



# Upstream Scheduler Mode for the Cisco CMTS Routers

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**First Published:** December 18, 2008

**Last Updated:** June 20, 2011



## Note

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Cisco IOS Release 12.2(33)SCA integrates support for the Upstream Scheduler Mode 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.

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This document describes how to configure optional upstream (US) scheduler modes.

With this feature, you can select Unsolicited Grant Services (UGS), Real Time Polling Service (rtPS) or Non-Real Time Polling Service (nrtPS) scheduling types, as well as packet-based or Time Division Multiplex (TDM) based scheduling. Low latency queueing (LLQ) emulates a packet-mode-like operation over the TDM infrastructure of DOCSIS. As such, the feature provides the typical trade-off between packets and TDM. With LLQ, you have more flexibility in defining service parameters for UGS, rtPS or nrtPS, but with no guarantee (other than statistical distribution) regarding parameters such as delay and jitter.

## Finding Feature Information

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

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

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## Prerequisites for the Upstream Scheduler Mode for the Cisco CMTS Routers

The table below shows the hardware compatibility prerequisites for this feature.

**Table 1: Upstream Scheduler Mode for the Cisco CMTS Hardware Compatibility Matrix**

CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR10012 Universal Broadband Router	Cisco IOS Release 12.2(33)SCA and later releases <ul style="list-style-type: none"> <li>• PRE2</li> </ul>	Cisco IOS Release 12.2(33)SCA and later releases <ul style="list-style-type: none"> <li>• Cisco uBR10-MC5X20S/U/H</li> </ul>
	Cisco IOS Release 12.2(33)SCB and later releases <ul style="list-style-type: none"> <li>• PRE4</li> </ul>	Cisco IOS Release 12.2(33)SCC and later releases <ul style="list-style-type: none"> <li>• CiscoUBR-MC20X20V</li> </ul>
	Cisco IOS Release 12.2(33)SCH and later releases <ul style="list-style-type: none"> <li>• PRE5</li> </ul>	Cisco IOS Release 12.2(33)SCE and later releases <ul style="list-style-type: none"> <li>• Cisco uBR-MC3GX60V<sup>1</sup></li> </ul>
Cisco uBR7246VXR Universal Broadband Router	Cisco IOS Release 12.2(33)SCA and later releases <ul style="list-style-type: none"> <li>• NPE-G1</li> <li>• NPE-G2</li> </ul>	Cisco IOS Release 12.2(33)SCA <ul style="list-style-type: none"> <li>• Cisco uBR-MC28U/X</li> <li>• Cisco uBR-MC16U/X</li> </ul>
		Cisco IOS Release 12.2(33)SCD and later releases <ul style="list-style-type: none"> <li>• Cisco uBR-MC88V<sup>2</sup></li> </ul>

CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR7225VXR Universal Broadband Router	<p>Cisco IOS Release 12.2(33)SCA and later releases</p> <ul style="list-style-type: none"> <li>• NPE-G1</li> </ul> <p>Cisco IOS Release 12.2(33)SCB and later releases</p> <ul style="list-style-type: none"> <li>• NPE-G2</li> </ul>	<p>Cisco IOS Release 12.2(33)SCA releases</p> <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> <p>Cisco IOS Release 12.2(33)SCD and later releases</p> <ul style="list-style-type: none"> <li>• Cisco uBR-MC88V</li> </ul>

<sup>1</sup> Cisco uBR-MC3GX60V cable interface line card is not compatible with PRE2.

<sup>2</sup> Cisco uBR-MC88V cable interface line card is compatible only with NPE-G2.

## Restrictions for Upstream Scheduler Mode for the Cisco CMTS Routers

- To ensure proper operation, Call Admission Control (CAC) must be enabled. When the LLQ option is enabled, it is possible for the upstream path to be filled with so many calls that it becomes unusable, making voice quality unacceptable. CAC must be used to limit the number of calls to ensure acceptable voice quality, as well as to ensure traffic other than voice traffic.
- Even if CAC is not enabled, the default (DOCSIS) scheduling mode blocks traffic after a certain number of calls.
- UGS with Activity Detection (UGS-AD) is not supported by the LLQ scheduler mode but remains supported by the default DOCSIS scheduler mode.
- Upstream bandwidth request rate limiting feature is supported only on the Cisco UBR-MC20X20V, Cisco uBR-MC3GX60V, Cisco uBR-MC88V, and Cisco uBR-MC5X20H cable interface line cards.

## Information About Upstream Scheduler Mode for the Cisco CMTS Routers

With UGS, a service flow is created that enables a cable modem to transmit fixed-size bursts of data at a guaranteed rate and with a guaranteed level of jitter by providing periodic transmission opportunities to the cable modem for fixed-sized frames. This kind of service flow is particularly suitable for VoIP applications.

With rtPS, a service flow is created that provides a periodic opportunity for a cable modem to request permission to transmit data by polling a single cable modem for a bandwidth request, rather than all the cable modems. This satisfies applications that have a requirement for real-time data transmission, and enables the cable

modem to transmit data bursts of varying length. This kind of service flow is particularly suitable for MPEG VoIP.

Starting with Cisco IOS Release 12.2(33)SCG, rtPS requests, by default, are internally treated as priority 7—the highest priority for all Best Effort traffic. This high priority reduces the latency of rtPS traffic under congestion.

With nrtPS, a service flow is created that provides a periodic opportunity for a cable modem to request permission to transmit data by polling a single cable modem for a bandwidth request, rather than all the cable modems. The data bursts may be of varying length. This kind of service flow is particularly suitable for non-interactive services such as file transfers.

## Upstream Peak Traffic Rate

The Cisco uBR10012 universal broadband routers support upstream traffic peak rates (DOCSIS 3.0 TLV 24.27). This feature is supported on the Cisco uBR10012 universal broadband routers with the Cisco uBR10-MC5X20H and Cisco UBR-MC20X20V cable interface line cards and supports DOCSIS 2.0 and DOCSIS 3.0 cable modems. The upstream peak traffic rate is configured using the cable service class command. To view the peak traffic rate value for a specific service flow, use the **show cable modem qos verbose** and **show cable service-class verbose** commands.

Some of the DOCSIS 1.x and DOCSIS 2.0 cable modems, which are not fully DOCSIS 1.x or DOCSIS 2.0 compliant, may fail to come online when they receive upstream peak rate TLV 24.27 from the Cisco CMTS. To overcome this, you can configure the **cable service attribute withhold-TLVs** command with **peak-rate** keyword to restrict sending of this type, length, value (TLV) to non-DOCSIS 3.0 cable modems.

## Upstream Bandwidth Request Rate Limiting

The Cisco CMTS US scheduler may report high CPU consumption because of extensive incoming bandwidth request processing. The Cisco IOS Release 12.2(33)SCF introduces the upstream Bandwidth Request Rate Limiting (BRRL) feature, which controls the CPU consumption of the US scheduler by monitoring the number of incoming bandwidth requests, and dropping excessive bandwidth requests.



### Note

Only the best effort (BE) service flows are subjected to bandwidth request rate limiting.

By default, the BRRL feature is enabled for the Cisco uBR-MC3GX60V line card.

By default, all the bandwidth requests with service flow priority from 0 to 7 are processed by the BRRL feature. However, the BRRL feature also enables you to configure a service flow priority that is exempted from BRRL. Any bandwidth request received with this configured priority or above, is exempted from BRRL processing and is therefore not dropped even if the CPU consumption by the US scheduler is high. For example, if the configured exempted priority is 5, any bandwidth request with priority 5, 6, or 7 is not dropped even if the CPU consumption is high.

Use the **cable upstream rate-limit-bwreq exempted-priority** command to configure the exempted service flow priority. If the **exempted-priority** is set to value zero, all the bandwidth requests are exempted from rate limiting, or in other words BRRL feature is disabled.

# How to Configure Upstream Scheduler Modes

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> <b>enable</b>	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# <b>configure terminal</b>	Enters global configuration mode.
Step 3	Use one the following commands:  <ul style="list-style-type: none"> <li>• <b>interface cable</b> <i>slot/subslot/port</i></li> <li>• <b>interface cable</b> <i>slot/port</i></li> </ul> <b>Example:</b> Router(config)# <b>interface cable</b> 5/1	Enters interface configuration mode for the specified cable interface.
Step 4	<b>cable upstream</b> <i>n</i> <b>scheduling type</b> <i>ugs mode</i> [ <b>llq</b>   <b>docsis</b> ]  <b>Example:</b> Router(config-if)# <b>cable upstream</b> 4 <b>scheduling type</b> <i>ugs mode llq</i>	Enables LLQ-type (packet-based) scheduling for UGS services.  <b>Note</b> Any combination of <b>ugs</b> , <b>rtps</b> , <b>nrtps</b> , <b>llq</b> , and <b>docsis</b> is allowed. The only default value is <b>docsis</b> .
Step 5	<b>cable upstream</b> <i>n</i> <b>scheduling type</b> <i>rtps mode</i> [ <b>llq</b>   <b>docsis</b> ]  <b>Example:</b> Router(config-if)# <b>cable upstream</b> 4 <b>scheduling type</b> <i>rtps mode docsis</i>	Enables standard DOCSIS (TDM-based) scheduling for rtPS services.  <b>Note</b> Any combination of <b>ugs</b> , <b>rtps</b> , <b>nrtps</b> , <b>llq</b> , and <b>docsis</b> is allowed. The only default value is <b>docsis</b> .
Step 6	<b>end</b>  <b>Example:</b> Router(config-if)# <b>end</b>	Exits interface configuration mode and returns to privileged EXEC mode.

### What to Do Next

To confirm whether the scheduler is operating in LLQ or DOCSIS mode, use the **show interface cable mac-scheduler** command. A new queue is added when LLQ mode is enabled, as shown in the following example:

```
Router# show interface cable 4/0 mac-scheduler 0
DOCSIS 1.1 MAC scheduler for Cable4/0/U0
```

```

Queue[Rng Polls] 0/128, 0 drops, max 1
Queue[CIR Grants] 0/64, 0 drops, max 0
Queue[BE(7) Grants] 0/64, 0 drops, max 0
Queue[BE(6) Grants] 0/64, 0 drops, max 0
Queue[BE(5) Grants] 0/64, 0 drops, max 0
Queue[BE(4) Grants] 0/64, 0 drops, max 0
Queue[BE(3) Grants] 0/64, 0 drops, max 0
Queue[BE(2) Grants] 0/64, 0 drops, max 0
Queue[BE(1) Grants] 0/64, 0 drops, max 0
Queue[BE(0) Grants] 0/64, 0 drops, max 0

!This queue is added in LLQ Mode
Queue[LLQ Grants] 0/64, 0 drops, max 0
  Req Slots 153607143, Req/Data Slots 0
  Init Mtn Slots 1305584, Stn Mtn Slots 145897
  Short Grant Slots 47, Long Grant Slots 2939
  ATDMA Short Grant Slots 0, ATDMA Long Grant Slots 0
  ATDMA UGS Grant Slots 0
  Awacs Slots 0
  Fragmentation count 3
  Fragmentation test disabled
  Avg upstream channel utilization : 0%
  Avg percent contention slots : 98%
  Avg percent initial ranging slots : 1%
  Avg percent minislots lost on late MAPs : 0%
  Sched Table Adm-State: Grants 0, Reqpolls 0, Util 1%
  UGS      : 0 SIDs, Reservation-level in bps 0
  UGS-AD   : 0 SIDs, Reservation-level in bps 0
  RTPS     : 0 SIDs, Reservation-level in bps 0
  NRTPS    : 0 SIDs, Reservation-level in bps 0
  BE       : 2 SIDs, Reservation-level in bps 0
  r4k ticks in lms 131000
  Total scheduling events 0
  No search was needed 0
  Previous entry free 0
  Next entry free0
  Could not schedule 0
  Recovery failed 0
  Curr time 8282 entry 90

```

## How to Configure Exempted Priority for BRRL feature

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> <b>enable</b>	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# <b>configure terminal</b>	Enters global configuration mode.
Step 3	<b>cable upstream rate-limit-bwreq exempted-priority <i>priority</i></b>	Configures the exempted priority:  <ul style="list-style-type: none"> <li>• <i>priority</i>—Service flow priority. Bandwidth requests with this service flow priority value (and above) are exempted from BRRL. The valid range is from 0 to 7.</li> </ul>

	Command or Action	Purpose
	<b>Example:</b> <pre>Router(config)# cable upstream rate-limit-bwreq exempted-priority 5</pre>	
<b>Step 4</b>	<b>end</b>  <b>Example:</b> <pre>Router(config)# end</pre>	Exits configuration mode and returns to privileged EXEC mode.

## Additional References

The following sections provide references related to the Cisco CMTS routers.

### Related Documents

Related Topic	Document Title
Cisco CMTS command reference	<i>Cisco CMTS Cable Command Reference</i> <a href="http://www.cisco.com/c/en/us/td/docs/cable/cmts/cmd_ref/b_cmts_cable_cmd_ref.html">http://www.cisco.com/c/en/us/td/docs/cable/cmts/cmd_ref/b_cmts_cable_cmd_ref.html</a>

### Standards

Standard	Title
DOCSIS	Data-Over-Cable Service Interface Specifications, DOCSIS 2.0, Radio Frequency Interface Specification, CM-SP-RFIV2.0-I08-050408

### Technical Assistance

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

# Feature Information for Upstream Scheduler Mode for the Cisco CMTS Routers

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



## Note

The below table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

**Table 2: Feature Information for Upstream Scheduler Mode for the Cisco CMTS Routers**

Feature Name	Releases	Feature Information
Upstream Scheduler Mode for the Cisco CMTS Routers	12.3(13)BC	This feature was introduced for all Cisco CMTS routers. The <b>cable upstream scheduling type</b> command was introduced.
Upstream Scheduler Mode for the Cisco CMTS Routers	12.2(33)SCA	This feature was integrated into Cisco IOS Release 12.2(33)SCA. Support for the Cisco uBR7225VXR universal broadband router was added.
Upstream Peak Traffic Rate	12.2(33)SCC	The upstream peak rate traffic (DOCSIS 3.0 TLV 24.27) is supported on Cisco uBR10012 universal broadband routers.  The following command outputs display the upstream peak traffic rate: <ul style="list-style-type: none"> <li>• <b>show cable modem qos verbose</b></li> <li>• <b>show cable service-class verbose</b></li> </ul>



Feature Name	Releases	Feature Information
Suppressing Downstream and Upstream Peak Rate TLVs for pre DOCSIS 3.0 Cable Modems	12.2(33)SCB10	This feature restricts sending of the DOCSIS 3.0 TLVs to DOCSIS 1.x and DOCSIS 2.0 cable modems.  The <b>cable service attribute withhold-TLVs</b> command was introduced.
Upstream Bandwidth Request Rate Limiting	12.2(33)SCF	In the Cisco IOS Release 12.2(33)SCF, this feature was introduced for all Cisco CMTS routers.  The <b>cable upstream rate-limit-bwreq exempted-priority</b> command was introduced.

