Quality of Service for Voice on the Cisco uBR7200 Series Cable Router

Feature Overview

This feature describes the software enhancements that support quality of service (QoS) features for voice transmission over a DOCSIS cable network. These enhancements include improving support for

- Delay/jitter requirements of real-time traffic typical of voice, video, and Fax traffic

- Increase in per-modem data throughput,

- New Media Access Control (MAC) scheduler

- MAC messaging support to help support real-time response to your service requests

Benefits

This feature improves voice transmission over a DOCSIS cable network.

Restrictions

Baseline Privacy Interface (BPI) encryption is not supported when using dynamic Service IDs (SIDs).

Related Features and Technologies

Table 1 lists the IOS cable router features released in the IOS 12.0 timeframe.

Table 1   uBR7200 Series Cable Router Features Available Since 12.0 T

Available With:	Category	Feature
11.3(5)NA & 12.0(3)T	Cable Features	Feature Enhancements
11.3(6)NA		MC16 Modem Card
11.3(8)NA		Access List Support Enhancements
12.0(4)T		Downstream Channel ID Configuration
12.0(4)T		Multiple Service ID Support
12.0(4)T		Cable Modem and Host Subnet Addressing
12.0(5)T		Telephone Return

Available With:	Category	Feature
12.0(5)T		Time Server Functionality
12.0(7)T		Amplitude Averaging Compensation
12.0(7)XR		Cable Interface Bundling
12.0(7)XR		Enhanced Modem Status Display
12.0(7)XR		Show Interface Cable Command Verbose Enhancements
12.0(7)XR		IP Address Verification
12.0(7)XR		Registration Timeout Configuration
12.0(7)XR		Show Cable Modem Command Enhancements
12.0(7)XR		Modem Status Summary Enhancements
12.0(7)XR		Show Controller Command Enhancements
12.0(7)XR		Configuring Concatenation
12.0(7)XR		Virtual Private Network Support
12.0(7)XR		Blind Hopping Support on the MC16S Modem Card
12.0(7)XR		Signal-to-Noise Ratio Data Support
11.3(9)NA and 12.0(4)T	Cable QoS	QoS Profile Enforcement
12.0(4)T		Quality of Service for Voice
11.3(9)NA	Network Management	Upstream Traffic Shaping Feature
12.0(5)T		Enhanced-Spectrum Management
12.0(5)T		Downstream Rate Shaping with TOS bits
12.0(7)XR		Spectrum Management Using the MC16S Modem Card
12.0(7)XR		Downstream Test Signals Configuration
12.0(7)XR	Wireless Features	Point-to-Point Wireless Support

Related Documents

The uBR7200 series cable router is described in *Voice, Video, and Home Applications Configuration Guide* for Cisco IOS Release 12.0 and in the following online feature modules:

- *Cisco uBR7246 Universal Broadband Router Feature Enhancements*
- *MC16 Modem Card for uBR7200*
- *uBR7200 Series Access List Support Enhancements*
- *QoS Profile Enforcement for the Cisco uBR7200 Series Router*
- *Upstream Traffic Shaping Feature*
- *Configuring Downstream Channel IDs*
- *Telephone Return for the Cisco uBR7200 Series Cable Router*
- *Enhanced-Spectrum Management for the Cisco uBR7200 Series Cable Router*
- *Time Server Functionality*
- *Cable Interface Bundling for the Cisco uBR7200 Series Cable Router*

- *Quality of Service for Voice on the Cisco uBR7200 Series Cable Router* (this feature)
- *Modem Status Enhancements for the Cisco uBR7200 Series Cable Router*
- *Load Sharing Support*
- *Cable Modem and Host Subnet Addressing*
- *MGX Resource Pool Management Hardware Diagnostics*
- *IP Address Verification for the Cisco uBR7200 Series Cable Router*
- *Configuring the Registration Timeout Value for the Cisco uBR7200 Series Cable Router*
- *Spectrum Management Using the MC16S Modem Card on the Cisco uBR7200 Series Cable Router*
- *Configuring Downstream Test Signals for the Cisco uBR7200 Series Cable Router*
- *Configuring Concatenation on the Cisco uBR7200 Series Cable Router*
- *Point-to-Point Wireless Support for the Cisco uBR7200 Series Universal Broadband Router*
- *Blind Hopping Support on the MC16S Modem Card for the Cisco uBR7200 Series Cable Router*
- *Downstream Rate Shaping with TOS bits on the uBR7200 Series Cable Router*
- *Amplitude Averaging Compensation on the Cisco uBR7200 Series Cable Router*

Supported Platforms

uBR7200 series cable router

Supported Standards, MIBs, and RFCs

Standards
- DOCSIS 1.0+

MIBs
No new or modified MIBs are supported by this feature.

RFCs
No new or modified RFCs are supported by this feature.

Configuration Tasks

See the following to configure this quality of service feature.

- Configuring a Modulation Profile (Required)

Configuring a Modulation Profile

Step	Command	Purpose
1	`Router(config)#` **cable qos-profile** *n* **name**	Assigns a name to the QoS profile.
2	`Router(config)#` **cable qos-profile** *n* **priority**	Sets the upstream traffic priority.
3	`Router(config)#` **qos-profile** *n* **max-upstream**	Sets the maximum upstream traffic rate.
4	`Router(config)#` **qos-profile** *n* **guaranteed-upstream**	Sets the guaranteed upstream traffic rate.
5	`Router(config)#` **qos-profile** *n* **grant-size**	Sets the size for unsolicited grants.
6	`Router(config)#` **qos-profile** *n* **grant-interval**	Sets the interval for unsolicited grants.
7	`Router(config)#` **qos-profile** *n* **max-burst**	Sets the maximum rate for upstream transmission bursts.
8	`Router(config)#` **qos-profile** *n* **tos-overwrite**	Sets the mask bits to overwrite the Type of Service byte.
9	`Router(config)#` **qos-profile** *n* **max-downstream**	Sets the maximum downstream traffic rate.
10	`Router(config)#` **qos-profile** *n* **privacy**	Enables baseline privacy.
11	`Router(config)#` **qos-profile** *n* **ip-precedence**	Downstream settings are based on IP precedence.

Monitoring and Maintaining QoS for Voice

Command	Purpose
`Router#` s**how cable qos profile** *n*	Displays the configuration for the specified profile.
`Router#` **show interface cable** *x/y* **sid**	Displays each Qos profile configured for the specified cable interface.
`Router#` **show interface cable** *x/y* **upstream**	Displays quality of service statistics for the upstream channel.

Configuration Examples

The following example shows how a cable modem with a QoS profile 30 created by the cable router (*mgmt*):

```
router(config)# cable qos profile 30 name qostest
router(config)# cable qos profile 30 grant-int 55
router(config)# cable qos profile 30 grant-size 100
router(config)# cable qos profile 30 guaranteed 60000
router(config)# cable qos profile 30 ip-prec 7
router(config)# cable qos profile 30 max-bur 256
router(config)# cable qos profile 30 max-down 3000
router(config)# cable qos profile 30 max-up 6000
router(config)# cable qos profile 30 prior 7
router(config)# cable qos profile 30 privacy

router# show cable qos profile 30
ID Prio Max        Guarantee Max         Max   TOS  TOS    Create  B     IP prec.
        upstream   upstream  downstream  tx    mask value by      priv  rate
        bandwidth  bandwidth bandwidth   burst                    enab  enab
30 7    6000000    60000000  100000000   256   0x0  0x0    mgmt    yes   no
```

Command Reference

This section documents modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.0T command reference publications.

- **cable qos profile**
- **show cable qos profile**

Note **For show** and **more** commands: Required information. When **show** or **more** commands are documented for a feature, you must include the following standard text about the search and filter functionality (introduced in Release 12.0(1)T) immediately after the bulleted list of commands.

In Cisco IOS Release 12.0(1)T or later releases, you can search and filter the output for **show** and **more** commands. This functionality is useful when you need to sort through large amounts of output, or if you want to exclude output that you do not need to see.

To use this functionality, enter a **show** or **more** command followed by the "pipe" character (|)**,** one of the keywords **begin**, **include**, or **exclude,** and an expression that you want to search or filter on:

command | {**begin** | **include** | **exclude**} *regular-expression*

See the following example of the **show atm vc** command in which you want the command output to begin with the first line where the expression "PeakRate" appears:

show atm vc | **begin PeakRate**

For more information on the search and filter functionality, refer to the Cisco IOS Release 12.0(1)T feature module *CLI String Search*.

cable qos profile

To configure a QoS profile, enter the **cable qos profile** global configuration command. To either set default values for profile group numbers 1 or 2 or remove the QoS profile if no specific parameters remain, enter the **no** form of this command.

cable qos profile {*groupnum* | **grant-interval** {*interval*} / **grant-size** {*size*} / **guaranteed-upstream** {*rate*} / **ip-precedence** {*value*} / **max-burst** {*rate*} / **max-downstream** {*rate*} / **max-upstream** {*rate*} / **name** {*string*} / **priority** {*value*} / **privacy** / **tos-overwrite** {*value*}}

no cable qos profile {*groupnum* | **grant-interval** {*interval*} / **grant-size** {*size*} / **guaranteed-upstream** {*rate*} / **ip-precedence** {*value*} / **max-burst** {*rate*} / **max-downstream** {*rate*} / **max-upstream** {*rate*} / **name** {*string*} / **priority** {*value*} / **privacy** / **tos-overwrite** {*value*}}

Syntax Description

groupnum	QoS profile group number. Qos profiles 1 and 2 are required by the system. QoS profile 1 is used during registration, and QoS profile 2 is the default QoS profile. Both profiles are preconfigured and cannot be removed. However, you can modify these profiles.
grant-interval	The periodic interval in microseconds at which the cable modem (CM) wants to send the fixed-sized upstream MAC frames. It is used to compute the period in between constant bit rate (CBR) slots for the CM. Valid range is from 0 to 65535.
grant-size	The size of the DOCSIS MAC frame the CM wants periodically to send on the upstream transmission. This value in bytes does not include any PHY layer overhead. It includes the complete fixed MAC frame size starting from the frame control byte to the CRC of the protocol data unit (PDU). This parameter is used by the CMTS to set the size of the periodic CBR slot for the CM after adding the PHY overhead.
guaranteed-upstream	Guaranteed minimum upstream rate in kilobytes per second. Valid values are from 0 to 100000. Default value is 0 (no reserved rate).
ip-precedence	Bits in the TOS byte that enable you to configure individual data rate limits on a per modem basis. Valid values are from 0 to 7.
max-burst	Maximum upstream transmit burst size in bytes that the modem can send for any single transmit burst. Valid values are from 0 to 65535 bytes. Default value is 0 (no limit).
max-downstream	Maximum downstream data rate in kilobytes per second that a modem using this QoS profile receives. Valid values are from 0 to 100000. Default value is 0 (no downstream rate limit).
max-upstream	Maximum upstream data rate in kilobytes per second that a modem using this QoS profile receives. Valid values are from 0 to 255. Default value is 0 (no upstream rate limit).
name	QoS name string.
priority	Relative priority number assigned to upstream traffic by this QoS profile. Valid values are from 0 to 7 with 7 being the highest priority. Default value is 0.
privacy	Enables cable baseline privacy.
tos-overwrite	Overwrite the Type of Service (TOS) field in the IP datagrams received on the upstream before forwarding them downstream (or IP backbone). This parameter sets the hexadecimal mask bits to a hexadecimal value, thereby helping the CMTS identify datagrams for QoS on the backbone. Valid range is from 0x0 to 0xFF.
value	The value substituted for the TOS value. See *tos_overwrite*.

Default

No default behavior or values.

Command Mode

Global configuration

Command History

Release	Modification
11.3 NA	This command was introduced.
12.0(3)T	Command was included in the mainline release.
12.0(5)T	The **ip-precedence** keyword was added and the **max-downstream** range was increased.
12.0(7)XR	Output was reorganized and **name**, **grant-size**, and **grant-interval** parameters were added.

Example

See the following example to configure QoS profile 4 with guaranteed upstream of 2 kbps, maximum transmission burst of 2, an IP precedence of 7, a maximum downstream rate of 300 kbps, with a priority of 4, cable baseline privacy set, and a *tos-overwrite* mask and value byte (in hex) of 0x7:

```
Router(config)# cable qos profile 4 name Mondayqos
Router(config)# cable qos profile 4 guaranteed-upstream 2
Router(config)# cable qos profile 4 max-burst 2
Router(config)# cable qos profile 4 ip-precedence 7 max-downstream 300
Router(config)# cable qos profile 4 priority 4
Router(config)# cable qos profile 4 tos-overwrite 0x7
```

Related Commands

Command	Description
cable qos permission	Configures permissions for updating the QoS table.
show cable qos profile	Displays QoS profiles.

show cable qos profile

To display QoS profiles, use the **show cable qos profile** privileged EXEC configuration command.

show cable qos profile *qos profile index* [**verbose**]

Syntax Description

qos profile index	(Optional) Displays the index of the QoS profile specified.
verbose	(Optional) Displays all details for the specified QoS profile index.

Command Mode

Privileged EXEC

Command History

Release	Modification
11.3(5)(NA)	This command was introduced.
12.0(3)T	The command was included in the mainline release.
12.0(5)T	**tos-overwrite** option was added.
12.0(7)XR	**verbose** option was added.

Examples

The following example shows the full QoS table for profile 30:

```
router# show cable qos profile 30 verbose
Profile Index                        30
Name                                 test
Upstream Traffic Priority            7
Upstream Maximum Rate (bps)          6000000
Upstream Guaranteed Rate (bps)       60000000
Unsolicited Grant Size (bytes)       100
Unsolicited Grant Interval (usecs)   55000
Upstream Maximum Transmit Burst (bytes) 256
IP Type of Service Overwrite Mask    0x0
IP Type of Service Overwrite Value   0x0
Downstream Maximum Rate (bps)        100000000
Created By                           mgmt
Baseline Privacy Enabled             yes
IP precedence rate limits
 IP precedence                           2
 Rate Limit                          100000
```

Table 2 describes the fields shown in the **show cable qos profile** displays.

Table 2   Show cable qos profile Command Field Descriptions

Field	Description
Profile Index	Profile number.

Table 2   Show cable qos profile Command Field Descriptions (continued)

Field	Description
Name	The name string for this profile.
Upstream Traffic Priority	Priority level for upstream traffic.
Upstream Maximum Rate (bps)	Maximum upstream transmission rate in bits per second.
Upstream Guarantee Rate (bps)	Guaranteed minimum upstream rate in bits per second.
Unsolicited Grant Size (bytes)	Number of grant-size parameters in bytes. Grant Size is used by the CMTS to set the size of the periodic CBR slot for the CM after adding the PHY overhead.
Unsolicited Grant Interval (usecs)	Number of unsolicited grant intervals in microseconds. The grant-interval parameter is used to compute the period in between CBR slots for the CM.
Upstream Maximum Transmit Burst (bytes)	Maximum transmit burst size in bytes.
IP Type of Service Overwrite Mask	Hex value of the mask bits.
IP Type of Service Overwrite Value	Value of the mask byte. This is the value the CMTS will overwrite into the ToS field (after masking bits specified in the ToS-mask parameter) of the IP datagram before forwarding the datagram into IP backbone/downstream. The IP ToS overwrite feature helps to propagate cable access QoS onto the IP backbone.
Downstream Maximum Rate (bps)	Minimum upstream transmission rate in bits per second.
Created by	Identity of the profile creator.
Baseline Privacy Enabled	Reports yes if Baseline Privacy is enabled for this QoS profile. Reports no if Baseline Privacy is not enabled for this Qos profile.
IP Precedence rate limits	Value of the IP precedence and the transmission rate limit in bits per second.

Related Commands

Command	Description
cable qos permission	Sets permissions for updating QoS tables.
cable qos profile	Configures QoS profiles.
show cable qos permission	Displays the status of permissions for updating QoS tables.

Debug Commands

This section documents new **debug** commands. All other commands used with this feature are documented in the Cisco IOS Release 12.0T command reference publications.

- **debug cable dynsrv**
- **debug cable scheduler**

debug cable dynsrv

To display debug messages for all dynamic MAC messages at the router, use the **debug cable dynsrv** privileged EXEC mode command. To stop debugging dynamic MAC messages, use the **no** form of this command.

[no] debug cable dynsrv

Syntax Description

This command has no arguments or keywords.

Defaults

No default behavior or values.

Command History

Release	Modification
12.0(7)XR	This command was introduced.

Examples

The following example shows the message you receive when you turn debugging on and off:

```
router# debug cable dynsrv
CMTS dynsrv debugging is on
router# no debug cable dynsrv
CMTS dynsrv debugging is off
```

Related Commands

Command	Description
debug cable scheduler	Displays debug messages for admission control activity and reception of unsolicited grants.

debug cable scheduler

To display debug messages for admission control activity and reception of unsolicited grants, use the **debug cable scheduler** privileged EXEC command. To stop debugging, use the **no** form of this command.

[**no**] **debug cable scheduler** [**admission-control** | **unsolicited-grants**]

Syntax Description

admission-control	Debugs admission control activity.
unsolicited-grants	Debugs the average delay and maximum delay jitter of unsolicited grants received by a specified SID for a specified cable interface.
	Note: Make sure only one debugging SID is active per cable interface at a time.

Defaults

No default behavior or values.

Command History

Release	Modification
12.0(7)XR	This command was introduced.

Examples

The following example shows the message you receive when you turn debugging on and off:

```
router# debug cable sched
CMTS scheduler debugging is on
router# no debug cable sched
CMTS scheduler debugging is off
```

To debug admission control activity of the new MAC scheduler on a cable interface c3/0, see the following command:

```
router# debug cable scheduler admission-control
router# debug cable interface cable 3/0
```

To debug the average delay, maximum delay jitter on the unsolicited grants received by SID 9 on cable interface cable 3/0, see the following command:

```
router# debug cable scheduler unsolicited-grants
router# debug cable interface cable 3/0 sid 9
```

Related Commands

Command	Description
debug cable dynsrv	Debugs dynamic MAC messages.