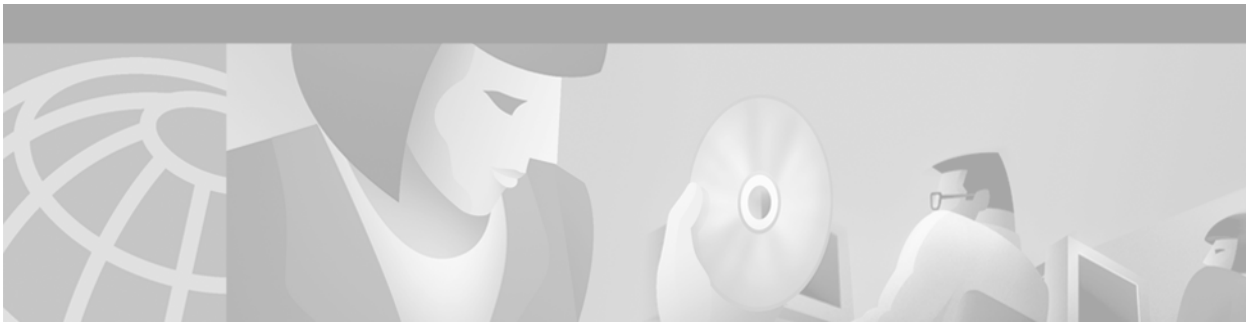


DOCSIS 1.1 for Cisco uBR7200 Series Universal Broadband Routers

Cisco IOS Release 12.1(7)CX1
October 1, 2001
OL-0564-02

This document describes the support for version 1.1 of the Data Over Cable System Interface Specifications (DOCSIS) in Cisco IOS Release 12.1(7)CX1 for the Cisco uBR7200 series universal broadband routers. This document focuses on the new software and the changes to the existing software architecture that provide DOCSIS 1.1 support. This document also describes Cable Modem Termination System (CMTS) to Cable Modem interoperability and provides instructions for migrating from DOCSIS 1.0 to DOCSIS 1.1.

This document includes the following sections:

Note DOCSIS 1.1 support for the Cisco uBR7200 series routers initially appeared in Cisco IOS Release 12.1(4)CX. Cisco IOS Release 12.1(7)CX1 adds support for a number of new and updated DOCSIS 1.1 MIBs, including a new command-line interface (CLI) command that provides access to some attributes in the subscriber management MIB.

Feature Overview

DOCSIS 1.1 is the first major revision of the initial DOCSIS 1.0 standard for cable networks. Although the initial standard provided quality data traffic over the coaxial cable network, the demands of real-time traffic such as voice and video required many changes to the DOCSIS specification.

Note At the time of publication, the DOCSIS 1.1 specification is still being finalized. This document describes the DOCSIS 1.1 specification SP-RFIv1.1-IO3-991105. See the CableLabs web site (http://www.cablelabs.com) for the current status on DOCSIS 1.1.

Feature History

Table 1 summarizes the history of the DOCSIS 1.1 for Cisco uBR7200 series routers feature set.

Table 1 Cisco IOS 12.1 CX Feature History

Release	Modification
12.1(4)CX	The DOCSIS 1.1 feature for Cisco uBR7200 series routers was introduced.
12.1(7)CX1	Several DOCSIS 1.1 MIBs were updated, reflecting changes in the DOCSIS 1.1 specification: • Revision 04 of DOCS-QOS-MIB—Describes the quality of service (QoS) attributes. **Note** Release 12.1(4)CX implemented revision 02 of this MIB. Revision 04 includes substantial changes to the tables and attributes. • Revision 02 of DOCS-SUBMGT-MIB—Describes the subscriber management attributes. • RFC2933—Describes the IGMP protocol attributes, as defined in RFC 2933. • DOCS-CABLE-DEVICE-MIB—Describes the operation of the CM and CMTS. Only the syslog and Event tables are supported by this MIB, which was released as RFC 2669. • DOCS-CABLE-DEVICE-TRAP-MIB—Defines the traps supported by CMs and the CMTS and is an extension of DOCS-CABLE-DEVICE-MIB. • DOCS-IF-EXT-MIB—Extends RFC 2670 (DOCS-IF-MIB) to provide information about whether CMs and the CMTS support DOCSIS 1.0 or 1.1. The **cable submgmt default** command was also added, to set the default value of the attributes in DOCS-SUBMGT-MIB.

DOCSIS 1.1 Enhancements

The DOCSIS 1.1 specification provides the following functional enhancements over DOCSIS 1.0 coaxial cable networks:

- Enhanced quality of service (QoS) to give priority for real-time traffic such as voice and video:
  - The DOCSIS 1.0 QoS model (a service ID (SID) associated with a QoS profile) has been replaced with a service flow model that allows greater flexibility in assigning QoS parameters to different types of traffic and in responding to changing bandwidth conditions.
  - Support for multiple service flows per cable modem allows a single cable modem to support a combination of data, voice, and video traffic.
  - Greater granularity in QoS per cable modem in either direction, using unidirectional service flows.
  - Dynamic MAC messages create, modify, and delete traffic service flows to support on demand traffic requests.
- Supported QoS models for the upstream are:
  - Best-effort—Data traffic sent on a non-guaranteed best-effort basis.
  - Committed information rate (CIR)—Guaranteed minimum bandwidth for data traffic.
  - Unsolicited grants (UGS)—Constant bit rate (CBR) traffic, such as voice, that is characterized by fixed size packets at fixed intervals.
  - Real-time polling (RTPS)—Real Time service flows, such as video, that produce unicast, variable size packets at fixed intervals.
  - Unsolicited grants with activity detection (USG-AD)—Combination of UGS and RTPS, to accommodate real time traffic that might have periods of inactivity (such as voice using silence suppression). The service flow uses UGS fixed grants while active, but switches to RTPS polling during periods of inactivity to avoid wasting unused bandwidth.
- Enhanced time-slot scheduling mechanisms to support guaranteed delay and jitter-sensitive traffic on the shared multiple access upstream link.
- Payload Header Suppression (PHS) conserves link-layer bandwidth by suppressing unnecessary packet headers on both upstream and downstream traffic flows.
- Layer 2 fragmentation on the upstream prevents large data packets from affecting real-time traffic, such as voice and video. Large data packets are fragmented and then transmitted in the time slots that are available between the time slots used for the real-time traffic.
- Concatenation allows a cable modem to send multiple MAC frames in the same time slot, as opposed to making an individual grant request for each frame. This avoids wasting upstream bandwidth when sending a number of very small packets, such as TCP acknowledgement packets.
- Advanced authentication and security through X.509 digital certificates and Triple Data Encryption Standard (3DES) key encryption.
- Secure software download allows a service provider to remotely upgrade a cable modem's software, without risk of interception or alteration.
- DOCSIS 1.1 cable modems can coexist with DOCSIS 1.0 and 1.0+ cable modems in the same network—the Cisco uBR7200 series provides the levels of service that are appropriate for each cable modem.

DOCSIS 1.1 Quality of Service

The DOCSIS 1.1 QoS framework is based on the following objects:

- Service class—A collection of settings maintained by the CMTS that provide a specific QoS service tier to a cable modem that has been assigned a service flow within a particular service class.
- Service flow—A unidirectional sequence of packets receiving a service class on the DOCSIS link.
- Packet classifier—A set of packet header fields used to classify packets onto a service flow to which the classifier belongs.
- PHS rule—A set of packet header fields that are suppressed by the sending entity before transmitting on the link, and are restored by the receiving entity after receiving a header-suppressed frame transmission. Payload Header Suppression increases the bandwidth efficiency by removing repeated packet headers before transmission.

In DOCSIS 1.1, the basic unit of QoS is the service flow, which is a unidirectional sequence of packets transported across the RF interface between the cable modem and CMTS. A service flow is characterized by a set of QoS parameters such as latency, jitter, and throughput assurances.

Every cable modem establishes a primary service flow in both the upstream and downstream directions. The primary flows maintain connectivity between the cable modem and CMTS at all times.

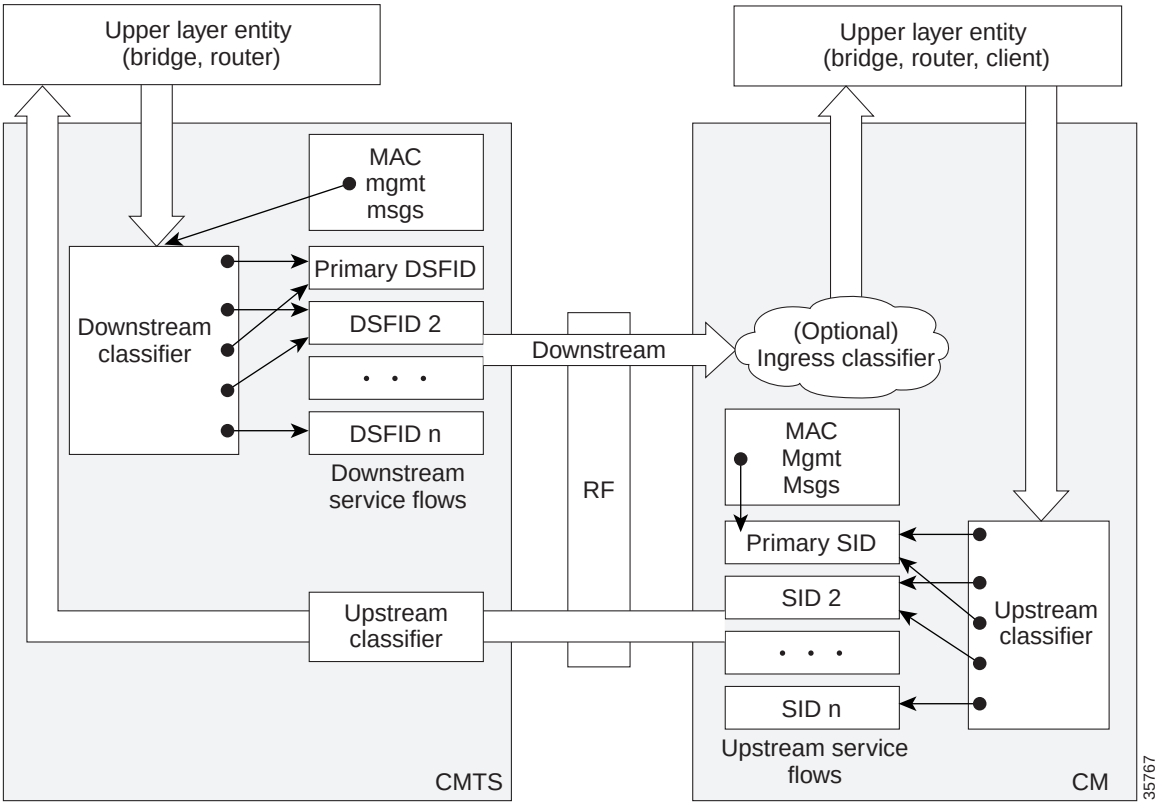
In addition, a DOCSIS 1.1 cable modem can establish multiple secondary service flows. The secondary service flows either can be permanently created (they persist until the cable modem is reset or powered off) or can be created dynamically to meet the needs of the on-demand traffic being transmitted.

Each service flow has a set of QoS attributes associated with it. These QoS attributes define a particular class of service and determine characteristics such as the maximum bandwidth for the service flow and the priority of its traffic. The class of service attributes can be inherited from a preconfigured CMTS local service class (class-based flows), or they can be individually specified at the time of the creation of the service flow.

Each service flow has multiple packet classifiers associated with it, which determine the type of application traffic allowed to be sent on that service flow. Each service flow can also have a Payload Header Suppression (PHS) rule associated with it to determine which portion of the packet header will be suppressed when packets are transmitted on the flow.

Figure 1 illustrates the mapping of packet classifiers.

Figure 1 Classification within the MAC Layer



Quality of Service Comparison

Quality of service (QoS) is a measure of performance for a transmission system that reflects its transmission quality and service availability. This section describes the differences in QoS between DOCSIS 1.0, 1.0+, and 1.1

DOCSIS 1.0

DOCSIS1.0 uses a static QoS model that is based on a class of service (CoS) that is preprovisioned in the TFTP configuration file for the cable modem. The CoS is a bidirectional QoS profile that has limited control, such as peak rate limits in either direction, and relative priority on the upstream.

DOCSIS 1.0 defines the concept of a service identifier (SID), which specifies the devices allowed to transmit and provided device identification and CoS. In DOCSIS 1.0, each cable modem is assigned only one SID, creating a one-to-one correspondence between a cable modem and the SID. All traffic originating from, or destined for, a cable modem is mapped to that cable modem's SID.

Typically, a DOCSIS 1.0 cable modem has one CoS and treats all traffic the same, which means that data traffic on a cable modem can interfere with the quality of a voice call in-progress. The CMTS, however, can prioritize downstream traffic based on IP precedent type-of-service (ToS) bits. For example, voice calls using higher IP precedence bits receive a higher queueing priority (but without a guaranteed

bandwidth or rate of service). A DOCSIS 1.0 cable modem could increase voice call quality by permanently reserving bandwidth for voice calls, but then that bandwidth would be wasted whenever a voice call is not in progress.

DOCSIS 1.0+

In response to the limitations of DOCSIS 1.0 in handling real-time traffic, such as voice calls, Cisco created the DOCSIS 1.0+ extensions to provide the more important QoS enhancements that were expected in DOCSIS 1.1. In particular, the DOCSIS 1.0+ enhancements provide basic Voice-over-IP (VoIP) service over the DOCSIS link.

Cisco's DOCSIS 1.0+ extensions include the following DOCSIS 1.1 features:

- Multiple SIDs per cable modem, creating separate service flows for voice and data traffic. This allows the CMTS and cable modem to give higher priority for voice traffic, preventing the data traffic from affecting the quality of the voice calls.
- Cable modem-initiated dynamic MAC messages—Dynamic Service Addition (DSA) and Dynamic Service Deletion (DSD). These messages allow dynamic SIDs to be created and deleted on demand, so that the bandwidth required for a voice call can be allocated at the time a call is placed and then freed up for other uses when the call is over.
- Unsolicited grant service (CBR-scheduling) on the upstream—This helps provide a higher-quality channel for upstream VoIP packets from an Integrated Telephony Cable Modem (ITCM) such as the Cisco uBR924 cable access router.
- Ability to provide separate downstream rates for any given cable modem, based on the IP-precedence value in the packet. This helps separate voice signaling and data traffic that goes to the same ITCM to address rate shaping purposes.
- Concatenation allows a cable modem to send several packets in one large burst, instead of having to make a separate grant request for each.

Caution All DOCSIS 1.0 extensions are available only when using a cable modem (such as the Cisco uBR924 cable access router) and CMTS (such as the Cisco uBR7200 series universal broadband router) that supports these extensions. The cable modem activates the use of the extensions by sending a dynamic MAC message. DOCSIS 1.0 cable modems continue to receive DOCSIS 1.0 treatment from the CMTS.

DOCSIS 1.1

DOCSIS 1.1 implemented a number of changes to allow great flexibility in the ability of a cable modem and service provider to transmit almost any combination of data traffic and real-time traffic, such as voice and video. These changes required a fundamental shift in how a cable modem requests service and how traffic can be transmitted across the cable network.

In DOCSSI 1.1, a service flow gets created at the time of cable modem registration (a static service flow) or as a result of a dynamic MAC message handshake between the cable modem and the CMTS (a dynamic service flow). At any given time, a service flow might be in one of three states (provisioned, admitted, or active). Only active flows are allowed to pass traffic on the DOCSIS link.

Every service flow has a unique (unique per DOCSIS MAC domain) identifier called the service flow identifier (SFID). The upstream flows in the admitted and active state have an extra Layer 2 SID associated with them. The SID is the identifier used by the MAC scheduler when specifying time-slot scheduling for different service flows.

When a packet is presented to the DOCSIS MAC layer at the CMTS or cable modem, it is compared to a set of packet classifiers until a matching classifier is found. The SFID from this classifier is used to identify the service flow on which the packet will be sent. The packet is then transferred to the service flow manager for rate shaping and output queueing.

In the upstream direction, the output queues at the cable modem get remotely served by the CMTS MAC scheduler, based on DOCSIS 1.1 slot scheduling constraints such as grant-interval and grant-jitter. In the downstream direction, the CMTS packet scheduler serves the flow queues depending on the flow attributes like traffic priority, guaranteed rate, and delay bound.

The principal mechanism for providing enhanced QoS is to classify packets traversing the RF MAC interface into service flows. A service flow is a MAC-layer transport service that provides unidirectional transport of packets to upstream packets transmitted by the cable modem or to downstream packets transmitted by the CMTS.

DOCSIS 1.1 adds several new MAC scheduling disciplines to provide guaranteed QoS for real-time service flows on the multiple access upstream channel. Multiple grants per interval helps in supporting multiple subflows (such as voice calls) on the same SID. Multiple subflows per SID reduces the minimum SID requirement in cable modem hardware.

The CMTS is responsible for supporting QoS for all cable modems in its control. The traffic in the downstream is assumed to be a combination of voice, committed information rate (CIR) data, and excess burst best-effort data. To provide QoS support, the following functions must be performed:

- Packet classification—Mapping packets to service flows based on header information
- Policing (rate limiting) the individual flows
- Queuing packets into appropriate output queues based on the type of service
- Serving the output queues to meet delay/rate guarantees

The admission control block helps the overall downstream QoS block to track the current bandwidth reservation state on a per-downstream basis. Decisions can be made whether to admit or reject a request for a new service flow on that DS channel, based on this reservation state and the QoS guarantees requested by the new service-flow.

IP packet classifiers help in filtering out unique service flows on an interface for differential QoS treatment. Rather than doing per-cable modem downstream rate shaping, DOCSIS 1.1 software provides rate shaping at a much more granular level of individual service flows of the cable modem.

Note Cisco uBR7200 series routers running Cisco IOS Release 12.1(4)CX or later can transparently interoperate with cable modems running DOCSIS 1.0, DOCSIS 1.0+ extensions, or DOCSIS 1.1. If a cable modem indicates at system initialization that it is DOCSIS 1.1-capable, the Cisco uBR7200 series router uses the DOCSIS 1.1 features. If the cable modem is not DOCSIS 1.1-capable, but does support the DOCSIS 1.0+ QoS extensions (for example, a Cisco uBR924 cable access router running 12.1(1)T or above), the Cisco uBR7200 series automatically supports the cable modem's requests for dynamic services. Otherwise, the cable modem is treated as a DOCSIS 1.0 device.

DOCSIS 1.1 Features in Cisco IOS Release 12.1 CX

The following sections describe the DOCSIS 1.1 software features that appear in Cisco IOS Release 12.1 CX, including the commands used to implement the features.

Cable Modem Database Manager

The Cable Modem Database Manager is a new software module that manages cable modem information on the CMTS. This module can be queried to obtain different types of information on a single cable modem (or a group of cable modems). Information maintained on a per cable-modem basis includes DOCSIS MAC capabilities, counters, errors, QoS configuration, MAC state, connectivity statistics, and so on.

Commands

```
Router# show cable modem
```

Service Flow Manager

The Service Flow Manager is a new module that manages different activities related to service flows on a cable interface. Typical events include the creation of new DOCSIS service flows, modification of the attributes of existing service flows, and the deletion of service flows.

Commands

```
Router# show interface cable x/y service-flow
Router# debug cab qos
```

Service Template/Class Manager

The Service Template/Class Manager is a software module that controls the creation, updating, and cleanup of various QoS service templates and user-defined service classes on the CMTS.

Commands

```
Router# show cable service-class
Router# show int cx/y cable qos-paramset
Router(config)# cable service class n
Router# debug cable qos
```

TLV Parser/Encoder

The TLV parser/encoder is a new module that handles parsing and encoding TLVs on the CMTS. All old DOCSIS1.0/1.0+ TLVs are supported. In addition, many new TLVs have been added in DOCSIS1.1, such as service flow encodings, classifier encodings, and support for PHS rules. The new TLV parser features are used by different MAC message modules.

Commands

```
Router# debug cable tlvs
```

Enhanced Registration

The registration module has been enhanced to support multiple registration styles (DOCSIS1.0/DOCSIS1.0+/DOCSIS1.1) seamlessly. Besides using services of new TLV parser/encoder, this module also supports the conditional registration-acknowledgment MAC message state machine.

Commands

```
Router# debug cable registration
Router# debug cable tlvs
```

Dynamic MAC Messages

Dynamic Service MAC messages allow dynamic signaling of QoS between the cable modem and the CMTS. These messages are DOCSIS link layer equivalents of the higher layer messages that create, tear down, and modify a service flow. These messages are collectively known as DSX messages.

The DSX state machine module on the CMTS manages the several concurrent dynamic service transactions between cable modems and the CMTS. It include state machine support for all three DOCSIS1.1 DSX MAC messages:

- Dynamic Service Add (DSA)—This message is used to create a new service flow.
- Dynamic Service Change (DSC)—This message is used to change the attributes of an existing service flow.
- Dynamic Service Deletion (DSD)—This message is used to delete an existing service flow.

Commands

```
Router# debug cable dynsrv
Router# debug cable tlvs
```

Note In Cisco IOS Release 12.1 CX, only DSX messages that are initiated by the cable modem are supported. DSX messages that are initiated by the CMTS are not supported.

Fragmentation

Grant fragmentation allows the upstream MAC scheduler to slice large data requests to fit into the scheduling gaps between UGS (voice slots). This reduces the jitter experienced by the UGS slots when large data grants preempt the UGS slots. The grant fragmentation gets triggered in the MAC scheduler, and fragment reassembly happens in the upstream receive driver.

Note DOCSIS fragmentation should not be confused with the fragmentation of IP packets, which is done to fit the packets on network segments with smaller maximum transmission unit (MTU) size. DOCSIS Fragmentation is Layer 2 fragmentation that is primarily concerned with efficiently transmitting lower-priority packets without interfering with high-priority real-time traffic, such as voice calls. IP fragmentation is done at Layer 3 and is primarily intended to accommodate routers that use different maximum packet sizes.

Commands

```
Router# show interface cable x/y sid [n] counters [verbose]
Router(config-if)# [no] cable upstream n fragmentation
Router# debug cable errors
```

Payload Header Suppression and Restoration

The PHS feature is used to suppress repetitive or redundant portions in packet headers before transmission on the DOCSIS link. This is a new feature in the DOCSIS1.1 MAC driver. The upstream receive driver is now capable of restoring headers suppressed by cable modems, and the downstream driver is capable of suppressing specific fields in packet headers before forwarding the frames to the cable modem.

Commands

```
Router# show interface cable x/0 service-flow [sfid] phs
Router# debug cable error
Router# debug cable phs
```

Concatenation

Concatenation allows the cable modem to make a single time-slice request for multiple packets and send all packets in a single large burst on the upstream. Concatenation was introduced in the upstream receive driver in the DOCSIS1.0+ releases. Per-SID counters have now been added in Cisco IOS Release 12.1(4)CX for debugging concatenation activity.

Commands

```
Router# show interface cable x/y sid [n] counters [verbose]
Router# show controller cable x/y
Router(config-if)# [no] cable upstream n concatenation
Router# debug cable errors
```

New MAC Scheduler

The MAC scheduler controls all time-slot assignment on the shared upstream channel. This block has been redesigned to support several new scheduling disciplines of DOCSIS1.1. Important enhancements include:

- Support for grant fragmentation.
- Support for multiple unsolicited grants per SID.
- Support for UGS-AD/RTPS slot scheduling mechanisms besides UGS, BE/CIR service of DOCSIS1.0+.
- Enhanced per-SID min/max rate shaping.

All old Cisco features, such as dynamic contention control are supported in the new design.

Commands

```
Router# show interface cable x/y mac-scheduler n
Router(config-if)# [no] cable upstream n fragmentation
Router(config-if)# [no] cable upstream n unfrag-slot-jitter
Router# cable service flow inactivity-threshold n
Router# debug cable mac-scheduler
```

Downstream Packet Classifier

Packet classifiers help to map packets into DOCSIS service flows. The CMTS supports downstream IP packet classifiers.

Commands

```
Router# show interface cable x/y classifier
Router# show interface cable x/y service-flow [n] classifiers
Router# debug cable qos
```

Downstream Packet Scheduler

The Downstream Packet Scheduler is a new module that controls all output packet queueing service on the downstream link of each cable interface.

Commands

```
Router# debug cable qos
Router# show interface cable x/y downstream
```

Baseline Privacy Interface Plus

DOCSIS 1.0 included a Baseline Privacy Interface (BPI) to protect user data privacy across the shared-medium cable network and to prevent unauthorized access to DOCSIS-based data transport services across the cable network. BPI encrypts traffic across the RF interface between the cable modem and CMTS, and also includes authentication, authorization, and accounting (AAA) features.

BPI supports access control lists (ACLs), tunnels, filtering, protection against spoofing, and commands to configure source IP filtering on RF subnets to prevent subscribers from using source IP addresses that are not valid. For a detailed description of how BPI was implemented in DOCSIS 1.0, see the *Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide.*

DOCSIS 1.1 enhances these security features with BPI Plus (BPI+), which includes the following enhancements:

- Digital certificates provide secure user identification and authentication.
- Key encryption uses 168-bit Triple DES (3DES) encryption that is suitable for the most sensitive applications.
- 1024-bit public key with Pkcs#1 Version 2.0 encryption.
- Multicast support.
- Secure software download allows a service provider to upgrade a cable modem's software remotely, without the threat of interception, interference, or alteration.

Note BPI+ is described in the Baseline Privacy Interface Plus Specification (SP-BPI+-I07-010829), available from CableLabs (http://www.cablelabs.com).

Additional DOCSIS 1.1 Features in Cisco IOS Release 12.1(7)CX1

Cisco IOS Release 12.1(7)CX1 enhances DOCSIS 1.1 support with the following new or changed MIBs:

- DOCS-BPI-PLUS-MIB—Describes the Baseline Privacy Interface Plus (BPI+) attributes and replaces the DOCS-BPI-MIB, which was used in DOCSIS 1.0. This is revision 05 of the MIB.

  Note Release 12.1(4)CX implemented revision 03 of this MIB. Revision 05 includes substantial changes to the tables and attributes.

- DOCS-QOS-MIB—Describes the quality of service (QoS) attributes. This is revision 04 of the MIB.

Note Release 12.1(4)CX implemented revision 02 of this MIB. Revision 04 includes substantial changes to the tables and attributes.

- DOCS-SUBMGT-MIB—Describes the subscriber management attributes. This is revision 02 of the MIB.
- RFC2933—Describes the IGMP protocol attributes, as defined in RFC 2933.
- message URL DOCS-CABLE-DEVICE-MIB—Describes the operation of the CM and CMTS. Only the syslog and event tables are supported by this MIB, which was released as RFC 2669.
- DOCS-CABLE-DEVICE-TRAP-MIB—Defines the traps supported by CMs and the CMTS and is the extension of the RFC 2669 (DOCS-CABLE-DEVICE-MIB).
- DOCS-IF-EXT-MIB—Extends the RFC 2670 (DOCS-IF-MIB) to provide information about whether the CMs and CMTS support DOCSIS 1.0 or DOCSIS 1.1.

In addition, the CLI supports a new command (**cable submgmt default**) to set the default value of attributes in DOCS-SUBMGT-MIB. This command can be included in the Cisco IOS configuration file so that the new values are automatically set after a reboot or reload of the Cisco uBR7200 series router.

Migrating from Earlier Versions of DOCSIS

DOCSIS 1.1 cable modems have additional features and better performance than earlier DOCSIS 1.0 and 1.0+ models, but all three models can coexist in the same network. DOCSIS 1.0 and 1.0+ cable modems will not hamper the performance of a DOCSIS 1.1 CMTS, nor will they interfere with operation of DOCSIS 1.1 features. There is full forward and backward compatibility in the standards.

For this configuration...	The result is...
DOCSIS 1.1 CMTS with DOCSIS 1.0 cable modems	DOCSIS 1.0 cable modems receive DOCSIS 1.0 features and capabilities. BPI is supported if available and enabled on the CMTS.
DOCSIS 1.1 CMTS with DOCSIS 1.0+ cable modems	DOCSIS 1.0+ cable modems receive basic DOCSIS 1.0 support. BPI is supported if available and enabled on the CMTS. In addition, DOCSIS 1.0+ cable modems also receive the following DOCSIS 1.1 features: • Multiple SIDs per cable modem • Dynamic Service MAC messaging initiated by the cable modem • Unsolicited grant service (UGS, CBR-scheduling) on the upstream • Separate downstream rates for any given cable modem, based on the IP-precedence value • Concatenation
DOCSIS 1.1 CMTS with DOCSIS 1.1 cable modems	DOCSIS 1.1 cable modems receive all the DOCSIS 1.1 features listed in this document. BPI+ is supported if available and enabled on the CMTS.

Benefits

DOCSIS 1.1 includes a rich set of features that provide advanced and flexible QoS capabilities for various types of traffic (voice, data, and video) over the cable network. It also provides enhanced security and authentication features.

Baseline Privacy Interface Plus Enhancement

The Plus (+) version of the Baseline Privacy Interface (BPI+) in DOCSIS 1.1 provides a set of extended services within the MAC sublayer that increase performance and system security. Digital certificates provide secure authentication for each cable modem, to prevent identity theft on the basis of MAC and IP addresses. Advanced encryption provides a secure channel between the cable modem and CMTS, and secure software download allows a service provider to upgrade the software on cable modems, without the threat of interception, interference, or alteration of the software code.

Note Ensure that the system clocks on the CMTS and on the time-of-day (ToD) servers are synchronized. If this does not occur, the clocks on the CMs will not match the clocks on the CMTS, which could interfere with BPI+ operations. In particular, this could prevent the proper verification of the digital certificates on the CM.

Dynamic Service Flows

The dynamic creation, modification, and deletion of service flows allows for on-demand reservation on Layer 2 bandwidth resources. The CMTS can now provide special QoS to the cable modem dynamically for the duration of a voice call or video session, as opposed to the static provisioning and reservation of resources at the time of cable modem registration. This provides a more efficient use of the available bandwidth.

Concatenation

The cable modem concatenates multiple upstream packets into one larger MAC data frame, allowing the cable modem to make only one time-slot request for the entire concatenated MAC frame, as opposed to requesting a time slot for each individual packet. This reduces the delay in transferring the packet burst upstream.

Enhanced QoS

Extensive scheduling parameters allow the CMTS and the cable modem to communicate QoS requirements and achieve more sophisticated QoS on a per service-flow level.

Different new time-slot scheduling disciplines help in providing guaranteed delay and jitter bound on shared upstream. Activity detection helps to conserve link bandwidth by not issuing time slots for an inactive service flow. The conserved bandwidth can then be reused for other best-effort data slots.

Packet classification helps the CMTS and cable modem to isolate different types of traffic into different DOCSIS service flows. Each flow could be receiving a different QoS service from CMTS.

Fragmentation

The MAC scheduler fragments data slots to fill the gaps inbetween UGS slots. Fragmentation reduces the jitter experienced by voice packets when large data packets are transmitted on the shared upstream channel and preempt the UGS slots used for voice. Fragmentation splits the large data packets so that they fit into the smaller time slots available around the UGS slots.

Multiple Subflows per SID

This feature allows the cable modem to have multiple calls on a single hardware queue. This approach scales much better than requiring a separate SID hardware queue on the cable modem for each voice call.

Payload Header Suppression

Payload Header Suppression (PHS) allows the CMTS/cable modem to suppress repetitive or redundant portions in packet headers before transmitting on the DOCSIS link. This helps to conserve link bandwidth, especially with types of traffic, such as voice, where the header size tends to be as large as the size of the actual packet.

Service Classes

The QoS attributes of a service flow can be specified in two ways: either explicitly by defining all attributes, or implicitly by specifying a service class name. A service class name is a string that the CMTS associates with a QoS parameter set.

The service class serves the following purposes:

- It allows operators to move the burden of configuring service flows from the provisioning server to the CMTS. Operators provision the modems with the service class name; the implementation of the name is configured at the CMTS. This allows operators to modify the implementation of a given service to local circumstances without changing modem provisioning. For example, some scheduling parameters might need to be set differently for two different CMTSs to provide the same service. As another example, service profiles could be changed by time of day.
- It allows CMTS vendors to provide class-based-queuing if they choose, where service flows compete within their class and classes compete with each other for bandwidth.
- It allows higher-layer protocols to create a service flow by its service class name. For example, telephony signaling might direct the cable modem to instantiate any available provisioned service flow of class G.711.

Note The service class is optional: the flow scheduling specification may always be provided in full; a service flow may belong to no service class whatsoever. CMTS implementations MAY treat such unclassed flows differently from classed flows with equivalent parameters.

Any service flow can have its QoS parameter set specified in any of three ways:

- By explicitly including all traffic parameters.
- By indirectly referring to a set of traffic parameters by specifying a service class name.
- By specifying a service class name along with modifying parameters.

The service class name is expanded to its defined set of parameters at the time the CMTS successfully admits the service flow.

Restrictions

In addition to the interoperability issues listed here, the CMTS must be running Cisco IOS Release 12.1(4)CX or Cisco IOS Release 12.1(7)CX1 to support DOCSIS 1.1 and the cable modem must also support the DOCSIS 1.1 feature set.

Limitations

Cisco IOS Release 12.1(7)CX1 supports the features listed in the DOCSIS 1.1 specification SP-RFIv1.1-IO3-991105. Additional features will be supported as they are added to the specification and as the specification is finalized.

DOCSIS 1.1 traffic is supported on Cisco uBR-MC1xC and Cisco uBR-MC28C cable interface line cards. The Cisco uBR-MC11 (FPGA) and Cisco uBR-MC16B line cards do not support DOCSIS 1.1.

In particular, the following DOCSIS 1.1 features are not supported in Cisco IOS Release 12.1(7)CX1:

- CMTS-initiated dynamic service MAC messages (CM-initiated messages are supported)
- Pre equalization coefficients for 16 QAM upstream operation
- non-real time polling (nRTPS)
- SNMPv3

In addition, 1+1 redundancy and the HCCP protocol are not supported during DOCSIS 1.1 operation.

Interoperability Issues

This section describes some of the differences between DOCSIS 1.0, DOCSIS 1.0 with extensions, and DOCSIS 1.1.

Baseline Privacy Interface Plus

BPI+ encryption and authentication must be supported and enabled by both the cable modem and CMTS. In addition, the cable modem must contain a digital certificate that conforms to the DOCSIS 1.1 and BPI+ specifications.

Also, ensure that the system clocks on the CMTS and on the time-of-day (ToD) servers are synchronized. If this does not occur, the clocks on the CMs will not match the clocks on the CMTS, which could interfere with BPI+ operations. In particular, this could prevent the proper verification of the digital certificates on the CM.

Maximum Burst Size

Previously, the maximum concatenated burst size parameter could be set to zero to specify an unlimited value. In a DOCSIS 1.1 environment, this parameter should be set to a nonzero value, with a maximum value of 1522 bytes for DOCSIS 1.0 cable modems.

If a cable modem attempts to register with a maximum concatenation burst size of zero, the DOCSIS 1.1 CMTS will refuse to allow the cable modem to come online. This avoids the possibility that a DOCSIS 1.0 cable modem could interfere with voice traffic on the upstream by sending extremely large data packets. Since DOCSIS 1.0 does not support fragmentation, transmitting such data packets could result in unwanted jitter in the voice traffic.

In addition, DOCSIS 1.1 requires that the maximum transmit burst size be set to either 1522 bytes or the maximum concatenated burst size, whichever is larger. Do not set the maximum concatenation burst size to values larger than 1522 bytes for DOCSIS 1.0 cable modems.

Note This change requires you to change any DOCSIS configuration files that specify a zero value for the maximum concatenation burst size. This limitation does not exist for DOCSIS 1.1 cable modems unless fragmentation has been disabled.

Provisioning

The format and content of the TFTP configuration file for a DOCSIS 1.1 cable modem are significantly different from the file for a DOCSIS 1.0 cable modem. A dual-mode configuration file editor is used to generate a DOCSIS 1.0 style configuration file for DOCSIS 1.0 cable modems and a DOCSIS 1.1 configuration file for DOCSIS 1.1 cable modems.

Registration

A DOCSIS 1.1 CMTS is designed to handle the existing registration TLVs from DOCSIS 1.0 cable modems as well as the new type TLVs from DOCSIS 1.1 cable modems. A DOCSIS 1.0 and DOCSIS 1.1 cable modem can successfully register with the same DOCSIS 1.1 CMTS.

A DOCSIS 1.1 cable modem can be configured to make an indirect reference to a service class that has been statically defined at the CMTS instead of explicitly asking for the service class parameters. When this registration request is received by a DOCSIS 1.1 CMTS, it encodes the actual parameters of the service class in the registration response and expects a DOCSIS 1.1-specific registration-acknowledge MAC message from the cable modem.

When a DOCSIS 1.0 cable modem registers with a DOCSIS 1.1 CMTS, the registration request explicitly requests all nondefault service-class parameters in the registration. The absence of an indirect service class reference eliminates the need for the DOCSIS 1.1 TLVs and eliminates the need to establish a local registration acknowledge wait state.

When a DOCSIS 1.1 CMTS receives a registration request from a DOCSIS 1.0 cable modem, it responds with the DOCSIS 1.0 style registration response and does not expect the cable modem to send the registration-acknowledge MAC message.

Performance

DOCSIS 1.0 cable modems lack the ability to explicitly request and provide scheduling parameters for advanced DOCSIS 1.1 scheduling mechanisms, such as unsolicited grants and real-time polling. DOCSIS 1.1 cable modems on the same upstream channel can benefit from the advanced scheduling mechanisms and a DOCSIS 1.1 CMTS can still adequately support voice traffic from DOCSIS 1.1 cable modems with DOCSIS 1.0 cable modems on the same upstream channel.

Related Documents

- *Cisco uBR7200 Series Universal Broadband Router Hardware Installation Guide*
- *Cisco uBR7100 Series Universal Broadband Router Hardware Installation Guide*
- *Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide*
- *Configuring Concatenation on the Cisco uBR7200 Series Cable Router*
- *Quality of Service for Voice on the Cisco uBR7200 Series Cable Router*

Supported Platforms

- Cisco uBR7223 universal broadband router
- Cisco uBR7246 universal broadband router
- Cisco uBR7246VXR universal broadband router
- NPE-300 with a minimum of 256 MB is recommended
- Cisco uBR-MC11C, Cisco uBR-MC12C, Cisco uBR-MC14C, Cisco uBR-MC16S, Cisco uBR-MC16C, Cisco uBR-MC28C, and Cisco uBR-MC28C-BNC cable line cards

Note When using any of the above cable line cards, only a software upgrade is required for the router to migrate from DOCSIS 1.0 to DOCSIS 1.1.

Supported Standards, MIBs, and RFCs

Standards

DOCSIS 1.1 specification SP-RFIv1.1-IO3-991105

Baseline Privacy Interface Plus Specification BPI+_I06-001215

MIBs

For DOCSIS 1.1 the new supported MIBs are:

- DOCS-BPI-PLUS-MIB
  This is revision 05 of this MIB and replaces the DOCS-BPI-MIB, which is supported only in DOCSIS 1.0. As required by the DOCSIS specifications, a DOCSIS 1.1 CMTS and CM support only the attributes in DOCS-BPI-PLUS-MIB and not the attributes in DOCS-BPI-MIB.

  Note Cisco IOS Release 12.1(4)CX implemented revision 03 of DOCS-BPI-PLUS-MIB. Revision 05 includes substantial changes to the tables and attributes.

- DOCS-QOS-MIB
  This is revision 04 of the MIB.

Note Cisco IOS Release 12.1(4)CX implemented revision 02 of DOCS-QOS-MIB. Revision 04 includes substantial changes to the tables and attributes.

- DOCS-SUBMGT-MIB
  This is revision 02 of the MIB.
- RFC2933
  Standard IGMP management MIB.
- DOCS-CABLE-DEVICE-MIB
  This MIB was released as RFC 2669.
- DOCS-CABLE-DEVICE-TRAP-MIB
  Extends RFC 2669 (DOCS-CABLE-DEVICE-MIB).
- DOCS-IF-EXT-MIB
  Extends RFC 2670 (DOCS-IF-MIB).

In addition, the CLI supports a new command (**cable submgmt default**) to set the default value of attributes in DOCS-SUBMGT-MIB. This command can be included in the Cisco IOS configuration file so that the new values are automatically set after a reboot or reload of the Cisco uBR7200 series router.

Note Because the DOCSIS 1.1 specification has not yet been finalized, the above MIBs are still in draft form and are subject to change with future releases.

In addition, DOCS-IF-MIB (RFC 2670) has been modified.

Tip For lists of supported MIBs by platform and Cisco IOS release, and to download MIB modules, go to the Cisco MIB web site on Cisco.com at http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml.

RFCs

RFC 2669 (DOCS-CABLE-DEVICE-MIB)

RFC 2670 (DOCS-IF-MIB)

RFC 2933 (IGMP-STD-MIB)

Prerequisites

Before you power on and configure the CMTS:

- Ensure that your network supports reliable broadband data transmission. Your plant must be swept, balanced, and certified based on NTSC or appropriate international cable plant recommendations. Ensure your plant meets all DOCSIS downstream and upstream RF requirements.
- Ensure that your Cisco CMTS is installed according to the instructions provided in the *Cisco uBR7200 Series Universal Broadband Router Hardware Installation Guide*. The chassis must contain at least one port adapter to provide backbone connectivity and one Cisco cable line card to serve as the RF cable TV interface.

- Ensure that all other required headend or distribution hub routing and network interface equipment is installed, configured, and operational based on the services to support. This includes all routers, servers (DHCP, TFTP, and ToD), network management systems, and other configuration or billing systems. This includes IP telephony equipment including gatekeepers and gateways; backbone and other equipment if supporting VPN; and dialup access servers, telephone circuits and connections and other equipment if supporting telco return.
- Ensure that DHCP and DOCSIS configuration files have been created and pushed to appropriate servers such that each cable modem, when initialized, can transmit a DHCP request, receive an IP address, obtain TFTP and ToD server addresses, and download DOCSIS configuration files. Optionally, ensure your servers can also download updated software images to DOCSIS 1.0 and DOCSIS 1.1 cable modems.
- Ensure that customer premises equipment (CPE)—cable modems or set-top boxes, PCs, telephones, or facsimile machines—meet the requirements for your network and service offerings.
- Familiarize yourself with your channel plan to ensure assigning of appropriate frequencies. Outline your strategies for setting up bundling or VPN solution sets, if applicable, to your headend or distribution hub. Know your dial plan if using H.323 for VoIP services and setting up VoIP-enabled cable modem configuration files. Obtain passwords, IP addresses, subnet masks, and device names, as appropriate.
- Ensure that the system clocks on the CMTS and on the time-of-day (ToD) servers are synchronized. If this does not occur, the clocks on the CMs will not match the clocks on the CMTS, which could interfere with BPI+ operations. In particular, this could prevent the proper verification of the digital certificates on the CM.

After these prerequisites are met, you are ready to configure the CMTS. This includes, at a minimum, configuring a host name and password for the CMTS and configuring the CMTS to support IP over the cable plant and network backbone.

Caution If you plan to use service-class-based provisioning, the service classes must be configured at the CMTS before cable modems attempt to make a connection. See the "cable service class" section on page 25 for information on configuring service classes.

Configuration Tasks

Perform the configuration tasks outlined in your CMTS documentation to configure the CMTS. When the Cisco uBR7200 series has been upgraded to Cisco IOS Release 12.1 CX, it automatically enables all DOCSIS 1.1 features and sets them to their default values.

Command Reference

This section documents new or modified commands. All other commands are documented in the Cisco IOS Release 12.1 and Cisco IOS 12.1 T command reference publications. The following commands are new or have been modified to accommodate DOCSIS 1.1 functionality.

New Commands

Modified Commands

Debug and Test Commands

Replaced Commands

- **cable service-flow inactivity-timeout**
- **cable qos** [**profile** | **permission**]
- **show cable qos profile**

cable dci-response

To configure how a cable interface responds to DCI-REQ messages for cable modems on that interface, use the **cable dci-response** command in cable interface configuration mode.

cable dci-response [**success** | **ignore** | **reject permanent** | **reject temporary**]

Syntax Description

success	Configures the interface so that the Cisco CMTS responds to DCI-REQ messages from cable modems on the interface by sending a DCI-RSP response with the confirmation code of Success (0).
ignore	Configures the interface so that the Cisco CMTS ignores DCI-REQ messages from cable modems on the interface. It does not send any DCI-RSP responses.
reject permanent	Configures the interface so that the Cisco CMTS responds to DCI-REQ messages from cable modems on the interface by sending a DCI-RSP response with the confirmation code of Reject Permanent (4).
reject temporary	Configures the interface so that the Cisco CMTS ignores the first four DCI-REQ messages from a cable modem on the interface, but on the fifth DCI-REQ message, the CMTS responds with a DCI-RSP response with the confirmation code of Reject Temporary (3). The CMTS then continues to ignore the next seven DCI-REQ messages and then restarts this process when it receives the 12th DCI-REQ message.

Defaults

The Cisco CMTS responds to DCI-REQ messages from all cable modems by sending a DCI-RSP response with the confirmation code of Success (0).

Command Modes

Cable interface configuration

Command History

Release	Description
12.1(4)CX	This command was introduced for DOCSIS 1.1 operation.

Usage Guidelines

The Device Class Identification (DCI) messages are part of the Media Access Control Specification section of the DOCSIS 1.1 specification (revision SP-RFIv1.1-I05-000714 and above). A cable modem (CM) can optionally use the DCI-REQ message to inform the CMTS of certain capabilities, such as whether it is a CPE-controlled cable modem (CCCM).

The CMTS then responds with one of the following confirmation codes:

- Success—Allows the CM to continue with the registration process.
- Reject Permanent—Instructs the CM to abort its registration process on this downstream channel. The CM must try all other available downstream channels before attempting to register on this downstream channel again.

- Reject Temporary—Instructs the CM to reset its DCI-REQ counter, to send another DCI-REQ message, and to wait for the DCI-RSP before proceeding with the registration process.

Note The CMTS can also respond with an Upstream Transmitter Disable (UP-DIS) message. See the description of the **cable dci-upstream-disable** command for details.

Examples

The following example shows how to configure the CMTS so that it ignores all DCI-REQ messages from cable modems on the cable interface at slot 6:

```
router# config t
router(config)# int c6/0
router(config-if)# cable dci-response ignore
router(config-if)#
```

The following example shows how to configure the CMTS so that it returns to its default behavior for the cable interface on slot 6, which is to respond to all DCI-REQ messages from cable modems by sending a DCI-RSP with a Success confirmation code:

```
router# config t
router(config)# int c6/0
router(config-if)# cable dci-response success
router(config-if)#
```

Note The **cable dci-response success** command does not appear in a startup or running configuration file, because it is the default configuration for a cable interface.

Related Commands

Command	Description
cable dci-upstream-disable	Configures the cable interface so that it transmits an Upstream Transmitter Disable (UP-DIS) message instead of a DCI-RSP message to a particular cable modem.
debug cable dci	Enables debugging of DCI-REQ, DCI-RSP, and UP-DIS messages.

cable dci-upstream-disable

To configure a cable interface so that it transmits a DOCSIS 1.1 Upstream Transmitter Disable (UP-DIS) message to a particular cable modem (CM), use the **cable dci-upstream-disable** command in cable interface configuration mode. To remove that configuration and return to the default configuration, use the **no** form of this command.

cable dci-upstream-disable *mac-address* [**enable** | **disable**]

no cable dci-upstream-disable *mac-address* [**enable** | **disable**]

Syntax Description

mac-address	Specifies the MAC physical layer address for a particular cable modem.
enable	Enables the UP-DIS message for the particular cable modem, so that when the CM sends a DCI-REQ message, the CMTS responds by sending an UP-DIS response.
disable	Disables the sending of UP-DIS messages to a particular CM.

Defaults

The Cisco CMTS does not transmit UP-DIS messages to any cable modems.

Command Modes

Cable interface configuration

Command History

Release	Description
12.1(4)CX	This command was introduced for DOCSIS 1.1 operation.

Usage Guidelines

The DOCSIS 1.1 specification (revision SP-RFIv1.1-I05-000714 and above) allows a CMTS to transmit an Upstream Transmitter Disable (UP-DIS) message to a CM. If the CM supports the UP-DIS message, it responds by immediately disabling its upstream transmitter circuitry. The CM must be power-cycled before it can begin transmitting on the upstream again.

Examples

The following example shows that the UP-DIS message is being enabled for the CM with the MAC address of 0123.4567.89ab.

```
router# config t
router(config)# int c6/0
router(config-if)# cable dci-upstream-disable 0123.4567.89ab enable
router(config-if)#
```

Related Commands

Command	Description
cable dci-response	Configures how the cable interface responds to DCI-REQ messages from cable modems on that interface.
debug cable dci	Enables debugging of DCI-REQ, DCI-RSP, and UP-DIS messages.

cable service class

To set parameters for cable service class, use the **cable service class** command in global configuration mode.

cable service class *class_index* [**keyword-options**]

Syntax Description

activity-timeout	Specifies the quality of service parameter set activity timeout (0-65535).
admission-timeout	Specifies the admitted quality of service parameter set timeout (0-65535).
grant-interval	Specifies the grant interval (0-4294967295 micro-seconds).
grant-jitter	Specifies the grant jitter (0-4294967295 micro-seconds).
grant-size	Specifies the grant size (0-65535 bytes).
grants-per-interval	Specifies the grants per interval (0-127 grants).
max-burst	Specifies the maximum transmission burst (1522-4294967295 bytes).
max-concat-burst	Specifies the maximum concatenation burst (0-65535 bytes).
max-latency	Specifies the maximum latency allowed (0-4294967295 micro-seconds).
max-rate	Specifies the maximum rate (0-4294967295 bps).
min-packet-size	Specifies the minimum packet size for reserved rate (0-65535 bytes).
min-rate	Specifies the minimum rate (0-4294967295 bps).
name	Specifies the service-class name string.
poll-interval	Specifies the poll interval (0-4294967295 microseconds).
poll-jitter	Specifies the poll jitter (0-4294967295 microseconds).
priority	Specifies the priority (0-7, where 7 is the highest priority).
req-trans-policy	Specifies the request transmission policy bit field (0x0-0xFFFFFFF in hexadecimal).
sched-type	Specifies the service class schedule type: 2–Best-Effort Schedule Type 3–Non Real-Time Polling Service Schedule Type (not supported in Cisco IOS Release 12.1 CX) 4–Real-Time Polling Service Schedule Type 5–Unsolicited Grant Service with Activity Detection Schedule Type 6–Unsolicited Grant Service Schedule Type
tos-overwrite	Overwrites the ToS byte by setting the mask bits to the specified value (0x1-0xFF in hexadecimal).

Defaults

Values that are not specified are set to their DOCSIS 1.1 defaults, if applicable to the service-class schedule type.

Command Modes

Global configuration

Command History

Release	Modification
12.1(4)CX	This command was introduced. This command replaces the **cable qos profile** command that was used in previous versions.

Usage Guidelines

The **sched-type** option must always be specified for each class. When a certain scheduling type is selected, ensure that the mandatory parameters for that scheduling type are explicitly entered, while nonapplicable parameters must be explicitly removed.

If the service class is newly created, a service-class name must be defined before entering the parameters for the service class.

Examples

The following examples show configurations that use the **cable service class** command to create service classes. Based on the scheduling type specified, some command lines are mandatory, while others are optional.

Each example shown here is a complete configuration set for creating a service class.

→ The arrows indicate mandatory command lines.

Configuring a Service Class for Unsolicited Grant Scheduling Service

```
Router(config)# cable service class 1 name UP_UGS
Router(config)# cable service class 1 sched-type 6
→ Router(config)# cable service class 1 grant-size 100
→ Router(config)# cable service class 1 grant-interval 20000
→ Router(config)# cable service class 1 grant-jitter 4000
Router(config)# cable service class 1 grants-per-interval 1
Router(config)# cable service class 1 min-packet-size 100
→ Router(config)# cable service class 1 req-trans-policy 0x1FF
Router(config)# cable service class 1 tos-overwrite 0xE0 0xA0
Router(config)# cable service class 1 activity-timeout 30
Router(config)# cable service class 1 admission-timeout 30
```

Configuring a Service Class for Unsolicited Grant Scheduling with Activity Scheduling

```
Router(config)# cable service class 2 name UP_UGSAD
Router(config)# cable service class 2 sched-type 5
→ Router(config)# cable service class 2 grant-size 100
→ Router(config)# cable service class 2 grant-interval 20000
→ Router(config)# cable service class 2 grant-jitter 4000
→ Router(config)# cable service class 2 grants-per-interval 1
Router(config)# cable service class 2 poll-interval 10000
Router(config)# cable service class 2 poll-jitter 4000
Router(config)# cable service class 2 min-packet-size 100
→ Router(config)# cable service class 2 req-trans-policy 0x1FF
Router(config)# cable service class 2 tos-overwrite 0xE0 0xA0
Router(config)# cable service class 2 activity-timeout 30
Router(config)# cable service class 2 admission-timeout 30
```

Configuring a Service Class with Real-Time Polling Service

```
Router(config)# cable service class 3 name UP_RTPS
Router(config)# cable service class 3 sched-type 4
→ Router(config)# cable service class 3 poll-interval 10000
Router(config)# cable service class 3 poll-jitter 4000
Router(config)# cable service class 3 min-rate 64000
Router(config)# cable service class 3 max-rate 128000
Router(config)# cable service class 3 max-burst 2000
```

```
Router(config)# cable service class 3 max-concat-burst 1522
Router(config)# cable service class 3 req-trans-policy 0x1FF
Router(config)# cable service class 3 tos-overwrite 0xE0 0xA0
Router(config)# cable service class 3 activity-timeout 30
Router(config)# cable service class 3 admission-timeout 30
```

Configuring a Service Class for Best-Effort Upstream Service

```
Router(config)# cable service class 4 name UP_BE
Router(config)# cable service class 4 sched-type 2
Router(config)# cable service class 4 priority 5
Router(config)# cable service class 4 min-rate 0
Router(config)# cable service class 4 max-rate 128000
Router(config)# cable service class 4 max-burst 2000
Router(config)# cable service class 4 max-concat-burst 1522
Router(config)# cable service class 4 req-trans-policy 0x0
Router(config)# cable service class 4 tos-overwrite 0xE0 0x00
Router(config)# cable service class 4 activity-timeout 30
Router(config)# cable service class 4 admission-timeout 30
```

Configuring a Service Class for Best-Effort Downstream Service

```
Router(config)# cable service class 5 name DOWN_BE
Router(config)# cable service class 5 priority 5
Router(config)# cable service class 5 min-rate 0
Router(config)# cable service class 5 max-rate 1000000
Router(config)# cable service class 5 max-burst 3000
Router(config)# cable service class 5 activity-timeout 30
Router(config)# cable service class 5 admission-timeout 30
```

Related Commands

Command	Description
cable qos profile	Creates a DOCSIS 1.0 QoS profile.
show cable service-class	Displays the service classes that have been created.

cable service flow inactivity-threshold

To set the inactivity threshold value for service flows using Unsolicited Grant Service with Activity Detection (UGS-AD), use the **cable service flow inactivity-threshold** command in global configuration mode. To disable the inactivity timer, so that service flows revert to UGS activity only, use the **no** form of this command.

cable service flow inactivity-threshold *n*

no cable service flow inactivity-threshold *n*

Syntax Description

n	Specifies the threshold limit in seconds, with 10 seconds as the default. Configurable limits are 1 to 3600 seconds.

Defaults

The default is to enable the inactivity timer, with a default value of 10 seconds.

Command Modes

Global configuration

Command History

Release	Modification
12.1(4)CX	This command replaced the **cable service-flow inactivity-timeout** command for DOCSIS 1.1 operation.

Usage Guidelines

DOCSIS 1.1 allows a cable modem (CM) to request Unsolicited Grant Service (UGS) for an upstream, allowing the CM to reserve a certain amount of Constant Bit Rate (CBR) bandwidth for real-time traffic, such as Voice over IP (VoIP) calls. The UGS-AD variation allows the CMTS to switch a service flow to Real Time Polling Service (RTPS) after a certain period of inactivity, so that bandwidth is not reserved when it is not needed. The CM can then request UGS service when the flow again becomes active.

Note This command replaced the **cable service-flow inactivity-timeout** command, which was used in DOCSIS 1.0 operation to enable or disable watchdog cleanup of dynamic service flows that are not sending any packets on the upstream.

The **cable service flow inactivity-threshold** command sets the inactivity timer for how long a service flow must be inactive before the CMTS can switch it from UGS-AD to RTPS. The **no cable service flow inactivity-threshold** command disables the timer, so that the CMTS always provides UGS service to the service flow, even when the flow is idle.

Caution The **no cable service flow inactivity-threshold** command effectively disables the use of USG-AD services and configures the CMTS to provide only UGS services. This will prevent a CM that registered for USG-AD services from being able to obtain upstream transmission opportunities, resulting in a significant loss of bandwidth when a large number of CMs are requesting UGS-AD service flows.

Examples

The following example shows the inactivity timer being set to 20 seconds:

```
Router(config)# cable service flow inactivity-threshold 20
Router(config)#
```

The following command disables the inactivity timer, so that the service flow remains UGS, even during periods of inactivity:

```
Router(config)# no cable service flow inactivity-threshold
Router(config)#
```

Related Commands

Command	Description
cable service class	Sets the DOCSIS 1.1 service class parameters.
cable service-flow inactivity-timeout	Sets the amount of time a dynamic service-flow can be present in the system without any activity (DOCSIS 1.0 operation).
show controllers cable	Displays information for the cable interface.

cable submgmt default

To set the default values for attributes in the Subscriber Management MIB (DOCS-SUBMGT-MIB), use the **cable submgmt default** command in global configuration mode. To restore the original defaults, use the **no** form of this command.

cable submgmt default [**active** | **learnable** | **max-cpe** *cpe-num*]

cable submgmt default filter-group {**cm** | **cpe**} {**downstream** | **upstream**} *group-id*

no cable submgmt default [**active** | **learnable** | **max-cpe** *cpe-num*]

no cable submgmt default filter-group {**cm** | **cpe**} {**downstream** | **upstream**} *group-id*

Syntax Description

no	When used with the **active** and **learnable** options, the **no** form of the command sets the default attributes to false. When used with the **max-cpe** and **filter-group** options, the **no** form of the command sets the attribute to 0.
active	Sets the docsSubMgtCpeActiveDefault attribute, which controls whether the CMTS manages the CPE devices for a particular CM—if set to true, the CMTS enforces the MAX-CPE value and the implemented filters. The **no cable submgmt default active** command sets the default value to false (the original default), which turns off CPE management at the CMTS.
learnable	Sets the docsSubMgtCpeLearnableDefault attribute, which controls whether the CMTS learns the CPE IP addresses for a particular CM—if set to true (the original default), the CMTS learns IP addresses up to the MAX-CPE value. The **no cable submgmt default learnable** command sets the default value to false, which means that the IP address for each allowable CPE device must be specified in the DOCSIS configuration file.
max-cpe *cpe-num*	Sets the docsSubMgtCpeMaxIpDefault attribute, which specifies the default number of simultaneous IP addresses (CPE devices) permitted for the CM. The possible range is 0–1024, where 0 specifies that all CPE traffic from the CM is dropped. The default is 16.
filter-group	Specifies a filter group, which can be applied to either upstream or downstream traffic for either a cable modem or its CPE devices.
cm	Specifies that the filter group applies to traffic to or from a cable modem.
cpe	Specifies that the filter group applies to traffic to or from a CPE device.
downstream	Specifies that the filter group applies to the downstream traffic that is going to the specified CM or CPE device.
upstream	Specifies that the filter group applies to the upstream traffic that is coming from the specified CM or CPE device.
group-id	Specifies the filter group ID (0–1024) to be applied for the CM or CPE, downstream or upstream filter. This ID references the filter indexes that are used for rows in the docsSubMgtPktFilterTable. A value of 0 indicates that no filtering is used for this particular type of traffic.

Defaults

The Subscriber Management MIB defaults to the following default values:

- The active parameter defaults to false (the CMTS does not actively manage CPE devices).
- The learnable parameter defaults to true (the CMTS learns the IP addresses for CPE devices).
- The MAX-CPE parameter defaults to 16 IP addresses.
- The filter group ID for each type of filter group defaults to 0. (No filtering is done on that type of traffic.)

Command Modes

Global configuration

Command History

Release	Modification
12.1(7)CX1	This command was introduced.

Usage Guidelines

The DOCSIS 1.1 Subscriber Management MIB (DOCS-SUBMGT-MIB) creates and maintains a number of tables that describe the state of subscriber management for the cable modems (CM) and customer premises equipment (CPE) devices being serviced by the Cisco CMTS. The CMTS creates rows in these tables for each CM and CPE device when the CM registers with the CMTS, and if the CM does not specify a value for an attribute in this table, the CMTS uses the defaults specified by the **cable submgmt default** command.

Timesaver

The DOCS-SUBMGT-MIB MIB contains its own default values for these attributes, and those defaults can be overridden by giving the appropriate SNMP SET commands. The **cable submgmt default** command, however, allows the new defaults to be included in the Cisco IOS configuration file, so that the defaults are automatically reconfigured whenever the CMTS reboots or reloads.

Note

The **cable submgmt default** command sets only the default value for these attributes. These default values are used only if the CM does not specify other values when it registers with the CMTS. If the CM does specify different values at registration time, those values are used instead of these default values.

The attributes in DOCS-SUBMGT-MIB control how the CMTS manages the CPE devices behind a CM and the filters that are applied to the traffic to and from a particular CM and its CPE devices. The following sections describe the relationship between the different forms of the **cable submgmt default** commands and the attributes in DOCS-SUBMGT-MIB.

CPE Management

The first form of the **cable submgmt default** command controls the default values for the entries in the docsSubMgtCpeControlTable, which controls how the CMTS manages the CPE devices for each CM:

cable submgmt default active

Sets the docsSubMgtCpeActiveDefault attribute, which is the default value for the docsSubMgtCpeControlActive attribute in docsSubMgtCpeControlTable. This attribute controls whether the CMTS performs CPE management for a particular CM.

- The **cable submgmt default active** command sets the default to true, which specifies that the CMTS is to manage CPE devices by enforcing the MAX-CPE number and the implemented filters.
- The **no cable submgmt default active** command sets the default to false (the default value), which specifies that the CMTS is not to perform CPE management for the particular CM.

cable submgmt default learnable

Sets the docsSubMgtCpeLearnableDefault attribute, which is the default value for the docsSubMgtCpeControlLearnable attribute in docsSubMgtCpeControlTable. This attribute controls whether the CMTS learns the IP addresses for CPE devices behind a particular CM.

- The **cable submgmt default learnable** command sets the default to true (the default value), which specifies that the CMTS is to learn the IP addresses for the CPE devices behind the CM, up to the value specified by the MAX-CPE parameter. The CMTS learns the IP addresses by monitoring the traffic sent by the CPE devices, and the first CPE devices to transmit traffic are the first CPE devices to be learned.
- The **no cable submgmt default learnable** command sets the default to false, which specifies that the CMTS does not learn the IP addresses for the CPE devices behind a particular CM. Instead, the IP addresses for each CM that is to be allowed access must be specified in the DOCSIS configuration file.

cable submgmt default max-cpe *cpe-num*

Sets the docsSubMgtCpeMaxIpDefault attribute, which specifies the default value for the docsSubMgtCpeControlMaxCpeIp attribute in docsSubMgtCpeControlTable. This attribute specifies the maximum number of IP addresses that can transmit traffic through a particular CM. The possible range is 0 to 1024, and the original default is 16.

Note The MAX-CPE attribute is used only when the CMTS is actively managing CPE devices for the CM.

Filter Group Management

The second form of the **cable submgmt default** command controls the default values for the entries in the docsSubMgtCmFilterTable, which assigns the CM to one or more filter groups. A filter group specifies what filters are applied to the traffic going to or coming from each particular CM or CPE device. Filter groups can be numbered 0 to 1024, where 0 specifies that no filtering is done for that particular traffic type.

Note The actual filters specified in these commands must be created by setting the appropriate attributes in the DOCS-SUBMGT-MIB MIB using SNMP SET commands.

cable submgmt default filter-group cpe downstream *group-id*

Sets the ocsSubMgtSubFilterDownDefault attribute, which is the default value for the docsSubMgtSubFilterDownstream attribute in the docsSubMgtCmFilterTable. This attribute applies to downstream traffic that is sent to the CPE devices behind a particular CM.

cable submgmt default filter-group cpe upstream *group-id*

Sets the docsSubMgtSubFilterUpDefault attribute, which is the default value for the docsSubMgtSubFilterUpstream attribute in the docsSubMgtCmFilterTable. This attribute applies to upstream traffic that is sent by the CPE devices behind a particular CM.

cable submgmt default filter-group cm downstream *group-id*

Sets the docsSubMgtCmFilterDownDefault attribute, which is the default value for the docsSubMgtCmFilterDownstream attribute in the docsSubMgtCmFilterTable. This attribute applies to downstream traffic that is addressed to a particular CM.

cable submgmt default filter-group cm upstream *group-id*

Sets the docsSubMgtCmFilterUpDefault attribute, which is the default value for the docsSubMgtCmFilterUpstream attribute in the docsSubMgtCmFilterTable. This attribute applies to upstream traffic that is sent by a particular CM.

Examples

The following commands specify that the CMTS defaults to actively managing the CPE devices for each CM that registers, allowing and learning up to four IP addresses for the CPE devices behind that CM.

```
Router# config t
Router(config)# cable submgmt default active
Router(config)# cable submgmt default learnable
Router(config)# cable submgmt default max-cpe 4
Router(config)#
```

The following commands specify that the CMTS defaults to actively managing the CPE devices for each CM that registers. Each CM, however, must specify its own MAX-CPE value; otherwise, that value defaults to 0 and all traffic to and from the CPE devices for that CM is blocked.

```
Router# config t
Router(config)# cable submgmt default active
Router(config)# cable submgmt default max-cpe 0
Router(config)#
```

The following commands specify that the CMTS defaults to not actively managing the CPE devices for each CM that registers. However, if the CM at registration time indicates that the CMTS is to actively manage the CPE devices, the CMTS defaults to allowing only one CPE device. Learning is also disabled, so at least one CPE device must be specified in the DOCSIS configuration file that the CM uses to register.

```
Router# config t
Router(config)# no cable submgmt default active
Router(config)# no cable submgmt default learnable
Router(config)# cable submgmt default max-cpe 1
Router(config)#
```

The following commands specify that the CMTS defaults to assigning three filter groups to each CM that registers. Unless the CM indicates otherwise at registration time, downstream and upstream traffic for the CPE devices behind the CM is filtered according to the rules for filter groups 20 and 21, respectively. Filter group 1 is applied to the downstream traffic addressed to the CM. Upstream traffic sent by the CM, however, is not filtered.

```
Router# config t
Router(config)# cable submgmt default filter-group cpe downstream 20
Router(config)# cable submgmt default filter-group cpe upstream 21
Router(config)# cable submgmt default filter-group cm downstream 1
Router(config)# cable submgmt default filter-group cm upstream 0
Router(config)#
```

Note The above example assumes that filter groups 1, 20, and 21 have already been created on the CMTS, using the appropriate SNMP commands.

cable upstream fragmentation

To enable fragmentation, use the **cable upstream fragmentation** command in cable interface configuration mode. To disable fragmentation, use the **no** form of this command. Fragmentation is enabled by default.

cable upstream *upstream-port* **fragmentation**

no cable upstream *upstream-port* **fragmentation**

Syntax Description

upstream-port	Identifies the number of the upstream port (0–8, depending on the cable line card)

Defaults

By default, fragmentation is enabled for all upstream ports on ASIC line cards (Cisco uBR-MC11C, Cisco uBR-MC12C, Cisco uBR-MC14C, Cisco uBR-MC16C, Cisco uBR-MC16S, and Cisco uBR-MC28C) and disabled for all upstream ports on FPGA line cards.

Note Cisco IOS Release 12.1 CX supports the Multiple Grant Mode of DOCSIS 1.1 fragmentation.

Command Modes

Cable interface configuration

Command History

Release	Modification
12.1(4)CX	This command was introduced.

Usage Guidelines

This command enables and disables DOCSIS layer 2 fragmentation, which reduces run-time jitter experienced by constant bit rate (CBR) slots on the corresponding upstream. Disabling fragmentation increases the run-time jitter, but also reduces the fragmentation reassembly overhead for fragmented MAC frames. For ports running CBR traffic, fragmentation should be enabled (the default).

Note Do not confuse DOCSIS Layer 2 fragmentation with IP Layer 3 fragmentation.

Examples

The following command shows DOCSIS fragmentation being enabled on the c2/0 cable upstream:

```
Router# config t
Router(config)# int c2/0
Router(config-if)# cable upstream 0 fragmentation
Router(config-if)#
```

cable upstream unfrag-slot-jitter

To control how much jitter can be tolerated on the corresponding upstream due to unfragmentable slots, use the **cable upstream unfrag-slot-jitter** command in cable interface configuration mode. To disallow all jitter, use the **no** form of this command.

cable upstream *n* **unfrag-slot-jitter** [**limit** *jitter* | **cac-enforce**]

no cable upstream *n* **unfrag-slot-jitter** [**limit** *jitter* | **cac-enforce**]

Syntax Description

n	Identifies the desired upstream port on the cable interface
limit *jitter*	Specifies the allowable unfrag-slot jitter limit, in microseconds (0-429496729)
cac-enforce	Rejects service flows requesting jitter less than the fragmentable slot jitter

Defaults

By default, the limit is 0 microseconds and the **cac-enforce** option is enabled.

Command Modes

Cable interface configuration

Command History

Release	Modification
12.1(4)CX	This command was introduced.

Usage Guidelines

This command controls how much jitter due to unfragmented slots is to be tolerated on each port. If the specified value for the tolerated limit is less than the size of a maximum unfragmentable slot, the MAC scheduler automatically blocks the difference numbering of slots in the scheduling table so that the unfragmentable slot can be accommodated in the blocked space and avoid causing excessive jitter to CBR slots.

The **cac-enforce** option enforces the rule that service flows requesting run-time jitter less than unfragmentable slot jitter should be rejected.

Examples

The following example shows the jitter being set to 10 milliseconds (10000 microseconds) for upstream port 0 on cable interface 2/0:

```
Router# config t
Router(config)# int c2/0
Router(config-if)# cable upstream 0 unfrag-slot-jitter limit 10000
```

show cable modem

To display information for the registered and unregistered cable modems, use the **show cable modem** command in privileged EXEC mode.

show cable modem [*ip-address* | *interface* | *mac-address*] [*options*]

Syntax Description

ip-address	Identifies the IP address of a specific modem to be displayed
interface	Displays all cable modems on a specific CMTS cable interface
mac-address	Identifies the MAC address of a specific cable modem to be displayed
Available options when displaying information for a cable interface or for a single cable modem	
access-group	Displays access group.
connectivity	Displays connectivity content.
counters	Displays cable counters.
errors	Displays cable error details.
flap	Displays flap content.
mac	Displays the DOCSIS MAC version and capabilities.
maintenance	Displays station maintenance error statistics.
offline	Displays cable modems that are offline.
phy	Displays the phy layer content.
registered	Displays information for cable modems that have registered with the CMTS.
summary	Displays the total number, number of active, and number of registered modems per interface. This option can be used with **total** and **upstream** options to display details for specific line cards and ports.
unregistered	Displays information for cable modems that have not registered with the CMTS.
verbose	Displays detailed information.
Available options when displaying information for a single cable modem	
classifiers	Displays the classifiers for the modem.
classifiers cache	Displays the classifiers in the cache maintained for each cable modem. (This cache is based on IP header field values and speeds up classifier lookups and reduces per packet processing overhead.)
classifiers verbose	Displays detailed information for the modem's classifiers.
cpe	Displays the CPE devices accessing the cable interface through the cable modem.
cnr	(For Cisco uBR-MC16S only) Displays the carrier/noise ratio (CNR) for the specified cable modem (in dB).

Defaults

No default behavior or values

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3XA	This command was introduced.
11.3(5)NA	Output was reorganized and the Receive Power field was added.
12.0(3)T	This command was ported to Cisco IOS Release 12.0 T.
12.0(4)XI	Output was expanded to show primary service identifier (SID) and customer premises equipment (CPE) count.
12.0(7)XR	The **offline** option was added.
12.0(7)T	The **detail** option was replaced with the **verbose** option.
12.1(4)CX	The following options were added to this command: **connectivity** (it was removed from the **show interface sid** command) **counters** **errors** **flap** **mac** **phy**
12.1(6)EC	The **show cable modem summary** command was enhanced with the following options to display per-card and per-port totals: • **show cable modem summary total**—Displays a summary and a total for all modems on the chassis. • **show cable modem summary** *cable x/0* **total**—Displays a summary of modems on a specified card. • **show cable modem summary** *cable x/0* **upstream** *port1 port2* **total**—Displays a summary of modems on the specified card and specified range of ports. • **show cable modem summary** *cable x/0 cable y/0* **total**—Displays a summary of modems on the specified range of cards. • **show cable modem summary** *cable x/0 cable y/0* **upstream** *port1 port2* **total**—Displays a summary of modems on the specified range of ports on the specified range of cards.
12.1(7)CX1	The **cnr** option was added for Cisco uBR7200 series routers using the Cisco uBR-MC16S line card.

Usage Guidelines

This command displays information for all cable modems, all cable modems attached to a specific CMTS cable interface, or for a particular CM that is identified by its IP address or MAC address.

Examples

The following sample output from the **show cable modem** command shows the default displays for individual CMs.

```
Router# show cable modem
MAC Address    IP Address      I/F     MAC         Prim RxPwr Timing Num  BPI
                                       State       Sid  (db)  Offset CPEs Enbld
0010.7b6b.58c1 0.0.0.0         C4/0/U5 offline     5   -0.25  2285   0    yes
0010.7bed.9dc9 0.0.0.0         C4/0/U5 offline     6   -0.75  2290   0    yes
0010.7bed.9dbb 0.0.0.0         C4/0/U5 offline     7    0.50  2289   0    yes
0010.7b6b.58bb 0.0.0.0         C4/0/U5 offline     8    0.00  2290   0    yes
0010.7bb3.fcd1 10.20.113.2     C5/0/U5 online      1    0.00  1624   0    yes
0010.7bb3.fcdd 0.0.0.0         C5/0/U5 init(r1)    2   -20.00 1624   0    no
```

```
0010.7b43.aa7f 0.0.0.0         C5/0/U5 init(r2)     3    7.25  1623   0    no

Router# show cable modem 0010.7bb3.fcd1
MAC Address    IP Address      I/F     MAC          Prim RxPwr Timing Num  BPI
                                       State        Sid  (db)  Offset CPEs Enbld
0010.7bb3.fcd1 10.20.113.2     C5/0/U5 online       1    0.00  1624   0    yes
```

The default cable modem displays show the following information for each modem:

Table 2 Descriptions for the Default show cable modem Fields

Field	Description
MAC Address	The MAC address for the CM.
IP Address	The IP address that the DHCP server has assigned to the CM.
I/F	The cable interface line card providing the upstream for this CM.
MAC State	The current state of the MAC layer (see Table 3).
Prim SID	The primary SID assigned to this CM.
RxPwr	The received power level (in dB) for the CM.
Timing Offset	The timing offset for the CM.
Num CPEs	Indicates the number of CPE devices for which the CM is providing services.
BPI Enbld	Indicates whether BPI encryption is enabled for the CM.

Table 3 shows the possible values for the MAC state field:

Table 3 Descriptions for the MAC State Field

MAC State Value	Description
Registration and Provisioning Status Conditions	
init(r1)	The CM sent initial ranging.
init(r2)	The CM is ranging.
init(rc)	Ranging completed.
init(d)	DHCP request received.
init(i)	DHCP reply received and IP address has been assigned.
init(o)	The option file (DOCSIS configuration file) transfer has started.
init(t)	Time of Day (TOD) exchange has started.
Non-error Status Conditions	
offline	The CM is considered offline (disconnected or powered down).
online	The CM has registered and is enabled to pass data on the network.
online(d)	The CM registered, but network access for the CM has been disabled through the DOCSIS configuration file.
online(pk)	The CM registered, BPI is enabled and KEK assigned.
online(pt)	The CM registered, BPI is enabled and TEK assigned; BPI encryption is now being performed.

Table 3 Descriptions for the MAC State Field (continued)

MAC State Value	Description
Error Status Conditions	
reject(m)	The CM attempted to register; registration was refused due to a bad Message Integrity Check (MIC) value.
reject(c)	The CM attempted to register; but registration was refused due to a bad Class of Service (COS) value.
reject(pk)	KEK key assignment is rejected, and BPI encryption has not been established.
reject(pt)	TEK key assignment is rejected, and BPI encryption has not been established.

The following example shows sample output for the **summary** option:

```
Router# show cable modem summary
Interface                        Cable Modem
                    Total Registered Unregistered Offline
Cable4/0/U5         4     0          4            4
Cable5/0/U5         3     1          2            0
```

The following example shows sample output for the **summary** option for all enabled cable interface line cards:

```
Router# show cable modem summary total
Interface     Total      Active      Registered
              Modems     Modems      Modems
Cable5/0       746        714         711
Cable6/0       806        764         759

Total:        1552       1478        1470
```

The following example shows sample output for the **summary** option for all enabled upstreams on a specific cable interface line card:

```
Router# show cable modem summary c5/0 total
Interface     Total      Active      Registered
              Modems     Modems      Modems
Cable5/0/U0   294         272         271
Cable5/0/U1   256         248         246
Cable5/0/U2   196         194         194

Total:        746         714         711
```

The following example shows sample output for the **phy** option for a particular cable modem:

```
Router# show cable modem 0010.7bb3.fcd1 phy
MAC Address    USPwr  USSNR  Timing MicroReflec DSPwr  DSSNR
               (dBmV) (dBmV) Offset (dBc)       (dBmV) (dBmV)
0010.7bb3.fcd1 0      25.16           0         0       -----
```

The following example shows sample output for the **mac** option for a particular cable modem:

```
Router# show cable modem 0010.7bb3.fcd1 mac
MAC Address    MAC         Prim  Ver     Frag  Concat PHS   Priv  DS    US
               State       Sid                                     Saids Sids
0010.7bb3.fcd1 online      1     DOC1.0  no    no     no    BPI   0     0
```

The following example shows sample output for the **maintenance** option for a particular CM:

```
Router# show cable modem 0010.7bb3.fcd1 maintenance
MAC Address    I/F         Prim  SM Exhausted          SM Aborted
                           Sid   Count Time            Count Time
0010.7bb3.fcd1 C5/0/U5     1     3     Jun 1  10:24:52 0     Jan 1  00:00:00
```

The following example shows sample output for the **connectivity** option for a particular cable modem:

Note The **connectivity** option has been moved from **show int sid** command to the **show cable modem** command, because the connectivity statistics are per-cable modem statistics and are better managed from the cable modem instance.

```
Router# show cable modem 0010.7bb3.fcd1 connectivity
Prim  1st time    Times  %online     Online time            Offline time
Sid   online      Online          min     avg     max     min     avg     max
1     May 30 2000 4      99.85   48:20   11h34m  1d2h23m 00:01   00:59   03:00
```

The following example shows sample output for the **flap** option for a particular cable modem:

```
Router# show cable modem 0010.7bb3.fcd1 flap
MAC Address    I/F       Ins   Hit   Miss  CRC   P-Adj   Flap  Time
0010.7bb3.fcd1 C5/0/U5   0     36278 92    0     369     372   Jun 1  13:05:23
```

The following example shows sample output for the **qos** option for a particular cable modem:

```
Router# show cable modem 0010.7bb3.fcd1 qos
Sfid  Dir Curr  Sid   Sched  Prio MaxSusRate  MaxBrst   MinRsvRate  Throughput
          State       Type
3     US  act   1     BE     7    2000000     1522      100000      0
4     DS  act   N/A   BE     0    4000000     1522      0           0
```

The following example shows sample output for the **classifiers** option for a particular cable modem:

```
Router# show cable modem 0010.7b6b.7215 classifiers

CfrId  SFID     cable modem Mac Address  Direction  State    Priority  Matches
2      1988     0010.7b6b.7215    US        act        101
```

The following example shows sample output for the **counter** option for a particular cable modem:

```
Router# show cable modem 0010.7bb3.fcd1 counter
MAC Address    US Packets   US Bytes   DS Packets   DS Bytes
0010.7bb3.fcd1 1452082      171344434  1452073      171343858
```

The following example shows sample output for the **errors** option for a particular cable modem:

```
Router# show cable modem 0010.7bb3.fcd1 errors
MAC Address    I/F          CRC        HCS
0010.7bb3.fcd1 C5/0/U5      0          0
```

The following example shows sample output for the **cpe** option for a particular cable modem:

```
Router# show cable modem 0010.7bb3.fcd1 cpe
SID   Priv bits  Type      State     IP address    method    MAC address
1     00         modem     up        10.20.113.2   dhcp      0010.7bb3.fcd1
```

The following example shows sample output for the **access-group** option for a particular cable modem:

```
Router# show cable modem 0010.7bb3.fcd1 access-group
MAC Address    IP Address      Access-group
0010.7bb3.fcd1 10.20.113.2     N/A

Upstream Power               : 42 dBmV (SNR = 10 dBmV)
```

```
Downstream Power              : 15 dBmV (SNR = 15 dBmV)
```

The following example shows sample output for the **verbose** option for a particular cable modem:

```
Router# show cable modem 0010.7bb3.fcd1 verbose
MAC Address                          : 0010.7bb3.fcd1
IP Address                           : 10.20.113.2
Prim Sid                             : 1
Interface                            : C5/0/U5
Upstream Power                       : 42 dBmV (SNR = 10 dBmV)
Downstream Power                     : 15 dBmV (SNR = 15 dBmV)
Timing Offset                        : 1624
Received Power                       :   0.25
MAC Version                          : DOC1.0
Capabilities                         : {Frag=N, Concat=N, PHS=N, Priv=BPI}
Sid/Said Limit                       : {Max Us Sids=0, Max Ds Saids=0}
Optional Filtering Support           : {802.1P=N, 802.1Q=N}
Transmit Equalizer Support           : {Taps/Symbol= 0, Num of Taps= 0}
Number of CPEs                       : 0(Max CPEs = 0)
Flaps                                : 373(Jun 1  13:11:01)
Errors                               : 0 CRCs, 0 HCSes
Stn Mtn Failures                     : 0 aborts, 3 exhausted
Total US Flows                       : 1(1 active)
Total DS Flows                       : 1(1 active)
Total US Data                        : 1452082 packets, 171344434 bytes
Total US Throughput                  : 0 bits/sec, 0 packets/sec
Total DS Data                        : 1452073 packets, 171343858 bytes
Total DS Throughput                  : 0 bits/sec, 0 packets/sec
```

The following example shows sample output for the **registered** option, which can be used with or without a cable modem address. If you specify a cable modem address, information for that cable modem is displayed only if the cable modem has actually registered with the CMTS. The display for the **unregistered** option is identical to that shown for the registered option, except that it shows cable modems that have not yet registered with the CMTS.

```
Router# show cable modem 10.20.114.34 registered
Interface Prim Online      Timing Rec    QoS CPE IP address      MAC address
          Sid  State       Offset Power
C6/0/U5   1    online      2808   0.25   2   1   10.20.114.34    00d0.ba77.7595
```

Note The QoS field displays the QoS profile assigned to the cable modem and appears only for DOCSIS 1.1 cable modems.

The following example shows sample output for the **cnr** option for a particular cable modem:

```
Router# show cable modem 10.20.114.34 cnr
MAC Address    IP Address      I/F          MAC         Prim  cnr
                                            State       Sid   (db)
00d0.ba77.7595 10.20.114.34    Cable3/0/U5 online      1     38.00
```

show interface cable qos paramset

To display the attributes of the service flow QoS parameter set, use the **show interface cable qos paramset** command in privileged EXEC mode.

show interface cable *slot/port* **qos paramset** [*paramset-index*] [**verbose**]

Note Parameter sets that contain a service class name string are in an "unexpanded" state and serve as provisioning envelopes of class-based service flows. The actual attributes of such parameter sets depend on the service class that is referenced at the time the parameter sets are expanded.

Syntax Description

slot/port	Identifies the Cisco uBR7200 chassis slot number and downstream port number.
paramset-index	Identifies the desired service template index (1-255)
verbose	Displays full details about the parameter set.

Defaults

No default behavior or values

Command Modes

Privileged EXEC

Command History

Release	Modification
12.1(4)CX	This command replaces the **show cable qos profile** command for DOCSIS 1.1 operation.

Examples

The following sample output shows the standard and verbose formats of the **show interface cable qos-paramset** command:

```
Router# show int c6/0 qos paramset
Index Name              Dir    Sched  Prio MaxSusRate  MaxBurst    MinRsvRate
1                       US     BE     0    64000       0           0
2                       DS     BE     0    1000000     0           0
3                       US     BE     7    2000000     1522        100000
4                       DS     BE     0    4000000     1522        0

Router# show int c6/0 qos paramset 1 verbose

Index:                                  1
Name:
Direction:                              Upstream
Traffic Priority:                       0
Maximum Sustained Rate:                 64000 bits/sec
Max Burst:                              0 bytes
Minimum Reserved Rate:                  0 bits/sec
Minimum Packet Size                     0 bytes
Maximum Concatenated Burst:             1522
Scheduling Type:                        Best Effort
```

```
Request/Transmission Policy:            0x0
Nominal Polling Interval:               0
Tolerated Poll Jitter:                  0
Unsolicited Grant Size:                 0 bytes
Nominal Grant Interval:                 0 usecs
Tolerated Grant Jitter:                 0 usecs
Grants per Interval:                    0
IP ToS Overwrite [AND-mask,OR-mask]:    0x0,0x0
```

Related Commands

show cable qos permission	Displays the status of permissions for changing quality-of-service (QoS) tables.
show cable qos profile	Displays the QoS profiles that have been defined.

show cable service-class

To display the parameters for cable service class, use the **show cable service class** command in privileged EXEC mode.

show cable service-class [*sclass-index*] [**verbose**]

Syntax Description

sclass-index	Identifies the index for a service class that has already been defined (1–255).
verbose	Displays all of the defined attributes for the service class.

Defaults

No default behavior or values

Command Modes

Privileged EXEC

Command History

Release	Modification
12.1(4)CX	This command was introduced.

Usage Guidelines

You can display a summary of either one service class or all service classes. You can also display a complete listing of each service class and of all the defined service classes.

Examples

The following sample output shows the standard and verbose formats of the **show cable service class** command:

```
Router# show cable service-class
Index Name             Dir   Sched  Prio MaxSusRate  MaxBurst    MinRsvRate
1     UP_UGS           US/DS UGS    0    0           1522        0
2     UP_UGSAD         US/DS UGS_AD 0    0           1522        0
3     UP_RTPS          US/DS RTPS   0    128000      2000        64000
4     UP_BE            US/DS BE     5    128000      2000        0
5     DOWN_BE          US/DS BE     5    1000000     3000        0

Router# show cable service-class 1
Index Name             Dir   Sched  Prio MaxSusRate  MaxBurst    MinRsvRate
1     UP_UGS           US/DS UGS    0    0           1522        0

Router# show cable service-class 1 verbose

Index:                                1
Name:                                 UP_UGS
Direction:                            Upstream/Downstream
Traffic Priority:                     0
Maximum Sustained Rate:               0 bits/sec
Max Burst:                            1522 bytes
Minimum Reserved Rate:                0 bits/sec
Minimum Packet Size                   100 bytes
Admitted QoS Timeout                  30 seconds
```

```
Active QoS Timeout                      30 seconds
Scheduling Type:                        Unsolicited Grant Service
Request/Transmission Policy:            0x1FF
Unsolicited Grant Size:                 100 bytes
Nominal Grant Interval:                 20000 usecs
Tolerated Grant Jitter:                 4000 usecs
Grants per Interval:                    1
IP ToS Overwrite [AND-mask,OR-mask]:    0xE0,0xA0
Max Latency:                            0 usecs
Parameter Presence Bitfield:            {0xE08, 0xBCC000}


Router# show cable service-class verbose

Index:                                  1
Name:                                   UP_UGS
Direction:                              Upstream/Downstream
Traffic Priority:                       0
Maximum Sustained Rate:                 0 bits/sec
Max Burst:                              1522 bytes
Minimum Reserved Rate:                  0 bits/sec
Minimum Packet Size                     100 bytes
Admitted QoS Timeout                    30 seconds
Active QoS Timeout                      30 seconds
Scheduling Type:                        Unsolicited Grant Service
Request/Transmission Policy:            0x1FF
Unsolicited Grant Size:                 100 bytes
Nominal Grant Interval:                 20000 usecs
Tolerated Grant Jitter:                 4000 usecs
Grants per Interval:                    1
IP ToS Overwrite [AND-mask,OR-mask]:    0xE0,0xA0
Max Latency:                            0 usecs
Parameter Presence Bitfield:            {0xE08, 0xBCC000}
Index:                                  2
Name:                                   UP_UGSAD
Direction:                              Upstream/Downstream
Traffic Priority:                       0
Maximum Sustained Rate:                 0 bits/sec
Max Burst:                              1522 bytes
Minimum Reserved Rate:                  0 bits/sec
Minimum Packet Size                     100 bytes
Admitted QoS Timeout                    30 seconds
Active QoS Timeout                      30 seconds
Scheduling Type:                        Unsolicited Grant Service(AD)
Request/Transmission Policy:            0x1FF
Nominal Polling Interval:               10000 usecs
Tolerated Poll Jitter:                  4000 usecs
Unsolicited Grant Size:                 100 bytes
Nominal Grant Interval:                 20000 usecs
Tolerated Grant Jitter:                 4000 usecs
Grants per Interval:                    1
IP ToS Overwrite [AND-mask,OR-mask]:    0xE0,0xA0
Max Latency:                            0 usecs
Parameter Presence Bitfield:            {0xE08, 0xBFC000}


Index:                                  3
Name:                                   UP_RTPS
Direction:                              Upstream/Downstream
Traffic Priority:                       0
Maximum Sustained Rate:                 128000 bits/sec
Max Burst:                              2000 bytes
Minimum Reserved Rate:                  64000 bits/sec
Minimum Packet Size                     64 bytes
```

```
Admitted QoS Timeout                    30 seconds
Active QoS Timeout                      30 seconds
Maximum Concatenated Burst:             1522 bytes
Scheduling Type:                        Realtime Polling Service
Request/Transmission Policy:            0x1FF
Nominal Polling Interval:               10000 usecs
Tolerated Poll Jitter:                  4000 usecs
IP ToS Overwrite [AND-mask,OR-mask]:    0xE0,0xA0
Max Latency:                            0 usecs
Parameter Presence Bitfield:            {0xDC8, 0x83E000}


Index:                                  4
Name:                                   UP_BE
Direction:                              Upstream/Downstream
Traffic Priority:                       5
Maximum Sustained Rate:                 128000 bits/sec
Max Burst:                              2000 bytes
Minimum Reserved Rate:                  0 bits/sec
Minimum Packet Size                     64 bytes
Admitted QoS Timeout                    30 seconds
Active QoS Timeout                      30 seconds
Maximum Concatenated Burst:             1522 bytes
Scheduling Type:                        Best Effort
Request/Transmission Policy:            0x0
IP ToS Overwrite [AND-mask,OR-mask]:    0xE0,0x0
Max Latency:                            0 usecs
Parameter Presence Bitfield:            {0xDE8, 0x80E000}


Index:                                  5
Name:                                   DOWN_BE
Direction:                              Upstream/Downstream
Traffic Priority:                       5
Maximum Sustained Rate:                 1000000 bits/sec
Max Burst:                              3000 bytes
Minimum Reserved Rate:                  0 bits/sec
Minimum Packet Size                     64 bytes
Admitted QoS Timeout                    30 seconds
Active QoS Timeout                      30 seconds
Maximum Concatenated Burst:             0 bytes
Scheduling Type:                        Best Effort
Request/Transmission Policy:            0x0
IP ToS Overwrite [AND-mask,OR-mask]:    0xFF,0x0
Max Latency:                            0 usecs
Parameter Presence Bitfield:            {0xDE8, 0x0}

Router#
```

Related Commands

cable service class	Defines and modifies a service class.
show interface cable qos paramset	Displays the parameters in one or more service templates.

show interface cable downstream

To display the downstream packet queuing and the scheduling state, use the **show interface cable downstream** command.

show interface cable *x/y* **downstream**

Syntax Description

x/y	Identifies the cable interface by chassis slot number and downstream port number. Valid slot numbers for the cable interface in the Cisco uBR7200 series routers are from 3 to 6.

Defaults

No default behavior or values

Command Modes

Privileged EXEC

Command History

Release	Modification
12.1(4)CX	This command was introduced.

Examples

The following example shows a typical display of downstream packet queueing statistics.

```
Router# show interface cable 4/0 downstream
Cable4/0:Downstream is up
   54335436 packets output, 2854290447 bytes, 0 discarded
   0 output errors
  1 total active devices, 1 active modems
  Total downstream bandwidth: 27000000 bps
  Total downstream reserved bandwidth: 1000000 bps
  Worst case latency for low latency queue: 0 usecs
  Current Upper limit for worst case latency: 0 usecs
  Output Priority Queue Status:
            Priority Queue contains 0 packets
          [Queue 0]: 0/40, total packets 2394
          [Queue 1]: 0/40, total packets 0
          [Queue 2]: 0/40, total packets 0
          [Queue 3]: 0/40, total packets 0
          [Queue 4]: 0/40, total packets 0
          [Queue 5]: 0/40, total packets 0
          [Queue 6]: 0/40, total packets 0
          [Queue 7]: 0/40, total packets 0
          [Queue 8]: 0/40, total packets 0
Rate Limit Statistics:
Reserved rate exceeded packets: 1434101
Peak rate exceeded packets: 441441
Traffic shaped packets: 41444
Rate limit drops: 112111
```

show interface cable mac-scheduler

To display the current time-slot scheduling state and statistics, use the **show interface cable mac-scheduler** command in privileged EXEC mode.

show interface cable *x/y* **mac-scheduler** [*usport*]

Note In previous releases, information for the MAC scheduler was displayed using the **show interface upstream** command. In Cisco IOS Release 12.1 CX, this information is moved into this new command.

Syntax Description

x/y	Identifies the cable interface by chassis slot number and downstream port number. Valid slot numbers for the cable interface in the Cisco uBR7200 series routers are from 3 to 6.
usport	Displays information for the indicated upstream port.

Defaults

No default behavior or values

Command Modes

Privileged EXEC

Command History

Release	Modification
12.1(4)CX	This command was introduced.

Examples

The following example shows typical output for upstream port 0 on the indicated cable interface.

```
Router# show interface c3/0 mac-scheduler 0
    DOCSIS 1.1 MAC scheduler for Cable3/0/U0
     Queue[Rng Polls] 0/64, 0 drops
     Queue[CIR Grants] 0/64, 0 drops
     Queue[BE(7) Grants] 0/64, 0 drops
     Queue[BE(6) Grants] 0/64, 0 drops
     Queue[BE(5) Grants] 0/64, 0 drops
     Queue[BE(4) Grants] 0/64, 0 drops
     Queue[BE(3) Grants] 0/64, 0 drops
     Queue[BE(2) Grants] 0/64, 0 drops
     Queue[BE(1) Grants] 0/64, 0 drops
     Queue[BE(0) Grants] 0/64, 0 drops
     Req Slots 21992195, Req/Data Slots 0
     Init Mtn Slots 313764, Stn Mtn Slots 37638
     Short Grant Slots 3739132, Long Grant Slots 512
     Fragmentation count 5
     Fragmentation test disabled
     Avg upstream channel utilization : 2%
     Avg percent contention slots : 96%
     Avg percent initial ranging slots : 1%
     Avg percent minislots lost on late MAPs : 0%
     Sched Table Adm-State: Grants 1, Reqpolls 0, Util 2%
```

```
UGS    : 1 SIDs, Reservation-level in bps 80000
UGS-AD : 0 SIDs, Reservation-level in bps 0
RTPS   : 0 SIDs, Reservation-level in bps 0
NRTPS  : Not Supported
BE     : 4 SIDs, Reservation-level in bps 0
```

show interface cable service-flow

To display the attributes of DOCSIS service flows on a given cable interface, use the **show interface cable service-flow** command in privileged EXEC mode.

show interface cable *x/y* **service-flow** [*sfid*] [**classifiers** | **counters** | **phs** | **qos**] [**verbose**]

Syntax Description

x/y	Identifies the cable interface by chassis slot number and downstream port number. Valid slot numbers for the cable interface in the Cisco uBR7200 series routers are from 3 to 6.
sfid	Identifies the service flow index (1-65535)
classifiers	Displays the classifiers associated with this service flow.
counters	Displays the real-time counters for the service flow.
phs	Displays packet header suppression rules for the service flow.
qos	Displays QoS information for the service flow.
verbose	Displays detailed information on the service flow.

Defaults

No default behavior or values

Command Modes

Privileged EXEC

Command History

Release	Modification
12.1(4)CX	This command was introduced.

Usage Guidelines

The **verbose** keyword can be used with any of the other options or by itself.

Examples

The following examples show output from the **show interface cable service-flow** command:

```
Router# show int c3/0 service-flow
Sfid  Sid   Mac Address     QoS Param Index   Type    Dir    Curr   Active
                            Prov  Adm  Act                    State  Time
4     N/A   0002.1685.ac63   5     5    5     prim    DS     act    8h09m
1258  N/A   0002.1685.ac63   6     6    6     sec(S)  DS     act    8h09m
3     1     0002.1685.ac63   3     3    3     prim    US     act    8h09m
1257  22    0002.1685.ac63   4     4    4     sec(S)  US     act    8h09m
6     N/A   0001.9659.51e1   5     5    5     prim    DS     act    10h30m
1254  N/A   0001.9659.51e1   6     6    6     sec(S)  DS     act    10h30m
5     2     0001.9659.51e1   3     3    3     prim    US     act    10h30m
1253  20    0001.9659.51e1   4     4    4     sec(S)  US     act    10h30m
8     N/A   0002.1685.ac3d   5     5    5     prim    DS     act    10h30m
1250  N/A   0002.1685.ac3d   6     6    6     sec(S)  DS     act    10h30m
7     3     0002.1685.ac3d   3     3    3     prim    US     act    10h30m
1249  18    0002.1685.ac3d   4     4    4     sec(S)  US     act    10h30m
10    N/A   0002.1685.ac5f   5     5    5     prim    DS     act    10h30m
1252  N/A   0002.1685.ac5f   6     6    6     sec(S)  DS     act    10h30m
```

```
9     4     0002.1685.ac5f   3     3     3     prim    US     act    10h30m
1251  19    0002.1685.ac5f   4     4     4     sec(S)  US     act    10h30m
16    N/A   0002.1685.ac67   2     2     2     prim    DS     act    00:28
15    5     0002.1685.ac67   1     1     1     prim    US     act    00:28
22    N/A   0050.f112.2224   5     5     5     prim    DS     act    40:11
1260  N/A   0050.f112.2224   6     6     6     sec(S)  DS     act    40:11
21    6     0050.f112.2224   3     3     3     prim    US     act    40:11
```

Table 4 shows the descriptions for the fields displayed by this command:

Table 4 show interface cable service-flow Field Descriptions

Field	Description
Sfid	Identifies the service flow identification number.
Sid	Identifies the service identification number (upstream service flows only).
Mac Address	Identifies the cable modem's MAC address.
QoS Parameter Index Prov	Identifies the QoS parameter index for the Provisioned state of this flow.
QoS Parameter Index Adm	Identifies the QoS parameter index for the Admitted state of this flow.
QoS Parameter Index Act	Identifies the QoS parameter index for the Active state of this flow.
Type	Indicates if the service flow is the primary flow or a secondary service flow. Secondary service flows are also identified by an "S" (created statically at the time of registration, using the DOCSIS configuration file) or "D" (created dynamically by the exchange of dynamic service messages between the cable modem and CMTS).
Dir	Indicates if this service flow is downstream (DS) or upstream (US).
Curr State	Indicates the current run-time state of the service flow.
Active Time	Indicates the length of time this service flow has been active.

```
Router# show interface cable 3/0 service-flow 23456 verbose
Sfid                                  : 23456
MAC Address                           : 0010.7b6b.7215
Type                                  : Primary
Direction                             : Upstream
Current State                         : Active
Active Time                           : 9h:27m
QoS Param timeout [Active, Admitted]  : [200, 200] secs
Classifiers                           :  123.3334, 556, 221
Sid                                   : 1000
Traffic Priority                      : 5
Maximum Sustained Rate                : 128000 bits/sec
Maximum Burst                         : 1522 bytes
Minimum Reserved Rate                 : 32000 bits/sec
Packets                               : 33445
Bytes                                 : 45612
Packet Drops                          : 34
Current Throughput                    : 100000 bits/sec, 200 packets/sec
```

```
Router# show int c4/0 service-flow qos
```

```
Sfid  Dir Curr  Sid   Sched  Prio MaxSusRate  MaxBrst   MinRsvRate  Throughput
          State       Type
12    DS  act   N/A   BE     0    1000000     0         0           0
11    US  act   5     BE     0    64000       0         0           0
14    DS  act   N/A   BE     0    1000000     0         0           0
13    US  act   6     BE     0    64000       0         0           0
16    DS  act   N/A   BE     0    1000000     0         0           0
15    US  act   7     BE     0    64000       0         0           0
18    DS  act   N/A   BE     0    1000000     0         0           0
17    US  act   8     BE     0    64000       0         0           0
```

Note To print out all service flows, leave out the 12 in the following example.

Sample Downstream Flow

```
Router# show int c4/0 service-flow 12 qos verbose
Sfid                                    : 12
Current State                           : Active
Sid                                     : N/A
Traffic Priority                        : 0
Maximum Sustained rate                  : 1000000 bits/sec
Maximum Burst                           : 0 bytes
Mimimum Reserved rate                   : 0 bits/sec
Minimum Packet Size                     : 0 bytes
Maximum Latency                         : 0 usecs
Current Throughput                      : 0 bits/sec, 0 packets/sec
```

Sample Upstream Flow

```
Router# show int c4/0 service-flow 11 qos verbose
Sfid                                    : 11
Current State                           : Active
Sid                                     : 5
Traffic Priority                        : 0
Maximum Sustained rate                  : 64000 bits/sec
Maximum Burst                           : 0 bytes
Mimimum Reserved rate                   : 0 bits/sec
Minimum Packet Size                     : 0 bytes
Maximum Concatenated Burst              : 1522
Scheduling Type                         : Best Effort
Unsolicited Grant Size                  : 0 bytes
Nominal Grant Interval                  : 0 usecs
Grants per interval                     : 0
Tolerated Grant Jitter                  : 0 usecs
Nominal Polling Interval                : 0 usecs
Tolerated Polling Jitter                : 0 usecs
Request/Transmission policy             : 0x0
IP ToS Overwrite[AND-mask, OR-mask]     : 0x0, 0x0
Current Throughput                      : 0 bits/sec, 0 packets/sec

Router# show int c4/0 service-flow counters
Sfid  Packets     Bytes       PacketDrops Bits/Sec    Packets/Sec
12    0           0           0           0           0
11    0           0           0           0           0
14    0           0           0           0           0
13    2           128         0           0           0
16    0           0           0           0           0
15    2           128         0           0           0
18    0           0           0           0           0
17    2           128         0           0           0
```

Note To print out all service flows, leave out the 12 in the following example.

```
Router# show int c4/0 service-flow 12 counters verbose
Sfid                   : 12
Packets                : 154
Octets                 : 51656
RateLimit Delayed Pkts : 0
RateLimit Dropped Pkts : 0
Bits/sec               : 0
Packets/Sec            : 0

Router# show int c4/0 service-flow classifiers
CfrId  SFID     cable modem Mac Address  Direction  State    Priority  Matches

2      14       00d0.bad3.c46b  upstream   active   8         0
1      14       00d0.bad3.c46b  upstream   inactive 5         0

Router# show int c4/0 service-flow 14 classifiers verbose
Sfid                                 : 14

Classifier Id                       : 2
Service Flow Id                     : 14
cable modem Mac Address                      : 00d0.bad3.c46b
Direction                           : upstream
Activation State                    : active
Classifier Matching Priority        : 8
PHSI                                : 0
Number of matches                   : 0
IP Classification Parameters:
        Destination Port Low        : 1024
        Destination Port High       : 65535

Router# show interface cable 3/0 service-flow phs
Sfid  PHSI  PHSS   PHSM                                PHSF
9      1        24        F7 FF 00 00 00 00 00 00     08 90 A0 B0 C0 D0 E0 F0

cmts#show interface cable 3/0 service-flow 9 phs verbose
Sfid:         9
PHSI:         1
PHSS:         24
PHSM:         F7 FF 00
PHSF:         08 90 A0 B0 C0 D0 E0 F0 00 10 20 30 40 50 60 70 00 00 00 00
              00 00 00 00
```

show interface cable sid

To display the service identifier (SID) for a cable modem, use the **show interface cable sid** command in Privileged EXEC mode.

show interface cable *x/y* **sid** [**counters** | **qos**] [**verbose**]

Syntax Description

x/y	Identifies the cable interface by chassis slot number and downstream port number. Valid slot numbers for the cable interface in the Cisco uBR7200 series routers are from 3 to 6.
counters	Displays the values of the per-SID usage counters.
qos	Displays the QoS characteristics received by each SID.
verbose	Displays detailed information.

Defaults

No default behavior or values

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 XA	This command was introduced.
11.3(6)NA	The keyword **stats** was changed to **counters**.
12.0(4)XI	Primary SID information was added.
12.0(5)T	The command output was modified to identify secondary SIDs.
12.0(7)XR and 12.0(7)T	The **verbose** keyword was added.
12.1(4)CX	The **qos** keyword was added to display information on the QoS received by the SID from the MAC scheduler. Also, the **connectivity** option was moved to the **show cable modem** command.

Usage Guidelines

Data transport over the radio frequency (RF) link uses the registered SID address rather than the Ethernet address. This allows multiple hosts to access the network via a single cable modem.

The **verbose** keyword can be used with any of the other options or by itself.

Examples

The following sample output from the **show interface cable sid** command shows the various forms of the command.

```
Router# show int c4/0 sid
Sid  Prim  MAC Address    IP Address      Type Age    Admin   Sched  Sfid
                                                    State   Type
5          0010.7b6b.58c1 0.0.0.0         stat 2d1h36menable  BE     11
6          0010.7bed.9dc9 0.0.0.0         stat 2d1h36menable  BE     13
```

```
7          0010.7bed.9dbb 0.0.0.0         stat 2d1h36menable  BE     15
8          0010.7b6b.58bb 0.0.0.0         stat 2d1h34menable  BE     17


Router# show int c4/0 sid qos
Sid  Pr MaxSusRate MinRsvRate Sched  Grant Grant  GPI Poll   Thrput
                              Type   Size  Intvl      Intvl
5    0  64000      0          BE     0     0      0   0      0
6    0  64000      0          BE     0     0      0   0      0
7    0  64000      0          BE     0     0      0   0      0
8    0  64000      0          BE     0     0      0   0      0


Router# show int c4/0 sid 5 qos
Sid  Pr MaxSusRate MinRsvRate Sched  Grant Grant  GPI Poll   Thrput
                              Type   Size  Intvl      Intvl
5    0  64000      0          BE     0     0      0   0      0


Router# show int c4/0 sid 5 qos verbose
Sid                                    : 5
Traffic Priority                       : 0
Maximum Sustained Rate                 : 64000
Maximum Burst                          : 0
Minimum Reserved Rate                  : 0
Minimum Packet Size                    : 0
Maximum Concatenated Burst             : 1522
Scheduling Type                        : Best Effort
Nominal Grant Interval                 : 0
Tolerated Grant Jitter                 : 0
Nominal Polling Interval               : 0
Tolerated Polling Jitter               : 0
Unsolicited Grant Size                 : 0
Grants per Interval                    : 0
Request/Transmission Policy            : 0x0
IP ToS Overwrite [AND-mask, OR-mask]   : 0x0, 0x0
Current Throughput                     : 0 bits/sec, 0 packets/sec


Router# show int c5/0 sid counter
00:02:23: %ENVM-3-LASTENV: Cannot save environmental data
Sid  Req-polls  BW-reqs    Grants     Packets    Frag       Concatpkts
     issued     received   issued     received   complete   received
1    0          22         22         22         0          0
2    0          3          3          2          0          0
3    0          0          0          0          0          0

Router# show int c4/0 sid 3 counter verbose
Sid                           : 3
Request polls issued          : 0
BW requests received          : 1
No grant buf BW request drops : 0
Rate exceeded BW request drops : 0
Grants issued                 : 1
Packets received              : 0
Bytes received                : 0
Fragment reassembly completed  : 0
Fragment reassembly incomplete : 0
Concatenated packets received  : 0
Queue-indicator bit statistics : 0 set, 0 granted
```

Table 5 describes the fields shown in the **show interface cable sid** display.

Table 5 show interface cable sid Field Descriptions

Field	Description
Sid	Service identification number.
Prim Sid	The primary service identifier (SID) assigned to the modem.
Type	Indicates that this SID was created statically at the time of registration or dynamically by the exchange of dynamic service messages between the cable modem and CMTS.
Online State Offline State	"Online" means that the modem owning this SID is processing traffic. "Offline" means that the modem owning this SID is not processing traffic.
Admin Status	"Disable" means that the SID has been turned off. "Enable" is the normal state.
QoS	Quality of service.
Create time	When the SID was created, number of seconds since the system booted.
Input octets (Inoctets)	Number of octets received by using this SID.
Input packets (Inpackets)	Number of packets received by using this SID.
Output octets (Outoctets)	Number of octets sent from this SID.
Output packets (Outpackets)	Number of packets sent from this SID.
IP address	IP address of the modem owning this SID.
MAC address	MAC address of the modem owning this SID.
BW requests received	Number of bandwidth requests received by this SID.
Grants issued	Number of bandwidth requests granted by this SID.
Rate exceeded BW request drops	Number of bandwidth requests not granted by this SID.
Rate exceeded DS packet drops	Number of downstream packets lost by this SID.
Ratelimit BWReqDrop	Number of bandwidth requests not granted by this SID.
Ratelimit DSPktDrop	Number of downstream packets lost by this SID.
1st time online	Time at which the modem with this SID connected.
Times online	Number of times the modem with this SID connected.
% online	Percentage of time the modem with this SID has been connected.
Online time	The minimum, average, and maximum number of hours and minutes the modem with this SID has been connected.
Offline time	The minimum, average, and maximum number of hours and minutes the modem with this SID has been disconnected.
MaxSusRate	The maximum rate (0-4294967295 bps).
MinRsvRate	The minimum guaranteed rate (0-4294967295 bps).
Sched Type	The service-class schedule type: 2–Best-Effort Schedule Type 3–Non Real-Time Polling Service Schedule Type 4–Real-Time Polling Service Schedule Type 5–Unsolicited Grant Service with Activity Detection Schedule Type 6–Unsolicited Grant Service Schedule Type
Grant Size	The grant size (0-65535 bytes).

Table 5 show interface cable sid Field Descriptions (continued)

Field	Description
Grant Interval	The grant interval (0-4294967295 microseconds).
GPI	The grants per interval (0-127 grants).
Poll Interval	The poll interval (0-4294967295 microseconds).
Throughput	The overall throughput for this SID.

Related Commands

Command	Description
show interface cable signal-quality	Displays information about the cable signal quality.

Debug Commands

The support for DOCSIS 1.1 includes the following new debugging commands:

- debug cable dci, page 59
- debug cable mac-scheduler, page 60
- debug cable phs, page 61
- debug cable tlvs, page 62

Caution The debug commands are primarily intended for use in controlled test and troubleshooting situations with a limited volume of traffic. You should use caution when enabling debug messages because sending these messages to the console consumes system resources. Cisco recommends that when you use the **debug cable** commands, you limit their output to a particular interface or cable modem, using the **debug cable interface** command.

debug cable dci

To display information about DOCSIS 1.1 Device Class Identification (DCI) messages, use the **debug cable dci** command in Privileged EXEC mode. To disable debugging output for DCI messages, use the **no** form of this command.

debug cable dci

no debug cable dci

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.1(4)CX	This command was introduced for DOCSIS 1.1 operation.

Usage Guidelines

This command shows debugging messages about the DCI-REQ messages that the CMTS receives from cable modems.

Note See the DOCSIS 1.1 specification (revision SP-RFIv1.1-I05-000714 and above) for additional information on the DCI-REQ, DCI-RSP, and UP-DIS messages.

Examples

The following example shows typical output for the **debug cable dci** command:

```
Router# debug cable dci
CMTS dci debugging is on
Router#
DCI-REQ: CM->1234.5678.abcd SID->1
Device Class 1st half->0000000000000000 Device Class 2nd half->0000000000000001
```

Related Commands

cable dci-response	Configures how a cable interface responds to DCI-REQ messages coming from cable modems on that interface.
cable dci-upstream-disable	Configures the cable interface so that it sends an Upstream Transmitter Disable (UP-DIS) message in response to a DCI-REQ message from a particular cable modem.

debug cable mac-scheduler

To display information about the MAC scheduler's admission control activities, use the **debug cable mac-scheduler** command in Privileged EXEC mode. The **no** form of this command disables debugging output.

debug cable mac-scheduler [**admission-control**]

no debug cable mac-scheduler [**admission-control**]

Syntax Description

admission-control	Displays debugging output for the MAC scheduler's admission control activities, which controls the percentage of overbooking allowed on the upstream channel.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.1(4)CX	This command was introduced.

Usage Guidelines

Do not use this command if you have a large number of modems on your network. The Cisco uBR7246 will become flooded with console printouts.

Examples

The following example shows debugging being turned on for the MAC scheduler:

```
Router# debug cable mac-scheduler admission-control
CMTS scheduler debugging is on

Router#
```

Related Commands

cable upstream admission-control	Determines the percentage of overbooking allowed on the upstream channel.

debug cable phs

To display the activities of the payload header suppression and restoration (PHS) driver, use the **debug cable phs** command in Privileged EXEC mode. The **no** form of this command disables debugging output.

debug cable phs

no debug cable phs

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.1(4)CX	This command was introduced.

Usage Guidelines

This command displays the output for both the upstream and downstream drivers. The upstream receive driver restores headers that have been suppressed by cable modems, and the downstream driver suppresses specific fields in packet header before forwarding a frame to the cable modem.

Note Do not use this command when you have a large number of active cable modems on your network because it could generate a huge amount of output to the console port.

Examples

The following example shows typical output for PHS debugging:

```
Router# debug cable phs
CMTS payload header suppression debugging is on

00:02:55: New PHS rule: 1 (SFID: 9)
   size : 34
   mask : 00 00 00 03 FC 00 00 00  field: 00 00 00 00 00 00 00 00
 Add PHS rule 1 to CFR ID 1

 00:02:57: New PHS rule: 1 (SFID: 11)
   size : 34
   mask : 00 00 00 03 FC 00 00 00  field: 00 00 00 00 00 00 00 00
 Add PHS rule 1 to CFR ID 1
Router#
```

debug cable tlvs

To display the TLVs parsed by the DOCSIS 1.1 TLV parser/encoder, use the **debug cable tlvs** command in Privileged EXEC mode. In particular, this command displays the TLVs for service flow encodings, classifier encodings, and PHS rules.

The **no** form of this command disables debugging output.

debug cable tlvs

no debug cable tlvs

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.1(4)CX	This command was introduced.

Usage Guidelines

Do not use this command when you have a large number of active cable modems on your network because it could generate a huge amount of output to the console port.

Examples

The following example shows typical output for the **debug cable tlvs** command:

```
Router# debug cable tlvs
CMTS TLV encodings debugging is on

 00:02:06: Registration request from 0003.e350.9b8d, SID 3 on Cable3/0/U0
 00:02:06: TLV-Block Bytes:
 00:02:06: 0x0000: 03 01 01 12 01 10 1D 01 00 16 0F 01 01 01 03 02
 00:02:06: 0x0010: 00 04 09 06 03 04 0A 0A 00 02 18 07 01 02 00 01
 00:02:06: 0x0020: 06 01 07 18 07 01 02 00 02 06 01 07 18 07 01 02
 00:02:06: 0x0030: 00 03 06 01 01 18 07 01 02 00 04 06 01 01 19 07
 00:02:06: 0x0040: 01 02 00 09 06 01 07 19 07 01 02 00 0A 06 01 01
 00:02:06: 0x0050: 19 07 01 02 00 0B 06 01 01 19 07 01 02 00 0C 06
 00:02:06: 0x0060: 01 01 06 10 33 E0 BA 7A DA 81 1B 9B 8E 37 F5 33
 00:02:06: 0x0070: 1C 84 E7 4D 07 10 01 0C C8 DB F9 26 B7 D2 DD 0A
 00:02:06: 0x0080: 00 58 1E 14 15 FD 0C 04 0A 0A 00 02 08 03 00 03
 00:02:06: 0x0090: E3 05 21 02 01 01 03 01 01 04 01 01 05 01 00 06
 00:02:06: 0x00A0: 01 01 07 01 00 08 01 04 09 01 00 0A 01 01 0B 01
 00:02:06: 0x00B0: 08 01 01 01
 00:02:06: Found Network Access TLV
 00:02:06: Ntw Access Control : 1
 00:02:06: Found Max CPEs TLV
 00:02:06: Maximum Number Of CPEs : 16
 00:02:06: Found Privacy Enable TLV
 00:02:06: Privacy Enable : 0
 00:02:06: Found Upstream Packet Classifier TLV
 00:02:06:       Classifier Reference : 1
 00:02:06:       Service-Flow Reference : 4
```

```
00:02:06:       Found IP Packet Classifier Sub-TLV
00:02:06:               Source Address : 10.10.0.2
00:02:06: Found Upstream Service Flow TLV
00:02:06:       Service Flow Reference : 1
00:02:06:       QoS Parameter Set Type : 0x7
00:02:06: Found Upstream Service Flow TLV
00:02:06:       Service Flow Reference : 2
00:02:06:       QoS Parameter Set Type : 0x7
00:02:06: Found Upstream Service Flow TLV
00:02:06:       Service Flow Reference : 3
00:02:06:       QoS Parameter Set Type : 0x1
00:02:06: Found Upstream Service Flow TLV
00:02:06:       Service Flow Reference : 4
00:02:06:       QoS Parameter Set Type : 0x1
00:02:06: Found Downstream Service Flow TLV
00:02:06:       Service Flow Reference : 9
00:02:06:       QoS Parameter Set Type : 0x7
00:02:06: Found Downstream Service Flow TLV
00:02:06:       Service Flow Reference : 10
00:02:06:       QoS Parameter Set Type : 0x1
00:02:06: Found Downstream Service Flow TLV
00:02:06:       Service Flow Reference : 11
00:02:06:       QoS Parameter Set Type : 0x1
00:02:06: Found Downstream Service Flow TLV
00:02:06:       Service Flow Reference : 12
00:02:06:       QoS Parameter Set Type : 0x1
00:02:06: Found CM-MIC TLV
00:02:06: CM MIC:
00:02:06: 0x0000: 33 E0 BA 7A DA 81 1B 9B 8E 37 F5 33 1C 84 E7 4D
00:02:06: Found CMTS-MIC TLV
00:02:06: CMTS MIC:
00:02:06: 0x0000: 01 0C C8 DB F9 26 B7 D2 DD 0A 00 58 1E 14 15 FD
00:02:06: Found CM IP Address TLV
00:02:06: Modem IP Address : 10.10.0.2
00:02:06: Vendor Id:
00:02:06: 0x0000: 00 03 E3
00:02:06: Found Modem Capabilities TLV
00:02:06:       DOCSIS Version : 1
00:02:06:       Fragmentation Support : 1
00:02:06:       Payload Header Suppresion Support : 1
00:02:06:       IGMP Support : 0
00:02:06:       Privacy Support : 1
00:02:06:       Downstream SAID Support : 0
00:02:06:       Upstream SID Support : 4
00:02:06:       Optional Filtering Support : 0
00:02:06:       Tx Equalizer Taps Per Symbol : 1
00:02:06:       Tx Equalizer Taps Support : 8
00:02:06:       Concatenation Support : 1
00:02:06: Performing admission control check
00:02:06: Added Modem Capabilities TLV:
00:02:06: 0x0000: 05 21 02 01 01 03 01 01 04 01 01 05 01 00 06 01
00:02:06: 0x0010: 01 07 01 00 08 01 04 09 01 00 0A 01 01 0B 01 08
00:02:06: 0x0020: 01 01 01
00:02:06: Sfref = 1, SFID = 7
00:02:06: Added Service Flow Parameters TLV:
00:02:06: 0x0000: 18 11 01 02 00 01 02 04 00 00 00 07 03 02 00 03
00:02:06: 0x0010: 06 01 07
00:02:06: Sfref = 2, SFID = 43
00:02:06: Added Service Flow Parameters TLV:
00:02:06: 0x0000: 18 11 01 02 00 02 02 04 00 00 00 2B 03 02 00 0B
00:02:06: 0x0010: 06 01 07
00:02:06: Sfref = 3, SFID = 44
00:02:06: Added Service Flow Parameters TLV:
00:02:06: 0x0000: 18 0D 01 02 00 03 02 04 00 00 00 2C 06 01 01
```

```
00:02:06: Sfref = 4, SFID = 45
00:02:06: Added Service Flow Parameters TLV:
00:02:06: 0x0000: 18 0D 01 02 00 04 02 04 00 00 00 2D 06 01 01
00:02:06: Sfref = 9, SFID = 8
00:02:06: Added Service Flow Parameters TLV:
00:02:06: 0x0000: 19 0D 01 02 00 09 02 04 00 00 00 08 06 01 07
00:02:06: Sfref = 10, SFID = 46
00:02:06: Added Service Flow Parameters TLV:
00:02:06: 0x0000: 19 0D 01 02 00 0A 02 04 00 00 00 2E 06 01 01
00:02:06: Sfref = 11, SFID = 47
00:02:06: Added Service Flow Parameters TLV:
00:02:06: 0x0000: 19 0D 01 02 00 0B 02 04 00 00 00 2F 06 01 01
00:02:06: Sfref = 12, SFID = 48
00:02:06: Added Service Flow Parameters TLV:
00:02:06: 0x0000: 19 0D 01 02 00 0C 02 04 00 00 00 30 06 01 01
00:02:06: Cfr-ref = 1, CFID = 1, SF-ref 4, SFID 45
00:02:06: Added Classifier Parameters TLV:
00:02:06: 0x0000: 16 19 01 01 01 03 02 00 04 02 02 00 01 04 04 00
00:02:06: 0x0010: 00 00 2D 09 06 03 04 0A 0A 00 02
00:02:06: REG-RSP Status : ok (0), REG-ACK required from CM (0)
00:02:06: Reg-Ack wait state successfully created
00:02:06: Registration Response:
00:02:06: 0x0000: C2 00 00 D9 00 00 00 03 E3 50 9B 8D 00 00 00 00
00:02:06: 0x0010: 30 30 00 C7 00 00 03 01 07 00 00 03 00 05 21 02
00:02:06: 0x0020: 01 01 03 01 01 04 01 01 05 01 00 06 01 01 07 01
00:02:06: 0x0030: 00 08 01 04 09 01 00 0A 01 01 0B 01 08 01 01 01
00:02:06: 0x0040: 18 11 01 02 00 01 02 04 00 00 00 07 03 02 00 03
00:02:06: 0x0050: 06 01 07 18 11 01 02 00 02 02 04 00 00 00 2B 03
00:02:06: 0x0060: 02 00 0B 06 01 07 18 0D 01 02 00 03 02 04 00 00
00:02:06: 0x0070: 00 2C 06 01 01 18 0D 01 02 00 04 02 04 00 00 00
00:02:06: 0x0080: 2D 06 01 01 19 0D 01 02 00 09 02 04 00 00 00 08
00:02:06: 0x0090: 06 01 07 19 0D 01 02 00 0A 02 04 00 00 00 2E 06
00:02:06: 0x00A0: 01 01 19 0D 01 02 00 0B 02 04 00 00 00 2F 06 01
00:02:06: 0x00B0: 01 19 0D 01 02 00 0C 02 04 00 00 00 30 06 01 01
00:02:06: 0x00C0: 16 19 01 01 01 03 02 00 04 02 02 00 01 04 04 00
00:02:06: 0x00D0: 00 00 2D 09 06 03 04 0A 0A 00 02
00:02:06: Registration Response Transmitted
00:02:06: Registration acknowledgement from 0003.e350.9b8d, SID 3 on Cable3/0/U0
00:02:06: REG-ACK confirmation code : 0
```

Glossary

active service flow—An admitted service flow that is available for packet transmissions from the cable modem to the CMTS.

admitted service flow—A provisioned or dynamically signaled service flow that is authorized, and for which resources have been reserved, but that is not active.

amplifier—Used on coaxial segments of a CATV plant to restore signal levels lost due to attenuation through distance.

availability—The long term ratio of the actual Radio Frequency (RF) channel operation time to the scheduled RF channel operation time (expressed as a percentage) based on a bit error rate (BER) assumption.

ATM—Asynchronous Transfer Mode.

bandwidth allocation map—The MAC management message that the CMTS uses to allocate transmission opportunities to cable modems.

branch line—A coaxial cable that runs from a trunk line to a subscriber drop point. A branch line is also known as a feeder cable.

cable interface line card—The modem front-end card of the cable router headend device, plugged into the midplane. Each cable line card provides a number of Radio Frequency (RF) channels as external interfaces.

cable modem (CM)—A modulator/demodulator at subscriber locations that is used in conveying data communications on a cable television system.

cable modem termination system (CMTS)—A device that provides complementary functionality to cable modems to enable connectivity to a wide area network (WAN).

cable access router—A modular chassis-based router that is optimized for the data over CATV HFC application.

CATV—Refers to any cable (coaxial or fiber) based system of television services.

CLI—command line interface.

codec—coder-decoder. A device that typically uses pulse code modulation to transform analog signals into a digital bit stream and digital signals back into analog.

CPE—customer premises equipment. One or more PCs located at the customer site.

distribution hub—A smaller or remote headend distribution point for a CATV system. Video signals are received here from another site (headend) and are redistributed. Sometimes a small number of locally originated signals are added. These signals might be city of information channels, HFC cable modem signals, and so on.

DOCSIS—Data-over-Cable Service Interface Specifications. Defines technical specifications for equipment at both subscriber locations and cable operators' headends. Adoption of DOCSIS can accelerate deployment of data-over-cable services and ensure interoperability of equipment throughout system operators' infrastructures.

downstream—A set of frequencies used to send data from a headend to a subscriber.

drop—A subscriber access point; the actual coaxial connection in a subscriber’s home.

fiber node (node)—An optical node (located in the outside plant distribution system) that terminates the fiber-based downstream signal as an electrical signal onto a coaxial RF cable. Each fiber node is defined to support a designated service area, defined either by the number of homes or by total amplifier cascade (the total number of active amplifiers in the longest line from the node to the end of the line).

Headend—The endpoint of a broadcast network and central distribution point for a CATV system. All stations transmit toward the headend; the headend then transmits toward the destination stations. Video signals are received from a satellite (either colocated or remote), and the frequency is converted to the appropriate channels where it is combined with locally originated signals and is rebroadcast onto the HFC plant. For a CATV data system, the headend is the typical place to link between the HFC system and any external data networks.

HFC—Hybrid fiber-coaxial. Older CATV systems were provisioned using only coaxial cable. Modern systems use fiber transport from the headend to an optical node located in the neighborhood to reduce system noise. Coaxial runs from the node to the subscriber. The fiber plant is generally a star configuration with all optical node fibers terminating at a headend. The coaxial part of the system is generally a trunk and branch configuration.

MAC—media access control. Typically refers to the lower of the two sublayers of the data link layer that is defined by the IEEE. The MAC sublayer handles access to shared physical transmission media. In DOCSIS networks, MAC also refers to the management messages that are sent between the CMTS and CM to maintain connectivity over the cable network.

optical node—A device used to convert broadband RF to and from a fiber-optic signal. An optical node is usually located in the outside field.

provisioning—The programming of allocatable resources, such as operating parameters, upstream and downstream frequencies, slot assignments, and logical identifiers, in headend and subscriber modems.

ranging—The adjustment of the subscriber modem upstream timing offset to ensure that an upstream packet inserted into a TDMA slot aligns correctly with the headend modem upstream frame.

registration—The process of a subscriber modem signing on to the cable network by identifying itself to the headend.

SAID—See security association identifier.

security association identifier—A Baseline Privacy security identifier between a CMTS and a cable modem.

service flow—A MAC-layer transport service that:

- Provides unidirectional transport of packets from the upper service layer entity to the RF device.
- Shapes, polices, and prioritizes traffic according to QoS traffic parameters defined for the flow.

service identifier (SID)—A service flow identifier (14 bits) assigned by the CMTS to an active or admitted upstream service flow.

SFID—service flow identifier.

SGCP—Simple Gateway Control Protocol. Controls Voice-over-IP (VoIP) gateways by an external call control element (called a call-agent).

SID— See Service Identifier.

SNMP—Simple Network Management Protocol.

status request—The periodic querying of subscriber cable modems by the headend for alarm and service requests.

tap—A passive device that divides a signal between the trunk or feeder lines and splits the signal into ports for subscriber drop access.

TDM—Time-Division Multiplexing. A technique in which information from multiple channels can be allocated bandwidth on a single wire, based on preassigned time slots. Bandwidth is allocated to each channel regardless of whether the station has data to transmit.

TDMA—Time Division Multiple Access.

trunk line—A CATV backbone coaxial cable. This cable runs from an optical node through a specific neighborhood or service area.

UBR—Universal Broadband Router. Refers to the family line of DOCSIS Cisco CMTS routers.

upstream—The set of frequencies used to send data from a subscriber to the headend.

VoIP—Voice-over-IP. The ability to carry normal telephone-style voice over an IP-based Internet with POTS-like functionality, reliability, and voice quality. VoIP is a blanket term that generally refers to the Cisco standards-based (for example, H.323 or SGCP) approach to IP voice traffic.

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This document is to be used in conjunction with the documents listed in the "Related Documents" section on page 17.