Subscriber Traffic Management

This document describes the Subscriber Traffic Management (STM) feature Version 1.3. STM feature supports all DOCSIS-compliant cable modems.

The STM feature allows a service provider to configure a maximum bandwidth threshold over a fixed period for a specific service class (or quality of service [QoS] profile)). The subscribers who exceed this configured threshold can then be identified and allocated reduced QoS. STM works as a low-CPU alternative to Network-Based Application Recognition (NBAR) and access control lists (ACLs). However, using STM does not mean that NBAR and ACLs have to be turned off; STM can be applied along with NBAR and ACLs. STM also works in conjunction with the Cisco Broadband Troubleshooter to support additional network management and troubleshooting functions in the Cisco CMTS.

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Important   In this document, the phrase QoS profile is synonymously used to indicate a service class for a DOCSIS 1.1 cable modem. However, QoS profile applies only to DOCSIS 1.0 operations. In instances where QoS profile is mentioned to indicate DOCSIS1.1 operations, the QoS profile should be treated as a service class.

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.

Hardware Compatibility Matrix for Cisco cBR Series Routers

Note The hardware components introduced in a given Cisco IOS-XE Release are supported in all subsequent releases unless otherwise specified.

Table 1: Hardware Compatibility Matrix for the Cisco cBR Series Routers

Cisco CMTS Platform	Processor Engine	Interface Cards
Cisco cBR-8 Converged Broadband Router	**Cisco IOS-XE Release 3.15.0S and Later Releases** Cisco cBR-8 Supervisor : • PID—CBR-CCAP-SUP-160G • PID—CBR-CCAP-SUP-60G[1] • PID—CBR-SUP-8X10G-PIC	**Cisco IOS-XE Release 3.15.0S and Later Releases** Cisco cBR-8 CCAP Line Cards: • PID—CBR-LC-8D30-16U30 • PID—CBR-LC-8D31-16U30 • PID—CBR-RF-PIC • PID—CBR-RF-PROT-PIC Cisco cBR-8 Downstream PHY Modules: • PID—CBR-D30-DS-MOD • PID—CBR-D31-DS-MOD Cisco cBR-8 Upstream PHY Modules: • PID—CBR-D30-US-MOD

[1] Effective with Cisco IOS-XE Release 3.17.0S, CBR-CCAP-SUP-60G supports 8 cable line cards. The total traffic rate is limited to 60Gbps, the total number of downstream service flow is limited to 72268, and downstream unicast low-latency flow does not count against the limits.

Restrictions for Subscriber Traffic Management on the Cisco CMTS Routers

Note In this document, the phrase QoS profile is synonymously used to indicate a service class for a DOCSIS 1.1 cable modem. However, QoS profile applies only to DOCSIS 1.0 operations. In instances where QoS profile is mentioned to indicate DOCSIS 1.1 operations, the QoS profile should be treated as a service class.

The STM feature has the following restrictions and limitations:

- In STM version 1.1, the sampling rate range (duration) is calculated using the monitoring duration rather than the constant range (10 to 30 minutes) used in STM 1.0.

    - If the monitoring duration is more than a day (1440 minutes), the duration sample rate is calculated as (duration / 100).
    - If the monitoring duration is less than a day, the sample rate range is from 10 to 30 minutes.
    - If you are using STM 1.0 with a duration of two days and a sample rate of 20 minutes, and you try to restore that configuration in STM 1.1, the command fails because now the valid range is from 28 to 86 minutes.

- For DOCSIS1.0, the registered QoS profile specified by an enforce-rule must match exactly a QoS profile that exists on the Cisco CMTS. To manage a cable modem that is using a modem-created QoS profile, you must first create that same exact QoS profile on the Cisco CMTS. All parameters in the QoS profile must match before the cable modem can be managed by the enforce-rule.
- The Cisco cBR series routers support a certain maximum of 40 enforce-rules. If you have created the maximum number of enforce-rules and want to create another rule, you must first delete one of the existing rules.

- Changing the configuration of an enforce-rule automatically resets all byte counters for the subscribers who are mapped to that enforce-rule.
- When specifying a QoS profile to be enforced when users violate their registered QoS profiles, both the originally provisioned QoS profile and the enforced QoS profile must be created on the Cisco CMTS.
- The Subscriber Traffic Management feature calculates duration based on the time set on the router, not uptime. Therefore, if you use the **clock set** command to change the time on the router, you might affect the STM monitoring behavior.
- The maximum cycle for subscriber traffic management is 31 days. If you choose a cycle of 31 days, the minimum sample rate that you can set is (31 days/100) minutes.

Information About Subscriber Traffic Management on the Cisco CMTS Routers

This section contains the following:

Feature Overview

The STM feature allows service providers to configure a maximum bandwidth threshold over a fixed period, for a specific service class (or QoS profile). The subscribers who exceed this configured threshold can then be identified and allocated a reduced QoS. This feature supplements current techniques such as NBAR and ACLs, to ensure that a minority of users do not consume a majority of a cable network's bandwidth.

Current subscriber controls, such as NBAR and ACLs, examine all packets coming into the CMTS. These techniques can curb a large volume of problem traffic, but they are not as effective in dealing with the latest generation of peer-to-peer file-sharing applications that can place heavy demands on a network's available bandwidth.

The STM feature allows service providers to focus on a minority of potential problem users without impacting network performance or other users who are abiding by their service agreements.

The STM feature supports two types of monitoring:

- Legacy Monitoring—Legacy monitoring allows you to set up a single monitoring duration without the ability to choose the time of day when that monitoring is performed. The configured monitoring parameters remain constant throughout the day.
- Peak-Offpeak Monitoring—Peak-Offpeak monitoring allows you to specify up to two high-traffic periods in a day for monitoring, in addition to the ability to continue monitoring during the remaining (or off-peak) periods. By combining the peak time option with weekend monitoring, you can identify and limit the bandwidth usage of certain subscribers for up to two peak network usage periods during weekdays, and during a different set of peak usage periods on weekends.

When a cable modem goes offline and remains offline for 24 hours, the Cisco CMTS router deletes its service flow IDs from its internal databases, and also deletes the modem's traffic counters. This can allow some users to exceed their bandwidth limits, go offline, and come back online with new counters. The Subscriber Traffic Management feature helps to thwart these types of theft-of-service attacks by implementing a penalty period for cable modems that violate their service level agreements (SLAs). Even if a cable modem goes offline, its counters are still reset, and the CMTS continues to enforce the penalty period.

Feature List

The Subscriber Traffic Management feature has the following operational features:

- Subscriber Traffic Management 1.1 (STM 1.1) supports cable modems that have registered for DOCSIS 1.1 operations (using the service class/service flow ID [SFID] model).
- Up to 40 enforce-rules can be created on each router.

- Separate enforce-rules can be used for downstream traffic and for upstream traffic. However, the limit on the total number of enforce-rules that can be configured includes the upstream and downstream rules combined.
- Each enforce-rule uses a subscriber's registered QoS profile to identify which users should be monitored for excessive traffic for DOCSIS1.0 cable modems. The registered QoS profile must exist on the Cisco CMTS. If you want to manage cable modems that are using QoS profiles that were created by the cable modem, you must first manually create a QoS profile with the exact same QoS parameters on the Cisco CMTS, and then allow the cable modem to come online using the manually created profile.

- Each enforce-rule specifies the maximum number of kilobytes a user can transmit during a specified window.
- Subscribers who exceed the maximum bandwidth that is specified by their enforce-rule can be automatically switched to a separate enforced QoS profile that limits their network use for a customizable penalty period. The enforced QoS profile can change the guaranteed bandwidth, priority, or any other aspect of the traffic that the service provider considers an acceptable response to subscribers who violate their service agreements.
- Subscribers are automatically switched back to their registered QoS profile at the end of their penalty period. A technician at the service provider's network operations center (NOC) can also switch them back before the penalty period expires.

> **Note** To manually switch back, delete the cable modem and allow it to register again.

- This feature also supports a **no-persistence** option, so that the enforced QoS profile does not remain in effect when a cable modem reboots. This option is particularly useful when the feature is initially implemented, so that the service providers can identify problem subscribers and applications, without

creating a major impact on the entire user base. When repeat offenders are found, they can then be switched to an enforce-rule that does keep the enforced QoS profile in effect even when the cable modem reboots.

- Service providers can display a list of all subscribers' current usage statistics. Service providers can also display a list of just those subscribers who are overconsuming bandwidth.
- The penalty period persists across reboots of the cable modem, so subscribers cannot avoid the enforced QoS profile by resetting their modems and reregistering on the cable network. This allows service providers to set an appropriate penalty for those users that consistently exceed the maximum bandwidth they have been allocated. Service providers also can specify a time of day when CMs that are identified for penalty can be released from the penalty period.
- If a user that is using excessive bandwidth decides to upgrade to a higher level of service, the service provider can reconfigure the provisioning system to assign a new QoS profile to the cable modem. The user can then reboot the cable modem and come online using the new level of service.
- Service providers can change subscriber service classes for a particular modem using the **cable modem service-class-name** command.
- Different subscriber monitoring parameters can be configured for weekends, including peak and offpeak monitoring windows. You can also establish the same monitoring windows for every day of the week, or turn off monitoring altogether on the weekends as desired.
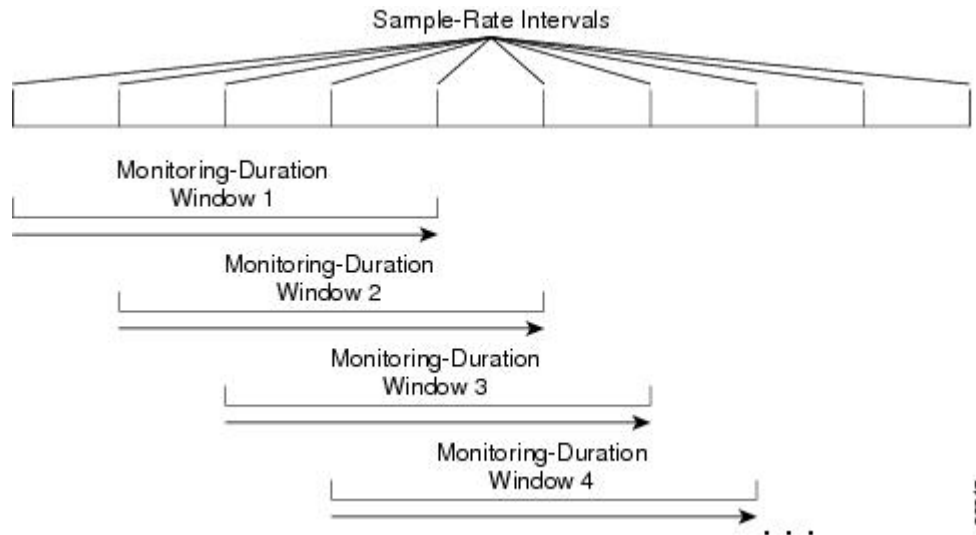
Sliding Window for Monitoring Service Flows

When an enforce-rule is activated, the CMTS periodically checks the bandwidth being used by subscribers to determine whether any subscribers are consuming more bandwidth than that specified by their registered QoS profiles. The CMTS keeps track of the subscribers using a sliding window that begins at each sample-rate interval and continues for the monitoring-duration period.

Each sample-rate interval begins a new sliding window period for which the CMTS keeps track of the total bytes transmitted. At the end of each sliding window period, the CMTS examines the byte counters to determine if any subscriber is currently overconsuming bandwidth on the network.

For example, with the default sample-rate interval of 15 minutes and the default monitoring-duration window of 360 minutes (6 hours), the CMTS samples the bandwidth usage every 15 minutes and determines the total bytes transmitted at the end of each 360-minute window. Therefore, every 15 minutes, the CMTS determines each subscriber's usage statistics for the preceding 6-hour period.

Figure below illustrates how this process works, with a new sliding window beginning at the beginning of each sample-rate interval period.

Figure 1: Monitoring-Duration Windows

Weekend Monitoring

With standard legacy and peak-offpeak monitoring configuration, monitoring continues to occur on the weekends.

STM version 1.2 supports configuration of different monitoring conditions on weekends. Weekend monitoring options support the same parameters that are available in the existing monitoring options, but use a separate set of commands to configure alternate monitoring on weekend days. This includes configuration of peak and offpeak weekend monitoring windows.

In addition, the CLI supports the ability to turn off any monitoring on the weekend, or to use the same monitoring conditions for every day of the week.

SNMP Trap Notifications

Simple Network Management Protocol (SNMP) trap notification can be sent whenever a subscriber violates the enforce-rule. This trap is defined in the CISCO-CABLE-QOS-MONITOR-MIB and is enabled using the **snmp-server enable traps cable** command.

Each SNMP trap notification contains the following information:

- MAC address of the subscriber's cable modem
- Name of the enforce-rule being applied to this subscriber
- Total bytes sent by the subscriber during the monitoring-duration window
- Time at which the subscriber's penalty period expires

The CISCO-CABLE-QOS-MONITOR-MIB also contains the following tables that provide information about the Subscriber Traffic Management configuration and about subscribers who violate their enforce-rules:

- ccqmCmtsEnforceRuleTable—Contains the attributes of the enforce-rules that are currently configured on the Cisco CMTS.
- ccqmEnfRuleViolateTable—Provides a snapshot list of the subscribers who violated their enforce-rules over the sliding monitoring-duration window.

The following objects are used for enforce rules:

- ccqmCmtsEnfRulePenaltyEndTime
- ccqmCmtsEnfRuleWkndOff
- ccqmCmtsEnfRuleWkndMonDuration
- ccqmCmtsEnfRuleWkndAvgRate
- ccqmCmtsEnfRuleWkndSampleRate
- ccqmCmtsEnfRuleWkndFirstPeakTime
- ccqmCmtsEnfRuleWkndFirstDuration
- ccqmCmtsEnfRuleWkndFirstAvgRate
- ccqmCmtsEnfRuleWkndSecondPeakTime
- ccqmCmtsEnfRuleWkndSecondDuration
- ccqmCmtsEnfRuleWkndSecondAvgRate
- ccqmCmtsEnfRuleWkndOffPeakDuration
- ccqmCmtsEnfRuleWkndOffPeakAvgRate
- ccqmCmtsEnfRuleWkndAutoEnforce
- ccqmCmtsEnfRuleFirstPeakTimeMin
- ccqmCmtsEnfRuleSecondPeakTimeMin
- ccqmCmtsEnfRuleWkndFirstPeakTimeMin
- ccqmCmtsEnfRuleWkndSecondPeakTimeMin
- ccqmCmtsEnfRulePenaltyEndTimeMin
- ccqmCmtsEnfRuleWkPenaltyPeriod
- ccqmCmtsEnfRuleWkndPenaltyPeriod
- ccqmCmtsEnfRuleRelTimeMonitorOn

The following objects are used for enforce rule violations:

- ccqmEnfRuleViolateID

- ccqmEnfRuleViolateMacAddr

- ccqmEnfRuleViolateRuleName

- ccqmEnfRuleViolateByteCount

- ccqmEnfRuleViolateLastDetectTime

- ccqmEnfRuleViolatePenaltyExpTime

- ccqmEnfRuleViolateAvgRate

Cable Modem Interaction with the Subscriber Traffic Management Feature

The Subscriber Traffic Management feature ensures that users cannot bypass the QoS restrictions by rebooting their cable modems or performing other configuration changes. The service provider, however, continues to be able to change the modems' profiles and other configuration parameters as desired.

When the Subscriber Traffic Management feature is enabled, the following behavior is in effect:

- The primary service flow counters for downstream and upstream traffic are preserved when the cable modem reboots. The service provider, however, can reset the counters by changing the QoS profile for the cable modem using the **cable modem qos profile** command and resetting the cable modem.

- Secondary service flow counters are reset whenever the cable modem reboots. This happens regardless of the enforce-rule configuration.
- The cable modem retains its current primary downstream and upstream service flows when it reboots. If the cable modem is in an enforced QoS profile penalty period when it reboots, it continues using the enforced QoS profile after the reboot. Service providers can manually change the profile by assigning a new QoS profile using the **cable modem qos profile** command.

Note Changing the QoS profile for a cable modem using the **cable modem qos profile** command, also changes the enforce-rule for the cable modem when it reboots. When the cable modem comes back online, it begins operating under the enforce-rule whose registered QoS profile (see the **qos-profile registered** command) matches the new QoS profile the modem is using.

- Service providers can also change the enforce-rule configuration. The following happens when the provider changes the enforce-rule configuration:
  - If the enforce-rule is disabled (using the **no enabled** command), all cable modems using that rule's registered QoS profile are no longer managed by the Subscriber Traffic Management feature. Configuring no enabled, deactivates the enforce-rule and moves all the modems in penalty to its registered QoS.
  - If the registered QoS profile for the rule is changed (using the **qos-profile registered** command), the cable modems that are using the previous registered QoS profile are no longer managed by the Subscriber Traffic Management feature. Instead, any cable modems that use the new registered QoS profile begin being managed by this rule.
  - If the enforced QoS profile for the rule is changed (using the **qos-profile enforced** command), any cable modems using this rule that are currently in the penalty period continue using the previously configured enforced QoS profile. Any cable modems that enter the penalty period after this configuration change, however, use the new enforced QoS profile.
- Service providers also have the option of making an enforce-rule nonpersistent, so that the enforced QoS profile does not remain in force when a cable modem reboots. Instead, when the cable modem reboots and reregisters with the Cisco CMTS, the CMTS assigns it the QoS profile that is specified in its DOCSIS configuration file.

How to Configure the Subscriber Traffic Management Feature on the Cisco CMTS Routers

This section contains the following:

Creating and Configuring an Enforce-Rule

Every service class name that needs to be monitored will be linked with an enforce-rule. An enforce-rule defines the monitoring duration, the sample rate, the penalty period, and the registered service class name that the enforce-rule is linked to and the enforced service class name.

Use the procedure given below to create and configure an enforce-rule. An enforce-rule does not become active until the **enabled** command is given.

Before you begin

- The registered and enforced service (QoS) profiles must be created on the CMTS before creating an enforce-rule that uses those profiles. If you want to manage a cable modem that currently uses a modem-created QoS profile, you must first manually create a new QoS profile on the CMTS with the same QoS parameters as the modem-created profile. Then allow the modem to come online using the manually created profile before beginning this procedure.

    - To display quality of service (QoS) profiles for a Cisco CMTS, use the show cable qos profile command in privileged EXEC mode.
    - To configure a QoS profile, use the cable qos profile command in global configuration mode. To set a particular value to its default, or to delete the profile when no specific parameters have been set, use the no form of this command.

- For monitoring of DOCSIS 1.1 cable modems:

    - Only DOCSIS 1.1 modems that register with a service class name are monitored.
    - To ensure that the DOCSIS 1.1 service flow counters remain across a reboot of the CM, configure the **cable primary-sflow-qos11 keep all** global configuration command.

- Only primary upstream and downstream service flows are supported.

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Restriction

- When configuring peak-offpeak monitoring, you can define a maximum of two peak durations within a day, and also monitoring of the remaining hours, if you configure the offpeak duration. The monitoring duration and threshold for first peak, second peak, and offpeak, can be different. However, the monitoring duration for any peak or offpeak configuration cannot be more than a day.
- The parameters defined by the named service class should always be a compatible subset of the registered set of parameters for the CM. Only certain options can be changed using a CMTS router service class, such as the **max-rate**, **priority**, or **tos-overwrite** options. The **max-burst** option in both the enforced and registered CMTS router service classes must strictly match the value for **max-burst** in the registered DOCSIS configuration file. If the service class value does not match, either the cable modem registration will fail with a reject-c state, or the enforced class will fail.

Procedure

	Command or Action	**Purpose**
Step 1	enable **Example:** Router> **enable**	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	configure terminal **Example:** Router# **configure terminal**	Enters the global configuration mode.

	Command or Action	Purpose
Step 3	**cable qos enforce-rule** *name* **Example:** `Router(config)# ` **`cable qos enforce-rule test`**	Creates an enforce-rule with the specified *name* and enters the enforce-rule configuration mode. **Note** Each enforce-rule can be created by giving it a name.
Step 4	**monitoring-basics**{**legacy** | **peak-offpeak**} {**docsis10** | **docsis11**} **Example:** `Router(enforce-rule)# ` **`monitoring-basics peak-offpeak docsis11`**	Defines the kind of monitoring desired and the type of modems to be monitored. The default is legacy and DOCSIS 1.0.

Step 5	Perform one of the following:
	
	  • If you specified DOCSIS 1.0 cable modems in Step 4, on page 10, use the following commands:
	
	    a. **qos-profile registered** *profile-id*
	
	    b. **qos-profile enforced** *profile-id* [**no-persistence**]
	
	  • If you specified DOCSIS 1.1 cable modems in Step 4, on page 10, use the **service-class** {**enforced** | **registered**} *name* command.
	
	Example:
	
	`Router(enforce-rule)# ` **`service-class enforced test`**
		• For DOCSIS 1.0 cable modems:
		
		  a. Specifies the registered quality of service (QoS) profile that should be used for this enforce-rule.
		
		    Note If you want to manage a cable modem that currently uses a modem-created QoS profile, you must first manually create a new QoS profile on the CMTS with the same QoS parameters as the modem-created profile. Then allow the modem to come online using the manually created profile before using this command.
		
		  b. Specifies the quality of service (QoS) profile that should be enforced when users violate their registered QoS profiles for DOCSIS 1.0 cable modems.
		
		• For DOCSIS 1.1 (and later) cable modems, identifies a particular service class with the specified *name* for cable modem monitoring in an enforce-rule.

Step 6	**duration** *minutes* **avg-rate** *rate* **sample-interval** *minutes*[**penalty** *minutes*] {**downstream** | **upstream**} [**enforce**] **Example:**	Specifies the time period and sample rate used for monitoring subscribers when legacy monitoring is configured (Step 4, on page 10).

	Command or Action	Purpose
	`Router(enforce-rule)# duration 10 avg-rate 500 sample-interval 10 penalty 120 downstream enforce`	

Step 7	**peak-time1** {*hour*	*hour:minutes}* **duration** *minutes* **avg-rate** *rate* [**peak-time2** {*hour*	*hour:minutes}* **duration** *minutes* **avg-rate** *rate*][**duration** *offpeak-minutes* **avg-rate** *offpeak-rate*] **sample-interval** *minutes*[**penalty** *minutes*] {**downstream**	**upstream**}[**enforce**]
				
				Example:
				
				`Router(enforce-rule)# peak-time1 6 duration 180 avg-rate 2 peak-time2 18 duration 180 avg-rate 2 duration 120 avg-rate 3 sample-interval 10 upstream enforce`
				`Router(enforce-rule)# peak-time1 6:30 duration 180 avg-rate 2 peak-time2 18:40 duration 180 avg-rate 2 duration 120 avg-rate 3 sample-interval 10 penalty 120 upstream enforce`
					Specifies peak monitoring periods when peak-offpeak monitoring is configured (Step 4, on page 10).

Step 8	**penalty-period** *minutes* [**time-of-day** {*hour*|*hour:minutes*}] [**monitoring-on**] **Example:** `Router(enforce-rule)# penalty-period 10`	(Optional) Specifies the period for which an enforced QoS profile should be in effect for subscribers who violate their registered QoS profiles.
Step 9	**enabled** **Example:** `Router(enforce-rule)# enabled`	(Optional) Activates the enforce-rule and begins subscriber traffic management.
Step 10	**end** **Example:** `Router(enforce-rule)# end`	Exits enforce-rule configuration mode and returns to privileged EXEC mode.

Examples

This section provides command-line interface (CLI) examples, including the help feature for some of the enforce-rule commands.

Example: Legacy Monitoring Configuration

The following example shows a sample configuration of an enforce-rule for legacy monitoring:

```
Router(config)# cable qos enforce-rule test
Router(enforce-rule)# monitoring-basics ?
  legacy        Enable legacy (same average rate for all day)  monitoring
  peak-offpeak  Enable peak-offpeak monitoring
Router(enforce-rule)# monitoring-basics legacy ?
  docsis10  Enforce-rule will map to docsis 1.0 modems
  docsis11  Enforce-rule will map to docsis 1.1 modems
Router(enforce-rule)# monitoring-basics legacy docsis11
Router(enforce-rule)# service-class ?
  enforced    Enforced service class
  registered  Registered service class
Router(enforce-rule)# service-class registered ?
  WORD  Registered service class name
Router(enforce-rule)# service-class registered BEUS
Router(enforce-rule)# service-class enforced test
Router(enforce-rule)# duration ?
  <10-10080>  Duration in minutes
Router(enforce-rule)# duration 10 ?
  avg-rate  Average rate for the duration in kbits/sec
Router(enforce-rule)# duration 10 avg-rate ?
  <1-4294967>  average rate in kbits/sec
Router(enforce-rule)# duration 10 avg-rate 2 ?
  sample-interval  Rate of sampling in Minutes
Router(enforce-rule)# duration 10 avg-rate 2 sample-interval ?
  <1-30>  Sampling rate in Minutes
Router(enforce-rule)# duration 10 avg-rate 2 sample-interval 10 ?
  downstream  downstream
  upstream    upstream
Router(enforce-rule)# duration 10 avg-rate 2 sample-interval 10 upstream ?
  enforce  enforce the qos-profile automatically
  <cr>
Router(enforce-rule)# duration 10 avg-rate 2 sample-interval 10 upstream enf
Router(enforce-rule)# $ avg-rate 2 sample-interval 10 upstream enforce
Router(enforce-rule)# enabled
Router(enforce-rule)# end
```

Example: Peak-offpeak Monitoring Configuration

The following example shows a sample configuration of an enforce-rule for peak-offpeak monitoring:

```
Router(config)# cable qos enforce-rule test
Router(enforce-rule)# monitoring-basics peak-offpeak
Router(enforce-rule)# monitoring-basics peak-offpeak docsis10
Router(enforce-rule)# qos-profile ?
  enforced    Enforced qos profile
  registered  QoS profile index
Router(enforce-rule)# qos-profile registered ?
  <1-255>  Registered QoS profile index
Router(enforce-rule)# qos-profile registered 5
Router(enforce-rule)# qos-profile enforced 4
Router(enforce-rule)# peak-time1 6 ?
  duration  First peak duration
Router(enforce-rule)# peak-time1 6 duration ?
  <60-1440>  Duration in minutes
Router(enforce-rule)# peak-time1 6 duration 180 ?
  avg-rate  First peak average rate in kbits/sec
Router(enforce-rule)# peak-time1 6 duration 180 avg-rate ?
  <1-4294967>  Average rate in kbits/sec
Router(enforce-rule)# peak-time1 6 duration 180 avg-rate 2 ?
  duration        Off-peak duration
```

```
            peak-time2      Second peak time
            sample-interval  Rate of sampling in minutes


Router(enforce-rule)# peak-time1 6 duration 180 avg-rate 2 peak-time2 ?
  <10-1440>  Start of second peak time
Router(enforce-rule)# peak-time1 6 duration 180 avg-rate 2 peak-time2 18 ?
  duration  Second peak duration
Router(enforce-rule)# $6 duration 180 avg-rate 2 peak-time2 18 duration ?
  <10-1440>  Duration in minutes
Router(enforce-rule)# $6 duration 180 avg-rate 2 peak-time2 18 duration 240 ?
  avg-rate  Second peak average rate in kbits/sec
Router(enforce-rule)# $ 180 avg-rate 2 peak-time2 18 duration 240 avg-rate ?
  <1-4294967>  Average rate in kbits/sec
Router(enforce-rule)# $ 180 avg-rate 2 peak-time2 18 duration 240 avg-rate 3 ?
  duration        Off-peak duration
  sample-interval  Rate of sampling in minutes
Router(enforce-rule)# $ 180 avg-rate 2 peak-time2 18 duration 240 avg-rate 3 d
Router(enforce-rule)# $-time2 18 duration 240 avg-rate 3 duration 120 ?
  avg-rate  Off-peak average rate in kbits/sec
Router(enforce-rule)# $duration 240 avg-rate 3 duration 120 avg-rate 1 ?

  sample-interval  Rate of sampling in minutes
Router(enforce-rule)# $40 avg-rate 3 duration 120 avg-rate 1 sample-interval ?
  <1-30>  Sampling rate in Minutes
Router(enforce-rule)# $e 3 duration 120 avg-rate 1 sample-interval 10 ?

  downstream  downstream
  upstream    upstream
Router(enforce-rule)# $e 3 duration 120 avg-rate 1 sample-interval 10 upstream ?
  enforce  enforce the qos-profile automatically
  <cr>
Router(enforce-rule)# $on 120 avg-rate 1 sample-interval 10 upstream enforce
Router(enforce-rule)# enabled
Router(enforce-rule)# end
```

Configuring Weekend Monitoring

This section describes the tasks required to configure weekend monitoring for STM on a Cisco CMTS router.

Prerequisites

You must first configure the weekday monitoring parameters for an enforce-rule before configuring weekend monitoring. See the Creating and Configuring an Enforce-Rule, on page 8.

Restrictions

- Up to 40 total enforce-rules across both upstream and downstream configurations are supported.
- When using SNMP for weekend monitoring, only SNMP GET and GETMANY operations are supported.

Configuring Different Legacy Monitoring Conditions for Weekends

Use the following procedure if you want to establish different legacy monitoring conditions for subscribers for either upstream or downstream traffic on weekend days.

Procedure

	Command or Action	**Purpose**
Step 1	**enable** **Example:** Router> **enable**	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# **configure terminal**	Enters global configuration mode.
Step 3	**cable qos enforce-rule** *name* **Example:** Router(config)# **cable qos enforce-rule test**	Accesses the enforce-rule with the specified *name* and enters enforce-rule configuration mode.
Step 4	**weekend duration** *minutes* **avg-rate** *rate* **sample-interval** *minutes* {**downstream** | **upstream**} [**penalty** *minutes*] [**enforce**] **Example:** Router(enforce-rule)# **weekend duration 15 avg-rate 500 sample-interval 10 penalty 120 downstream enforce**	Specifies the time period and sample rate used for monitoring subscribers on weekends.
Step 5	**end** **Example:** Router(enforce-rule)# **end**	Exits enforce-rule configuration mode and returns to privileged EXEC mode.

Configuring Different Peak-Offpeak Monitoring Conditions for Weekends

Use the following procedure if you want to establish different peak and offpeak monitoring conditions for subscribers for either upstream or downstream traffic on weekend days.

Procedure

	Command or Action	**Purpose**
Step 1	**enable** **Example:** Router> **enable**	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	Router# **configure terminal**	
Step 3	**cable qos enforce-rule** *name* **Example:** Router(config)# **cable qos enforce-rule test**	Accesses the enforce-rule with the specified *name* and enters enforce-rule configuration mode.
Step 4	**weekend peak-time1**{*hour* | *hour:minutes*} **duration** *minutes* **avg-rate** *rate* [**peak-time2** *hour* **duration** *minutes* **avg-rate** *rate*] [**duration** *offpeak-minutes* **avg-rate** *offpeak-rate*] **sample-interval** *minutes*[**penalty** *minutes*] {**downstream**| **upstream**}[**enforce**] **Example:** Router(enforce-rule)# **weekend peak-time1 9 duration 180 avg-rate 2 peak-time2 16 duration 180 avg-rate 2 duration 120 avg-rate 3 sample-interval 10 upstream enforce** **Example:** Router(enforce-rule)# **weekend peak-time1 9:30 duration 180 avg-rate 2 peak-time2 16:58 duration 180 avg-rate 2 duration 120 avg-rate 3 sample-interval 10 penalty 120 upstream enforce**	Specifies peak and offpeak monitoring times on weekends.
Step 5	**end** **Example:** Router(enforce-rule)# **end**	Exits enforce-rule configuration mode and returns to privileged EXEC mode.

Disabling Weekend Monitoring

Use the following procedure to turn off the weekend monitoring configuration and monitor on weekdays only.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> **enable**	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	Router# **configure terminal**	
Step 3	**cable qos enforce-rule** *name* **Example:** Router(config)# **cable qos enforce-rule test**	Accesses the enforce-rule with the specified *name* and enters enforce-rule configuration mode.
Step 4	**weekend off** **Example:** Router(enforce-rule)# **weekend off**	Disables monitoring on weekends.
Step 5	**end** **Example:** Router(enforce-rule)# **end**	Exits enforce-rule configuration mode and returns to privileged EXEC mode.

Removing Weekend Monitoring Conditions and Use the Same Monitoring Criteria Every Day

Use the following procedure to remove the specified weekend monitoring conditions and use the same monitoring criteria all week (including weekends).

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> **enable**	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# **configure terminal**	Enters global configuration mode.
Step 3	**cable qos enforce-rule** *name* **Example:** Router(config)# **cable qos enforce-rule test**	Accesses the enforce-rule with the specified *name* and enters enforce-rule configuration mode.
Step 4	**no weekend** **Example:** Router(enforce-rule)# **no weekend**	Performs monitoring on the weekends using the same parameters for weekdays and weekends.

	Command or Action	Purpose
Step 5	**end** **Example:** Router(enforce-rule)# **end**	Exits enforce-rule configuration mode and returns to privileged EXEC mode.

Disabling an Enforce-Rule

Use the following procedure to disable an enforce-rule. The enforce-rule remains in the CMTS configuration file, but any subscriber traffic management that uses this enforce-rule ends.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> **enable**	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# **configure terminal**	Enters global configuration mode.
Step 3	**cable qos enforce-rule***name* **Example:** Router(config)# **cable qos enforce-rule test**	Creates an enforce-rule with the specified *name* and enters enforce-rule configuration mode.
Step 4	**no enabled** **Example:** Router(enforce-rule)# **no enabled**	Disables the enforce-rule and ends subscriber traffic management for users with the rule's registered QoS profile. It moves all modems in penalty to its registered QoS.
Step 5	**end** **Example:** Router(enforce-rule)# **end**	Exits enforce-rule configuration mode and returns to privileged EXEC mode.

Removing an Enforce-Rule

Use the following procedure to delete an enforce-rule and remove it from the CMTS configuration file. Any subscriber traffic management that uses this rule also ends.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> **enable**	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# **configure terminal**	Enters global configuration mode.
Step 3	**no cable qos enforce-rule***name* **Example:** Router(config)# **no cable qos enforce-rule ef-rule**	Deletes the enforce-rule with the specified *name*. This enforce-rule and its configuration are removed from the CMTS configuration, and any subscriber traffic management that uses this rule ends.
Step 4	**end** **Example:** Router(config)# **end**	Exits global configuration mode and returns to privileged EXEC mode.

Changing a Cable Modem Service Class

Use the following procedure to change a QoS service class for a particular DOCSIS 1.1 cable modem.

☞

Restriction

- The command is supported only on DOCSIS 1.1 CM primary service flows.
- You can specify the **cable modem service-class-name** command only after the CM has been online for at least 200 seconds.
- The parameters defined by the named service class should always be a compatible subset of the registered set of parameters for the CM. Only certain options can be changed using a CMTS router service class, such as the **max-rate**, **priority**, or **tos-overwrite** options. The **max-burst** option in both the enforced and registered CMTS router service classes must strictly match the value for **max-burst** in the registered DOCSIS configuration file. If the service class value does not match, then CM registration will fail with a reject-c state, or the enforced class will fail.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> **enable**	Enables privileged EXEC mode. Enter your password if prompted.

	Command or Action	Purpose
Step 2	**cable modem** {*ip-address* | *mac-address*} **service-class-name** *name* **Example:** Router# **cable modem aaaa.bbbb.cccc service-class-name test**	Changes a QoS service class for a particular cable modem.
Step 3	**end** **Example:** Router# **end**	Exits privileged EXEC mode.

Monitoring the Subscriber Traffic Management Feature on the Cisco CMTS Routers

This section describes the following tasks that can be used to monitor the Subscriber Traffic Management feature:

Displaying the Currently Defined Enforce-Rules

To display all enforce-rules that are currently defined on the Cisco CMTS router, or the definitions for a particular enforce-rule, use the **show cable qos enforce-rule** command in privileged EXEC mode.

For offpeak monitoring, use the **show cable qos enforce-rule** command to display the monitoring duration and average-rate values applicable for that time of day. If no monitoring is taking place, 0 is displayed.

The following example shows sample output from the **show cable qos enforce-rule** command for all configured enforce-rules:

```
Router# show cable qos enforce-rule
          Name             Dur  Dir byte-cnt Auto rate   penalty Reg Enf Ena Persist
                           (min)     (kbytes) enf  (min)  (min)   QoS QoS
residential                10   us  5        act  1      10080   5   10  Yes Yes
ef-q11d                    30   ds  150      act  1      20      11  99  Yes Yes
ef-q11u                    30   us  60       act  1      20      11  99  Yes Yes
ef-q21                     720  us  60       act  1      10      21  81  Yes Yes
ef-q21d                    300  ds  150      act  1      10      21  81  Yes Yes
ef-q22                     720  us  60       act  1      10      22  82  Yes Yes
ef-q22d                    300  ds  150      act  1      10      22  82  Yes No
ef-q23                     720  us  60       act  1      10      23  83  Yes Yes
ef-q23d                    300  ds  150      act  1      10      23  83  Yes Yes
ef-q24                     720  us  60       act  1      10      24  84  Yes Yes
ef-q24d                    300  ds  150      act  1      10      24  84  Yes Yes
ef-q25                     720  us  60       act  1      10      25  85  Yes Yes
ef-q25d                    300  ds  150      act  1      10      25  85  Yes Yes
ef-q26                     720  us  60       act  1      10      26  86  Yes Yes
ef-q26d                    300  ds  150      act  1      10      26  86  Yes Yes
ef-q27                     720  us  60       act  1      10      27  87  Yes Yes
ef-q27d                    300  ds  150      act  1      10      27  87  Yes Yes
ef-q28                     720  us  60       act  1      10      28  88  Yes Yes
```

```
ef-q28d                         300  ds  150       act  1    10       28  88  Yes No
ef-q5d                          300  ds  150       act  1    10       5   99  Yes Yes
ef-q5u                          720  us  600       act  1    10       5   99  Yes Yes
```

The following example shows sample output from the **show cable qos enforce-rule** command for a particular enforce-rule named "test":

```
Router# show cable qos enforce-rule test
     Name           Type Dur  Dir Avg-rate Auto rate    Reg       Enf      En Per
                         (min)     kbits/s  enf  (min)
test               p-off 120   us 1        act  10   255          4        Y  Y
```

The following example shows the sample output from the **show cable qos enforce-rule verbose** command for an enforce-rule named "test":

```
Router# show cable qos enforce-rule test verbose
Name                         : test
Version                      : docsis11
Monitoring Type              : peak-offpeak
Registered                   : REG-DS
Enforced                     : ENF-DS
Monitoring Duration          : 70 (in minutes)
Sample-rate                  : 10 (in minutes)
Average-rate                 : 3 kbits/sec
Direction                    : downstream
Auto Enforce                 : Yes
Current Penalty Duration     : 10 (in minutes)
Default Penalty Duration     : 10 (in minutes)
Penalty End-time             : 23:0 (time of day)
Rule Enabled                 : Yes
Persistence                  : Yes
Weekend                      : No
Penalty Off                  : No
Monitor Weekend              : Yes
Monitoring after RelTime     : Off
First Peak Time              : 10:0
Duration                     : 60 (in minutes)
First Average-rate           : 1 kbits/sec
Second Peak Time             : 19:0
Duration                     : 65 (in minutes)
Second Average-rate          : 2 kbits/sec
Offpeak Duration             : 70 (in minutes)
Offpeak Average-rate         : 3 kbits/sec
Auto Enforce                 : Yes
Sample Rate                  : 10
Penalty-Period for week-days : 0
Weekend First Peak Time      : 11:0
Weekend Duration             : 75 (in minutes)
Weekend First Average-rate   : 4 kbits/sec
Weekend Second Peak Time     : 20:0
Weekend Duration             : 80 (in minutes)
Weekend Second Average-rate  : 5 kbits/sec
Weekend Offpeak Duration     : 85 (in minutes)
Weekend Offpeak Average-rate : 6 kbits/sec
Weekend Auto Enforce         : Yes
Weekend Sample Rate          : 12
Penalty-Period for week-ends : 0
router#sh clock
*17:30:50.259 UTC Mon Apr 19 2010
```

The following example shows sample output from the **show cable qos enforce-rule verbose** command for a particular enforce-rule named "test" that has specified peak-offpeak weekend monitoring options:

```
Router# show cable qos enforce-rule test verbose
Name : test
Version : docsis10
Monitoring Type : peak-offpeak
Registered : 255
Enforced : 4
Monitoring Duration : 120 (in minutes)
Sample-rate : 10 (in minutes)
Average-rate : 1 kbits/sec
Direction : upstream
Penalty Time : 10080 (in minutes)
Penalty End-time : 23 (time of day in hrs)
Rule Enabled : Yes
Persistence : Yes
Week-end : Yes
First Peak Time : 6
Duration : 180 (in minutes)
First Average-rate : 2 kbits/sec
Second Peak Time : 18
Duration : 240 (in minutes)
Second Averate-rate : 3 kbits/sec
Offpeak Duration : 120 (in minutes)
Offpeak Average-rate : 1 kbits/sec
Auto-enforce : active
Weekend First Peak Time : 8
Weekend First Duration : 120 (in minutes)
Weekend First Average-rate : 2 kbits/sec
Weekend Second Peak Time : 18
Weekend Second Duration : 180 (in minutes)
Weekend Second Average-rate : 5 kbits/sec
Weekend Offpeak Duration : 240 (in minutes)
Weekend Offpeak Average-rate : 4 kbits/sec
Weekend Auto-enforce : active
```

Displaying the Current Subscriber Usage

To display the usage for all subscribers on a cable interface, use the show cable subscriber-usage command in privileged EXEC mode without any options.

To display the usage for just those subscribers who are violating their registered quality of service (QoS) profiles, use the show cable subscriber-usage over-consume form of the command.

The following example shows sample output from the **show cable subscriber-usage** command for all users on the specified cable interface:

```
Router# show cable subscriber-usage cable 6/0/1
Sfid Mac Address    Enforce-rule Total-Kbyte   Last-detect      Last-penalty    Pen
                    Name         Count          time             time            Flag
3    0007.0e03.110d efrule-q5    121944817  Jan1  03:44:08  Jan1  03:54:08  Act
4    0007.0e03.110d efrule-q5d   1879076068 Jan1  03:35:05  Jan1  03:45:06  Act
5    0007.0e03.1431 efrule-q5    120052387  Jan1  03:44:18  Jan1  03:54:18  Act
6    0007.0e03.1431 efrule-q5d   1838493626 Jan1  03:34:55  Jan1  03:44:55  Act
7    0007.0e03.1445 efrule-q5    120919427  Jan1  03:44:08  Jan1  03:54:08  Act
8    0007.0e03.1445 efrule-q5d   1865955172 Jan1  03:35:06  Jan1  03:45:06  Act
9    0007.0e03.1225 efrule-q5    120200155  Jan1  03:44:18  Jan1  03:54:18  Act
10   0007.0e03.1225 efrule-q5d   1839681070 Jan1  03:34:55  Jan1  03:44:55  -
11   0007.0e03.0cb1 efrule-q5    122941643  Jan1  03:43:58  Jan1  03:53:58  Act
12   0007.0e03.0cb1 efrule-q5d   1889107176 Jan1  03:35:06  Jan1  03:45:06  Act
13   0007.0e03.1435 efrule-q5    119504795  Jan1  03:44:18  Jan1  03:54:18  Act
14   0007.0e03.1435 efrule-q5d   1835164034 Jan1  03:34:55  Jan1  03:44:55  -
```

By default, the display is sorted by the service flow ID (SFID). To sort the display by the subscriber byte count, with the largest byte counts listed first, use the **sort-byte-count** option. The following example shows sample output for **show cable subscriber-usage sort-byte-count** form of the command:

Note The **sort-byte-count** option was replaced by the **sort-avg-rate** option.

```
Router# show cable subscriber-usage
 sort-byte-count

Sfid Mac Address     Enforce-rule Total-Kbyte Last-detect     Last-penalty   Pen
                       Name         Count       time            time         Flag
7    0007.0e03.2cad test1          65157114    Feb24 11:36:34  Mar3  11:36:34  Act
9    0007.0e03.2c45 test1          16381014                                   -
5    0007.0e03.2c25 test1          13440960                                   -
```

Configuration Examples for Subscriber Traffic Management on the Cisco CMTS Routers

This section lists sample configurations for the Subscriber Traffic Management feature on a CMTS router:

Example: DOCSIS Configuration File and STM Service Classes

The following example shows a sample DOCSIS configuration file along with sample registered and enforced QoS service classes that you could define on a Cisco CMTS router to perform subscriber traffic management.

DOCSIS Configuration File Options

This is an example of a very basic set of options that you can configure for a cable modem in your DOCSIS configuration file that supports a successful configuration of new QoS service class options on the Cisco CMTS router.

Note There are certain QoS parameters that cannot be changed from the registered QoS parameter set and a new service class. For example, the **max-burst** value must match the originally registered in the DOCSIS configuration file, and the registered and enforced QoS service classes on the Cisco CMTS router. If the **max-burst** value differs from the registered CMTS service class and the DOCSIS configuration file, the CM might go into reject-c state, or the enforced class could fail.

The following example shows the configuration of two service classes named "BE-STM-US-1" and "BE-STM-DS-1" in a DOCSIS configuration file to define a basic set of upstream and downstream parameters:

```
03 (Net Access Control) = Yes
17 (Baseline Privacy Block)
S01 (Authorize Wait Timeout) = 10
18 (Maximum Number of CPE) = 10
24 (Upstream Service Flow Block)
S01 (Flow Reference) = 1
```

```
S04 (Service Class Name) = BE-STM-US-1
S06 (QoS Parameter Set Type) = 7
25 (Downstream Service Flow Block)
S01 (Flow Reference) = 2
S04 (Service Class Name) = BE-STM-DS-1
S06 (QoS Parameter Set Type) = 7
29 (Privacy Enable) = Yes
The following example shows sample cable service class
commands on the Cisco CMTS router for configuration of subscriber traffic management that
correspond to the service class names in the DOCSIS configuration file of "BE-STM-US-1" and
 "BE-STM-DS-1." These service classes correspond to the registered service classes configured
 by the service-class registered
 command for the QoS enforce-rules shown later in this example:
cable service class 2 name BE-STM-US-1
cable service class 2 upstream
cable service class 2 max-rate 2000000
cable service class 2 max-burst 3044
cable service class 2 max-concat-burst 8000
cable service class 3 name BE-STM-DS-1
cable service class 3 downstream
cable service class 3 max-rate 30000000
cable service class 3 max-concat-burst 8000
```

For the cable modem to achieve maximum US thoroughput, provide a large value to the max-concat-burst keyword in the cable service class command.

The following example shows sample **cable service class** commands on the Cisco CMTS router that configure new QoS parameters for identified subscribers to limit bandwidth using the **max-rate** parameter. These service classes correspond to the enforced service classes configured by the **service-class enforced** command for the QoS enforce rules shown later in this example:

```
cable service class 102 name BEUS-1
cable service class 102 upstream
cable service class 102 max-rate 48888
cable service class 102 max-burst 3044
cable service class 102 max-concat-burst 8000
cable service class 103 name BEDS-1
cable service class 103 downstream
cable service class 103 max-rate 988888
cable service class 103 max-concat-burst 8000
```

The following example shows configuration of the corresponding enforce-rules for upstream and downstream monitoring, which identifies the registered and enforced service classes:

```
cable qos enforce-rule US-1
  monitoring-basics legacy docsis11
  penalty-period 10
  service-class registered BE-STM-US-1
  service-class enforced BEUS-1
  duration 10 avg-rate 1 sample-interval 10 up enf
  enabled
!
cable qos enforce-rule DS-1
  monitoring-basics legacy docsis11
  penalty-period 10
  service-class registered BE-STM-DS-1
  service-class enforced BEDS-1
  duration 10 avg-rate 1 sample-interval 10 do enf
  enabled
```

Example: Downstream Configuration

The following example shows a typical enforce-rule configuration for traffic in the downstream direction:

```
!
cable qos enforce-rule downstream-rule
  monitoring-basics legacy docsis11
  penalty-period 10
  service-class registered class5
  service-class enforced class99
  duration 30 avg-rate 1 sample-interval 10 downstream enforce
  enabled
```

Example: Upstream Configuration

The following example shows a typical enforce-rule configuration for traffic in the upstream direction:

```
!
cable qos enforce-rule upstream-rule
  monitoring-basics legacy docsis11
  penalty-period 10
  service-class registered class5
  service-class enforced class99
  duration 30 avg-rate 1 sample-interval 10 upstream enforce
  enabled
```

Example: Downstream and Upstream Configuration

The following example shows a typical enforce-rule configuration for traffic in both the downstream and upstream directions. Two separate rules are created, using the identical configuration, except for the keywords **upstream** and **downstream** in the **duration** command.

> **Note** The enforce rules for the upstream and downstream directions can use either an identical configuration, or they can use their own individual configurations.

```
!
cable qos enforce-rule upstream-rule
  monitoring-basics legacy docsis11
  penalty-period 10
  service-class registered class5
  service-class enforced class99
  duration 30 avg-rate 5 sample-interval 10 upstream enforce
  enabled
cable qos enforce-rule downstream-rule
  monitoring-basics legacy docsis11
  penalty-period 10
  service-class registered class5
  service-class enforced class99
  duration 30 avg-rate 5 sample-interval 10 downstream enforce
  enabled
```

The following example shows an enforce-rule configuration for traffic in upstream direction. A unique penalty duration is configured for upstream, with monitoring turned on after the penalty release time.

Note For upstream direction, a unique penalty duration (120 minutes) is configured, which takes precedence over the duration configured using the penalty-period command (60 minutes). A fresh monitoring starts after the penalty release time (23:00), when all the traffic counters are reset to 0.

```
!
cable qos enforce-rule upstream_rule
  monitoring-basics peak-offpeak docsis10
  penalty-period 60 time-of-day 23:00 monitoring-on
  qos-profile registered 6
  qos-profile enforced 100
  peak-time1 10:30 duration 120 avg-rate 10 peak-time2 22:10 duration 60 avg-rate 10
sample-interval 10 penalty 120 upstream enforce
enabled
```

Example: Weekend Monitoring Configuration

The following example shows a sample configuration of peak-offpeak weekend monitoring for DOCSIS 1.0 cable modems:

```
cable qos enforce-rule monitoring
    monitoring-basics peak-offpeak docsis10
    penalty-period 60
    qos-profile registered 6
    qos-profile enforced 100
    peak-time1 10 duration 120 avg-rate 10 peak-time2 23 duration 60 avg-rate 10
sample-interval 10 upstream enforce
    weekend peak-time1 8 duration 60 avg-rate 100 peak-time2 20 duration 60 avg-rate 10000
 duration 90 avg-rate 20000 sample-interval 20 downstream enforce
    enabled
```

Additional References

For additional information related to the Subscriber Traffic Management feature, refer to the following references:

Related Documents

Related Topic	Document Title
Cable commands	Cisco IOS CMTS Cable Command Reference

Standards

Standards[2]	Title
SP-RFIv1.1-I09-020830	*Data-over-Cable Service Interface Specifications Radio Frequency Interface Specification, version 1.1* (http://www.cablemodem.com)

Standards[2]	Title
draft-ietf-ipcdn-docs-rfmibv2-06	*Radio Frequency (RF) Interface Management Information Base for DOCSIS 2.0 Compliant RF Interfaces*

[2] Not all supported standards are listed.

MIBs

MIBs[3]	MIBs Link
• CISCO-CABLE-QOS-MONITOR-MIB • DOSCIS-QOS-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

[3] Not all supported MIBs are listed.

RFCs

RFCs[4]	Title
RFC 2233	DOCSIS OSSI Objects Support
RFC 2665	DOCSIS Ethernet MIB Objects Support
RFC 2669	Cable Device MIB

[4] Not all supported RFCs are listed.

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Subscriber Traffic Management

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 Subscriber Traffic Management

Feature Name	Releases	Feature Information
Subscriber Traffic Management	Cisco IOS-XE Release 3.17.0S	This feature was introduced on the Cisco cBR Series Converged Broadband Router s.