



# Configuring Upstream Cable Interface Features on the Cisco CMTS Routers

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Revised: February 14, 2008  
Last Published: Cisco IOS Release 12.3BC



## Note

Cisco IOS Release 12.2(33)SCA integrates support for this feature on the Cisco CMTS routers. This feature is also supported in Cisco IOS Release 12.3BC, and this document contains information that references many legacy documents related to Cisco IOS 12.3BC. In general, any references to Cisco IOS Release 12.3BC also apply to Cisco IOS Release 12.2SC. For the latest information on Cisco CMTS router support in Cisco IOS Release 12.2SC, refer to the [Cross-Platform Release Notes for Cisco Universal Broadband Routers in Cisco IOS Release 12.2SC](#).

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The cable interface in the Cisco universal broadband router supports downstream and upstream signals, and serves as the cable TV radio frequency (RF) interface. The downstream signal is output as an intermediate-frequency (IF) signal suitable for use with an external upconverter. Your cable plant, combined with your planned and installed subscriber base, service offering, and external network connections, determines the combination of cable interfaces, network uplink line cards, and other components that you should use.

The Cisco IOS software command-line interface (CLI) can be used to configure the Cisco cable interface line card for correct operation on the hybrid fiber-coaxial (HFC) cable network. This chapter provides a configuration summary for the various upstream cable interface features available on a Cisco CMTS router. Details about some of these features can be found in other chapters of this book.

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**Note**

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The configuration commands and examples in this chapter may show slot numbering or references to either Cisco uBR7200 series or Cisco uBR10012 Universal Broadband Routers. However, the features can be configured on either platform. Use the slot numbering appropriate for your CMTS router configuration.

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# Prerequisites for Configuring Upstream Cable Interfaces on the Cisco CMTS Routers

The configuration of upstream cable interface features is supported on the Cisco CMTS routers in Cisco IOS Release 12.3BC and 12.2SC. Table 1 shows the hardware compatibility prerequisites for this feature.

**Table 1** *Configuring Upstream Cable Interfaces on the Cisco CMTS Routers Hardware Compatibility Matrix*

CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR10012 Universal Broadband Router	<b>Cisco IOS Release 12.2(33)SCA</b> <ul style="list-style-type: none"> <li>PRE-2</li> </ul>	<b>Cisco IOS Release 12.2(33)SCA</b> <ul style="list-style-type: none"> <li>Cisco uBR10-MC5X20S/U/H</li> </ul>
Cisco uBR7246VXR Universal Broadband Router	<b>Cisco IOS Release 12.2(33)SCA</b> <ul style="list-style-type: none"> <li>NPE-G1</li> <li>NPE-G2</li> </ul>	<b>Cisco IOS Release 12.2(33)SCA</b> <ul style="list-style-type: none"> <li>Cisco uBR-MC28U/X</li> <li>Cisco uBR-MC16U/X</li> </ul>
Cisco uBR7225VXR Universal Broadband Router	<b>Cisco IOS Release 12.2(33)SCA</b> <ul style="list-style-type: none"> <li>NPE-G1</li> </ul>	<b>Cisco IOS Release 12.2(33)SCA</b> <ul style="list-style-type: none"> <li>Cisco uBR-E-28U</li> <li>Cisco uBR-E-16U</li> <li>Cisco uBR-MC28U/X</li> <li>Cisco uBR-MC16U/X</li> </ul>

## Activating Upstream Admission Control

Upstream admission control tallies up the total amount of guaranteed minimum upstream throughput reserved by CMs on an upstream interface. Once the total exceeds an allowable level, no more CMs requiring a guaranteed minimum upstream rate are allowed online on that upstream port.

Cisco CMTS upstream admission control is turned off by default and must be activated. To set the upstream admission control as a percentage of the upstream channel capacity, use the following command in cable interface configuration mode. The admission control is set as a percentage of the specified upstream channel capacity. The acceptable range is from 10 to 1000 percent.

```
Router(config-if)# cable upstream usport admission-control percentage
```

For example:

```
7246VXR(config-if)#cable upstream 0 admission-control ?
    Max Reservation Limit As Percentage of Raw Channel Capacity
```

### Syntax Description

usport	The upstream port that has admission control enabled.
percentage	The optional <i>percentage</i> parameter specifies the overbooking rate that will be used when deciding the amount of bandwidth that is available to be guaranteed.

**Note**

If *percentage* is left blank or set to 100%, the CMTS will only allow a total up to the real available upstream bandwidth to be guaranteed. If percentage is set to its maximum of 1000, then up to 10 times the real interface bandwidth may be “guaranteed”.

## Verifying Upstream Admission Control

To determine if upstream admission control is configured and activated, enter the **show running-config** command in privileged EXEC mode and look for the cable interface configuration information. If upstream admission control is configured and enabled, an admission control entry appears in the **show running-config** command output, indicating the user-defined percentage of upstream channel capacity allowable. If upstream admission control is disabled, no admission control entry appears in the output.

Perform these steps if you are having difficulty with verification:

- 
- Step 1** Ensure that the cable connections are not loose or disconnected.
  - Step 2** Ensure that the cable interface line card is firmly seated in its chassis slot.
  - Step 3** Ensure that the captive installation screws are tight.
  - Step 4** Verify that you have entered the correct slot and port numbers.
  - Step 5** Verify that you selected a valid frequency for your router.
- 

## Activating Upstream Differential Encoding

Differential encoding on the upstream is a digital encoding technique whereby a binary value is denoted by a signal change rather than a particular signal level. To enable differential encoding on upstream traffic to a specified cable interface, use the following command in cable interface configuration mode. Upstream differential encoding is enabled by default.

```
Router(config-if)# cable upstream usport differential-encoding
```

## Verifying Upstream Differential Encoding

To determine if upstream differential encoding is activated, enter the **show running-config** command and look for the cable interface configuration information. If upstream differential encoding is enabled, a differential encoding entry appears in the **show running-config** output. If upstream differential encoding is disabled, no differential encoding entry appears in the output.

Perform these steps if you are having difficulty with verification:

- 
- Step 1** Ensure that the cable connections are not loose or disconnected.
  - Step 2** Ensure that the cable interface line card is firmly seated in its chassis slot.
  - Step 3** Ensure that the captive installation screws are tight.

- Step 4** Verify that you have entered the correct slot and port numbers.
  - Step 5** Verify that you selected a valid frequency for your router.
- 

## Activating Upstream Forward Error Correction

The Cisco uBR7200 series CMTS uses forward error correction (FEC) to attempt to correct any upstream data that might have been corrupted. When FEC is activated, all CMs on the network also activate FEC.

**Note**

Although upstream FEC is an option, Cisco recommends that you use upstream FEC. FEC is activated by default and should not be disabled.

---

To activate the upstream forward error correction and to enable FEC, use the following command in cable interface configuration mode.

```
Router(config-if)# cable upstream usport fec
```

## Verifying Upstream FEC

To verify whether FEC is activated or deactivated, enter the **more system:running-config** command and look for the cable interface configuration information. If FEC is enabled, an FEC entry appears in the **show running-config command** output. If FEC is disabled, no FEC entry appears in the output.

Perform these steps if you are having difficulty with verification:

---

- Step 1** Ensure that the cable connections are not loose or disconnected.
  - Step 2** Ensure that the cable interface line card is firmly seated in its chassis slot.
  - Step 3** Ensure that the captive installation screws are tight.
  - Step 4** Verify that you have entered the correct slot and port numbers.
  - Step 5** Verify that you selected a valid frequency for your router.
- 

## Activating the Upstream Ports

Each upstream port must be activated to enable upstream data transmission from the CMs on the HFC network to the Cisco uBR7200 series CMTS.

**Note**

The upstream cable interface does not operate until you either set a fixed upstream frequency or create and configure a spectrum group. Refer to the [“Setting the Upstream Frequency” section on page 42](#) for details.

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To activate the upstream ports, use the following commands in global configuration mode.

	Command	Purpose
Step 1	Router(config)# <b>interface cable slot/port</b>	Specifies a cable interface and enters cable interface configuration mode.
Step 2	Router(config-if)# <b>no cable upstream usport shutdown</b>	Enables upstream data traffic.

## Verifying the Upstream Ports

To determine if the upstream ports are activated or deactivated, enter the **show interface cable** command for the upstream port just configured:

```
Router# show interface cable5/0
```

```
Cable5/0 is up, line protocol is up
Hardware is BCM3210 FPGA, address is 00e0.1e5f.7a60 (bia 00e0.1e5f.7a60)
Internet address is 1.1.1.3/24
MTU 1500 bytes, BW 27000 Kbit, DLY 1000 usec, rely 255/255, load 1/255
Encapsulation, loopback not set, keepalive not set
ARP type: ARPA, ARP Timeout 04:00:00
Last input 00:00:25, output 00:00:00, output hang never
Last clearing of "show interface" counters never
Queuing strategy: fifo
Output queue 0/40, 0 drops; input queue 0/75, 0 drops
5 minute input rate 0 bits/sea, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
 10878 packets input, 853740 bytes, 0 no buffer
  Received 3679 broadcasts, 0 runts, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
 5401 packets output, 645885 bytes, 0 underruns
  0 output errors, 0 collisions, 9 interface resets
  0 output buffer failures, 0 output buffers swapped out
```

## Activating Upstream Power Adjustment

To enable upstream power adjustment for a specified cable interface, use one of the following commands in cable interface configuration mode.

Command	Purpose
Router(config-if)# <b>cable upstream usport power-adjust continue db</b>	Sets the minimum power adjustment in dB that allows continued ranging status. Valid values are 2 to 15 dB. Default = 2 dB.
Router(config-if)# <b>cable upstream usport power-adjust noise percentage</b>	Sets the minimum number (percentage) of power-adjustment packets required to justify changing the upstream power rating. Valid values are 10 to 100 percent. The default is 30 percent.
Router(config-if)# <b>cable upstream 0 power-adjust threshold db</b>	Sets the power-adjustment threshold in dB. Valid values are 0 to 2 dB. The default is 1 dB.
Router(config-if)# <b>end</b> Router#	Returns to enable (privileged EXEC) mode.

To return the automatic upstream power-adjustment ranging value to the default of 2 dB, enter the following command in cable interface configuration mode:

```
Router(config-if)# no cable upstream usport power-adjust continue
```

To return the automatic upstream power-adjustment noise value to the default of 30 percent, enter the following command in cable interface configuration mode:

```
Router(config-if)# no cable upstream usport power-adjust noise
```

To return the upstream power-adjustment threshold value to the default of 1 dB, enter the following command in cable interface configuration mode:

```
Router(config-if)# no cable upstream usport power-adjust threshold
```

## Verifying Upstream Power Adjustment

To determine if upstream power adjustment is configured and activated, enter the **show running-config** command and look for the cable interface configuration information. If upstream power adjustment is enabled, any or all three of the **continue**, **noise**, and **threshold** power-adjustment entries appear in the **show running-config** command output. If all three upstream power adjustments are disabled, no power-adjustment entry appears in the **show running-config** command output.

## Activating the Upstream Scrambler

The scrambler on the upstream RF carrier enables CMs on the HFC network to use built-in scrambler circuitry for upstream data transmissions. The scrambler circuitry improves reliability of the upstream receiver on the cable interface line card.



### Caution

The upstream scrambler is activated by default and should not be disabled under normal circumstances. Disabling it can result in corrupted packets. Disable it only for prototype modems that do not support the upstream scrambler.

To activate the upstream scrambler, use the following command in cable interface configuration mode. The upstream scrambler is enabled by default.

```
Router(config-if)# cable upstream usport scrambler
```

## Verifying the Upstream Scrambler

To determine if the upstream scrambler is activated, enter the **more system:running-config** command and look for the cable interface configuration information. Perform these steps if you are having difficulty with verification:

- Step 1** Ensure that the cable connections are not loose or disconnected.
- Step 2** Ensure that the cable interface line card is firmly seated in its chassis slot.
- Step 3** Ensure that the captive installation screws are tight.
- Step 4** Verify that you have entered the correct slot and port numbers.

**Step 5** Verify that you selected a valid frequency for your router.

---

## Activating Upstream Timing Adjustment

To enable upstream timing adjustment for a specified cable interface, use one of the following commands in cable interface configuration mode.

Command	Purpose
Router(config-if)# <b> cable upstream usport time-adjust continue seconds</b>	Sets the minimum timing adjustment that allows continued ranging status. Valid <i>second</i> values are 2 to 64 seconds. The default is 2 seconds.
Router(config-if)# <b> cable upstream usport time-adjust threshold seconds</b>	Sets the timing adjustment threshold value in seconds. Valid <i>second</i> values are 1 to 32 seconds. The default is 1 second.
Router(config-if)# <b> end</b> Router#	Returns to enable (privileged EXEC) mode.

To return the upstream time-adjustment ranging value to the default of 2 seconds, enter the following command in cable interface configuration mode:

```
Router(config-if)# no cable upstream usport time-adjust continue
```

To return the upstream time adjustment threshold value to the default of 1 second, enter the following command in cable interface configuration mode:

```
Router(config-if)# no cable upstream usport time-adjust threshold
```

## Verifying Upstream Timing Adjustment

To determine if upstream timing adjustment is configured and activated, enter the **show running-config** command and look for the cable interface configuration information. If upstream timing adjustment is enabled, either or both of the **continue** and **threshold** timing-adjustment entries appear in the **show running-config** command output. If both the **continue** and **threshold** upstream timing adjustments are disabled, no timing adjustment entry appears in the **show running-config** command output.



**Tip**

Perform the following steps if you are having difficulty with verification:

---

- Step 1** Verify that the cable connections are not loose or disconnected.
  - Step 2** Verify that the cable interface line card is firmly seated in its chassis slot
  - Step 3** Verify that the captive installation screws are tight.
  - Step 4** Confirm that you have entered the correct slot and port numbers.
-

# Traffic Shaping

Traffic shaping basically uses queues to limit data surges that can congest a network. The data is buffered and then sent into the network in regulated amounts to ensure that the traffic fits within the expected traffic envelope for the particular connection.

Traffic shaping reduces the chance that information must be retransmitted to hosts on the cable plant. When cable modems (CMs) have rate limits established, the CMTS typically drops data packets to enforce the rate limit. Dropping packets from the requesting CM causes the host sending the information to retransmit its information, which wastes bandwidth on the network. If both hosts sending and requesting information are on the cable plant, the upstream bandwidth is wasted as well.

Traffic shaping allows the CMTS to perform upstream and downstream rate limiting on the DOCSIS upstream and downstream channels. Rate limiting restricts the data rate to and from a CM; the MAC scheduler supports traffic-shaping capabilities for downstream and upstream traffic. Rate limiting ensures that no single CM consumes all of the channel bandwidth and allows a CMTS administrator to configure different maximum data rates for different subscribers. Subscribers requiring higher sustained rates and willing to pay for higher rates can be configured with higher sustained rate limits in their CM DOCSIS configuration file over regular subscribers, who pay less and get lower rate limits.

Each time a packet belonging to a flow is transmitted on an output channel, the token-bucket policer function checks the rate limit status of the flow, passing the following parameters:

- Token bucket maximum sustained rate in bits per millisecond.
- Token bucket depth (maximum transmit burst) in bits.
- Length of current packet to be sent in bits.
- Pointer to the flow's token bucket.
- Pointer to the flow's token bucket last update time stamp.
- Variable to return the milliseconds buffering delay in case the packet needs to be shaped.
- Maximum buffering delay that the subsequent traffic shaper can handle in milliseconds.

Every flow has its own shaping buffer where rate-exceeded packets are typically held back in first-in/first-out (FIFO) order for later transmission.



**Tip**

---

Token bucket policing with shaping is the per-upstream default rate limiting setting at the CMTS. Shaping can be enabled or disabled for the token-bucket algorithm.

---

## Upstream Traffic Shaping

Upstream traffic shaping allows the CMTS to perform rate limiting on a DOCSIS upstream channel. The upstream traffic shaping feature delays the scheduling of the upstream packet, which in turn, causes the packet to be buffered on the cable modem device, instead of being dropped. This allows the user TCP/IP stack to pace the application traffic appropriately and approach throughput commensurate with the subscriber's defined quality of service (QoS) levels. Upstream traffic shaping enables the CMTS to enforce the peak upstream rate for each CM without degrading overall TCP performance for the subscriber CMs.

When you do not enable the shaping option for upstream rate limiting, the CMTS upstream-rate-policing code drops bandwidth requests from cable modems that are found to have exceeded their configured-peak-upstream rate (using different local drop policies). The effect of bandwidth requests

(eventually upstream packets) being dropped causes degraded throughput performance of window-based protocols (like TCP) for these rate-exceeded modems because of the timeouts and retransmits that follow.

Upstream grant shaping is on a per-CM (service identifier-SID) basis. The grant shaping feature is a configurable option for the current upstream token-bucket rate-limiting algorithm.

A traffic shaping feature is restricted QoS class assignment, which allows a CMTS administrator to override the class of service provisioned for a CM. When this feature is enabled, the user-defined QoS profile is enforced on the CM attempting to register with the CMTS, regardless of the CM's provisioned class of service. Use the **cable qos profile** command to configure a QoS profile.

**Note**

The restricted QoS class assignment feature is added to address instances where a cable operator implemented rate limiting incorrectly. The feature allows an administrator to override the statically provisioned QoS parameters of the CM and force the CM to use a specific QoS profile defined at the CMTS.

## Configuring Upstream Rate Limiting and Traffic Shaping

You can configure rate limiting and traffic shaping on a DOCSIS upstream channel. This delays the scheduling of the upstream packet, which in turn causes the packet to be buffered on the cable CPE device, instead of being dropped. This allows the user's TCP/IP stack to pace the application traffic appropriately and approach throughput commensurate with the subscriber's defined QoS levels.

To configure this, use the following command in cable interface configuration mode.

Command	Purpose
Router (config-if) # [no] <b>cable upstream &lt;n1&gt; rate-limit [token-bucket]</b>	Enables or disables DOCSIS rate limiting or shaping on an upstream channel. <n1> depends on the number of upstream channels on the specific cable interface line card.

Using Cisco IOS Release 12.0(5)T1 or higher, the software supports:

- Generic calendar queuing routines
- New token bucket policing function
- Grant shaping application of the calendar queues
- Upstream rate shaping option to the token-bucket keyword
- A default state change from 1 second burst policing to token-bucket with shaping

**Tip**

Upstream grant shaping is per CM (SID). Shaping can be enabled or disabled for the token-bucket algorithm.

**Note**

Before the introduction of this feature, the CMTS would drop bandwidth requests from a CM it detected as exceeding its configured peak upstream rate. Such request dropping affects the throughput performance of IP-based protocols such as FTP, TCP, and SMTP. With this feature, the CMTS can shape (buffer) the grants for a CM that is exceeding its upstream rate, rather than dropping the bandwidth requests.

```
Router# show interface c3/0 sid 1 counters
```

Sid	Inpackets	Inoctets	Outpackets	Outoctets	Ratelimit BWReqDrop	Ratelimit DSPktDrop
1	67859	99158800	67570	98734862	2579	0

## Setting Upstream Backoff Values

The DOCSIS-specified method of contention resolution for CMs wanting to transmit data or requests on the upstream channel is a truncated binary exponential backoff value, with the initial backoff window and the maximum backoff window controlled by the CMTS. The Cisco uBR7200 series CMTS specifies backoff window values for both data and initial ranging, and sends these values downstream as part of the Bandwidth Allocation Map (MAP) MAC message.

The values are configurable on the Cisco uBR7200 series software and are power-of-two values. For example, a value of 4 indicates a window between 0 and 15; a value of 10 indicates a window between 0 and 1023. You can set fixed start and end values for data backoff on the upstream ports, or you can set the upstream ports for automatic data backoff. You have the same options for ranging backoff. For both backoff windows, the default start value is 0; the default end value is 4. Valid values are from 0 to 15.



### Note

Cisco does not recommend that you adjust default values, but that you enable the automatic dynamic backoff algorithm.

To set data or ranging backoff values for an upstream port, use one or more of the following commands in cable interface configuration mode.

	Command	Purpose
<b>Step 1</b>	Router(config-if)# <b>cable upstream</b> <i>usport data-backoff start end</i>	Optimizes the <b>automatic</b> setting for as many as 250 cable interfaces per upstream port. Sets manual values for data backoff windows only when operating with more than 250 cable interfaces per upstream port.
	or  Router(config-if)# <b>cable upstream</b> <i>usport data-backoff automatic</i>	Configures the default backoff window values of 0 and 4.
<b>Step 2</b>	Router(config-if)# <b>cable upstream</b> <i>usport range start end</i>	Optimizes the <b>automatic</b> setting for as many as 250 cable interfaces per upstream port. Sets manual values for data backoff windows only when operating with more than 250 cable interfaces per upstream port.
	or  Router(config-if)# <b>cable upstream</b> <i>usport range automatic</i>	Configures the default backoff window values of 0 and 4.

When considering whether to adjust backoff values, keep the following considerations in mind:

- The cable interface reconnection time after a power outage is related to the following factors:
  - DHCP, ToD, and TFTP servers often operate well below 1 percent load under normal situations, but can jump to over 100 percent after an outage.
  - Adjusting the backoffs to larger numbers slows cable interface reconnection and reduces server load.

- Backoffs that are too small result in cable interfaces failing to range the upstream RF levels correctly and cycling to maximum power, thus increasing connection time and reducing network performance.
- Backoffs that are too large result in increased recovery time after a large service outage.
- There is significant variation in cable interface performance (brand to brand) in cable interface restart time.
- All cable interfaces should recover in 0 to 10 minutes after all services are restored (Cisco uBR7200 series, RF transport, DHCP, TFTP, and ToD servers). A CM that takes longer than 10 minutes could be experiencing a problem with the modem itself, a problem with CMTS settings, or a problem in the DOCSIS provisioning servers.



**Note** Upstream segments serving a relatively large number of cable interfaces (for example, more than 1600) might suffer recovery times greater than 10 minutes.

## Verifying Upstream Data Backoff

To verify backoff window settings, enter the **show controllers cable** command for the upstream port you have just configured:

```
Router# show controllers cable5/0 u0

Cable5/0 Upstream 0 is up
Frequency 24.016 MHz, Channel Width 1.600 MHz, QPSK Symbol Rate 1.280 Msps
Spectrum Group is overridden
SNR 33.2560 dB
Nominal Input Power Level 0 dBmV, Tx Timing Offset 2288
Ranging Backoff automatic (Start 0, End 3)
Ranging Insertion Interval automatic (60 ms)
Tx Backoff Start 0, Tx Backoff End 4
Modulation Profile Group 1
part_id=0x3137, rev_id=0x03, rev2_id=0xFF
nb_agc_thr=0x0000, nb_agc_nom=0x0000
Range Load Reg Size=0x58
Request Load Reg Size=0x0E
Minislot Size in number of Timebase Ticks is = 8
Minislot Size in Symbols = 64
Bandwidth Requests = 0xFE
Piggyback Requests = 0xD
Invalid BW Requests= 0x2
Minislots Requested= 0x2963
Minislots Granted = 0x2963
Minislot Size in Bytes = 16
Map Advance = 4000 usecs
UCD Count = 32964
DES Ctrl Reg#0 = C000C043, Reg#1 = 0
```

## Setting the Upstream Channel Width

Use the commands below to enter the upstream channel width in hertz (Hz). For NTSC operations, valid values are 200,000 Hz (160 kilo symbols per second [ksps]), 400,000 Hz (320 ksps), 800,000 Hz (640 ksps), 1,600,000 Hz (1280 ksps), and 3,200,000 Hz (2560 ksps). The default is 1,600,000 Hz.

If no acceptable channels of the specified width are found, the spectrum management card automatically begins to scan the upstream spectrum for the next largest available channel width; for example, if the spectrum management card is unable to find a usable 1.6 MHz upstream channel, it automatically begins searching for usable 800 kHz channels.

**Caution**

Higher symbol rates are more susceptible to RF noise and interference. If you use a symbol rate or modulation format beyond the capabilities of your HFC network, you might experience packet loss or loss of cable interface connectivity.

**Note**

For QAM-16 channel widths of 400 kHz (320 kps) or greater, Cisco recommends that you use QAM-16 modulation for long and short data, and that you use QPSK for request, initial, and station communications. For QAM-16 channel widths of 200 kHz (160 kps), all communication must be able to use QAM-16. That is, 160 kps with QAM-16 requires an exceptional signal-to-noise ratio (SNR) in your upstream channels. When you use QAM-16 for request, initial, and station maintenance messages with channel widths greater than 400 kHz, the QAM-16 preamble and message data take longer to transmit than the QPSK format.

**Note**

To set the upstream channel width, use the following commands in cable interface configuration mode.

	Command	Purpose
Step 1	Router(config-if)# <b>cable upstream usport channel-width width</b>	Enters the channel width for your upstream RF carrier in Hz.
Step 2	Router(config-if)# <b>no cable upstream usport channel-width</b>	Returns the channel width to its default setting of 1,600,000 Hz.

For additional information about channel width and minislots size, refer to the [Cable Radio Frequency \(RF\) FAQs](#) on Cisco.com.

## Verifying Upstream Channel Width

To verify the current value of the upstream channel width, enter the **show controllers cable** command for the upstream port you just configured. A sample follows below:

```
Router# show controllers cable5/0 u0

Cable5/0 Upstream 0 is up
  Frequency 24.016 MHz, Channel Width 0.800 MHz, QPSK Symbol Rate 0.640 Msps
  Spectrum Group is overridden
  SNR 33.2560 dB
  Nominal Input Power Level 0 dBmV, Tx Timing Offset 2288
  Ranging Backoff automatic (Start 0, End 3)
  Ranging Insertion Interval automatic (60 ms)
  Tx Backoff Start 0, Tx Backoff End 4
  Modulation Profile Group 1
```

Perform these steps if you are having difficulty with verification:

- 
- Step 1** Use a valid combination of modulation format (QPSK and QAM-16), minislot size, frequency, and the **no shutdown** command.
- Step 2** Use a recommended or previously tested modulation profile. It is not uncommon to create a modulation profile that does not allow cable interface-to-headend communication. Because each message type is individually specified, some messages might not work.
- Step 3** Verify using IP ping packets of varying lengths (64 to 1500 bytes). Ping from the headend to the cable interface.
- Step 4** Verify with your cable interface vendor that your CM software is fully certified or compatible with DOCSIS 1.0 and extensions, as appropriate.
- 

## Setting the Upstream Frequency

The upstream channel frequency of your RF output must be set to comply with the expected input frequency of your Cisco cable interface line card. To configure upstream channel frequencies, perform one of the following tasks:

- Configure a fixed frequency from 5 to 42 MHz for NTSC operations, then enable the upstream port.
- Create a global spectrum group, assign the interface to it, and enable the upstream port.



### Note

You can also select a default that does not set a specific fixed value.



### Note

The upstream port is frequency agile. If you define spectrum groups, the frequency can change while the interface is up and carrying traffic.

A modulation profile consists of a table of physical layer characteristics for the different types of upstream bursts; for example, initial maintenance, long grant, request/data, request, short grant, and station maintenance.



### Note

The upstream cable interface does not operate until you either set a fixed upstream frequency or create and configure a spectrum group.

If you are setting a fixed upstream frequency, make sure that the frequency selected does not interfere with the frequencies used for any other upstream applications running on the cable plant.

To set a fixed upstream frequency, use the following commands in cable interface configuration mode.

	Command	Purpose
<b>Step 1</b>	Router(config-if)# <b>cable upstream</b> <i>usport</i> <b>frequency</b> <i>up-freq-hz</i>	Enters the fixed center frequency for your upstream RF carrier in Hz.
<b>Step 2</b>	Router(config-if)# <b>no cable upstream</b> <i>usport</i> <b>shutdown</b>	Places the upstream port in the “admin up” state.

**Tip**

For National Television Standards Committee (NTSC) operations, valid ranges are 5000000 to 42000000 Hz.

**Caution**

Some cable systems cannot reliably transport frequencies near these band edges. The wider the upstream channel (in MHz), the more difficulty you might have. Enter a center frequency between 20 and 38 MHz if you have difficulty.

**Note**

You can also select a default that does not set a specific fixed value. The Cisco uBR7200 series software instructs the cable interfaces to use this frequency as the center frequency.

## Verifying the Upstream Frequency

To verify the current value of the upstream frequency, enter the **show controllers cable** command for the upstream port you have just configured:

```
Router# show controllers cable5/0 u0

Cable5/0 Upstream 0 is up
Frequency 24.016 MHz, Channel Width 1.600 MHz, QPSK Symbol Rate 1.280 Msps
  Spectrum Group is overridden
  SNR 33.2560 dB
  Nominal Input Power Level 0 dBmV, Tx Timing Offset 2288
  Ranging Backoff automatic (Start 0, End 3)
  Ranging Insertion Interval automatic (60 ms)
  Tx Backoff Start 0, Tx Backoff End 4
  Modulation Profile Group 1
```

**Note**

The upstream frequency displayed in the **show controllers cable** command output might not match the frequency that you entered when you set the upstream frequency. The Cisco uBR7200 series CMTS might select an upstream frequency close to the frequency you entered that offers better performance. The Cisco uBR7200 series CMTS selects the closest frequency available.

Perform these steps if you are having difficulty with verification:

- Step 1** Ensure that the cable connections are not loose or disconnected
- Step 2** Ensure that the cable interface line card is firmly seated in its chassis slot.
- Step 3** Ensure that the captive installation screws are tight.
- Step 4** Verify that you have entered the correct slot and port numbers.
- Step 5** Verify that you have selected a valid frequency for your router.

## Setting the Upstream Input Power Level

The Cisco uBR7200 series CMTS controls the output power levels of CMs to meet the desired upstream input power level. The nominal input power level for the upstream RF carrier is specified in decibels per millivolt (dBmV). The default setting of 0 dBmV is the optimal setting for the upstream power level.

The valid range for the input power level depends on the data rate. At 1.6 MHz, the valid range is -10 to 25 dBmV. If your power levels operate at greater than the maximum valid level, use an inline attenuator to bring the power level to within the valid range.



### Caution

If you increase the input power level, CMs on your HFC network increase their transmit power level. This increases the carrier-to-noise ratio (C/N) on the network, but also increases distortion products. Composite Second Order Beat (CSO) and Composite Triple Beat (CTB) values worsen by 2 dB for every 1 dB-increased C/N. The return path laser immediately enters a nonlinear mode called *clipping*, and all communication becomes unreliable. Many return lasers send short bursts above the clipping thresholds and fail on longer or successive bursts.

You should not adjust your input power level by more than 5 dB in a 30-second interval. If you increase the power level by more than 5 dB within 30 seconds, cable interface service on your network is disrupted. If you decrease the power level by more than 5 dB within 30 seconds, cable interfaces on your network are forced offline.



### Note

When you run the **cable upstream 0 power-level** command, Cisco recommends that the adjacent channel not have a large variation. The recommended maximum input power variance is 5 to 6 dBmV.

To set the upstream input power level in dBmV, use the following command in cable interface configuration mode. The default is 0 dBmV.

```
Router(config-if)# cable upstream usport power-level dbmv
```

## Verifying the Upstream Input Power Level

To verify the current value of the upstream input power level, enter the **show controllers cable** command for the upstream port you have just configured:

```
Router# show controllers cable5/0 u0

Cable5/0 Upstream 0 is up
  Frequency 24.016 MHz, Channel Width 0.800 MHz, QPSK Symbol Rate 0.640 Msps
  Spectrum Group is overridden
  SNR 33.2560 dB
  Nominal Input Power Level 0 dBmV, Tx Timing Offset 2288
  Ranging Backoff automatic (Start 0, End 3)
  Ranging Insertion Interval automatic (60 ms)
  Tx Backoff Start 0, Tx Backoff End 4
  Modulation Profile Group 1
```

Perform these steps if you are having difficulty with verification:

1. Verify that the upstream amplitude of an optimal RF carrier (injected at the fiber node reference input point) reaches the cable interface line card input point at a consistent level (node-to-node and port-to-port).

2. Verify that this absolute level, as installed, matches both the design and software settings on the Cisco uBR7200 series CMTS.

**Note**

Software adjustments of 1 to 3 dB can be used to adjust for minor variations in measurement or setup and port-to-port calibration differences. These adjustments can significantly improve cable interface performance, especially in marginal situations. Larger adjustments should be made in conjunction with spectrum analyzer support at the headend or distribution hub.

## Specifying Upstream Minislot Size

To specify the minislot size (in ticks) for specific upstream cable interfaces, use the following command in cable interface configuration mode. Acceptable values are 2, 4, 8, 16, 32, 64, and 128. The default is 8.

```
Router(config-if)# cable upstream usport minislot-size size
```

For additional information about channel width and minislot size, refer to the [Cable Radio Frequency \(RF\) FAQs](#) on Cisco.com.

## Verifying Upstream Minislot Size

To verify upstream minislot size, enter the **show controllers cable** command for the upstream port you have just configured:

```
Router# show controllers cable5/0 u0

Cable5/0 Upstream 0 is up
Frequency 24.016 MHz, Channel Width 1.600 MHz, QPSK Symbol Rate 1.280 Msp
Spectrum Group is overridden
SNR 33.2560 dB
Nominal Input Power Level 0 dBmV, Tx Timing Offset 2288
Ranging Backoff automatic (Start 0, End 3)
Ranging Insertion Interval automatic (60 ms)
Tx Backoff Start 0, Tx Backoff End 4
Modulation Profile Group 1
part_id=0xFFFF, rev_id=0xFF, rev2_id=0xFF
nb_agc_thr=0x0000, nb_agc_nom=0x0000
Range Load Reg Size=0x58
Request Load Reg Size=0x0E
Minislot Size in number of Timebase Ticks is = 8
Minislot Size in Symbols = 64
Bandwidth Requests = 0xFE
Piggyback Requests = 0xD
Invalid BW Requests= 0x2
Minislots Requested= 0x2963
Minislots Granted = 0x2963
Minislot Size in Bytes = 16
Map Advance = 4000 usecs
UCD Count = 32964
DES Ctrl Reg#0 = C000C043, Reg#1 = 0
```

Perform these steps if you are having difficulty with verification:

- Step 1** Ensure that the cable connections are not loose or disconnected.

- Step 2** Ensure that the cable interface line card is firmly seated in its chassis slot.
- Step 3** Ensure that the captive installation screws are tight.
- Step 4** Verify that you have entered the correct slot and port numbers.
- Step 5** Verify that you selected a valid frequency for your router.

## Setting Upstream Traffic Shaping

Upstream traffic shaping, available on the DOCSIS upstream channel, delays the scheduling of the upstream packet, which in turn causes the packet to be buffered on the cable customer premises equipment (CPE) device, instead of being dropped. This allows the user's TCP/IP stack to pace the application traffic appropriately and approach throughput commensurate with the subscriber's defined quality of service (QoS) levels.

The CMs are buffered without incurring TCP-related timeouts and retransmits. This enables the CMTS to enforce the peak upstream rate for each CM, without degrading overall TCP performance for the subscriber CPEs. Upstream grant shaping is per cable interface (per service ID (SID)).

Token-bucket policing with shaping is the per-upstream default rate-limiting setting at the CMTS. Shaping can be enabled or disabled for the token-bucket algorithm.

To enable upstream traffic shaping for an upstream port on a Cisco cable interface line card, use one of the following commands in cable interface configuration mode.

	Command	Purpose
<b>Step 1</b>	<code>Router(config-if)# cable upstream usport rate-limit</code>	Enables traffic shaping for the specified upstream cable interface.
	<code>Router(config-if)# cable upstream usport rate-limit token-bucket</code>	Enables traffic shaping for the upstream cable interface employing the token-bucket policing algorithm. With this command the Cisco uBR7200 series CMTS automatically drops packets in violation of allowable upstream bandwidth.
	<code>Router(config-if)# cable upstream usport rate-limit token-bucket shaping</code>	Default. Enables traffic shaping for the upstream cable interface employing the token-bucket policing algorithm with traffic shaping.
<b>Step 2</b>	<code>Router(config-if)# ^Z</code> <code>Router#</code>	Exits back to the EXEC mode so that you can verify upstream traffic shaping.

To disable upstream traffic shaping for an upstream port, enter the following command in cable interface configuration mode:

```
Router(config-if)# no cable upstream usport rate-limit
```

The software supports:

- Generic calendar queuing routines
- New token-bucket policing function
- Grant shaping application of the calendar queues
- Upstream rate-shaping option to the **token-bucket** keyword

- A default state change from 1-second burst policing to token bucket with shaping

**Tip**

Upstream grant shaping is per CM (per service ID (SID)). Shaping can be enabled or disabled for the token-bucket algorithm.

**Note**

Before the introduction of this feature, the CMTS would drop bandwidth requests from a CM it detected as exceeding its configured peak upstream rate. Such request dropping affects the throughput performance of IP-based protocols such as FTP, TCP, and Simple Network Management Protocol (SNMP). With this feature, the CMTS can shape (buffer) the grants for a CM that is exceeding its upstream rate, rather than dropping the bandwidth requests.

```
Router# show interface c5/0 sid 1 counters
00:02:23: %ENV3-3-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
```

## Verifying Upstream Traffic Shaping

To determine if upstream traffic shaping is configured and activated, enter the **show running-config** command and look for the cable interface configuration information. If upstream traffic shaping is configured and enabled, a traffic shaping entry appears in the **show running-config** output. If upstream traffic shaping is disabled, **no cable upstream rate-limit** appears in the output.

You can also perform the following tasks to verify that traffic shaping is enabled on the upstream channel:

- Step 1** Configure a low-peak upstream rate limit for the CM in its QoS profile. Either use the command-line interface (CLI) to modify the modem's QoS profile, or edit the modem's TFTP configuration file. refer to the [DOCSIS 1.1 for the Cisco uBR7200 Series Universal Broadband Routers](#) feature module on Cisco.com.
- Step 2** Use a regular rate-limiting algorithm on the upstream without rate shaping, and note the drops of the excess bandwidth requests from this CM when it exceeds its peak upstream rate.  
Use the **show interface cx/y sid counters verbose** command to see the bandwidth request drops. Verify that the upstream rate received by that modem is less than its configured peak rate, due to the timeouts and backoffs produced by the drop in bandwidth requests. Enter the **show interface cx/y service flow qos** command to see the input rate at CMTS in bps.
- Step 3** Enable grant shaping on the upstream channel by using the new **shaping** keyword extension to the token-bucket algorithm CLI command.
- Step 4** Make the CM exceed its peak upstream rate by generating upstream traffic, and note the effect of grant buffering (shaping) at the CMTS. If you use CM-to-CMTS pings, there is a perceivable decrease in the frequency of the pings.

Let the pings run long enough to allow the averages at the CMTS to settle; then view the upstream rate received by this single modem. Use the **show interface cx/y** command and see the input rate in bps. This value should be close to the modem's peak upstream rate. Also note the drop counts for the modem's SID by using the **show interface sid counters** command, and verify that the CMTS no longer drops the bandwidth requests from the CM.

The bandwidth request drop count (from the previous nonshaping test) remains unchanged when upstream rate shaping is used, indicating that the CMTS is actually shaping (buffering) the grants for the modem. Verify that the input rate at the CMTS (from the single rate-exceeded CM) stabilizes close to the configured peak rate of 128 Kbps.

## Troubleshooting Tips

Perform these steps if you are having difficulty with verification:

- 
- Step 1** Ensure that the cable connections are not loose or disconnected.
  - Step 2** Ensure that the cable interface line card is firmly seated in its chassis slot.
  - Step 3** Ensure that the captive installation screws are tight.
  - Step 4** Verify that you have entered the correct slot and port numbers.
  - Step 5** Verify that you selected a valid frequency for your router.
- 

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