PacketCable and PacketCable Multimedia on the Cisco CMTS Routers

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Cisco IOS Release 12.2(33)SCA integrates support for the PacketCable and PacketCable Multimedia on the Cisco CMTS Routers feature. This feature is also supported in Cisco IOS Release 12.3BC, and this document contains information that references many legacy documents related to Cisco IOS 12.3BC. In general, any references to Cisco IOS Release 12.3BC also apply to Cisco IOS Release 12.2SC.

This document describes how to configure the Cisco CMTS for PacketCable and PacketCable Multimedia operations over an existing DOCSIS (1.1 and later versions) network.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://tools.cisco.com/ITDIT/CFN/. An account on http://www.cisco.com/ is not required.

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Prerequisites for PacketCable Operations

This section provides information about requirements for the PacketCable feature on the Cisco CMTS routers. For information about requirements for PacketCable Multimedia on the Cisco CMTS routers, see the Prerequisites for PacketCable Multimedia Operations, on page 23.

PacketCable Prerequisites

- To support PacketCable 1.0 and the Communications Assistance for Law Enforcement Act (CALEA) intercept capabilities, a Cisco uBR7246VXR broadband router must be running Cisco IOS Release 12.2(33)SCA or later.

- To support PacketCable 1.0 and the Communications Assistance for Law Enforcement Act (CALEA) intercept capabilities, a Cisco uBR10012 router must be running Cisco IOS Release 12.2(33)SCA or later.

Table below shows the hardware compatibility prerequisites for this feature.

| Note | The hardware components introduced in a given Cisco IOS Release are supported in all subsequent releases unless otherwise specified. |
Table 1: PacketCable Feature Hardware Compatibility Matrix

<table>
<thead>
<tr>
<th>CMTS Platform</th>
<th>Processor Engine</th>
<th>Cable Interface Cards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco uBR10012 Universal Broadband Router</td>
<td>Cisco IOS Release 12.2(33)SCA and later</td>
<td>Cisco IOS Release 12.2(33)SCA and later</td>
</tr>
<tr>
<td></td>
<td>• PRE2</td>
<td>• Cisco uBR10-MC5X20U/H</td>
</tr>
<tr>
<td></td>
<td>Cisco IOS Release 12.2(33)SCB and later</td>
<td>Cisco IOS Release 12.2(33)SCC and later</td>
</tr>
<tr>
<td></td>
<td>• PRE4</td>
<td>• Cisco UBR-MC20X20V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cisco IOS Release 12.2(33)SCE and later</td>
</tr>
</tbody>
</table>
|                                            |                                                | • Cisco uBR-MC3GX60V                           |\(^1\)
| Cisco uBR7246VXR Universal Broadband Router| Cisco IOS Release 12.2(33)SCA and later         | Cisco IOS Release 12.2(33)SCA and later         |
|                                            | • NPE-G1                                        | • Cisco uBR-MC28U/X                           |
|                                            | • NPE-G2                                        | Cisco IOS Release 12.2(33)SCD and later         |
|                                            |                                                | • Cisco uBR-MC88V                            |\(^2\)
| Cisco uBR7225VXR Universal Broadband Router| Cisco IOS Release 12.2(33)SCA and later         | Cisco IOS Release 12.2(33)SCA and later         |
|                                            | • NPE-G1                                        | • Cisco uBR-E-28U                             |
|                                            | Cisco IOS Release 12.2(33)SCB and later         | • Cisco uBR-E-16U                             |
|                                            | • NPE-G2                                        | • Cisco uBR-MC28U/X                           |
|                                            |                                                | Cisco IOS Release 12.2(33)SCD and later         |
|                                            |                                                | • Cisco uBR-MC88V                            |

\(^1\) Cisco uBR3GX60V cable interface line card is compatible only with PRE4.
\(^2\) Cisco uBR-MC88V cable interface line card is compatible only with NPE-G2.

Restrictions for PacketCable Operations

- To avoid packet drops of voice calls, the Cisco CMTS should be using the default token bucket configuration (cable downstream rate-limit token-bucket shaping). Packet drops are guaranteed to occur when the shaping option is not used (cable downstream rate-limit token-bucket).
Information About PacketCable Operations

This section provides an overview and other information about PacketCable operations, the components of a PacketCable network, and how they interact with the other components of a DOCSIS cable networks.

Feature Overview

PacketCable is a program initiative from Cablelabs and its associated vendors to establish a standard way of providing packet-based, real-time video and other multimedia traffic over hybrid fiber-coaxial (HFC) cable networks. The PacketCable specification is built upon the Data-over-Cable System Interface Specifications (DOCSIS) 1.1, but it extends the DOCSIS protocol with several other protocols for use over noncable networks, such as the Internet and the public switched telephone network (PSTN).

This allows PacketCable to be an end-to-end solution for traffic that originates or terminates on a cable network, simplifying the task of providing multimedia services over an infrastructure composed of disparate networks and media types. It also provides an integrated approach to end-to-end call signaling, provisioning, quality of service (QoS), security, billing, and network management.

Emergency 911 Features

Cisco IOS Release 12.2(33)SCA includes support for the following two Emergency 911 features that were introduced in Cisco IOS Release 2.3(13a)BC:

PacketCable Emergency 911 Cable Interface Line Card Prioritization

The PacketCable Emergency 911 cable interface line card prioritization feature enables cable interface line cards that are supporting an Emergency 911 call to be given automatic priority over cable interface line cards supporting non-emergency voice calls, even in the case of HCCP switchover events. In such cases, Protect HCCP line card interfaces automatically prioritize service to Emergency 911 voice calls, should Working HCCP cable interface line cards be disrupted. This feature is enabled by default, and may not be disabled with manual configuration.

- Supports only embedded multimedia terminal adapter (E-MTA) clients. Standalone MTA (S-MTA) clients are not supported.
- PacketCable operations can be configured together with HCCP N+1 redundancy, but the PacketCable states are not synchronized between the Working and Protect interfaces. If a switchover occurs, existing voice calls continue, but when the user hangs up, PacketCable event messages are not generated because the Protect interface is not aware of the previous call states. However, new voice calls can be made and proceed in the normal fashion.
- The 200,000 Hz channel width cannot be used on upstreams that support PacketCable voice calls, or on any upstreams that use Unsolicited Grant Service (UGS) or UGS with Activity Detection (UGS-AD) service flows. Using this small a channel width with voice and other UGS/UGS-AD service flows results in calls being rejected because of "DSA MULTIPLE ERRORS".
Emergency 911 cable interface line card prioritization applies only to PacketCable voice calls.

During HCCP switchover events, cable modems recover in the following sequence:

1. Cable modems supporting Emergency 911 voice traffic
2. Cable modems supporting non-emergency voice traffic
3. Cable modems that are nearing a T4 timeout event, in which service would be disrupted
4. Remaining cable modems

To view information about Emergency 911 voice events and cable interface line card prioritization on the Cisco CMTS router, use the show hccp, show cable calls, and show hccp event-history commands in privileged EXEC mode.

PacketCable Emergency 911 Services Listing and History

Cisco IOS release 12.2(33)SCA includes enhanced informational support for PacketCable Emergency 911 calls on the Cisco CMTS router.

The enhanced informational support for PacketCable Emergency 911 calls on the Cisco CMTS router provides the following information and related history:

- active Emergency 911 calls
- recent Emergency 911 calls
- regular voice calls
- voice calls made after recent Emergency 911 calls

This feature is enabled and supported with the following configuration and show commands:

- cable high-priority-call-window
- show cable calls
- show cable modem calls

To set the call window (in minutes) during which the Cisco CMTS router maintains records of Emergency 911 calls, use the cable high-priority-call-window command in global configuration mode. To remove the call window configuration from the Cisco CMTS router, use the no form of this command:

The following command example configures the call window on the Cisco uBR10012 router to be 1 minute in length:

```
Router(config)# cable high-priority-call-window 1
```

PacketCable Network Components

A PacketCable network contains a number of components. Some components are the same as those that exist in a DOCSIS 1.1 network, while other components are new entities that create the end-to-end infrastructure that the PacketCable network needs to establish calls. Wherever possible, the PacketCable components and protocols build on existing protocols and infrastructures to simplify implementation and interoperability.
Packet Cable Network Components

- **Cable modem**—A customer premises equipment (CPE) device that connects to a DOCSIS 1.0 or DOCSIS 1.1 cable network. All DOCSIS cable modems provide high-speed data connectivity to the Internet, while other cable modems can provide additional features, such as telephone connectivity.

- **Cable Modem Termination System (CMTS)**—A headend-based router that connects a DOCSIS cable network to the IP backbone network. The CMTS controls the DOCSIS 1.1 MAC layer and enforces the quality of service (QoS) limits that the cable operator guarantees to its subscribers. A typical CMTS services between several hundred and several thousand cable modems. The Cisco uBR7246VXR and Cisco uBR10012 routers operate as the CMTS in the PacketCable network.

*Note*

See the DOCSIS 1.1 specifications for information about cable modem and CMTS operations.

- **Multimedia terminal adapter (MTA)**—A CPE device that connects telephones and other end-user devices to the PacketCable network. The PacketCable specification defines two MTA types, an embedded MTA (E-MTA) and a standalone MTA (S-MTA). The E-MTA is an MTA integrated into a DOCSIS 1.1 cable modem, while the S-MTA is a separate MTA that requires a DOCSIS 1.1 cable modem to connect to the cable network.

- **Call management server (CMS)**—A centrally located server that provides the signaling functions that allow MTAs to establish calls over the network. The CMS uses the Network-based call signaling (NCS) protocol to provide authentication and authorization, call routing, and support for special features such as three-way calling. A PacketCable network could have multiple CMS servers, depending on its size and complexity.

*Note*

The CMS implements several protocols on top of the Common Open Policy Service (COPS) protocol to communicate with the rest of the PacketCable network.

- **Gate controller (GC)**—A server that controls the establishment of gates in the PacketCable network. A gate is a logical entity in the CMTS that ensures that a service flow is authorized for the QoS features it is requesting. A separate gate controls the upstream and downstream directions of a service flow. When a call is established, the GC instructs the CMTS to create each gate and supplies the set of authorized parameters for each gate, which the CMTS uses to authorize the QoS requests that the MTA is making for the call. The GC is also responsible for coordinating the creation of the two sets of gates at each end of the call so that the call can be authorized and established.

*Note*

A PacketCable network can contain multiple GCs, although only one server at a time is in control of any particular call. Typically, the same workstation provides both the CMS and GC servers.

- **Record keeping server (RKS)**—Billing server that collects the information about each call as it is made. The RKS uses the Remote Authentication Dial-In User Service (RADIUS) protocol to collect the billing data from the CMTS and other PacketCable servers. The RKS generates a call data record (CDR) for every call and forwards that information to the appropriate application server at the service provider’s data processing center for further processing.
Dynamic Quality of Service

A key feature of a PacketCable network is a dynamic quality of service (DQoS) capability that is similar to the dynamic services provided by DOCSIS 1.1. However, DOCSIS 1.1 DQoS authorizes and provisions services only in the cable network and does not reserve the resources needed to propagate a call from one endpoint to another across the network.

The PacketCable DQoS extends the DOCSIS 1.1 services across the entire network, so that resources can be dynamically authorized and provisioned from one endpoint to another. This prevents possible theft-of-service attacks and guarantees customers the services they are authorized to use.

PacketCable 1.0 requires that DOCSIS 1.1 be used for resource reservation within the cable network for E-MTA clients.

Two-Stage Resource Reservation Process

The PacketCable DQoS model uses a two-stage resource reservation process, in which resources are first reserved and then committed. This allows a bidirectional reservation process that ensures that resources are available at both endpoints of the connection before actually placing the call.

When an MTA makes a call request, the local CMTS communicates with the gate controller to authorize the call’s resources. After the resources are authorized, the CMTS reserves the local resources while it negotiates with the remote end for the resources that are required at that end.

The CMTS uses DOCSIS 1.1 Dynamic Service Addition (DSA) messages to reserve the resources, and then uses Dynamic Service Change (DSC) messages to commit the resources.

When all required resources are available, the local CMTS and remote CMTS both commit the resources, allowing traffic to flow. Usage accounting and billing do not begin until the remote MTA picks up and the call is actually in progress.

The DQoS model ensures that both endpoints of a call, as well as the backbone network, have reserved the same bandwidth, and that the bandwidth is reserved only while the call is in progress. When a call terminates, all portions of the network can release the call’s resources and make them available for other users.

Making a Call Using DQoS

DOCSIS 1.1 networks use service flows to implement different QoS policies, but service flows exist only within the cable network. To control the service flows and to extend them across the entire network, a PacketCable network creates and maintains “gates.”

A gate is a logical entity created on the CMTS at each side of a connection that authorizes and establishes a particular DQoS traffic flow. The CMTS communicates with the gate controller to coordinate the creation of matching gates at each side of the connection.

Gates are unidirectional, so separate gates are required for the downstream and upstream traffic flows. The same gate ID, however, is usually used for the downstream and upstream gates for a call. Each CMTS maintains its own set of gates, so a bidirectional traffic flow requires four gates to be created, two gates on the local CMTS and two gates on the remote CMTS.
For a typical call, gates progress through the following stages to create a DQoS traffic flow:

1. The local MTA makes a call request, and the gate controller sends a Gate-Allocation command to the CMTS, which creates a gate in response and puts it into the Allocated state.
2. The call management server, which might be the same server as the gate controller, parses the call request to translate the destination phone number into the appropriate destination gateway.
3. The gate controller verifies that the MTA making the call request is authorized for the required resources and sends a Gate-Set command to the CMTS, which puts the gate into the Authorized state.
4. The CMTS on each side of the connection reserves the local resources needed for the call, putting the gate into the Reserved state.
5. As the remote CMTS and local CMTS perform gate coordination, their respective gates get put into the Local_Committed and Remote_Committed states.
6. When both sides have reserved all required resources, each CMTS puts its gates into the Committed state, allowing traffic to flow.

**Dynamic Service Transaction ID Support**

DOCSIS 2.0 mandates unique Transaction IDs (TAIDs) across transactions. The TAIDs must be unique and not incremented. The TAIDs are assigned by the senders and sometimes the TAIL timeout is mismatched between senders and receivers. This affects the uniqueness of the TAIL.

A TAID can be reused when the sender finishes a transaction. Similarly, DOCSIS allows the receiver to identify a transaction by TAIL without the SFID. Problems arise in DSD transaction and DSA/DSC interrupted transactions, when these two requirements are combined.

The uniqueness of TAIL must be ensured to resolve the interoperability issue. This is done by making the CMTS wait until T10 to reuse the same TAIL. A new TAIL allocation algorithm is used to fulfill this requirement.

It creates a TAIL pool to replace the existing 16-bit counter. This TAIL pool is monitored by timers to track the TAIL expiration. A flag is assigned to each TAIL in the pool to indicate its availability. When new TAIL is requested, the dynamic service process checks the availability of the TAIL. If the TAIL is available, it is allocated to the new service flow, else the request is rejected.

Once the TAIL is allocated, the timer starts with T10 expiration time and the TAIL flag is set to FALSE to indicate the unavailability of TAIL. The dynamic service process keeps track of the timer. When the time expires, the timer stops and the flag is set to TRUE to indicate the availability of TAIL.

The TAIL pool is allocated and initialized at the process initialization. All timers associated with the TAILs are added as leaf timers to the process’ parent timer.

**PacketCable Subscriber ID Support**

The PacketCable Subscriber ID feature adds a subscriber ID to all Gate Control messages and enhances error codes returned from the Cisco CMTS router.

Previously, the Gate ID was unique only to individual CMTS systems, with the CMTS proxying all CMS Gate Control messaging through a central device, which manages the CMTS connections on behalf of the CMS. The CMS had a single Common Open Policy Service (COPS) association to the proxy device. Therefore, the Gate IDs could be duplicated when using multiple CMTS systems.

A subscriber ID is added to each Gate Control message to disambiguate the Gate IDs between the CMS and proxy device. The subscriber ID parameter is added to the following COPS messages:
• GATE-INFO
• GATE-DELETE
• GATE-OPEN
• GATE-CLOSE

The subscriber ID is available at the CMS and is used in the Gate-Set messages. Additionally, the error codes returned from CMTS or its proxy are enhanced to include more specific information about gate operation failures.

To enable this feature, use the `packetcable gate send-subscriberID` command in global configuration mode.

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**Note**
The PacketCable Subscriber ID feature is not supported in Cisco IOS Release 12.2(33)SCA. However, it is supported beginning in Cisco IOS Release 12.2(33)SCB.

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**Benefits**

The PacketCable feature offers the following benefits to service providers and their customers:

**Integrated Services on a Cable Network**
PacketCable allows cable operators the ability to offer multimedia, real-time services, in addition to data connectivity, across their entire network. These services could include basic telephony with lifeline support, as well as telephony that offers competitive extended calling services. Operators can deploy new services while heavily leveraging their existing network infrastructures.

The widespread use of IP as the standard transport mechanism for data networks today is enabling many advanced Internet applications such as multimedia e-mail, real-time chat, streaming media (including music and video), and videoconferencing. The PacketCable initiative provides the network architecture for a cable operator to deliver these services quickly and economically.

**Standardized Provisioning**
PacketCable provides a standardized, efficient method to provision IP services for individual subscribers, because PacketCable specifications define a uniform, open, and interoperable network. Cable operators are assured of standardized provisioning and the associated lower costs of deployment.

**Interoperability**
Customer premises equipment (CPE) devices account for a major portion of the capital expense in deploying a VoIP solution at a cable plant. The PacketCable specifications ensure that vendors will build MTA clients that support the voice and other services that cable operators plan to deploy. Because these CPE devices are based on existing DOCSIS-compliant cable modems, time and cost of development is minimized.

Interoperability with the other components of the PacketCable network is also guaranteed because of the standards-based approach to the specifications. Any PacketCable-certified component will be able to interoperate within a network that conforms to the PacketCable standards.
Secure Architecture

Because PacketCable is built upon the security features available in DOCSIS 1.1, cable operators will be assured of networks that are secure from end to end, with a high standard of security that prevents the most common theft-of-service attacks. The comprehensive, standards-based PacketCable specifications are designed to create a network that is as secure as the public switched telephone network (PSTN).

CALEA Support

The PacketCable architecture was designed to accommodate the 1994 Communications Assistance for Law Enforcement Act (CALEA), which requires telecommunications carriers to assist law-enforcement agencies in conducting court-ordered electronic surveillance. PacketCable networks will be able to provide the two types of information that a carrier must provide, depending on the type of court order:

- Call-identifying information—The carrier must provide the call-identifying information for calls to or from an intercept target. For telephone calls, this information includes the phone numbers called by the target or calling the target.
- Call content—The carrier must provide the content of calls to or from an intercept target. For telephone calls, this real-time content is the voice conversation.

How to Configure PacketCable Operations

This section contains the following tasks to configure the PacketCable feature. Each task is required unless otherwise identified as optional.

Enabling PacketCable Operation

To enable PacketCable operation, use the following commands beginning in user EXEC mode. This is a required procedure.

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode. Enter your password if prompted.</td>
</tr>
<tr>
<td>Example:</td>
<td>Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>packetcable</td>
<td>Enables PacketCable operation on all cable interfaces.</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config)# packetcable</td>
<td></td>
</tr>
</tbody>
</table>
Disabling PacketCable Operation

To disable PacketCable operation, use the following commands beginning in user EXEC mode. This procedure is required only when you no longer want the Cisco CMTS to support PacketCable signaling.

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode. Enter your password if prompted.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td>no packetcable</td>
<td>Disables PacketCable operation on all cable interfaces.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config)# no packetcable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
</tr>
<tr>
<td>exit</td>
<td>Exits global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config)# exit</td>
<td></td>
</tr>
</tbody>
</table>

Configuring PacketCable Operation

To configure the different parameters that affect PacketCable operations, use the following commands beginning in user EXEC mode. All of these procedures are optional, because each parameter is set to a default that is appropriate for typical PacketCable operations.
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode. Enter your password if prompted.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>packetcable element-id ( n )</td>
<td>Configures the Event Message Element ID for the Cisco CMTS. If you do not manually configure the Element ID, the CMTS defaults to a random value between 0 and 99,999 when PacketCable operations are enabled.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# packetcable element-id 23</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>packetcable gate maxcount ( n )</td>
<td>Sets the maximum number of gate IDs to be allocated in the gate database on the Cisco CMTS.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# packetcable gate maxcount 524288</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>packetcable timer ( T0 ) ( \text{timer-value} )</td>
<td>Sets the T0 timer in milliseconds.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# packetcable timer T0 40000</td>
<td></td>
</tr>
<tr>
<td>Step 6</td>
<td>packetcable timer ( T1 ) ( \text{timer-value} )</td>
<td>Sets the T1 timer in milliseconds.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# packetcable timer T1 300000</td>
<td></td>
</tr>
<tr>
<td>Step 7</td>
<td>exit</td>
<td>Exits global configuration mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# exit</td>
<td></td>
</tr>
</tbody>
</table>

### Enabling Both PacketCable and Non-PacketCable UGS Service Flows

By default, when PacketCable operations are enabled using the `packetcable` command, cable modems must follow the PacketCable protocol when requesting Unsolicited Grant Service (UGS) service flows. This prevents DOCSIS cable modems that do not support PacketCable operations from using DOCSIS-style UGS service flows.
If you have a mixed network that contains both PacketCable and non-PacketCable DOCSIS CMs, you can use the `packetcable authorize vanilla-docsis-mta` command to enable both types of UGS service flows. This is an optional procedure.

### DETAILED STEPS

<table>
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<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode. Enter your password if prompted.</td>
</tr>
<tr>
<td>Example: <code>Router&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: <code>Router# configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> packetcable</td>
<td>Enables PacketCable operations.</td>
</tr>
<tr>
<td>Example: <code>Router(config)# packetcable</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> packetcable authorize vanilla-docsis-mta</td>
<td>Enables the use of DOCSIS-style UGS service flow requests.</td>
</tr>
<tr>
<td>Example: <code>Router(config)# packetcable authorize vanilla-docsis-mta</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> exit</td>
<td>Exits global configuration mode.</td>
</tr>
<tr>
<td>Example: <code>Router(config)# exit</code></td>
<td></td>
</tr>
</tbody>
</table>

### What to Do Next

Use the `show packetcable global` command to display whether non-PacketCable UGS service flows have been enabled.

### Enabling PacketCable Subscriber ID Support

To include subscriber identification in GATE-OPEN and GATE-CLOSE Gate Control messages, use the `packetcable gate send-subscriberID` command in global configuration mode.
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example:</td>
<td>Router&gt; enable</td>
</tr>
<tr>
<td></td>
<td>Enables privileged EXEC mode. Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# configure terminal</td>
</tr>
<tr>
<td></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>packetcable</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config)# packetcable</td>
</tr>
<tr>
<td></td>
<td>Enables PacketCable operations.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>packetcable gate send-subscriberID</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config)# packetcable gate send-subscriberID</td>
</tr>
<tr>
<td></td>
<td>Enables the use of gate control subscriber identification information.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>exit</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config)# exit</td>
</tr>
<tr>
<td></td>
<td>Exits global configuration mode.</td>
</tr>
</tbody>
</table>

### Configuring RADIUS Accounting for RKS Servers

To enable the Cisco CMTS router to communicate with the Record Keeping Servers (RKS servers) using the RADIUS protocol, use the following commands. This is a required procedure.

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example:</td>
<td>Router&gt; enable</td>
</tr>
<tr>
<td></td>
<td>Enables privileged EXEC mode. Enter your password if prompted.</td>
</tr>
<tr>
<td>Step 2</td>
<td><code>configure terminal</code></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Example:</td>
<td><code>Router# configure terminal</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th><code>aaa new-model</code></th>
<th>Enables the authentication, authorization, and accounting (AAA) access control model.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td><code>Router(config)# aaa new-model</code></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 4</th>
<th><code>aaa group server radius group-name</code></th>
<th>Creates a group of RADIUS servers for authentication and enters RADIUS group configuration mode. The value of <code>group-name</code> is a unique, arbitrary string that identifies this group.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td><code>Router(config)# aaa group server radius packetcable</code></td>
<td></td>
</tr>
</tbody>
</table>

| Step 5 | `server {hostname | ip-address} [auth-port udp-port] [acct-port udp-port]` | Specifies the host name or IP address for the RADIUS server that is providing the RKS services. |
|---|---|---|
| Example: | `Router(config-sg-radius)# server radius-server1` |  |
| Note | Repeat this command as needed to enter multiple RADIUS servers. The Cisco CMTS uses the servers in the order given with this command. |

<table>
<thead>
<tr>
<th>Step 6</th>
<th><code>exit</code></th>
<th>Exits RADIUS group configuration mode.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td><code>Router(config-sg-radius)# exit</code></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 7</th>
<th><code>aaa accounting network default start-stop group radius group group-name</code></th>
<th>Enables AAA services using the group of RADIUS servers that are defined in the previously created group. The <code>group-name</code> parameter should be the same name specified in Step 4.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td><code>Router(config)# aaa accounting network default start-stop group radius group packetcable</code></td>
<td></td>
</tr>
</tbody>
</table>

| Step 8 | `radius-server host {hostname | ip-address} [auth-port port-number] [acct-port port-number] [timeout seconds] [retransmit retries] key 0000000000000000` | Specifies a RADIUS host. Use the same values for `hostname` or `ip-address` as for one of the servers specified in Step 5. If you also specified the `auth-port` or `acct-port` values in Step 5, you must also specify those here, as well. The `key` value is required and must be 16 ASCII zeros, as shown. |
|---|---|---|
| Example: | `Router(config)# radius-server host radius-server1 key 0000000000000000` |  |
| Note | Repeat this command for each RADIUS server entered in Step 5. |
### PacketCable Client Accept Timeout

If the connection between a PacketCable CMS and the Cisco CMTS router is not completely established, and the PacketCable CMS does not correctly terminate the session by sending a TCP FIN message, the connection shows a COPS server in the output of the `show cops server` command.

#### PacketCable Client Accept Timeout

The PacketCable Client Accept Timeout feature supports COPS for PacketCable on the Cisco CMTS router. This feature also allows you to set timeout values for COPS Telnet connections on the Cisco CMTS router, and for clearing COPS Telnet sessions.

Telnet errors on the network or Cisco CMTS router might cause incomplete COPS sessions to be created. In order to address this issue, the timeout timer enables clearing and cleaning of allocated resources for the stale COPS Telnet sessions on the Cisco CMTS router.

The timeout timer applies to each COPS Telnet connection on the Cisco CMTS router. When this timeout setting expires, it terminates the Telnet session and clears supporting resources on the Cisco CMTS router.

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1**
| enable
| Enables privileged EXEC mode.
| Example:
| Router> enable
| • Enter your password if prompted.
| **Step 2**
| configure terminal
| Enters global configuration mode.
| Example:
| Router# configure terminal |
### Configuration Examples for PacketCable

This section provides a PacketCable configuration example.

#### Example: Typical PacketCable Configuration

This section provides a typical configuration for a Cisco CMTS router that has been configured for PacketCable operations, using default parameters. To use this configuration, you must change the IP addresses for the RADIUS and RKS servers to match the addresses for the servers in your network.

```
! version 12.2
no parser cache
no service pad
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
no service password-encryption
service internal
service udp-small-servers max-servers no-limit
service tcp-small-servers max-servers no-limit
!
```
hostname Router
!
no logging rate-limit
aaa new-model
!
!
aaa group server radius a
server 10.9.62.12 auth-port 1813 acct-port 1812
server 10.9.62.13 auth-port 1813 acct-port 1812
!
!
aaa accounting network default start-stop group radius group a
aaa session-id common
enable password <delete>
!
cable modulation-profile 2 request 0 16 0 8 qpsk scrambler 152 no-diff 64 fixed uw16
cable modulation-profile 2 initial 5 34 0 48 qpsk scrambler 152 no-diff 128 fixed uw16
cable modulation-profile 2 station 5 34 0 48 qpsk scrambler 152 no-diff 128 fixed uw16
cable modulation-profile 2 short 6 75 6 8 16qam scrambler 152 no-diff 144 shortened uw8
!
cable modulation-profile 2 long 8 220 0 8 16qam scrambler 152 no-diff 160 shortened uw8
!
cable modulation-profile 5 request 0 16 2 8 qpsk scrambler 152 no-diff 64 fixed uw16
!
cable modulation-profile 5 initial 5 34 0 48 qpsk scrambler 152 no-diff 128 fixed uw16
!
cable modulation-profile 5 station 5 34 0 48 qpsk scrambler 152 no-diff 128 fixed uw16
!
cable modulation-profile 5 short 6 78 7 8 16qam scrambler 152 no-diff 144 shortened uw8
!
cable modulation-profile 5 long 8 220 0 8 16qam scrambler 152 no-diff 160 shortened uw8
!
cable qos profile 5 max-burst 1200
!
cable qos profile 5 max-downstream 2000
!
cable qos profile 5 max-upstream 128
!
cable qos profile 5 priority 5
!
cable qos profile 5 privacy
!
cable qos profile 7 guaranteed-upstream 87
!
cable qos profile 7 max-upstream 87
!
cable qos profile 7 privacy
!
no cable qos permission create
!
cable qos permission update
!
cable qos permission modems
!
cable qos permission enforce 5
!
cable time-server
!
no cable privacy accept-self-signed-certificate
!
ip subnet-zero
!
no ip domain-lookup
!
ip domain-name cisco.com
!
ip host tftp 10.8.8.8
!
ip host cnr 10.9.62.17
!
packetcable
packetcable element-id 12456
!
!
interface Tunnel0
ip address 10.55.66.3 255.255.255.0
load-interval 30
!
interface Tunnel10
ip address 10.0.1.1 255.255.0.0
!
!
interface FastEthernet0/0
ip address 10.9.60.10 255.255.0.0
!
interface FastEthernet0/0
ip address 10.9.60.10 255.255.0.0
!
interface FastEthernet1/0
ip address 172.22.79.44 255.254.0.0
!
interface Cable3/0
ip address 10.3.1.33 255.255.255.0 secondary
ip address 10.4.1.1 255.255.255.0 secondary
ip address 10.4.1.33 255.255.255.0 secondary
ip address 10.3.1.1 255.255.255.0
ip helper-address 10.9.62.17
load-interval 30
no keepalive
cable downstream annex B
cable downstream modulation 64qam
cable downstream interleave-depth 32
cable downstream frequency 55500000
no cable upstream 0
no cable upstream 0 shutdown
cable upstream 1 frequency 12000000
cable upstream 1 power-level 0
cable upstream 1 channel-width 3200000
cable upstream 1 data-backoff automatic
cable upstream 1 modulation-profile 2
cable upstream 1 shutdown
cable upstream 2 frequency 16000000
cable upstream 2 power-level 0
cable upstream 2 channel-width 3200000
cable upstream 2 data-backoff automatic
cable upstream 2 modulation-profile 2
cable upstream 2 shutdown
no cable upstream 2
no cable upstream 3
no cable upstream 3 shutdown
cable upstream 4 frequency 24000000
cable upstream 4 power-level 0
cable upstream 4 channel-width 3200000
cable upstream 4 data-backoff automatic
no cable upstream 4 shutdown
cable upstream 5 frequency 28000000
cable upstream 5 power-level 0
cable upstream 5 channel-width 3200000
cable upstream 5 data-backoff automatic
cable upstream 5 modulation-profile 2
no cable upstream 5 shutdown
cable dhcp-giaddr policy!
router eigrp 48849
network 1.0.0.0
network 10.0.0.0
auto-summary
no eigrp log-neighbor-changes!
! ip default-gateway 10.9.0.1
ip classless
ip route 0.0.0.0 0.0.0.0 172.22.78.1
ip route 10.8.0.0 255.255.0.0 10.9.0.1
ip route 192.168.80.0 255.255.255.0 172.27.184.69
ip route 10.255.254.254 255.255.255.255 10.9.0.1
no ip http server
ip pim bidir-enable!
!
cdp run!
!
radius-server host 10.9.62.12 auth-port 1813 acct-port 1812 key 6000000000000000
radius-server retransmit 3
radius-server vsa send accounting!
line con 0
exec-timeout 0 0
privilege level 15
line aux 0
line vty 0 4
Verifying PacketCable Operations

To verify and maintain information about PacketCable operations, use one or more of the following commands:

- `show packetcable global`
- `show packetcable gate`
- `show packetcable gate ipv6`
- `show packetcable gate dqos`
- `show packetcable gate counter commit`

To verify the PacketCable configuration, values for the Element ID, maximum number of gates, and the different CMBS-based DQoS timers, use the `show packetcable global` command in privileged EXEC mode.

```
Router# show packetcable global
Packet Cable Global configuration:
Enabled : Yes
Element-ID: 12456
Max Gates : 1048576
Allow non-PacketCable UGS
Default Timer value -
  T0 : 30000 msec
  T1 : 300000 msec
```

To verify information about one or more gates in the gate database, use the `show packetcable gate` command as shown in the following example:

```
Router# show packetcable gate summary
GateID   i/f    SubscriberID   GC-Addr  State    Type     SFID(us) SFID(ds)
13582    Ca8/1/0 3.18.1.4    20.5.0.254 RECOVERY MM  74
29962    Ca8/1/0 3.18.1.5    20.5.0.254 RECOVERY MM  73
46354    Ca8/1/0 ------     20.5.0.254 RECOVERY MM  72
62738    Ca8/1/0 ------     20.5.0.254 RECOVERY MM  69
Total number of gates = 4
Total Gates committed(side bootup or clear counter) = 8
```

To verify information about one or more PacketCable gates associated with IPv6 subscriber IDs in the gate database, use the `show packetcable gate ipv6` command as shown in the following example:

```
Router# show packetcable gate ipv6 summary
GateID   i/f    SubscriberID   State    SFID(us) SFID(ds)
Total number of gates = 4
Total Gates committed(side bootup or clear counter) = 8
```

To verify information about one or more PacketCable gates associated with IPv4 subscriber IDs in the gate database, use the `show packetcable gate dqos` command as shown in the following example:

```
Router# show packetcable gate dqos summary
GateID   i/f    SubscriberID   GC-Addr  State    Type     SFID(us) SFID(ds)
```
Verifying Emergency 911 Calls

This section provides a few examples to illustrate how you can use the show cable calls and show cable modem calls commands to verify different scenarios associated with Emergency 911 calls.

The following example displays Emergency 911 calls made on the Cable8/1/1 interface on the Cisco CMTS router during the window set for high priority calls:

```
Router# show cable calls
Interface  ActiveHiPriCalls  ActiveAllCalls  PostHiPriCallCMs  RecentHiPriCMs
Cable5/0/0  0                0              0                 0
Cable5/0/1  0                0              0                 0
Cable5/1/0  0                0              0                 0
Cable5/1/1  0                0              0                 0
Cable5/1/2  0                0              0                 0
Cable5/1/3  0                0              0                 0
Cable5/1/4  0                0              0                 0
Cable6/0/0  0                0              0                 0
Cable6/0/1  0                0              0                 0
Cable7/0/0  0                0              0                 0
Cable7/0/1  0                0              0                 0
Cable8/1/0  0                0              0                 0
Cable8/1/1  1                1              0                 0
Cable8/1/2  0                0              0                 0
Cable8/1/3  0                0              0                 0
Cable8/1/4  0                0              0                 0
Total      1                1              0                 0
```

The following example displays the change on the Cisco CMTS router when this Emergency 911 calls ends:

```
Router# show cable calls
Interface  ActiveHiPriCalls  ActiveAllCalls  PostHiPriCallCMs  RecentHiPriCMs
Cable5/0/0  0                0              0                 0
Cable5/0/1  0                0              0                 0
Cable5/1/0  0                0              0                 0
Cable5/1/1  0                0              0                 0
Cable5/1/2  0                0              0                 0
Cable5/1/3  0                0              0                 0
Cable5/1/4  0                0              0                 0
Cable6/0/0  0                0              0                 0
Cable6/0/1  0                0              0                 0
Cable7/0/0  0                0              0                 0
Cable7/0/1  0                0              0                 0
Cable8/1/0  0                0              0                 0
Cable8/1/1  0                0              0                 1
Cable8/1/2  0                0              0                 0
Cable8/1/3  0                0              0                 0
Cable8/1/4  0                0              0                 0
Total      0                0              0                 1
```

The following example displays information that is available when making a voice call from the same MTA to another MTA on the same interface:

```
Router# show cable calls
```
The following example displays information that is available when a voice call from the same MTA to another MTA on the same interface ends:

Router# show cable calls
Interface ActiveHiPriCalls ActiveAllCalls PostHiPriCallCMs RecentHiPriCMs
  Cable5/0/0 0 0 0 0
  Cable5/0/1 0 0 0 0
  Cable5/1/0 0 0 0 0
  Cable5/1/1 0 0 0 0
  Cable5/1/2 0 0 0 0
  Cable5/1/3 0 0 0 0
  Cable5/1/4 0 0 0 0
  Cable6/0/0 0 0 0 0
  Cable6/0/1 0 0 0 0
  Cable7/0/0 0 0 0 0
  Cable7/0/1 0 0 0 0
  Cable8/1/0 0 0 0 0
  Cable8/1/1 0 2 1 1
  Cable8/1/2 0 0 0 0
  Cable8/1/3 0 0 0 0
  Cable8/1/4 0 0 0 0
  Total 0 2 1 1

The following examples display the show cable modem calls command output on the Cisco CMTS router over a period of time, with changing call status information. The call information disappears when a call ends.

Router# show cable modem calls
Cable Modem Call Status Flags:
H: Active high priority calls
R: Recent high priority calls
V: Active voice calls (including high priority)
MAC Address IP Address I/F Prim CMCallStatus LatestHiPriCall Sid (min:sec)
  0000.cab7.7b04 10.10.155.38 C8/1/1/U0 18 R 0:39

Router# show cable modem calls
Cable Modem Call Status Flags:
H: Active high priority calls
R: Recent high priority calls
V: Active voice calls (including high priority)
MAC Address IP Address I/F Prim CMCallStatus LatestHiPriCall Sid (min:sec)
  0000.cab7.7b04 10.10.155.38 C8/1/1/U0 18 R 0:39

The following example displays a new Emergency 911 call on the Cisco CMTS router:

Router# show cable modem calls
Cable Modem Call Status Flags:
H: Active high priority calls
R: Recent high priority calls
V: Active voice calls (including high priority)
MAC Address IP Address I/F Prim CMCallStatus LatestHiPriCall Sid (min:sec)
  0000.cab7.7b04 10.10.155.38 C8/1/1/U0 18 HV 1:30
The following example displays the end of the Emergency 911 call on the Cisco CMTS router:

```
Router# show cable modem calls
Cable Modem Call Status Flags:
H: Active high priority calls
R: Recent high priority calls
V: Active voice calls (including high priority)
MAC Address  IP Address  I/F  Prim CMCallStatus LatestHiPriCall
         Sid (min:sec)
0000.cab7.7b04 10.10.155.38 C8/1/1/U0 18  R 0:3
```

The following example displays a non-emergency voice call on the Cisco CMTS router from the same MTA:

```
Router# show cable modem calls
Cable Modem Call Status Flags:
H: Active high priority calls
R: Recent high priority calls
V: Active voice calls (including high priority)
MAC Address  IP Address  I/F  Prim CMCallStatus LatestHiPriCall
         Sid (min:sec)
0000.ca36.f97d 10.10.155.25 C8/1/1/U0 5  V  -
0000.cab7.7b04 10.10.155.38 C8/1/1/U0 18  RV 0:30
```

The following example displays the end of the non-emergency voice call on the Cisco CMTS router:

```
Router# show cable modem calls
Cable Modem Call Status Flags:
H: Active high priority calls
R: Recent high priority calls
V: Active voice calls (including high priority)
MAC Address  IP Address  I/F  Prim CMCallStatus LatestHiPriCall
         Sid (min:sec)
0000.cab7.7b04 10.10.155.38 C8/1/1/U0 18  R 0:36
```

**Prerequisites for PacketCable Multimedia Operations**

This section provides information about requirements for the PacketCable Multimedia feature on the Cisco CMTS routers. For information about requirements for the PacketCable feature on the Cisco CMTS routers, see the Prerequisites for PacketCable Operations, on page 2.

**Cisco uBR7225VXR Router**

Support for the Cisco uBR7225VXR router was introduced in Cisco IOS Release 12.2(33)SCA.

**Cisco uBR7246VXR Router**

- To support PacketCable Multimedia and the Communications Assistance for Law Enforcement Act (CALEA) intercept capabilities, a Cisco uBR7246VXR broadband router must be running Cisco IOS Release 12.2(33)SCA and later.

**Cisco uBR10012 Router**

- To support PacketCable Multimedia and the Communications Assistance for Law Enforcement Act (CALEA) intercept capabilities, a Cisco uBR10012 router must be running Cisco IOS Release 12.2(33)SCA and later.

Table below shows the hardware compatibility prerequisites for this feature.
The hardware components introduced in a given Cisco IOS Release are supported in all subsequent releases unless otherwise specified.

### Table 2: PacketCable Multimedia Feature Hardware Compatibility Matrix

<table>
<thead>
<tr>
<th>CMTS Platform</th>
<th>Processor Engine</th>
<th>Cable Interface Cards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco uBR10012 Universal Broadband Router</td>
<td>Cisco IOS Release 12.2(33)SCA and later</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PRE2</td>
<td>Cisco IOS Release 12.2(33)SCA and later</td>
</tr>
<tr>
<td></td>
<td>• Cisco uBR10-MC5X20U/H</td>
<td>• Cisco uBR10-MC5X20U/H</td>
</tr>
<tr>
<td></td>
<td>Cisco IOS Release 12.2(33)SCB and later</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PRE4</td>
<td>Cisco IOS Release 12.2(33)SCC and later</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cisco UBR-MC20X20V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cisco IOS Release 12.2(33)SCE and later</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cisco uBR-MC3GX60V ³</td>
</tr>
<tr>
<td>Cisco uBR7246VXR Universal Broadband Router</td>
<td>Cisco IOS Release 12.2(33)SCA and later</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• NPE-G1</td>
<td>Cisco IOS Release 12.2(33)SCA and later</td>
</tr>
<tr>
<td></td>
<td>• NPE-G2</td>
<td>• Cisco uBR-MC28U/X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cisco IOS Release 12.2(33)SCD and later</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cisco uBR-MC88V ⁴</td>
</tr>
<tr>
<td>Cisco uBR7225VXR Universal Broadband Router</td>
<td>Cisco IOS Release 12.2(33)SCA and later</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• NPE-G1</td>
<td>Cisco IOS Release 12.2(33)SCA and later</td>
</tr>
<tr>
<td></td>
<td>• Cisco uBR-E-28U</td>
<td>• Cisco uBR-E-28U</td>
</tr>
<tr>
<td></td>
<td>• Cisco uBR-E-16U</td>
<td>• Cisco uBR-MC28U/X</td>
</tr>
<tr>
<td></td>
<td>• Cisco uBR-MC28U/X</td>
<td>Cisco IOS Release 12.2(33)SCD and later</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cisco uBR-MC88V</td>
</tr>
</tbody>
</table>

³ Cisco uBR3GX60V cable interface line card is compatible only with PRE4.
⁴ Cisco uBR-MC88V cable interface line card is compatible only with NPE-G2.
Restrictions for PacketCable Multimedia Operations

The PacketCable Multimedia feature supports only the unicast gate-based PCMM configuration in Cisco IOS Releases earlier than Cisco IOS Release 12.2(33)SCE.

Information About PacketCable Multimedia Operations

The PacketCable Multimedia (PCMM) feature is a powerful implementation of the CableLabs® standards for PacketCable Multimedia. PCMM provides enhanced QoS for multimedia applications, voice, and bandwidth-intensive services over a DOCSIS (DOCSIS 1.1 and later versions) network.

The Cisco CMTS router supports DOCSIS QoS for SIP-based telephones and SIP video phones, Bandwidth-on-Demand applications, and network-based gaming applications, all of which place extensive bandwidth demands on the network.

This section provides information about the following aspects of PacketCable Multimedia for the Cisco CMTS router, emphasizing PCMM components that are configured with the Cisco IOS command-line interface later in this document:

PCMM Overview

The following network components are required to support the PCMM feature:

- Application Server—Responsible for relaying client requests to the Application Manager.
- Application Manager—Responsible for application or session-level state and for applying session control domain (SCD) policy.
- Policy Server—Responsible for applying the RCD policy and for managing relationships between the Application Manager and a Cisco CMTS router.
- Cisco CMTS router—Responsible for performing admission control and managing network resources through DOCSIS service flows.
Figure below provides an architectural overview of the PCMM functionality:

**Figure 1: PCMM Architectural Overview**

**PCMM Enhancements over PacketCable 1.x**

PacketCable Multimedia is a service delivery framework that leverages and uses as much of existing PacketCable 1.x deployments and functionality as possible. Furthermore, PCMM offers powerful enhancements to the VoIP service delivery framework with straightforward CLI implementation. The key enhancements that the PCMM provides are:

- Time and volume based network resource authorizations are based on DOCSIS 1.1 Quality of Service (QoS) mechanisms.
- Event-based network resource auditing and management functions.
- Secure infrastructure that protects all interfaces at appropriate levels.
- Preauthorized model from PacketCable 1.x, where the PCMM gate installation and management is supplemented with service flow creation, modification and deletion functions. Together, these provide a secure, network-based QoS.
PCMM and High Availability Features on the Cisco CMTS Router

In Cisco IOS Release 12.2(33)SCA and later, High Availability on the Cisco CMTS router only accommodates synchronization of service flows created for the PCMM applications. This means that the PCCM gate configuration will be recreated in the standby line card in the event of a PRE or line card switchover.

PCMM Gates

PCMM Gate Overview and PCMM Dynamic Quality of Service

A PacketCable 1.x gate defines QoS parameters and policy-based authorization for subscribers, and a specific envelope of network resources. A PacketCable 1.x gate also maintains classifiers for originating and terminating IP addresses and ports.

Before Cisco IOS Release 12.2(33)SCE, the subscriber ID was used to identify only the IPv4 address of either the cable modem or the client CPE. The PCMM feature includes support for IPv6 addresses in Cisco IOS Release 12.2(33)SCE and later. This means that the subscriber ID can identify both IPv4 and IPv6 addresses.

PacketCable 1.x defines a preauthorization model. The PacketCable gates are created and installed at the Cisco CMTS router prior to network resource reservation or activation requests. This process, termed gate control, is managed through a COPS-based policy interface on the Cisco CMTS router.

In PCMM, this COPS-based interface is enhanced for QoS life-cycle management. PCMM gates maintain service flow creation, modification and deletion functions to provide for network-based QoS. Multiple PCMM gates and service flow policies can be maintained on the Cisco CMTS router at a given time, and these PCMM gates are fully interoperable with PacketCable 1.x gates.

When a cable modem subscriber requests bandwidth for a network-intensive application, the network Policy Server sends a Gate-Set message to the Cisco CMTS router. This message contains QoS, service flow, and billing information for this subscriber. This gate profile information is maintained on the Cisco CMTS router, to include PCMM gate states and PCMM state transitions.

The Cisco CMTS router initiates service flows with cable modems, and optimizes DOCSIS resource availability on the Cisco CMTS router for bandwidth-intensive service flows characteristic to PCMM.

Restrictions

On some upstream paths, best effort service flows are configured on some modems with Committed Information Rate (CIR). When a number of bandwidth requests are queued in the modems, only a few requests are sent to the CMTS. This occurs due to congestion of sending requests caused by higher number of service flows, greater traffic and small size of packets. Therefore, only a few best effort service flow requests are satisfied by the CMTS.

PCMM Persistent Gate

Cisco IOS Release 12.2(33)SCA supports the Persistent Gate feature for PacketCable Multimedia. Persistent Gate is a feature by which PCMM gate information is maintained for cable modems that go offline. This gate information is quickly enabled after a cable modem returns online. When a cable modem returns online, the Cisco CMTS router scans PCMM gates previously stored, and initiates service to the cable modem according to the respective PCMM gate. This re-enabled service maintains traffic support profiles for that gate, and allocates DOCSIS resources based on the new online subscriber.
The Cisco CMTS router maintains the PC and PCMM gate databases separately and independently. Information for either is available with multiple `show` commands.

## PCMM Interfaces

PCMM optimizes the IPC handshake between the cable interface line card and the Network Processing Engine (NPE) for the Cisco uBR7246VXR router, or the Route Processor (RP) for the Cisco uBR10012 router. Additional PCMM interface changes from PacketCable 1.x include the handling for COPS interface and distributed cable interface line cards.

### PCMM to COPS Interface

PCMM differs from PacketCable 1.x in handling COPS sessions. The COPS sessions on PCMM use TCP port number 3918 by default. Whereas, PacketCable uses the DQoS specification for TCP port requirements and COPS sessions.

When the PCMM module initializes for the first time, a PCMM registry is added to the cable interface line card and the route processor. The PCMM module also registers the PCMM COPS client with the COPS layer on the Cisco CMTS router.

### PCMM and Distributed Cable Interface Line Cards

As with PacketCable 1.x, PCMM uses IPC messages for voice support. When PCMM gates are created on the Network Processing Engine (NPE) or route processor (RP), the PCMM gate parameters are sent to cable interface line cards. IPC maintains all communication between the NPE or RP, and the cable interface line cards.

Event messaging is used with PCMM to support billing information based on Gate-Set messages. Event messaging for distributed cable interface line cards originates from the line cards, based on the success of DSX operation.

The PCMM module also registers the PCMM COPS client with the COPS layer.

## PCMM Unicast and Multicast

The PacketCable Multimedia feature supports only the unicast gate-based PCMM configuration in Cisco IOS Releases earlier than Cisco IOS Release 12.2(33)SCE. In unicast transmission, content is sent to a unique user.

Support for the PCMM multicast feature was introduced in Cisco IOS Release 12.2(33)SCE. In multicast transmission, content is sent to multiple users simultaneously.

### PCMM Multicast Session Range

Beginning with Cisco IOS Release 12.2(33)SCE, you can configure a PCMM multicast session range by specifying IPv4 IP addresses and a mask for a PCMM multicast group. The PCMM multicast session range enables the Cisco CMTS router to accept Gate-Set messages from the PCMM Policy Server. If a PCMM multicast session range is configured, the Cisco CMTS router does not allow you to create multicast sessions using other sources such as Internet Group Management Protocol (IGMP) and DOCSIS Set-Top Gateway (DSG).
PCMM Multicast

Beginning with Cisco IOS Release 12.2(33)SCJ, you can enable PCMM multicast by using `packetcable multimedia` command. Now both PCMM multicast and mVPN feature can work simultaneously, except for the NextGen mVPN.

The following restrictions are applicable to the PCMM Multicast feature:

- PCMM multicast can not work in VRF.
- Encrypted PCMM multicasts Service Flows are not supported.
- The number of unique GCs, GQCs and Service-Class definitions is restricted to 512.
- After switchover, traffic forwarding can take up to 10 secs to resume.
- Locally configured GCs and GQCs on the interface will not be applicable to PCMM flows, even if they match the PCMM multicast IP address range.
- IPv6 based classifiers are not supported.
- Non-MDF capable CM will not be supported.

PCMM IPv6 Voice

Starting with Cisco IOS Release 12.2(33)SCJ, the Cisco CMTS routers support the PCMM IPv6 Voice feature. As DOCSIS 3.0 has introduced new requirements and features to be used in Cable network, PCMM I04 specification has also incorporated a list of ECN to take advantage these new DOCSIS features, and a few other enhancements. IPv6 Subscriber and Classifier ECN added new objects to support:

- IPv6 subscriber ID object for PCMM session triggering by IPv6 subscriber.
- IPv6 classifier for both upstream and downstream service flow.

How to Configure PCMM Operations

The following tasks describe how to enable PCMM operations and configure its related features on the Cisco CMTS router:

Enabling PCMM Operations on the Cisco CMTS Router

To enable PCMM operations on the Cisco CMTS router:

<table>
<thead>
<tr>
<th>DETAILED STEPS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Command or Action</strong></td>
</tr>
<tr>
<td>Step 1</td>
</tr>
<tr>
<td>Step 2</td>
</tr>
<tr>
<td>--------</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>packetcable multimedia</td>
<td>Enables and displays PCMM processing on the Cisco CMTS router. This command enables the Cisco CMTS router to start or stop responding to PCMM COPS messages received from the PCMM Policy Server.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# packetcable multimedia</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 4</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>packetcable authorize vanilla-docsis-mta</td>
<td>Allows non-DQoS MTAs to send DOCSIS DSX messages.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# packetcable authorize vanilla-docsis-mta</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 5</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>packetcable gate maxcount n</td>
<td>Sets the maximum number of PCMM gates in the gate database.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# packetcable gate maxcount 890</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 6</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>packetcable timer multimedia T1 timer-value</td>
<td>Sets the timeout value for T1 timer used in PCMM gate processing.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# packetcable timer multimedia T1 300000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 7</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>clear packetcable gate counter commit [d qos</td>
<td>multimedia]</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# clear packetcable gate counter commit multimedia</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 8</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# end</td>
<td></td>
</tr>
</tbody>
</table>
Configuring a PCMM Multicast Session Range

A PCMM multicast session range enables the Cisco CMTS router to use a range of IP addresses for a PCMM multicast group.

**Before You Begin**

Ensure that PCMM is configured using the `packetcable multimedia` command.

**Note**

- You can configure only one PCMM multicast group on the Cisco CMTS router. You can configure a maximum of ten multicast sessions for a single multicast group.
- The PCMM multicast feature is supported only with the cable modems that are capable of Multicast DSID-based Forwarding (MDF).

### Detailed Steps

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router# configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> cable multicast source pcmm</td>
<td>Enables PCMM-based multicast service on the Cisco CMTS router and enters multicast session range configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router(config)# cable multicast source pcmm</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> session-range ip-address ip-mask</td>
<td>Configures a session range for the PCMM multicast group.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router(config)# session-range 229.0.0.0 255.0.0.0</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router(config)# end</code></td>
<td></td>
</tr>
</tbody>
</table>
Configuration Examples for PacketCable Multimedia

The following sections provide configuration examples for PCMM operations on the Cisco CMTS router:

Example: Enabling PCMM Operations on the Cisco CMTS Router

```
Router# configure terminal
Router(config)# packetcable multimedia
Router(config)# packetcable authorize vanilla-docsis-mta
Router(config)# packetcable gate maxcount 890
Router(config)# packetcable timer multimedia 30000
```

Example: Enabling a Multicast Session Range on the Cisco CMTS Router

```
Router# configure terminal
Router(config)# cable multicast source pcmm
Router(config)# session-range 229.0.0.0 255.0.0.0
```

Verifying PCMM Operations

Use the following `show` commands to verify PCMM operations:

- `show packetcable gate multimedia`
- `show cable multicast db`
- `show interface wideband-cable`
- `show cable multicast qos`

To verify the PCMM multicast gates, use the `show packetcable gate multimedia` command as shown in the following example:

```
Router# show packetcable gate multimedia multicast summary
GateID i/f SubscriberID GC-Addr State Type SFID(us) SFID(ds)
134 Ca5/0/0 60.1.1.202 2.39.26.19 COMMIT MM 4
Total number of Multimedia-MCAST gates = 1
Total Gates committed(since bootup or clear counter) = 1
```

To verify the PCMM IPv6 gates, use the `show packetcable gate multimedia ipv6` command as shown in the following example:

```
Router# show packetcable gate multimedia ipv6 summary
Load for five secs: 10%/1%; one minute: 9%; five minutes: 9%
Time source is NTP, 03:29:42.153 EST Mon Nov 9 2015
GateID i/f SubscriberID State SFID(us) SFID(ds)
```
<table>
<thead>
<tr>
<th>MAC Address</th>
<th>Interface</th>
<th>Service Flow ID</th>
<th>Fwd Intf</th>
<th>Host Intf</th>
<th>CM MAC</th>
<th>CPE IP</th>
<th>Gate-ID</th>
<th>SFID</th>
</tr>
</thead>
<tbody>
<tr>
<td>65953</td>
<td>Ca5/0/2</td>
<td>2001:420:2C7F:FC38:5AB:AA0B:34AD:ACCF</td>
<td>COMMIT 1336</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>82337</td>
<td>Ca5/0/2</td>
<td>2001:420:2C7F:FC38:5AB:AA0B:34AD:ACCF</td>
<td>COMMIT 1337</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number of Multimedia gates = 10
Total Gates committed (since bootup or clear counter) = 1024

To verify all the PCMM client entries available with the multicast database, use the `show cable multicast db` command as shown in the following example:

```
Router# show cable multicast db client pcmm
Interface : Bundle1
Session (S,G) : (*,229.2.2.12)
Fwd Intf Bundle Intf Host Intf CM MAC CPE IP Gate-ID SFID
Wi1/1/0:0 Bundle1 Ca5/0/0 0018.6852.8056 60.1.1.202 134 4
```

To verify multicasts sessions on a specific wideband cable interface, use the `show interface wideband-cable` command as shown in the following example:

```
Router# show interface wideband-cable 1/1/0:0 multicast-sessions
Default Multicast Service Flow 3 on Wideband-Cable1/1/0:
Multicast Group : 229.2.2.12
Source : N/A
Act GCRs : 1
Interface : Bu1 State: A GI: Bu1 RC: 0
GCR : GC SAID SFID Key GQC GEn
512 8196 4 0 512 0
```

To verify the attribute-based assignment of service flows on a specific wideband cable interface, use the `show interface wideband-cable` command as shown in the following example:

```
Router# show interface wideband-cable 1/1/0:0
service-flow 4 verbose
Sfid : 4
Mac Address : ffff.ffff.ffff
Type : Secondary(Static)
Direction : Downstream
Current State : Active
Active Time : 05:26
Required Attributes : 0x00000000
Forbidden Attributes : 0x00000000
Aggregate Attributes : 0x00000000
Multicast Sid : 8196
Traffic Priority : 0
Maximum Sustained rate : 0 bits/sec
Maximum Burst : 3044 bytes
Minimum Reserved Rate : 250000 bits/sec
Minimum Packet Size : 0 bytes
Maximum Latency : 0 usecs
Peak Rate : 0 bits/sec
Admitted QoS Timeout : 200 seconds
Active QoS Timeout : 0 seconds
Packets : 0
Bytes : 0
Rate Limit Delayed Packets : 0
Rate Limit Dropped Packets : 0
Current Throughput : 0 bits/sec, 0 packets/sec
Application Priority : 0
Low Latency App : No
```
To verify that the PCMM-basedMQoS gate controllers are created using the correct session ranges, use the 
`show cable multicast qos` command as shown in the following example:

```
Router# show cable multicast qos group-qos
```

<table>
<thead>
<tr>
<th>Group QOS Index</th>
<th>Service Class</th>
<th>Control</th>
<th>Igmp Limit</th>
<th>Override</th>
<th>App</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFAULT</td>
<td>mcast_default</td>
<td>Aggregate</td>
<td>NO-LIMIT</td>
<td>No</td>
<td>CLI</td>
</tr>
<tr>
<td>1</td>
<td>SDV_SD</td>
<td>Single</td>
<td>---</td>
<td>No</td>
<td>CLI</td>
</tr>
<tr>
<td>512</td>
<td>SDV_HD</td>
<td>Single</td>
<td>---</td>
<td>No</td>
<td>PCMM</td>
</tr>
</tbody>
</table>

**High Availability Stateful Switchover (SSO) for PacketCable and PacketCable MultiMedia**

Cisco IOS Release 12.2(33)SCA includes enhanced high availability support that enables the synchronization of PacketCable and PacketCable MultiMedia (PCMM) gates during switchover events on the Cisco CMTS router. This enhancement is enabled by default on the Cisco uBR10012 router and Cisco uBR7246VXR router. This enhancement requires no additional configuration commands for line card redundancy in the Cisco N+1 Redundancy feature, nor the RPR+ Redundancy feature on the Cisco uBR10012 router. However, this functionality uses the existing per-interface HCCP commands that are used to associate the working and protect interfaces in the case of N+1 redundancy.

**Debugging High Availability Stateful Switchover for PacketCable and PCMM**

The `debug packetcable hccp` command enables debugging and troubleshooting functions on the Cisco CMTS router when PacketCable and PCMM features are supported in N+1 or RPR+ redundancy mode.

After the implementation of the PacketCable or PCMM feature, you will be able to connect to the standby line card and check if the gate information has been synchronized using the `show packetcable gate summary` command.

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
</tbody>
</table>
| **Example:**
  Router> enable                  | • Enter your password if prompted. |
| **Step 2**                      |         |
| `debug packetcable hccp`        | Enables debugging for gate synchronization within N+1 or RPR+ redundancy mode when they are operational on the network. To disable debugging, use the `no` form of this command. |
| **Example:**
  Router# debug packetcable hccp |         |
### Step 3
**Command or Action**: `showpacketcablegatesummary`  
**Purpose**: Displays PacketCable HCCP information, supporting gate synchronization status and switchover information.

**Example:**
```
Router# show packetcable gate summary
```

### Step 4
**Command or Action**: `showhccpbrief`  
**Purpose**: Displays general information pertaining to N+1 redundancy on the Cisco CMTS router.

**Example:**
```
Router# show hccp brief
```

The following abbreviated example displays PacketCable gate synchronization information when debugging is enabled with the `debug packetcable hccp` command:

<table>
<thead>
<tr>
<th>GateID</th>
<th>i/f</th>
<th>SubscriberID</th>
<th>GC-Addr</th>
<th>State</th>
<th>Type</th>
<th>SFID(us)</th>
<th>SFID(ds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5242</td>
<td>Ca5/0/0</td>
<td>7.7.1.254</td>
<td>1.10.90.1</td>
<td>COMMIT</td>
<td>DQoS</td>
<td>1233</td>
<td>1234</td>
</tr>
</tbody>
</table>

The following example displays additional information that tracks the activity as a call is made:

```
10:58:09: PktCbl(hccp): Grp 1 sync type=add from Cable5/0/0
10:58:09: PktCbl(hccp): Sync gate-add 38010 len=308
10:58:10: PktCbl(hccp): Grp 1 sync type=add from Cable5/0/0
10:58:10: PktCbl(hccp): Sync gate-add 5242 len=308
10:58:10: PktCbl(hccp): Gate=5242 written to service flow dir US SFID=1233
10:58:10: PktCbl(hccp): Gate=5242 written to service flow dir DS SFID=1234
10:58:10: PktCbl(hccp): Sync gate-update 5242 len=24
10:58:10: PktCbl(hccp): Grp 1 sync type-update from Cable5/0/0
10:58:10: PktCbl(hccp): Gate=38010 written to service flow dir US SFID=1235
10:58:10: PktCbl(hccp): Gate=38010 written to service flow dir SFID=1235
10:58:10: PktCbl(hccp): Parse add gate 38010 sync_len=300 from 5/0 status 2
10:58:10: PktCbl(hccp): Parse add gate 38010 sync_len=16
10:58:10: PktCbl(hccp): Gate=38010 written to service flow dir US SFID=1236
10:58:10: PktCbl(hccp): Gate=38010 written to service flow dir DS SFID=1236
10:58:10: PktCbl(hccp): Sync gate-update 38010 len=24
10:58:10: PktCbl(hccp): Grp 1 sync type-update from Cable5/0/0
10:58:10: PktCbl(hccp): Gate=38010 written to service flow dir US SFID=1235
10:58:11: PktCbl(hccp): Gate=38010 written to service flow dir SFID=1235
10:58:11: PktCbl(hccp): Gate=5242 written to service flow dir US SFID=1233
10:58:11: PktCbl(hccp): Gate=5242 written to service flow dir DS SFID=1234
10:58:11: PktCbl(hccp): Sync gate-update 5242 len=24
10:58:11: PktCbl(hccp): Grp 1 sync type-update from Cable5/0/0
10:58:11: PktCbl(hccp): Gate=38010 written to service flow dir US SFID=1235
10:58:11: PktCbl(hccp): Gate=38010 written to service flow dir DS SFID=1236
10:58:11: PktCbl(hccp): Grp 1 sync type-update from Cable5/0/0
10:58:11: PktCbl(hccp): Gate=38010 written to service flow dir US SFID=1235
10:58:11: PktCbl(hccp): Gate=38010 written to service flow dir DS SFID=1236
10:58:11: PktCbl(hccp): Grp 1 sync type-update from Cable5/0/0
10:58:11: PktCbl(hccp): Gate=5242 written to service flow dir US SFID=1233
10:58:11: PktCbl(hccp): Gate=5242 written to service flow dir DS SFID=1234
10:58:11: PktCbl(hccp): Sync gate-update 5242 len=24
10:58:34: PktCbl(hccp): Parse update gate 38010 sync_len=16
10:58:34: PktCbl(hccp): Parse update gate 5242 sync_len=16
10:58:34: PktCbl(hccp): Gate=38010 written to service flow dir US SFID=1235
10:58:34: PktCbl(hccp): Gate=38010 written to service flow dir DS SFID=1236
10:58:34: PktCbl(hccp): Gate=5242 written to service flow dir US SFID=1233
10:58:34: PktCbl(hccp): Gate=5242 written to service flow dir DS SFID=1234
```

sch_3 gate

<table>
<thead>
<tr>
<th>GateID</th>
<th>i/f</th>
<th>SubscriberID</th>
<th>GC-Addr</th>
<th>State</th>
<th>Type</th>
<th>SFID(us)</th>
<th>SFID(ds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5242</td>
<td>Ca5/0/0</td>
<td>7.7.1.254</td>
<td>1.10.90.1</td>
<td>COMMIT</td>
<td>DQoS</td>
<td>1233</td>
<td>1234</td>
</tr>
<tr>
<td>38010</td>
<td>Ca5/0/0</td>
<td>7.7.1.252</td>
<td>1.10.90.1</td>
<td>COMMIT</td>
<td>DQoS</td>
<td>1235</td>
<td>1236</td>
</tr>
</tbody>
</table>

Total number of gates = 2

Total Gates committed(since bootup or clear counter) = 627
The following is a sample output of the `show hccp` command:

```
Router# show hccp brief

Interface Config Grp Mbr Status WaitToResync WaitToRestore
Ca5/0/0 Working 1 1 active never
Ca8/0/0 Protect 1 1 standby
Ca8/0/0 Protect 1 2 non-functional
Ca8/1/0 Protect 3 1 non-functional
Ca8/1/1 Protect 4 1 non-functional

sch_3#
```

PacketCable and PCMM with Admission Control

A PacketCable or PacketCable Multimedia network contains a number of components that benefit from Admission Control QoS. Admission Control manages and optimizes QoS for PacketCable and PCMM in these ways:

- QoS (based on DOCSIS 1.1 or later versions) for voice and data
- Cable modem registration
- CMS
- Gateway controllers (GC)
- Record keeping servers (RKS)
- Video telephony

When configuring Admission Control with either PacketCable or PCMM, PacketCable or PCMM must be fully operational on the Cisco CMTS headend prior to gaining the benefits from Admission Control.

For Admission Control configuration information, refer to the following documents:

- Admission Control for the Cisco Cable Modem Termination System
- Service Flow Admission Control for the Cisco Cable Modem Termination System

Voice MGPI Support

The multiple grants per interval (MGPI) feature, introduced in Cisco IOS Release 12.2(33)SCF, enables the Cisco CMTS router to map multiple PacketCable or PacketCable Multimedia gates (application flows) to a single DOCSIS service flow using UGS traffic profiles of the same cable modem. In other words, the Cisco CMTS router increases the number of grants per interval for each application flow based on a single service flow, resulting in multiple grants per interval.

The MGPI feature supports the flow-aggregated voice MGPI functionality based on CableLabs PacketCable Specification (PKT-SP-MM-I05-091029). The flow-aggregated MGPI functionality allows the application manager to use the UGS traffic profile to explicitly set the number of grants per interval and place several
application flows on a single gate. This results in an aggregated view for event messages, volume, and time usage limits.

**Voice Support Over DOCSIS 3.0 E-MTAs**

Beginning with Cisco IOS Release 12.2(33)SCF, PacketCable and PCMM services are supported on embedded multimedia terminal adapters (E-MTAs). An E-MTA is a network element that contains the interface to a physical voice device, a network interface, and all signaling and encapsulation functions required for the VoIP transport, class features signaling, and QoS signaling.

**PacketCable and PCMM Call Trace**

The PacketCable and PCMM call trace functionality is introduced in Cisco IOS Release 12.2(33)SCF for advanced debugging of PacketCable and PCMM calls. To effectively capture signaling information, this functionality buffers signaling for a configured number of PacketCable or PCMM gates. By default, only ten user-configured gate traces are saved in a buffer. After the specified number is reached, any subsequent gate signaling information does not get buffered. When one of the gates being traced is deleted, gate signaling of a new gate is buffered.

Use the `cable dynamic-qos trace` command in global configuration mode to enable the call trace functionality for PacketCable and PacketCable Multimedia gates on the Cisco CMTS router. You will have to specify the number of subscribers for whom call trace needs to be enabled.

**Verifying Call Traces**

Use the following commands to verify PacketCable and PCMM call trace functionality on the Cisco CMTS router:

- `debug cable dynamic-qos subscriber`
- `debug cable dynamic-qos trace`
- `show cable dynamic-qos trace`

To verify debugging information for all the configured subscribers on the Cisco CMTS router, use the `debug cable dynamic-qos subscriber` command as shown in the following example:

```
Router# debug cable dynamic-qos subscriber
CMTS dynqos subscriber debugging is on ubr10k#
*Mar 17 08:32:27.135: Pktcbl(qdb): Created gate IE on Cable7/1/0, gateid = 108042
*Mar 17 08:32:27.135: Pktcbl(qdb): Found Cable7/1/0 for Gate=108042 21.21.2.10
*Mar 17 08:32:27.135: Pktcbl(mm): Change profile 0 qos 0
*Mar 17 08:32:27.135: Pktcbl(qdb): IPC timer [id 108042] [10000 msec]
*Mar 17 08:32:27.135: Pktcbl(mm): Found Cable7/1/0 for Gate=108042 21.21.2.10
*Mar 17 08:32:27.135: Pktcbl(qdb): MM gate spec: t1:200, t2:0, t3:0, t4:0
*Mar 17 08:32:27.135: Pktcbl(qdb): MM Authorized Profile
*Mar 17 08:32:27.135: Pktcbl(qdb): MM Reserved Profile
*Mar 17 08:32:27.135: Pktcbl(qdb): MM Committed Profile
*Mar 17 08:32:27.135: Classifier prototype: 1, src: 9.9.1.95, dest: 2.39.26.11, src port: 0, dest port: 0
*Mar 17 08:32:27.179: Pktcbl(mm): Received gate-set IPC RSP from LC for gate 108
```
042  rsp 1 state new(4) old(2)
*Mar 17 08:32:27.179: Pktcbl(gdb): Found Cable7/1/0 for Gate=108042 21.21.2.10
*Mar 17 08:32:27.179: Pktcbl(gdb): Started gate [id 108042] timer [type 3] [0 ms ec]
*Mar 17 08:32:27.179: Pktcbl(d2r): extract id: gate=108042, resource=74
*Mar 17 08:32:27.179: Pktcbl(mm-r2d): DSA-ACK notification received on RP, gateid 108042 sfid 74
*Mar 17 08:32:27.179: PktCbl(d2r): extract id: gate=108042, resource=74
*Mar 17 08:32:27.179: Pktcbl(gdb): TOS Overwrite gate spec info, gate_id=108042 dir=1 gie=26DD5C98
*Mar 17 08:32:27.179: Pktcbl(gdb): TOS Overwrite Gate=108042 DSCP=0xD0 mask=0xF
*Mar 17 08:32:27.179: PktCbl(d2r): extract id: gate=108042, resource=74
*Mar 17 08:32:27.183: Pktcbl(gdb): Found Cable7/1/0 for Gate=108042 21.21.2.10
*Mar 17 08:32:27.183: Pktcbl(gdb): Found Cable7/1/0 for Gate=108042 21.21.2.10
*Mar 17 08:32:27.183: PktCbl(mm): Building GCP message, added obj TRANSACTION
ubr10k# ID ; len:8 padding:0
*Mar 17 08:32:27.183: Pktcbl(mm): Building GCP message, added obj AM ID ; len:8 padding:0
*Mar 17 08:32:27.183: Pktcbl(mm): Building GCP message, added obj SUBSCRIBER ID ; len:8 padding:0
*Mar 17 08:32:27.183: Pktcbl(mm): Building GCP message, added obj GATE ID ; len:8 padding:0
*Mar 17 08:32:27.183: Pktcbl(mm): Building GCP message, added obj OPAQUE ; len:12 padding:0
*Mar 17 08:32:27.183: Pktcbl(mm): Built GCP message, GATE SET ACK, length: 44, copsLen 72
*Mar 17 08:32:27.183: --- Pktcbl: Sending GCP message -----
*Mar 17 08:32:27.183: TRANSACTION ID : Object.[snum/stype/len 1/1/8]
*Mar 17 08:32:27.183: transaction id : 0x1
*Mar 17 08:32:27.183: gcp cmd : 5 (GATE SET ACK)
*Mar 17 08:32:27.183: AM ID : Object.[snum/stype/len 2/1/8]
*Mar 17 08:32:27.183: AM ID : 0x1 (0/1)
*Mar 17 08:32:27.183: GATE ID : Object.[snum/stype/len 4/1/8]
*Mar 17 08:32:27.183: GateID : 108042 (0x1A60A)
*Mar 17 08:32:27.183: GATE SPEC : Object.[snum/stype/len 5/1/16]
*Mar 17 08:32:27.183: flag : 0x3
*Mar 17 08:32:27.183: dscp : 0x08
*Mar 17 08:32:27.183: dscp tos mask : 0xF0
*Mar 17 08:32:27.183: Timers t1 : 0, t2 : 0
*Mar 17 08:32:27.183: t3 : 0, t4 : 0
*Mar 17 08:32:27.183: session class : 0x0
*Mar 17 08:32:27.183: TRAFFIC PROFILE : Object.[snum/stype/len 7/6/56]
*Mar 17 08:32:27.183: envelope : 0x7
*Mar 17 08:32:27.183: service number : 0x0
*Mar 17 08:32:27.183: Authorized : 0
*Mar 17 08:32:27.183: Request Xmit Policy: 0x17F
*Mar 17 08:32:27.183: Grant size : 232
*Mar 17 08:32:27.183: Grant Per Interval : 2
*Mar 17 08:32:27.183: Grant Interval : 20000

SLOT 7/1: Mar 17 08:32:27.152: Pktcbl(gdb): Gate ID 108042 not found in gdb, pktcbl_find_gate_ie.
SLOT 5/0: Mar 17 08:32:27.151: Pktcbl(gdb): Gate ID 108042 not found in gdb, pktcbl_find_gate_ie.

ubr10k#
To verify call trace debugging information for all the configured subscribers on the Cisco CMTS router, use the `debug cable dynamic-qos trace` command as shown in the following example:

Router# debug cable dynamic-qos trace

CMTS dynqos trace debugging is on ubr10k#

*Mar 17 02:43:05.448: Pktcbl(mm): Received GATE SET message, tid=0x2
*Mar 17 02:43:05.448: --- Pktcbl(mm): Received GCP message ------
*Mar 17 02:43:05.448: TRANSACTION ID : Object.[snum/stype/len 1/1/8]
*Mar 17 02:43:05.448: transaction id : 0x2
*Mar 17 02:43:05.448: gcp cmd : 4 (GATE SET)
*Mar 17 02:43:05.448: AM ID : Object.[snum/stype/len 2/1/8]
*Mar 17 02:43:05.448: AM ID : 0x1 (0/1)
*Mar 17 02:43:05.448: SUBSCRIBER ID : Object.[snum/stype/len 3/1/8]
*Mar 17 02:43:05.448: Addr : 21.21.2.10
*Mar 17 02:43:05.448: GATE ID : Object.[snum/stype/len 4/1/8]
*Mar 17 02:43:05.448: GateID : 58886 (0xE606)
*Mar 17 02:43:05.448: GATE SPEC : Object.[snum/stype/len 5/1/16]
*Mar 17 02:43:05.448: flag : 0x3
*Mar 17 02:43:05.448: dscp : 0xD8
*Mar 17 02:43:05.448: dscp tos mask : 0xF0
*Mar 17 02:43:05.448: Timers t1 : 0, t2 : 0
*Mar 17 02:43:05.448: t3 : 0, t4 : 0
*Mar 17 02:43:05.448: session class : 0x0
*Mar 17 02:43:05.448: TRAFFIC PROFILE : Object.[snum/stype/len 7/6/56]
*Mar 17 02:43:05.448: envelope : 0x7
*Mar 17 02:43:05.448: service number : 0x0
*Mar 17 02:43:05.448: Authorized :
*Mar 17 02:43:05.448: Request Xmit Policy: 0x17F
*Mar 17 02:43:05.448: Grant size : 232
*Mar 17 02:43:05.448: Grant Per Interval : 2
*Mar 17 02:43:05.448: Grant Interval : 20000
*Mar 17 02:43:05.448: Tolerated Jitter : 800
*Mar 17 02:43:05.448: Required Mask : 0
*Mar 17 02:43:05.448: Forbidden Mask : 0
*Mar 17 02:43:05.448: Aggr Rule Mask : 0
*Mar 17 02:43:05.448: Reserved :
*Mar 17 02:43:05.448: Request Xmit Policy: 0x17F
*Mar 17 02:43:05.448: Grant size : 232
*Mar 17 02:43:05.448: Grant Per Interval : 2
*Mar 17 02:43:05.448: Grant Interval : 20000
*Mar 17 02:43:05.448: Tolerated Jitter : 800
*Mar 17 02:43:05.448: Required Mask : 0
*Mar 17 02:43:05.448: Forbiden Mask : 0
*Mar 17 02:43:05.448: Aggr Rule Mask : 0
*Mar 17 02:43:05.448: Reserved :

Verifying Call Traces
**Mar 17 02:43:05.452:** dscp tos mask : 0x0
**Mar 17 02:43:05.452:** src/port : 9.9.1.43 0
**Mar 17 02:43:05.452:** dest/port : 2.39.26.19 0
**Mar 17 02:43:05.452:** priority : 64
**Mar 17 02:43:05.452:** OPAQUE : Object.[snum/stype/len ubr10k#n 11/1/12]
**Mar 17 02:43:05.452:** data : [31 32 33 34 00 00 00 00 ]

<table>
<thead>
<tr>
<th>Mar 17 02:43:05.452</th>
<th>Backup gate IE [58886]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(qdb): Found Cable7/1/0 for Gate=58886 21.21.2.10</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(mm): Change profile 1 qos 1</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(qdb): IPC timer [id 58886] [10000 msec]</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(qdb): Started gate [id 58886] timer [type 8] [10000 msec]</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(qdb): Found Cable7/1/0 for Gate=58886 21.21.2.10</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(qdb): MM gate spec: t1:200, t2:0, t3:0, t4:0</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(qdb): MM traffic profile type: 6</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(qdb): MM Authorized Profile</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(gdb): MM Reserved Profile</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(gdb): MM Committed Profile</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Classifier prototype: 1, src: 9.9.1.95, dest: 2.39.26.11, src port: 0, dest port: 0</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Classifier prototype: 1, src: 9.9.1.43, dest: 2.39.26.19, src port: 0, dest port: 0</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(mm): Received gate-set IPC RSP from LC for gate 58886 \nstate new(4) old(4)</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(gdb): Cancelled gate [id 58886] timer [type 8]</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(gdb): Found Cable7/1/0 for Gate=58886 21.21.2.10</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(gdb): Started gate [id 58886] timer [type 3] [0 msec]</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(gdb): Cleanup saved gate IE info, gate(58886)</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(mm): Building GCP message, added obj TRANSACTION ID</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(mm): Building GCP message, added obj AM ID</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(mm): Building GCP message, added obj SUBSCRIBER ID</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(mm): Building GCP message, added obj GATE ID</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(mm): Building GCP message, added obj OPAQUE</td>
</tr>
<tr>
<td>Mar 17 02:43:05.452</td>
<td>Pktcbl(mm): Built GCP message, GATE SET ACK</td>
</tr>
</tbody>
</table>

To verify the number of subscribers for whom call trace is enabled on the Cisco CMST router, use the `show cable dynamic-qos trace` command as shown in the following example:

```
Router# show cable dynamic-qos trace
Total number of subscribers: 0
Max configured number of subscribers: 12
```
Verifying PacketCable and PCMM Statistics

Use the following commands to verify PacketCable and PCMM statistics on the Cisco CMTS router:

- `show interface cable dynamic-service statistics`
- `show interface cable packetcable statistics`
- `show packetcable cms`

To verify dynamic service statistics based on the cable interface, use the `show interface cable dynamic-service statistics` command as shown in the following example:

```
Router# show interface cable 7/1/0 dynamic-service statistics
```

<table>
<thead>
<tr>
<th>Upstream</th>
<th>Downstream</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSA REQ</td>
<td>0</td>
</tr>
<tr>
<td>DSA RSP</td>
<td>5</td>
</tr>
<tr>
<td>DSA ACK</td>
<td>0</td>
</tr>
<tr>
<td>DSC REQ</td>
<td>0</td>
</tr>
<tr>
<td>DSC RSP</td>
<td>5</td>
</tr>
<tr>
<td>DSC ACK</td>
<td>0</td>
</tr>
<tr>
<td>DSD REQ</td>
<td>0</td>
</tr>
<tr>
<td>DSD RSP</td>
<td>0</td>
</tr>
<tr>
<td>Retransmission counts</td>
<td></td>
</tr>
<tr>
<td>Upstream</td>
<td>Downstream</td>
</tr>
<tr>
<td>DSA REQ</td>
<td>0</td>
</tr>
<tr>
<td>DSA RSP</td>
<td>0</td>
</tr>
<tr>
<td>DSA ACK</td>
<td>0</td>
</tr>
<tr>
<td>DSC REQ</td>
<td>0</td>
</tr>
<tr>
<td>DSC RSP</td>
<td>5</td>
</tr>
<tr>
<td>DSC ACK</td>
<td>0</td>
</tr>
<tr>
<td>DSD REQ</td>
<td>0</td>
</tr>
<tr>
<td>DSD RSP</td>
<td>0</td>
</tr>
</tbody>
</table>

To verify PacketCable IPC statistics based on the cable interface, use the `show interface cable packetcable statistics` command as shown in the following example:

```
Router# show interface cable 7/1/0 packetcable statistics
```

Packetcable IPC Statistics on RP

<table>
<thead>
<tr>
<th>Msg</th>
<th>create</th>
<th>gate</th>
<th>gate</th>
<th>gate set</th>
<th>dsd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gie</td>
<td>set</td>
<td>del</td>
<td>notify</td>
<td>notify</td>
</tr>
<tr>
<td>Sent</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rcvd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

Packetcable IPC Statistics on LC

<table>
<thead>
<tr>
<th>Msg</th>
<th>create</th>
<th>gate</th>
<th>gate set</th>
<th>dsd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gie</td>
<td>set</td>
<td>del</td>
<td>notify</td>
</tr>
<tr>
<td>Sent</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Rcvd</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

To verify all gate controllers that are currently connected to the PacketCable client, use the `show packetcable cms` command as shown in the following example:

```
Router# show packetcable cms
```

<table>
<thead>
<tr>
<th>GC-Addr</th>
<th>GC-Port</th>
<th>Client-Addr</th>
<th>COPS-handle</th>
<th>Version</th>
<th>PSID</th>
<th>Key</th>
<th>PDD-Cfg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.100.30.2</td>
<td>47236</td>
<td>2.39.34.1</td>
<td>0x2FF9E268/1</td>
<td>4.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.39.26.19</td>
<td>55390</td>
<td>2.39.34.1</td>
<td>0x2FF9D890/1</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

To verify all gate controllers including the COPS servers for which the PacketCable connection is gone down, use the `show packetcable cms all` command with the all keyword as shown in the following example:

```
Router# show packetcable cms all
```

<table>
<thead>
<tr>
<th>GC-Addr</th>
<th>GC-Port</th>
<th>Client-Addr</th>
<th>COPS-handle</th>
<th>Version</th>
<th>PSID</th>
<th>Key</th>
<th>PDD-Cfg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.100.30.2</td>
<td>47236</td>
<td>2.39.34.1</td>
<td>0x2FF9E268/1</td>
<td>4.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.39.26.19</td>
<td>55390</td>
<td>2.39.34.1</td>
<td>0x2FF9D890/1</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1.10.30.22</td>
<td>42307</td>
<td>2.39.34.1</td>
<td>0x0</td>
<td>/0</td>
<td>4.0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
To verify gate controller statistics, use the `show packetcable cms` command with the keyword, verbose, as shown in the following example:

```
Router# show packetcable cms verbose
Gate Controller
Addr : 1.100.30.2
Port : 47236
Client Addr : 2.39.34.1
COPS Handle : 0x2FF9E268
Version : 4.0
Statistics :
  gate del = 0 gate del ack = 0 gate del err = 0
  gate info = 0 gate info ack = 0 gate info err = 0
  gate open = 0 gate report state = 0
  gate set = 0 gate set ack = 0 gate set err = 0
  gate alloc = 0 gate alloc ack = 0 gate alloc err = 0
  gate close = 0
Gate Controller
Addr : 2.39.26.19
Port : 55390
Client Addr : 2.39.34.1
COPS Handle : 0x2FF9D890
Version : 1.0
Statistics :
  gate del = 0 gate del ack = 0 gate del err = 0
  gate info = 0 gate info ack = 0 gate info err = 0
  gate open = 0 gate report state = 0
  gate set = 2 gate set ack = 2 gate set err = 0
  gate alloc = 0 gate alloc ack = 0 gate alloc err = 0
  gate close = 0
PCMM Timers Expired
  Timer T1 = 0 Timer T2 = 0 Timer T3 = 0 Timer T4 = 0
```

### Additional References

#### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
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</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
</tr>
<tr>
<td>CMTS commands</td>
<td>Cisco CMTS Cable Command Reference</td>
</tr>
<tr>
<td>N+1 redundancy</td>
<td>N+1 Redundancy for the Cisco CMTS Routers</td>
</tr>
</tbody>
</table>
To configure the Cisco CMTS router to use Network Time Protocol (NTP) or Simple Network Time Protocol (SNTP) to set its system clock, see the "Performing Basic System Management" chapter in the "System Management" section of the Cisco IOS Configuration Fundamentals Configuration Guide.

### Standards

<table>
<thead>
<tr>
<th>Standards</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PKT-SP-MM-I06-110629</td>
<td>PacketCable™ Specification Multimedia Specification</td>
</tr>
<tr>
<td>ITU X.509 V3</td>
<td>International Telecommunications Union (ITU) X.509 Version 3.0 standard</td>
</tr>
<tr>
<td>PKT-EM-I03-011221</td>
<td>PacketCable™ Event Message Specification</td>
</tr>
<tr>
<td>PKT-SP-DQOS-I04-021018</td>
<td>PacketCable™ Dynamic Quality-of-Service Specification</td>
</tr>
<tr>
<td>PKT-SP-EC-MGCP-I04-011221</td>
<td>PacketCable™ Network-Based Call Signaling Protocol Specification</td>
</tr>
<tr>
<td>PKT-SP-ESP-I01-991229</td>
<td>PacketCable™ Electronic Surveillance Specification</td>
</tr>
<tr>
<td>PKT-SP-ISTP-I02-011221</td>
<td>PacketCable™ Internet Signaling Transport Protocol (ISTP) Specification</td>
</tr>
<tr>
<td>PKT-SP-PROV-I03-011221</td>
<td>PacketCable™ MTA Device Provisioning Specification</td>
</tr>
</tbody>
</table>

5 Not all supported standards are listed.

### MIBs

<table>
<thead>
<tr>
<th>MIBs</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>No new or changed MIBs are supported by this feature.</td>
<td>To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
</tbody>
</table>
RFCs

<table>
<thead>
<tr>
<th>RFCs</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 1321</td>
<td><em>The MD5 Message-Digest Algorithm</em></td>
</tr>
<tr>
<td>RFC 1510</td>
<td><em>The Kerberos Network Authentication Service (V5)</em></td>
</tr>
<tr>
<td>RFC 2138</td>
<td><em>Remote Authentication Dial In User Service (RADIUS)</em></td>
</tr>
<tr>
<td>RFC 2205</td>
<td><em>Resource ReSerVation Protocol (RSVP)</em></td>
</tr>
<tr>
<td>RFC 2327</td>
<td><em>SDP: Session Description Protocol</em></td>
</tr>
<tr>
<td>RFC 2748</td>
<td><em>The COPS (Common Open Policy Service) Protocol</em></td>
</tr>
</tbody>
</table>

Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>

Feature Information for PacketCable and PacketCable Multimedia on the Cisco CMTS Routers

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://tools.cisco.com/ITDIT/CFN/. An account on http://www.cisco.com/ is not required.

Note

The below table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>PacketCable</td>
<td>12.2(8)BC2</td>
<td>This feature was introduced on the Cisco uBR7246VXR router on the Cisco uBR-MC28U cable interface line card. The following commands were introduced:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• clear packetcable gate counter commit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• debug packetcable gate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• packetcable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• packetcable gate maxcount</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• packetcable timer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• show packetcable gate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• show packetcable gate counter commit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• show packetcable global</td>
</tr>
<tr>
<td>PacketCable</td>
<td>12.2(11)BC1</td>
<td>Support was added for version 3 of the PacketCable DQoS specification (PKT-SP-DQOS-103-020116) and for configuring the Event Message Element ID for the Cisco uBR7246VXR router. The packetcable element-id command was introduced.</td>
</tr>
<tr>
<td>PacketCable</td>
<td>12.2(11)BC2</td>
<td>Support was added for the packetcable authorize vanilla-docsis-mta command, which allows both PacketCable and non-PacketCable DOCSIS UGS service flows when PacketCable is enabled. The show packetcable global command was also enhanced to show whether non-PacketCable UGS service flows are enabled, and the T2 and T5 timers were removed from the display to conform to the requirements of the PacketCable Engineering Change Notice (ECN) 02148.</td>
</tr>
<tr>
<td>Feature Name</td>
<td>Releases</td>
<td>Feature Information</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| PacketCable  | 12.2(15)BC1 | PacketCable 1.x supported on the Cisco uBR7246VXR router and the Cisco uBR10012 router. In addition, several **debug packetcable** commands have been added or enhanced. The following commands were introduced:  
  - **debug packetcable ipc**  
  - **debug packetcable subscriber** |
| PacketCable  | 12.2(15)BC2 | The following commands were introduced:  
  - **debug packetcable hccp**  
  - **show packetcable event** |
<p>| PacketCable  | 12.3(9a)BC  | This feature was integrated into Cisco IOS Release 12.3(9a)BC. Support was added for Packet Cable 1.0 with CALEA on the Cisco uBR10012 router. |</p>
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| PacketCable Multimedia               | 12.3(13a)BC | This feature was introduced for the Cisco uBR7246VXR router and Cisco uBR10012 router. The following PacketCable 1.x features introduced for the Cisco uBR7246VXR router and Cisco uBR10012 router:  
  - PacketCable Emergency 911 Cable Interface Line Card Prioritization  
  - PacketCable Emergency 911 Services Listing and History  
  The following commands were introduced or modified:  
  - `debug packetcable gate docsis-mapping`  
  - `debug packetcable gate event`  
  - `packetcable multimedia`  
  - `packetcable timer multimedia t1`  
  - `show packetcable gate` |
| PacketCable and PacketCable Multimedia | 12.3(21)BC  | The following features were introduced on the Cisco CMTS routers:  
  - High Availability Stateful Switchover (SSO) for PacketCable and PacketCable MultiMedia  
  - PacketCable Client Accept Timeout |
<p>| PacketCable and PacketCable Multimedia | 12.2(33)SCA | These features were integrated into Cisco IOS Release 12.2(33)SCA. Support for the Cisco uBR7225VXR Universal Broadband Router was added. |</p>
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| PacketCable  | 12.2(33)SCB | The following features were introduced on the Cisco CMTS routers:  
  - PacketCable Subscriber ID  
  - Dynamic Service Transaction ID is introduced to conform to the requirements of the new transaction ID allocation algorithm for dynamic services on CMTS (DOCSIS ECN - RFIv2.0-N-04.0147-1.)  

**Note**  The PacketCable Subscriber ID feature is not supported in Cisco IOS Release 12.2(33)SCA. However, it is supported beginning in Cisco IOS Release 12.2(33)SCB.  
The following commands were introduced or modified:  
- `packetcable gate send-subscriberID`  
- `show cable calls`  

| PacketCable  | 12.2(33)SCD | The PacketCable functionality was extended to Cisco uBR7200 series routers.  
  The clear packetcable rks command was introduced. |
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| Multicast Session Range    | 12.2(33)SCE | Support for the multicast session range configuration was added in Cisco IOS Release 12.2(33)SCE. The following sections provide information about this feature:  
  • Configuring a PCMM Multicast Session Range, on page 31  
  • Verifying PCMM Operations, on page 32  
  The following commands were introduced or modified:  
  • cable multicast source pcmcm  
  • show packetcable gate multimedia  
  • show cable multicast db  
  • show cable multicast qos |
| PacketCable Subscriber ID  | 12.2(33)SCE | The PacketCable Subscriber ID feature includes support for IPv6 addresses in Cisco IOS Release 12.2(33)SCE. The following commands were introduced or modified:  
  • show packetcable gate ipv6  
  • show packetcable gate  
  • show packetcable event |
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| Call Trace                   | 12.2(33)SCF| The PacketCable and PCMM call trace functionality was introduced for advanced debugging of PacketCable and PCMM calls. The following section provides information about this feature:  
  - Voice MGPI Support, on page 36  
  The following commands were introduced or modified:  
    - cable dynamic-qos trace  
    - debug cable dynamic-qos subscriber  
    - debug cable dynamic-qos trace  
    - show cable dynamic-qos trace |
| Voice MGPI Support and Statistics | 12.2(33)SCF| The MGPI feature enables the Cisco CMTS router to map multiple PacketCable or PCMM gates to a single DOCSIS service flow using UGS traffic profiles of the same cable modem. The following commands were introduced or modified:  
  - show interface cable dynamic-service statistics  
  - show interface cable packetable statistics  
  - show packetable cms |
| PCMM IPv6 Voice              | 12.2(33)SCJ| This feature was introduced on the Cisco CMTS routers. |
| PCMM Multicast               | 12.2(33)SCJ| This feature was introduced on the Cisco CMTS routers. |
Feature Information for PacketCable and PacketCable Multimedia on the Cisco CMTS Routers