | 3GPP2 Type | AVP Type | Vendor | Length | Format  | Description                                                                                                     | Reference Specs | Attribute Present In |      |         |
|----------------------------------------|------------|----------|--------|--------|---------|-----------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------|---------|
|                                        |            |          |        |        |         |                                                                                                                 |                 | start                | stop | interim |
| 3GPP2-Num-Active-Transitions           | G9         | 26/30    | 3GPP2  | 4      | integer | Number of dormant to active transitions by the user.                                                            | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-SDB-Octet-Count-Terminating      | G10        | 26/31    | 3GPP2  | 4      | integer | Total number of octets sent to the user via Short Data Bursts.                                                  | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-SDB-Octet-Count-Originating      | G11        | 26/32    | 3GPP2  | 4      | integer | Total number of octets sent by the user via Short Data Bursts.                                                  | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Num-SDB-Terminating              | G12        | 26/33    | 3GPP2  | 4      | integer | Total number of Short Data Burst transactions sent to the user                                                  | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Num-SDB-Originating              | G13        | 26/34    | 3GPP2  | 4      | integer | Total number of Short Data Burst transactions sent by the user.                                                 | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-IP- QOS                          | 11         | 26/36    | 3GPP2  | 4      | integer | Differentiated Services Code Points associated with the user data<br><br>Use is not yet specified in the specs. | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Airlink-QOS                      | 14         | 26/39    | 3GPP2  | 4      | integer | Identifies airlink QoS associated with the user data.<br><br>Use is not yet specified in the specs.             | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-RP-Session-ID                    | Y2         | 26/41    | 3GPP2  | 4      | integer | RP Session ID associated with user session                                                                      | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Num-Bytes-Received- Total        | G14        | 26/43    | 3GPP2  | 4      | integer | Count of all bytes received in the reverse direction by the HDLC layer in PDSN.                                 | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-Correlation-ID                   | C2         | 26/44    | 3GPP2  | 8      | integer | Identifies all the accounting sessions authorized for this NAI at a PDSN.                                       | IS-835-B        | Yes                  | Yes  | Yes     |
| 3GPP2-MobileIP-InBound-Signaling-Count | G15        | 26/46    | 3GPP2  | 4      | integer | Total number of octets in Registration Requests and Solicitations sent by the mobile.                           | IS-835-B        | Yes                  | Yes  | Yes     |

**Table 32 Accounting AVPs For Packet Data Services (continued)**

| Name                                    | 3GPP2 Type | AVP Type | Vendor | Length | Format  | Description                                                                                                                                                                                | Reference Specs | Attribute Present In |                  |                  |
|-----------------------------------------|------------|----------|--------|--------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------------------|------------------|
|                                         |            |          |        |        |         |                                                                                                                                                                                            |                 | start                | stop             | interim          |
| 3GPP2-MobileIP-OutBound-Signaling-Count | G16        | 26/47    | 3GPP2  | 4      | integer | Total number of octets in Registration Replies and advertisements sent to the mobile.                                                                                                      | IS-835-B        | Yes                  | Yes              | Yes              |
| 3GPP2-Session-Continue                  | C3         | 26/48    | 3GPP2  | 4      | integer | Session Continue Indicator to the RADIUS server.<br><br>Supported values: <ul style="list-style-type: none"> <li>• 0 for End of a Session</li> <li>• 1 for Session to Continue</li> </ul>  | IS-835-B        | Yes                  | Yes              | Yes              |
| 3GPP2-Active-Time                       | G8         | 26/49    | 3GPP2  | 4      | integer | Total active connection time on traffic channel in seconds.                                                                                                                                | IS-835-B        | Yes                  | Yes              | Yes              |
| 3GPP2-DCCH-Frame-Format                 | F14        | 26/50    | 3GPP2  | 4      | integer | Frame sizes on DCCH channel<br><br>Supported values: <ul style="list-style-type: none"> <li>• 0 (no DCCH)</li> <li>• 1 (5 ms and 20 ms)</li> <li>• 2 (20ms)</li> <li>• 3 (5 ms)</li> </ul> | IS-835-B        | Yes                  | Yes              | Yes              |
| 3GPP2-Always-On                         | F15        | 26/78    | 3GPP2  | 4      | integer | Always On Service Indication.<br><br>Supported values: <ul style="list-style-type: none"> <li>• 0 when not enabled</li> <li>• 1 when enabled</li> </ul>                                    | IS-835-B        | Yes <sup>1</sup>     | Yes <sup>2</sup> | Yes <sup>3</sup> |
| CDMA-Forward PDCH RC                    | F16        | 26/83    | 3GPP2  | 4      | integer | The Radio Configuration of the Forward Packet Data Channel. (This parameter can be used as an indication that the MS is 1xEV DV capable.).                                                 | IS-835-B        | Yes                  | Yes              | Yes              |
| CDMA-Forward DCCH Mux Option            | F17        | 26/84    | 3GPP2  | 4      | integer | Forward Dedicated Control Channel multiplex option.                                                                                                                                        | IS-835-B        | Yes                  | Yes              | Yes              |

**Table 32 Accounting AVPs For Packet Data Services (continued)**

| Name                           | 3GPP2 Type | AVP Type | Vendor | Length   | Format  | Description                                                                                                                                                                                                                     | Reference Specs | Attribute Present In |      |         |
|--------------------------------|------------|----------|--------|----------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------|---------|
|                                |            |          |        |          |         |                                                                                                                                                                                                                                 |                 | start                | stop | interim |
| CDMA-Reverse DCCH Mux Option   | F18        | 26/85    | 3GPP2  | 4        | integer | Reverse Dedicated Control Channel multiplex option.                                                                                                                                                                             | IS-835-B        | Yes                  | Yes  | Yes     |
| CDMA-Forward DCCH RC           | F19        | 26/86    | 3GPP2  | 4        | integer | The format and structure of the radio channel in the forward Dedicated Control Channel.<br><br>A set of forward transmission formats that are characterized by data rates, modulation characteristics, and spreading rates [6]. | IS-835-B        | Yes                  | Yes  | Yes     |
| CDMA-Reverse DCCH RC           | F20        | 26/87    | 3GPP2  | 4        | integer | The format and structure of the radio channel in the reverse Dedicated Control Channel.<br><br>A set of reverse transmission formats that are characterized by data rates, modulation characteristics, and spreading rates [6]. | IS-835-B        | Yes                  | Yes  | Yes     |
| CDMA-Reverse PDCH RC           | F22        | 26/114   | 3GPP2  | 4        | integer | The Radio Configuration of the Reverse Packet Data Channel. (This parameter can be used as an indication that the MS is capable of 1xEV DV enhanced reverse packet data rates.)                                                 | IS-835-B        | Yes                  | Yes  | Yes     |
| Flow ID                        | C6         | 26/144   | 3GPP2  | 2        | string  | Indicates the IP flow ID.                                                                                                                                                                                                       | IS-835-B        | Yes                  | Yes  | Yes     |
| Flow Status                    | F24        | 26/145   | 3GPP2  | 4        | integer | Indicates the IP flow status.                                                                                                                                                                                                   | IS-835-B        | Yes                  | Yes  | Yes     |
| CDMA-Granted QoS               | I5         | 26/132   | 3GPP2  | variable | string  | The granted QoS for the IP flow.                                                                                                                                                                                                | IS-835-B        | Yes                  | Yes  | Yes     |
| RSVP Signaling Octets Inbound  | G22        | 26/162   | 3GPP2  | 4        | integer | RSVP signaling octets sent by the MS.                                                                                                                                                                                           | IS-835-B        | Yes                  | Yes  | Yes     |
| RSVP Signaling Octets Outbound | G23        | 26/163   | 3GPP2  | 4        | integer | RSVP signaling octets sent to the MS.                                                                                                                                                                                           | IS-835-B        | Yes                  | Yes  | Yes     |

**Table 32 Accounting AVPs For Packet Data Services (continued)**

| Name                            | 3GPP2 Type | AVP Type | Vendor | Length | Format  | Description                                      | Reference Specs | Attribute Present In |      |         |
|---------------------------------|------------|----------|--------|--------|---------|--------------------------------------------------|-----------------|----------------------|------|---------|
|                                 |            |          |        |        |         |                                                  |                 | start                | stop | interim |
| RSVP Signaling Packets Inbound  | G24        | 26/164   | 3GPP2  | 4      | integer | Number of RSVP signaling packets sent by the MS. | IS-835-B        | Yes                  | Yes  | Yes     |
| RSVP Signaling Packets Outbound | G25        | 26/165   | 3GPP2  | 4      | integer | Number of RSVP signaling packets sent to the MS. | IS-835-B        | Yes                  | Yes  | Yes     |

1. F15 will be sent only when the Always On service is enabled for the user. However, the configuration option is provided to send it for all users.
2. F15 will be sent only when the Always On service is enabled for the user. However, the configuration option is provided to send it for all users.
3. F15 will be sent only when the Always On service is enabled for the user. However, the configuration option is provided to send it for all users.

## Prepaid RADIUS Attributes

Table 33 describes prepaid-specific attributes:

**Table 33 Prepaid Specific Standard Attributes**

| Name | Length | Format       | Description                                                                                                                                            | Attribute Present In |                |               |
|------|--------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------|---------------|
|      |        |              |                                                                                                                                                        | Access Request       | Access Accept  | Access Reject |
| PPAC | >2     | Octet String | <ul style="list-style-type: none"> <li>• PDSN capability</li> <li>• Prepaid mechanism authorized for user</li> </ul>                                   | Yes, mandatory       | Yes, mandatory | —             |
| PPAQ | >8     | Octet String | <ul style="list-style-type: none"> <li>• Prepaid quota authorized for the user</li> <li>• Prepaid quota utilized by the user</li> </ul>                | Yes, mandatory       | Yes, mandatory | —             |
| PTS  | >8     | Octet String | <ul style="list-style-type: none"> <li>• Prepaid tariff switch capability</li> <li>• Prepaid quota utilized by the user after tariff switch</li> </ul> | Yes, mandatory       | Yes, optional  | —             |

## Mandatory AVPs in Connection Setup/Release Messages

Table 34 lists the information elements carried in the Connection Setup and Release messages.

**Table 34** *Connection Setup and Release Messages*

| Message Type | Description             | Mandatory AVPs                                                            | Optional AVPs                                         | Unsupported AVPs                                                                                                                                            |
|--------------|-------------------------|---------------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ICRQ         | Incoming Call Request   | Msg Type, Session ID, Call Serial No, Data-Message-Payload-Indicator      | Calling Number1, Session Inquiry, MSC/BSID, ESN, MEID | Bearer Type, Phys Chan ID, Called Number, Sub Address                                                                                                       |
| ICRP         | Incoming Call           | ReplyMsg Type, Session ID                                                 | —                                                     | —                                                                                                                                                           |
| ICCN         | Incoming Call Connected | Msg Type, Framing Type, Tx Conn Speed2, CDMA-Service-Configuration-Record | Rx Conn Speed3, Sequencing Required                   | Init Rcv Cfg Msg4, Last Sent Cfg Msg, Last Rcv Cfg Msg, Proxy Auth Type, Proxy Auth Name, Proxy Auth Chal, Proxy Auth ID, Proxy Auth Resp, Private Group ID |
| CDN          | Call Disconnect Notify  | Msg Type, Result Code, Session ID                                         | Q.931 Cause Code                                      | —                                                                                                                                                           |

### Q.931 Cause Codes Used in Call Disconnect Notify Message

The Call Disconnect Message uses Cause Code AVP to give additional information in case of unsolicited call disconnection. This AVP consists of Cause Code and a Cause Message field. The Cause Code field is always set to 0, any other value for Cause Code will cause the L2TP session to disconnect. The values for Cause Code and Cause Message defined by Q.931 standards are not sufficient, and Closed-RP defines the following addition values for Call Management (Table 35):

**Table 35** *Call Disconnect Notify Messages*

| Cause Code | Cause Message      | Description                                                                                              |
|------------|--------------------|----------------------------------------------------------------------------------------------------------|
| 0          | 253 and 43         | Normal Disconnect                                                                                        |
| 0          | 254                | PDSN has completed an RP handoff. The old RP session is disconnected with CDN                            |
| 0          | 255                | An ICRP has been received with Session Inquiry AVP. A PPP session for the requesting MSID is not located |
| 0          | Other Q.931 Values | Normal Disconnect                                                                                        |

## Glossary

1XRTT—Single Carrier, Radio Transmission Technology

1xEV-DO—Evolution-Data Optimized

3GPP2—3rd Generation Partnership Project 2  
A10—3GPP2 TSG-A defined interface for user data  
A11—3GPP2 TSG-A defined interface for control messages  
AAA—Authentication, Authorization and Accounting  
ACCM—Asynchronous Control Character Map  
AGW—Access Gateway  
AH—Authentication Header  
AHDLC—Asynchronous High-Level Data Link Control  
AN—Access Network  
APN—Access Point Name  
AUX—Auxiliary  
BG—Border Gateway  
BSC—Base Station Controller  
BSS—Base Station Subsystem  
BTS—Base Transceiver Station  
CCE—Common Classification Engine  
CDMA—Code Division Multiple Access  
CEF—Cisco Express Forwarding  
CHAP—Challenge Handshake Authentication Protocol  
CLID—Calling Station Identification  
CN—Corresponding Node  
CoA—Care-of-Address  
CPS—Calls Per Second  
CRB—Cisco RADIUS Billing (part of the VSA)  
CVSE—Critical Vendor Specific Extension  
DES—Data Encryption Standard  
DFP—Dynamic Feedback Protocol  
DNS—Domain Name Server  
DSCP—Differentiated Services Code Point  
EAP—Extensible Authentication Protocol  
EIA—Electronic Industries Alliance  
ESN—Electronic Serial Number  
EVDO—EVolved Data Optimized  
FA—Foreign Agent  
FAC—Foreign Agent Challenge (also FA-CHAP)  
GGSN—GPRS Gateway Support Node  
GRE—Generic Routing Encapsulation  
HA—Home Agent

HAAA—Home AAA  
HDLC—High-Level Data Link Control  
HRPD—High Rate Packet Data  
HSRP—Hot Standby Router Protocol  
IMSI—International Mobile Subscriber Identifier  
IOMEM—I/O MEMory  
IP—Internet Protocol  
IPC—Interprocessor Communication  
IPCP—IP Control Protocol  
IS-835B—Specification of the CDMA 2000 Wireless Data Architecture  
ISP—Internet Service Provider  
ITU—International Telecommunications Union  
L2TP—Layer 2 Tunneling Protocol  
LAC—L2TP Access Controller  
LB—Load Balancer  
LCP—Link Control Protocol  
LMA—Local Mobility Anchor  
LNS—L2TP Network Server  
MAC—Medium Access Control  
MEID—Mobile Equipment Identifier  
MIB—Management Information Base  
MIN—Mobile Identification Number  
MIP—Mobile IP  
MN—Mobile Node  
MQC—Modular QoS CLI  
MS—Mobile Station (= TE + MT)  
MSC—Mobile Switching Center  
mSEF—Mobile Severely Errored Frames  
MSID—Mobile Station Identification  
MT—Mobile Termination  
MTU—Maximum Transmission Unit  
MWAM—Multi-processor WAN Application Module  
MWTM—Mobile Wireless Transport Manager  
NAI—Network Access Identifier  
NAS—Network Access Server  
NMS—Network Management Systems  
NVRAM—Non-Volatile Random Access Memory  
NVSE—Normal Vendor specific Extension

PMIP—Proxy Mobile IP  
PAP—Password Authentication Protocol  
PCF—Packet Control Function  
PCOP—Proxy Control Processor  
PDSN—Packet Data Serving Node  
POD—Packet Of Disconnect  
PPP—Point-to-Point Protocol  
PPTP—Point-to-Point Tunneling Protocol  
PTT—Push To Talk  
QoS—Quality of Service  
RADIUS—Remote Authentication Dial-in User Service  
RAN—Radio Access Network  
R—Radio Frequency  
RP—Radio-PDSN Interface  
RRQ—Registration Request  
RSVP—Resource reSerVation Protocol  
SAMI—Service and Application Module for IP  
SCCCN—Start-Control-Channel-Connected  
SCCRQ—Start-Control-Connection-Reply  
SDB—Short Data Burst  
SEF—Severely Errored Frames  
SIP—Simple IP  
SNMP—Simple Network Management Protocol  
SO—Service Option  
SSO—Stateful SwitchOver  
SPI Value—Security Parameter Index Value  
TE—Terminal Equipment  
TFT—Traffic Flow Template  
TIA—Telecommunications Industry Association  
TID—Tunnel Identifier  
UDR—Usage Data Record  
UDP—User Datagram Protocol  
VAAA—Visiting AAA  
Vaccess—Virtual Access  
VPDN—Virtual Packet Data Network  
VRF—Virtual Routing and Forwarding  
VSA—Vendor-specific Attribute  
WAP—Wireless Application Protocol

## Product Documentation


**Note**

We sometimes update the printed and electronic documentation after original publication. Therefore, you should also review the documentation on Cisco.com for any updates.

Table 36 describes the product documentation that is available.

**Table 36**      **Product Documentation**

| Document Title                                                               | Available Formats                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cisco Packet Data Serving Node Release 5.1 for Cisco IOS Release 12.4(22)XR1 | <ul style="list-style-type: none"> <li>PDF on the documentation CD-ROM</li> <li>On Cisco.com at:<br/><a href="http://www.cisco.com/en/US/docs/ios/12_4/12_4x/12_4_22_xr1/feature/guide/pdsn5_1_fcs.html">http://www.cisco.com/en/US/docs/ios/12_4/12_4x/12_4_22_xr1/feature/guide/pdsn5_1_fcs.html</a></li> </ul> |

## Related Documentation


**Note**

We sometimes update the printed and electronic documentation after original publication. Therefore, you should also review the documentation on Cisco.com for any updates.

Table 37 describes the additional documentation that is available.

**Table 37**      **Related Documentation**

| Document Title                                                          | Available Formats                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Reference for Cisco PDSN Release 5.1 in IOS Release 12.4(22)XR1 | <ul style="list-style-type: none"> <li>PDF on the documentation CD-ROM</li> <li>On Cisco.com at:<br/><a href="http://www.cisco.com/en/US/docs/ios/12_4/12_4x/12_4_22_xr1/command/reference_xr1/pdsn_5_1cr.html">http://www.cisco.com/en/US/docs/ios/12_4/12_4x/12_4_22_xr1/command/reference_xr1/pdsn_5_1cr.html</a></li> </ul> |
| Release Notes for Cisco PDSN Release 5.1 in IOS Release 12.4(22)XR1     | <ul style="list-style-type: none"> <li>PDF on the documentation CD-ROM</li> <li>On Cisco.com at:<br/><a href="http://www.cisco.com/en/US/docs/ios/12_4/12_4x/12_4_22_xr1/release/notes/124_22xr1rn.html">http://www.cisco.com/en/US/docs/ios/12_4/12_4x/12_4_22_xr1/release/notes/124_22xr1rn.html</a></li> </ul>               |

CCDE, CCENT, CCSI, Cisco Eos, Cisco HealthPresence, Cisco IronPort, the Cisco logo, Cisco Nurse Connect, Cisco Pulse, Cisco SensorBase, Cisco StackPower, Cisco StadiumVision, Cisco TelePresence, Cisco Unified Computing System, Cisco WebEx, DCE, Flip Channels, Flip for Good, Flip Mino, Flipshare (Design), Flip Ultra, Flip Video, Flip Video (Design), Instant Broadband, and Welcome to the Human Network are trademarks; Changing the Way We Work, Live, Play, and Learn, Cisco Capital, Cisco Capital (Design), Cisco:Financed (Stylized), Cisco Store, Flip Gift Card, and One Million Acts of Green are service marks; and Access Registrar, Aironet, AllTouch, AsyncOS, Bringing the Meeting To You, Catalyst, CCDA, CCDP, CCIE, CCIP, CCNA, CCNP, CCSP, CCVP, Cisco, the Cisco Certified Internetwork Expert logo, Cisco IOS, Cisco Lumin, Cisco Nexus, Cisco Press, Cisco Systems, Cisco Systems Capital, the Cisco Systems logo, Cisco Unity, Collaboration Without Limitation, Continuum, EtherFast, EtherSwitch, Event Center, Explorer, Follow Me Browsing, GainMaker, iLYNX, IOS, iPhone, IronPort, the IronPort logo,

Laser Link, LightStream, Linksys, MeetingPlace, MeetingPlace Chime Sound, MGX, Networkers, Networking Academy, PCNow, PIX, PowerKEY, PowerPanels, PowerTV, PowerTV (Design), PowerVu, Prisma, ProConnect, ROSA, SenderBase, SMARTnet, Spectrum Expert, StackWise, WebEx, and the WebEx logo are registered trademarks of Cisco Systems, Inc. and/or its affiliates in the United States and certain other countries.

All other trademarks mentioned in this document or website are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (0910R)

© 2009 Cisco Systems, Inc.  
All rights reserved.