



8-Port OC-3 STM-1 ATM Line Card for Cisco 12000 Series Internet Routers

Feature History

Release	Modification
12.0(22)S	This feature was introduced on Cisco 12000 series Internet Routers.
12.0(23)S	Software support for the 8-Port OC-3 STM-1 ATM line card was expanded to include ATM Cell Loss Priority (CLP) bit setting, ATM virtual circuit (VC) bundle management, MPLS virtual private network (VPN) Carrier supporting Carrier (CsC), MPLS VPN Inter-Autonomous Systems (Inter-AS), and 128-line input Access Control Lists (ACLs).

This feature module describes the Cisco 8-Port OC-3 STM-1 ATM line card and its use in the Cisco 12000 series Internet Routers.

This document includes information on the following sections:

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Feature Overview

The 8-Port OC-3 STM-1 ATM line card supports traffic shaping and delivers line rate OC-3/STM-1 bandwidth while performing traffic shaping and per-virtual circuit (VC) queueing. It also supports per-VC Modified Deficit Round Robin (MDRR) with per-VC low latency queueing (LLQ).

MDRR is implemented on a per-VC basis, with up to eight queues per VC. One of the queues is a low latency queue (LLQ). Both per-VC Weighted Random Early Detection (WRED) and per-VC MDRR are performed in hardware.

The 8-Port OC-3 STM-1 ATM line card provides the Cisco 12000 series product line with eight 155 Mbps ATM interfaces. The card communicates with the Cisco 12000 series product line switch fabric.

Benefits

- Traffic shaping on a per-VC and per-virtual path (VP) basis with N x 64kbps shaping granularity.
- Per-VC queueing using configurable per-VC queue limits or per-VC WRED.
- Supports up to 2048 traffic-shaped VC connections per interface.¹
- Alternatively supports up to 1024 MDRR VC connections per interface with per-VC LLQ capability.¹
- Bidirectional OC-3 line rate for 64-byte packets (2 cells) on all eight ports. This is an aggregate line rate of approximately 2.8 million packets per second.
- A VC address can be any of the virtual path identifier (VPI) (0..255) and virtual channel identifier (VCI) (0..65535) range.
- Per-VC statistics through hardware.
- Per-port statistics through hardware.
- AAL5 [I.362] [I.363] reassembly and segmentation.
- VBR-nRT traffic shaping with 99+ percent shaping accuracy.
- Unspecified bit rate (UBR) with support for optional peak cell rate (PCR) parameter with 99+ percent shaping accuracy.
- VP tunnel traffic shaping for up to 250 VP tunnels per port.
- Maximum transmission unit (MTU) of up to 9180 bytes.
- Support for 2048 simultaneous reassemblies per port with an average of 1024 bytes per reassembly.
- F4 and F5 flows of operation, administration and maintenance (OAM) cells and OAM management specified as requirements by [UNI 3.x] [I.610].
- Basic Multiprotocol Label Switching (MPLS) forwarding.
- MPLS virtual private network (VPN).
- UNI 3.x and Interim Local Management Interface (ILMI).
- Switched virtual circuit (SVC) support for point-to-point and point-to-multipoint connections.
- Multicast packet replication.
- Supports up to 56 distinct WRED profiles per interface. These profiles are configurable using Cisco IOS software.
- Support for ATM CLP bit setting.
- Support for ATM VC bundle management.
- Support for 128-line input ACLs.
- Support for MPLS VPN Inter-AS.
- Support for MPLS VPN CsC.

1. Subject to overall system configuration.

Restrictions

The following qualifications apply when you are configuring an 8-Port OC-3 STM-1 ATM line card:

- You can configure VCs using any VPI/VCI values on up to 256 VPIs per port. However, if you configure more than 256 VCs per port using sparse VCI numbers, this may restrict the configuration to fewer than the maximum of 2048 VCs per port. It is recommended that you use contiguous VCI numbers inside each VPI.
- If you configure eight traffic classes, one class must be explicitly configured as the priority class.
- You can configure either per-VC queue limits or random-detect, but not both on the same queue.

Related Features and Technologies

- Multiprotocol Label Switching (MPLS)
- Layer 3 quality-of-service (QoS)
- Weighted Random Early Detection (WRED)
- Modified Deficient Round Robin (MDRR)
- Low Latency Queueing (LLQ)

See the “[Related Documents](#)” in the next section for a list of documents that describe these features and technologies.

Related Documents

The following documents provide additional information about installing and configuring the 8-Port OC-3 STM-1 ATM line card:

- *8-Port OC-3 STM-1 ATM Line Card Installation and Configuration*
- *Release Notes for Cisco 12000 Series Routers for Cisco IOS Release 12.0 S*
- *Release Notes for Cisco IOS Release 12.0 S*
- *Cisco IOS Release 12.0 Wide-Area Networking Configuration Guide*
- *Weighted Random Early Detection on the Cisco 12000 Series Router*
- *Multiprotocol Label Switching on Cisco Routers*
- *MPLS Virtual Private Networks*
- *Modular Quality of Service Command-Line Interface*

For information on the software features added in the 12.0(23)S release, see the *Release Notes for Cisco 12000 Series Routers for Cisco IOS Release 12.0 S*. The MPLS VPN Inter-AS and CsC features are described in the release notes. The remaining three software features added in 12.0(23)S have separate feature module publications that provide additional information about these features:

- *ATM Cell Loss Priority Setting on Cisco 12000 Series 8-Port OC-3 STM-1 ATM Line Cards*
- *ATM VC Bundle Management on Cisco 12000 Series 8-Port OC-3 STM-1 ATM Line Cards*
- *128-Line Input Access Control Lists on Cisco 12000 Series 8-Port OC-3 STM-1 ATM Line Cards*

You can also find additional information in the installation and configuration guide for your Cisco 12000 series Internet Router and in the Cisco IOS Release 12.0 documentation set.

Supported Platforms

The 8-Port OC-3 STM-1 ATM line card is compatible with all Cisco 12000 series Internet Routers and Cisco 12400 series Internet Routers that are operating with Cisco IOS Release 12.0(22)S or later.

Supported Standards, MIBs, and RFCs

Standards

- AAL5 [I.362] [I.363] reassembly and segmentation
- F4 and F5 flows of OAM cells and OAM management specified as requirements by [UNI 3.X][I.610]
- Multiprotocol Encapsulation [RFC1483] with support for LLC/SNAP encapsulation and VC multiplexing, and NLPID encapsulation
- Classical IP and ARP over ATM; Client and ARP Server [RFC1577][RFC1755][RFC1626]
- Interim Local Management Interface (ILMI) [UNI 3.X]
- Default IP MTU for use over ATM AAL5 [RFC1626]
- ATM Signaling Support for IP over ATM [RFC1755]
- VBR-NRT
- UBR

MIBs

In addition to industry-standard Simple Network Management Protocol (SNMP) and other Management Information Bases (MIBs) supported on the Cisco 12000 series Internet Router, the 8-Port OC-3 STM-1 ATM line card also supports the following:

- ATM-MIB
- CISCO-AAL5-MIB
- CISCO-ATM-EXT-MIB
- IF-MIB
- SONET-MIB
- CISCO-IETF-ATM2-PVCTRAP-MIB
- MPLS-TE-MIB
- CISCO-QUEUE-MIB

To obtain lists of supported MIBs by platform and Cisco IOS software release, and to download MIB modules, go to the Cisco MIB website on Cisco.com at

<http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>.

Configuration Tasks

See the following sections for configuration tasks for the 8-Port OC-3 STM-1 ATM line card.

- [Selecting an 8-Port OC-3 STM-1 ATM Line Card Interface, page 5](#)
- [Configuring Virtual Circuits, page 5](#)
- [Configuring Interfaces, page 7](#)
- [Verifying Operation, page 9](#)

Selecting an 8-Port OC-3 STM-1 ATM Line Card Interface

The interface of the 8-Port OC-3 STM-1 ATM line card interface is referred to as “atm” in the configuration commands. An interface is created for each 8-Port OC-3 STM-1 ATM line card found in the system at reset time.

To select a specific 8-Port OC-3 STM-1 ATM line card interface, use the **interface atm slot/port.subifnum** command:

```
Router(config)# interface atm slot/port.subifnum
```

Configuring Virtual Circuits

A virtual circuit (VC) is a point-to-point connection between two ATM devices. A virtual circuit is established for each ATM end node with which the router communicates. The characteristics of the virtual circuit are established when the virtual circuit is created and include the following for the 8-Port OC-3 STM-1 ATM line card:

- Quality of service (QoS)
- ATM adaptation layer (AAL) mode (AAL5 only)
- Encapsulation type (LLC/SNAP, IP MUX, and NLPID)
- Peak and average transmission rates

Configuring Permanent Virtual Circuits

Each permanent virtual circuit (PVC) configured on the router remains active until the circuit is removed from the configuration. All virtual circuit characteristics apply to PVCs. When a PVC is configured, all configuration options are passed to the 8-Port OC-3 STM-1 ATM line card. These PVCs are written to the nonvolatile RAM (NVRAM) as part of the configuration and are used when the Cisco IOS image is reloaded.

Using PVC Configuration Commands

When you create a PVC, you create a virtual circuit descriptor (VCD) and attach it to the VPI and VCI. The VCD tells the card which VPI/VCI to use for a particular packet. The 8-Port OC-3 STM-1 ATM line card requires this feature to manage the packets for transmission. The number chosen for the VCD is independent of the VPI/VCI used.

When you create a PVC, you also specify the AAL and encapsulation. To create a PVC on an 8-Port OC-3 STM-1 ATM line card interface, use the **atm pvc** command:

```
Router(config-subif)# pvc vpi/vci
Router(config-if-atm-vc)#
```

where

- *vpi* is the ATM network VPI to use for this virtual circuit, in the range of 0 to 255.
- *vci* is the ATM network VCI to use for this virtual circuit, in the range of 0 to 65,535.

To configure the VBR-NRT QoS and specify output peak cell rate, output sustainable cell rate, and output maximum burst cell size for an ATM PVC, SVC, or VC class, use the following command:

```
Router(config-if-atm-vc)# vbr-nrt peak average [burst]
```

where

- *peak* is the maximum rate, in kbps, at which this virtual circuit can transmit data. This is a layer 2 rate in kbps of IP, ATM, and AAL5 overhead. It does not include layer 1 SONET overhead.
- *average* is the average rate, in kbps, at which this virtual circuit transmits data. This is a layer 2 rate in kbps of IP, ATM, and AAL5 overhead. It does not include layer 1 SONET overhead.
- *burst* is a value between 1 and 8192 that specifies the maximum number of ATM cells the virtual circuit can transmit to a network at the peak rate of the PVC. Other router platforms multiply the number by a factor to get the actual number of burst cells. On this platform, the factor is 1 (the burst is configured in units of 1 cell).

To configure a nondefault QoS on the PVC, use the following command:

```
Router(config-if-atm-vc)# ubr peak
```

To change the type of encapsulation, use the following command:

```
Router(config-if-atm-vc)# encapsulation {aal5mux | aal5mlpid | aal5snap}
```

To remove a PVC, use the **no** form of this command:

```
Router(config-subif)# no pvc vpi/vci
```

The following is an example of the **atm pvc** command:

```
Router(config)# interface atm 2/0.1 point-to-point
Router(config-subif)# pvc 1/128
Router(config-if-atm)# vbr-nrt 100 100 256
```

The **pvc** command creates PVC *n* and attaches the PVC to VPI and VCI.



Note

The **atm pvc** command is supported, but not recommended.

Back-to-Back 8-Port OC-3 STM-1 ATM Line Card Connection

The following is an example of the configuration of two routers, each containing an 8-Port OC-3 STM-1 ATM line card connected directly back-to-back with a standard cable. This arrangement allows you to verify the operation of the ATM port and to link the routers directly in order to build a larger node. To connect two routers, attach the cable to the ATM port on each one.

By default, the 8-Port OC-3 STM-1 ATM line card expects a connected ATM switch to provide transmit clocking.

The configuration of the first router is as follows:

```
interface ATM3/0
atm clock internal
interface atm 3/0.1 point-to-point
ip address 1.0.0.1 255.0.0.0
pvc 1/5
!
```

The configuration of the second router is as follows:

```
interface ATM3/0.1 point-to-point
ip address 1.0.0.2 255.0.0.0
pvc 1/5
!
```

Configuring Interfaces

Use the **show running-config** command to display current port configuration information. On power up, the interface on a new 8-Port OC-3 STM-1 ATM line card is shut down. To enable the interface, you must enter a **no shutdown** command in configuration mode.

Default or Initial Interface Configuration

When the 8-Port OC-3 STM-1 ATM line card is enabled (taken out of shutdown) with no additional configuration commands applied, the default interface configuration file parameters, described in [Table 1](#), are used.

Table 1 8-Port OC-3 STM-1 ATM Line Card Default Configuration Values

Parameter	Configuration File Entry	Default Value
Maximum transmission unit (MTU)	[no] <i>mtu bytes</i>	4470 bytes
Maximum numbers of virtual circuits	[no] <i>atm maxvc numvc</i>	2048
Cisco Discovery Protocol (CDP)	[no] <i>cdp enable</i>	Enabled
Loopback	[no] <i>loopback [diagnostic line]</i>	Loopback line
Internal clock	[no] <i>atm clock internal</i>	no atm clock internal
SONET framing	[no] <i>atm sonet stm-1</i>	no atm sonet stm-1

To enter a **no shutdown** command for an interface on a 8-Port OC-3 STM-1 ATM line card or to change the configuration of an interface, you must enter configuration mode by using the **configure** privileged EXEC command.

Configuring the Interface

After you verify that the new 8-Port OC-3 STM-1 ATM line card is installed correctly, use the **configure** command to configure the new interface. Be prepared with the information that you will need, such as the interface IP address.

Use the following procedure to create a basic configuration, including enabling an interface and specifying IP routing. You might also need to enter other configuration subcommands, depending on the requirements for your system configuration.

(For descriptions of configuration subcommands and the configuration options available, see the appropriate software publications in the “[Related Documents](#)” section on page 3.)

The Cisco 12000 series Internet Router identifies an interface address by its line card slot number and port number, in the format *slot/port*. Because each 8-Port OC-3 STM-1 ATM line card contains eight ATM interfaces, the port numbers are 0 to 7. For example, the slot/port address of an ATM interface on an 8-Port OC-3 STM-1 ATM line card installed in line card slot 2 is 2/0 to 2/7.

Before you can use the **configure** command, you must enter the privileged level of the EXEC command interpreter using the **enable** command. The system will prompt you for a password if one is set.

To configure an interface on the 8-Port OC-3 STM-1 ATM line card, perform the following steps:

	Command	Purpose
Step 1	Router# show version	Confirm that the system recognizes the line card.
Step 2	Router# show interfaces	Check the status of each port on the line card.
Step 3	Router# configure terminal	Enter configuration mode and specify that the console terminal will be the source of the configuration subcommands.
Step 4	Router(config)# interface atm slot/port.subifnum { point-to-point multipoint }	Specify the new ATM subinterface to configure. For example, to configure port three, subinterface 2 of an 8-Port OC-3 STM-1 ATM line card in interface processor slot 1, enter: Router(config)# interface atm 1/3.2 multipoint
Step 5	Router(config-subif)# ip address 10.1.2.3 255.255.255.255	Assign an IP address and subnet mask to the interface.
Step 6	Router(config-subif)# pvc vpi/vci	Configure a PVC. For example to configure the PVC using VPI 1 and VCI 17, enter: Router(config-if)# pvc 1/17  Note For traffic to flow successfully, PVCs must use the same VPI and VCI numbers on both sides of the line.
Step 7	Router(config-if-atm-vc)# interface atm slot/port	Change to the ATM interface. For example, to configure port 3 of an 8-Port OC-3 STM-1 ATM line card in interface processor slot 1, enter: Router(config)# interface atm 1/3
Step 8	Router(config-if)# no shutdown	Change the shutdown state to up and enable the interface.
Step 9	(Use any other configuration subcommands required to enable routing protocols and adjust the interface characteristics.)	Complete the configuration based on the unique and specific requirements of your network.
Step 10	Press Ctrl-Z to exit configuration mode.	Exit configuration mode.
Step 11	Router# copy running-config startup-config	Write the new configuration to memory.

Verifying Operation

To verify the operation of the interfaces configured on the 8-Port OC-3 STM-1 ATM line card, perform the following steps:

	Command	Purpose
Step 1	Router# show version	Displays the configuration of the system hardware, the software release, the names and sources of configuration files, and the boot images. Verify that the list includes the newly configured 8-Port OC-3 STM-1 ATM line card ports and interfaces.
Step 2	Router# show gsr	Displays information about the hardware modules installed in the Cisco 12000 series Internet Router.
Step 3	Router# show interfaces atm slot/port	Displays information about the ATM interfaces. For example, to display information about slot 2, port 0, enter: Router# show interfaces atm 2/0
Step 4	Router# show running-config	Displays information about the currently running configuration in RAM.

To display information about the current state of the ATM network and the connected virtual circuits, follow these steps:

	Command	Purpose
Step 1	Router# show atm interface atm slot/port	Displays current ATM-specification information about the 8-Port OC-3 STM-1 ATM line card interface.
Step 2	Router# show atm traffic	Displays current ATM statistics.
Step 3	Router# show atm pvc	Displays current ATM PVC information.
Step 4	Router# show atm vc	Displays current ATM VC information.

Configuration Examples

This section provides configuration examples.

Configuring Per-VC Queue Limits

In the following example, per-VC queue limits are configured on a single queue.

First, configure the policy map:

```
Router(config)# policy-map qlimit1
Router(config-pmap)# class class-default
Router(config-pmap-c)# queue-limit 576 cells
Router(config-pmap-c)# exit
Router(config-pmap)# exit
```

Then, attach the policy map to an ATM subinterface.

```
Router(config)# int atm4/0.1 point-to-point
Router(config-subif)# pvc 4/11
Router(config-if-atm-vc)# service-policy output qlimit1
```

Configuring Per-VC WRED

In the following example, simple WRED is configured on a VC without MDRR.

In this example, class-default is a special class. It is the only kind of class that can be configured without using the **bandwidth** or **priority** commands.

```
Router(config)# policy-map WRED-1
Router(config-pmap)# class class-default ! <- must use class-default for
Router(config-pmap)#                               ! per-VC WRED without per-VC MDRR
Router(config-pmap-c)# random-detect
Router(config-pmap-c)# random-detect exponential-weighting-constant 10
Router(config-pmap-c)# random-detect precedence 0 300 cells 700 cells 1
Router(config-pmap-c)# random-detect precedence 1 350 cells 800 cells 1
Router(config-pmap-c)# random-detect precedence 2 400 cells 900 cells 1
Router(config-pmap-c)# random-detect precedence 3 450 cells 1000 cells 1
Router(config-pmap-c)# random-detect precedence 4 500 cells 1100 cells 1
Router(config-pmap-c)# random-detect precedence 5 550 cells 1200 cells 1
Router(config-pmap-c)# random-detect precedence 6 600 cells 1300 cells 1
Router(config-pmap-c)# random-detect precedence 7 650 cells 1400 cells 1
```

Once the policy map has been created, configure it on the VC using the **service-policy** command:

```
Router(config-if)# exit
Router(config)# int atm1/0.1
Router(config-if)# pvc 1/1
Router(config-if-atm-vc)# service-policy output WRED-1
```

Configuring Per-VC MDRR and Low Latency Queueing

Using MDRR, the 8-Port OC-3 STM-1 ATM line card supports up to eight queues for classes of traffic per VC. One of the queues is always reserved for a special class called class-default. Up to seven of the classes are normal queues, including the class-default queue. The eighth class is always a low latency queue.

The class, `class-default`, is always configured, and it consumes one of the eight queues. If not configured explicitly, it is configured implicitly. When the `bandwidth` command is used, at least 1 percent of traffic must be reserved for the `class-default` queue. The `class-default` queue receives all IP/MPLS precedences that are not configured in another class on the same policy.

The low latency queue is also always created. All traffic sourced from the router (including ping traffic and multicast traffic) uses this queue, regardless of precedence.

Bandwidth percentages are converted into weights in units of ATM cells. The weights are internally proportioned such that the bandwidth is divided accurately between VCs.

The following are recommendations for configuring per-VC MDRR on the 8-Port OC-3 STM-1 ATM line card:

- Set bandwidth percentages in increments of 10 percent or greater (for example, 10%, 11%, 12%, and so on, not 1%, 2%, 3%,...9%). Ensure that the bandwidth percentages for nondefault classes add up to no more than 90 percent.
- Set the MTU as low as possible on each subinterface, using the `ip mtu` command, while still avoiding fragmentation. Fragmentation causes extreme performance degradation, because it is done in the slow path. Do not decrease the MTU to the point where it causes fragmentation.



Note Changing MTU settings may cause all VCs on the interface or subinterface to be torn down and set back up.

In the following example, precedence 6-7 traffic is given strict priority over all other traffic (which may cause starvation). To give precedence 4-5 traffic 50 percent of the remaining bandwidth and precedence 0-3 traffic the remaining 50 percent, follow the steps below.

First, configure three class-maps, as follows:

```
Router(config)# class-map match-any MDRR-CLASS-GOLD
Router(config-cmap)# match ip precedence 6 7
Router(config-cmap)# match mpls experimental 6 7

Router(config)# class-map match-any MDRR-CLASS-SILVER
Router(config-cmap)# match ip precedence 4 5
Router(config-cmap)# match mpls experimental 4 5

Router(config)# class-map match-any MDRR-CLASS-BRONZE
Router(config-cmap)# match ip precedence 0 1 2 3
Router(config-cmap)# match mpls experimental 0 1 2 3
```

You can also configure this example using two class-maps and then use the `class-default` to include all other traffic. It is also possible to configure more than 4 precedences in a single class; however, it requires the use of additional `match` commands.

Next, attach all three classes to a policy map. If none of the classes is a priority class, the maximum number of classes configurable, including the `class-default` class, is seven. When `class-default` is not specified, at least 1 percent must be allocated to this class.

```
Router(config)# policy-map MDRR-POLICY-1
Router(config-pmap)# class MDRR-CLASS-GOLD
Router(config-pmap-c)# priority
Router(config-pmap-c)# class MDRR-CLASS-SILVER
Router(config-pmap-c)# bandwidth remaining percent 50
Router(config-pmap-c)# class class-default
```

The class named `class-default` is attached, instead of `MDRR-CLASS-BRONZE`, to avoid having an extra class. This is the recommended way to configure a policy map for the 8-Port OC-3 STM-1 ATM line card.

**Note**

If specific values for WRED thresholds and queue limits are not required on the default queue, it is not necessary for you to configure the class-default. A default queue is always created for traffic classes that have not been included in the classes specified in the policy map.

If priority is not specified on class MDRR-CLASS-GOLD, or if bandwidth percent is specified on MDRR-CLASS-GOLD instead of *priority*, then *bandwidth percent* must be used instead of *bandwidth remaining percent* on the other classes.

After the policy map has been created, configure it on the VC using the **service-policy** command.

```
Router(config)# int atm1/0
Router(config-if)# int atm1/0.1 point-to-point
Router(config-if)# ip address 106.1.1.1 255.255.255.0
Router(config-if)# ip mtu 1500
Router(config-if)# pvc 1/1
Router(config-if-atm)# service-policy output MDRR-POLICY-1
Router(config-if-atm)# end
```

Configuring Per-VC MDRR and Low Latency Queueing with Queue Limits

In the following example, per-VC MDRR and LLQ are configured with nondefault queue limits.

First, configure three class-maps, as follows:

```
Router(config)# class-map match-any MDRR-CLASS-GOLD
Router(config-cmap)# match ip precedence 6 7
Router(config-cmap)# match mpls experimental 6 7

Router(config)# class-map match-any MDRR-CLASS-SILVER
Router(config-cmap)# match ip precedence 4 5
Router(config-cmap)# match mpls experimental 4 5

Router(config)# class-map match-any MDRR-CLASS-BRONZE
Router(config-cmap)# match ip precedence 0 1 2 3
Router(config-cmap)# match mpls experimental 0 1 2 3
```

Next, configure the policy map:

```
Router(config)# policy-map MDRRandQlimit
Router(config-pmap)# class MDRR-CLASS-GOLD
Router(config-pmap-c)# priority
Router(config-pmap-c)# class MDRR-CLASS-SILVER
Router(config-pmap-c)# bandwidth remaining percent 50
Router(config-pmap-c)# queue-limit 576 cells
Router(config-pmap-c)# class class-default
Router(config-pmap-c)# queue-limit 576 cells
```

After the policy map has been created, configure it on the VC using the **service-policy** command. You must configure an IP address on the interface or subinterface to which the VC is attached in order for the service policy to take effect.

```
Router(config)# int atm1/0.1 point-to-point
Router(config-subif)# ip address 106.1.1.1 255.255.255.0
Router(config-subif)# ip mtu 1500
Router(config-subif)# pvc 1/1
Router(config-if-atm-vc)# service-policy output MDRR-POLICY-1
Router(config-if-atm-vc)# end
```

Configuring Per-VC MDRR and Low Latency Queueing with RED and WRED

This example configures WRED and MDRR in the same policy map. WRED has different behavior when combined with MDRR, because the queue depths for WRED are calculated per class/queue.



Note

Random-detect cannot be configured on a class that has priority configured.

First, configure three class-maps, as follows:

```
Router(config)# class-map match-any COS-CLASS-GOLD
Router(config-cmap)# match ip precedence 6 7
Router(config-cmap)# match mpls experimental 6 7

Router(config)# class-map match-any COS-CLASS-SILVER
Router(config-cmap)# match ip precedence 4 5
Router(config-cmap)# match mpls experimental 4 5

Router(config)# class-map match-any COS-CLASS-BRONZE
Router(config-cmap)# match ip precedence 0 1 2 3
Router(config-cmap)# match mpls experimental 0 1 2 3
```

Attach the class map for all three classes to a policy map. If none of the classes is a priority class, the maximum number of classes configurable, including the class-default class, is seven.

```
Router(config)# policy-map WRED-MDRR-POLICY-1
Router(config-pmap)# class COS-CLASS-GOLD
Router(config-pmap-c)# priority

Router(config-pmap-c)# class COS-CLASS-SILVER
Router(config-pmap-c)# bandwidth remaining percent 50
Router(config-pmap-c)# random-detect
Router(config-pmap-c)# random-detect exponential-weighting-constant 10
Router(config-pmap-c)# random-detect precedence 4 500 cells 1100 cells 1
Router(config-pmap-c)# random-detect precedence 5 550 cells 1200 cells 1

Router(config-pmap-c)# class class-default
Router(config-pmap-c)# random-detect
Router(config-pmap-c)# random-detect exponential-weighting-constant 10
Router(config-pmap-c)# random-detect precedence 0 300 cells 700 cells 1
Router(config-pmap-c)# random-detect precedence 1 350 cells 800 cells 1
Router(config-pmap-c)# random-detect precedence 2 400 cells 900 cells 1
Router(config-pmap-c)# random-detect precedence 3 450 cells 1000 cells 1
```

After the policy map has been created, configure it on the VC using the **service-policy** command.

```
Router(config)# int atm1/0.1 point-to-point
Router(config-subif)# ip address 106.1.1.1 255.255.255.0
Router(config-subif)# ip mtu 1500
Router(config-subif)# pvc 1/1
Router(config-if-atm-vc)# service-policy output WRED-MDRR-POLICY-1
```

Verifying the Configuration

To verify that the policy map is configured correctly, use the **show policy-map** command.

```
Router# show policy-map int atm4/0.4
ATM4/0.4: VC 1/70 -

Service-policy output: WRED-MDRR-POLICY-1 (1189)

Class-map: COS-CLASS-GOLD (match-any) (1190/13)
  0 packets, 0 bytes
  5 minute offered rate 0 bps, drop rate 0 bps
  Match: ip precedence 6 7 (1192)
    0 packets, 0 bytes
    5 minute rate 0 bps
  Match: mpls experimental 6 7 (1194)
    0 packets, 0 bytes
    5 minute rate 0 bps
Class of service queue: 2
Tx Queue (PRIORITY configured)
Class-map: COS-CLASS-SILVER (match-any) (1196/14)
  0 packets, 0 bytes
  5 minute offered rate 0 bps, drop rate 0 bps
  Match: ip precedence 4 5 (1198)
    0 packets, 0 bytes
    5 minute rate 0 bps
  Match: mpls experimental 4 5 (1200)
    0 packets, 0 bytes
    5 minute rate 0 bps
Class of service queue: 1
Tx Queue (DRR configured)
bandwidth percent          Weight
      50                      94
Tx Random-detect:
Exp-weight-constant: 10 (1/1024 )
Precedence    RED Label    min          max          Mark
4              4              500         1100         1
5              5              550         1200         1

Class-map: class-default (match-any) (1203/0)
  0 packets, 0 bytes
  5 minute offered rate 0 bps, drop rate 0 bps
  Match: any (1205)
    0 packets, 0 bytes
    5 minute rate 0 bps
Class of service queue: 0
Tx Queue (DRR configured)
bandwidth percent          Weight
      0                      94
Tx Random-detect:
Exp-weight-constant: 10 (1/1024 )
Precedence    RED Label    min          max          Mark
0              0              300         700         1
1              1              350         800         1
2              2              400         900         1
3              3              450        1000         1
```

Command Reference

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

- [atm pvp, page 16](#)
- [queue-limit, page 18](#)
- [random-detect precedence, page 20](#)
- [service-policy, page 23](#)
- [show controller atm, page 25](#)
- [ubr, page 30](#)

Use the following debug commands to help troubleshoot the 8-Port OC-3 STM-1 ATM line card:

- [debug lc atm cos, page 32](#)
- [debug lc atm sar, page 34](#)

atm pvp

To create a permanent virtual path (PVP) used to multiplex (or bundle) one or more VCs into a VP tunnel, use the **atm pvp** interface configuration command. To remove a permanent virtual path, use the **no** form of this command.

```
atm pvp vpi [peak-rate [sustained-rate max-burst-size]]
```

```
no atm pvp vpi
```

Syntax Description

<i>vpi</i>	ATM network virtual path identifier (VPI) of the VC to multiplex on the permanent virtual path. The range is 0 to 255. The VPI is an 8-bit field in the header of the ATM cell. The VPI value is unique only on a single link, not throughout the ATM network, because it has local significance only. The VPI value must match that of the switch.
<i>peak-rate</i>	(Optional) Maximum rate in kbps at which the PVP can transmit data. The range is 84 kbps to line rate. The default is the line rate.
<i>sustained-rate</i>	(Optional) Average rate in kbps at which the PVP can transmit data. The range is 84 kbps to peak rate.
<i>max-burst-size</i>	(Optional) Maximum burst size in number of cells. The range is 1 to 8192. The default is 94.

Defaults

PVP is not configured.

Command Modes

Interface configuration, but not subinterface configuration

Command History

Release	Modification
11.1	This command was introduced.
12.0(22)S	The optional <i>sustained-rate</i> and <i>max-burst-rate</i> arguments were added to this command to support the 8-Port OC-3 STM-1 ATM line card on the Cisco 12000 series Internet Routers.

Usage Guidelines

All subsequently created VCs with a *vpi* matching the *vpi* specified with the **atm pvp** command are multiplexed onto this PVP. This PVP connection is an ATM connection where switching is performed on the VPI field of the cell only. A PVP is created and left up indefinitely. All VCs that are multiplexed over a PVP share and are controlled by the traffic parameters associated with the PVP.

When you create a PVP, two VCs are created (VCI 3 and 4) by default. These VCs are created for VP end-to-end loopback and segment loopback OAM support.

If the number specified for the VPI is already used by an existing VC, the command is rejected. If the number specified for this VPI is already used by a PVP, the existing PVP traffic parameter values are replaced with the newly specified values.

Hierarchical shaping is not supported on the 8-Port OC-3 STM-1 ATM line card. If a VPI is configured using the **atm pvp** command, you cannot specify UBR or VBR traffic shaping on VCs with the same VPI. For example, if you configure `atm pvp 47`, VCs that have a VPI of 47 do not support per-VC traffic shaping.

To verify the configuration of a PVP, use the **show atm vp** command.

Examples

The following example creates a permanent virtual path (VP tunnel) with a peak rate of 140000 Kbps, sustained rate of 100000 Kbps, and maximum burst size of 1 cell, along with 2 PVCs that belong to it. Traffic on the 2 PVCs will be shaped according to the parameters configured for the VP tunnel.

```
interface atm 6/0
  atm PVP 1 140000 100000 1
interface atm 6/0.1 point-to-point
ip addr 106.1.1.1 255.255.255.0
pvc 1/101
  encaps aal5snap
interface atm 6/0.2 point-to-point
ip addr 107.1.1.1 255.255.255.0
pvc 1/102
  encaps aal5snap
end
```

Related Commands

Command	Description
<code>show atm vp</code>	Displays the statistics for all VPs on an interface or for a specific VP.

queue-limit

To specify or modify the maximum number of ATM cells a queue can hold, use the **queue-limit** policy map class configuration command. To remove the queue limit from a class, use the **no** form of this command.

queue-limit *number-of-cells* **cells**

no queue-limit *number-of-cells* **cells**

Syntax Description

<i>number-of-cells</i>	Threshold in the range from 1 to 65535 specifying the maximum number of ATM cells that the queue for this class can accumulate. When the queue length reaches the threshold, all packets coming in to the queue are dropped until the queue length is lower than the threshold.
cells	For the 8-Port OC-3 STM-1 ATM line card on the Cisco 12000 series Internet Router, the queue limit threshold must be specified as a count of ATM cells.

Defaults

On the 8-Port OC-3 STM-1 ATM line card for the Cisco 12000 router, the default value is 192 cells (two default MTU-sized packets). See [Table 1](#) for the values of the default MTU.

If per-VC MDRR is configured, the default queue limit is proportional to bandwidth and MTU.

On most other platforms, the default is 64 packets.



Note

To control latency on your per-VC queue, use the following rule of thumb:
latency = queue limit/shape rate.

Command Modes

policy map class configuration

Command History

Release	Modification
12.0(5)T	This command was introduced.
12.0(5)XE	This command was integrated into Cisco IOS Release 12.0(5)XE. Support for VIP-enabled Cisco 7500 series routers was added.
12.1(5)T	This command was integrated into Cisco IOS Release 12.1(5)T. Support for VIP-enabled Cisco 7500 series routers was added.
12.0(22)S	The cells keyword was added to this command to specify the queue threshold value as a count of ATM cells, as required to support the 8-Port OC-3 STM-1 ATM line card for the Cisco 12000 series Internet Routers.

Usage Guidelines

A queue is created for every class for that uses the **bandwidth** or **priority** commands. A queue is always created for the class-default class. Packets satisfying the match criteria for a class accumulate in the queue reserved for the class until they are sent, which occurs when the queue is serviced by the MDRR process. When the queue limit you defined for the class is reached, enqueueing of any further packets to the queue causes tail drop to take effect.

Examples

The following example configures a policy map called qlimit576 to contain policy for class-default. Policy for this class is set so that the queue reserved for it has a maximum packet limit of 576 cells.

```
policy-map qlimit576
  class class-default
    queue-limit 576 cells
```

Related Commands

Command	Description
bandwidth	Sets a bandwidth value for an interface.
class <i>class-name</i>	Specifies the name of the class whose policy you want to create or change, and the default class (commonly known as the class-default class) before you configure its policy.
class class-default	Specifies the default traffic class whose bandwidth is to be configured or modified.
policy-map <i>policy-name</i>	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
priority	Gives priority to a class within a policy map.
random-detect	Enables WRED.

random-detect precedence

To configure Weighted Random Early Detection (WRED) parameters for a particular IP precedence, use the **random-detect precedence** policy map class configuration command. To return the values to the default for the precedence, use the **no** form of this command.

random-detect precedence *precedence min-threshold* **cells** *max-threshold* **cells**
[*mark-prob-denominator*]

no random-detect precedence *precedence min-threshold* **cells** *max-threshold* **cells**
[*mark-prob-denominator*]

Syntax Description

<i>precedence</i>	IP precedence number. The value range is 0 to 7.
<i>min-threshold</i>	Minimum threshold in number of cells. The value range of this argument is 1 to 65535. When the average queue length reaches the minimum threshold, WRED drops all packets with the specified IP precedence.
<i>max-threshold</i>	Maximum threshold in number of cells. The value range of this argument is 1 to 65535. When the average queue length exceeds the maximum threshold, WRED drops all packets with the specified IP precedence.
cells	On the 8-Port OC-3 STM-1 ATM line card for the Cisco 12000 series Internet Router, the <i>min-threshold</i> and <i>max-threshold</i> values must be specified as a count of ATM cells.
<i>mark-prob-denominator</i>	Denominator for the fraction of packets dropped when the average queue depth is at the maximum threshold. For example, if the denominator is 512, one out of every 512 packets is dropped when the average queue is at the maximum threshold. The value range is 1 to 32768. The default is 8; one out of every eight packets is dropped at the maximum threshold.



Note

For the 8-Port OC-3 STM-1 ATM line card, the mark probability denominator is rounded to the nearest power of 2.

Defaults

For all precedences, the default *mark-prob-denominator* is 8, and the default *max-threshold* for the 8-Port OC-3 STM-1 ATM line card is 576 cells.

The default *min-threshold* depends on the precedence. The *min-threshold* for IP precedence 0 corresponds to half of the *max-threshold*. The values for the remaining precedences fall between half the *max-threshold* and the *max-threshold* at evenly spaced intervals. The *max-threshold* value must be larger than the *min-threshold* value; it cannot be less than or equal to it. The *min-threshold* and *max-threshold* values should differ by a power of two.

Table 2 lists the default minimum threshold value for each IP precedence.

Table 2 Default WRED Minimum Threshold Values

IP Precedence	Minimum Threshold Value (Fraction of Maximum Threshold Value)
	WRED
0	288 cells
1	324 cells
2	360 cells
3	396 cells
4	432 cells
5	468 cells
6	504 cells
7	540 cells

Before you can use the **random-detect precedence** command, you must first use the **random-detect command** to enable WRED.

Command Modes

policy map class configuration

Command History

Release	Modification
11.1 CC	This command was introduced.
12.0(22)S	This command was modified to support the 8-Port OC-3 STM-1 ATM line card. The keyword cells was added to distinguish between different units of measurement (packets vs. ATM cells) for the minimum and maximum thresholds. The 8-Port OC-3 STM-1 ATM line card requires that thresholds be configured in <i>cells</i> .

Usage Guidelines

When you apply a service policy containing the **random-detect** command to a VC on an 8-Port OC-3 STM-1 ATM line card, packets are given preferential treatment based on the IP precedence of the packet. Use the **random-detect precedence** command to adjust the treatment for different IP precedences.

If you want WRED to ignore the precedence when determining which packets to drop, enter this command with the same parameters for each precedence. Remember to use reasonable values for the minimum and maximum thresholds.

**Note**

The default WRED parameter values are based on the best available data. We recommend that you do not change the parameters from their default values unless you have determined that your applications would benefit from the changed values. At most, 56 unique WRED profiles can be configured per interface. (A WRED profile is the combination of min-threshold, max-threshold, mark-prob-denominator, and exponential-weighting-constant.)

The WRED feature is supported on these Cisco router platforms:

- Cisco 1600 series
- Cisco 2500 series
- Cisco 3600 series
- Cisco 4000 series (including 4500 and 4700 series)
- Cisco 7200 series
- Cisco 7500 series with RSP interface card
- Cisco 12000 series

Examples

The following example enables WRED on the interface and specifies parameters for the different IP precedences:

```
router(config)# policy-map wred1
router(config-pmap)# class class-default
router(config-pmap-c)# random-detect
router(config-pmap-c)# random-detect precedence 0 288 cells 576 cells 1
router(config-pmap-c)# random-detect precedence 1 324 cells 576 cells 1
router(config-pmap-c)# random-detect precedence 2 360 cells 576 cells 1
router(config-pmap-c)# random-detect precedence 3 396 cells 576 cells 1
router(config-pmap-c)# random-detect precedence 4 432 cells 576 cells 1
router(config-pmap-c)# random-detect precedence 5 468 cells 576 cells 1
router(config-pmap-c)# random-detect precedence 6 504 cells 576 cells 1
router(config-pmap-c)# random-detect precedence 7 540 cells 576 cells 1
router(config-pmap-c)# random-detect exponential-weighting-constant 9
router(config)# interface ATM4/7.1 point-to-point
router(config-subif)# ip address 4.7.1.1 255.255.255.0
router(config-subif)# ip mtu 1500
router(config-subif)# pvc 47/11
router(config-if-atm-vc)# service-policy out wred1
```

Related Commands

Command	Description
random-detect	Enables WRED.
random-detect exponential-weighting-constant	Configures the WRED exponential weight factor for the average queue size calculation.

service-policy

To attach a policy map to an output virtual circuit (VC), to be used as the service policy for that VC, use the **service-policy** interface configuration command. To remove a service policy from an output VC, use the **no** form of this command.

service-policy output *policy-map-name*

no service-policy output *policy-map-name*

Syntax Description

output	Attaches the specified policy map to the output VC.
<i>policy-map-name</i>	The name of a service policy map (created using the policy-map command) to be attached.

Defaults

No service policy is specified.

Command Modes

VC submode

Command History

Release	Modification
12.0(5)T	This command was introduced.
12.0(5)XE	This command was integrated into Cisco IOS Release 12.0(5)XE.
12.0(7)S	This command was integrated into Cisco IOS Release 12.0(7)S.
12.1(1)E	This command was integrated into Cisco IOS Release 12.1(1)E.
12.1(2)T	This command was integrated into Cisco IOS Release 12.1(2)T. This command was modified to enable low latency queueing (LLQ) on Frame Relay VCs.
12.0(22)S	This command was integrated into Cisco IOS Release 12.0(22)S to support the 8-Port OC-3 STM-1 ATM line card for the Cisco 12000 series Internet Routers.

Usage Guidelines

You can attach a service policy to one or more VCs on the 8-Port OC-3 STM-1 ATM line card to specify the policy map for those VCs. A VC can have, at most, one service policy attached.

The **service-policy** command is used to attach a policy map (and the associated policies) to a VC. The command is only applicable to packets going out on the VC.

Examples

The following example shows how to attach the service policy map called WRED-1 to the VC on interface ATM 1/0.1:

```
int atm1/0.1 point-to-point
 pvc 1/1
  service-policy output WRED-1
```

Related Commands	Command	Description
	class-map	Creates a class map for the specified class.
	policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
	show policy-map	Displays the configuration of all classes for a specified service policy map or all classes for all existing policy maps.
	show policy-map interface	Displays the configuration of all classes configured for the service policy on the specific PVC on the point-to-point subinterface.

show controller atm

To display the ATM-specific configuration on the line card, use the line card **show controller atm** privileged EXEC command.

```
show controller atm port# { vcconfig [vcid#] | traffic [vcid#] }
```

Syntax Description		
<i>port#</i>	The physical port on the 8-Port OC-3 STM-1 ATM line card (0–7).	
vcconfig	Displays information about the VC configuration.	
traffic	Displays statistics for a VC.	
<i>vcid</i>	Specifies a particular VC.	

Command Modes Privileged EXEC

Command History	Release	Modification
	12.0(22)S	This command was introduced.

Examples The following is sample output from the **show controller atm vcconfig** command:

```
Router#exec slot 1 show controller atm 0 vcconfig
```

```
===== Line Card (Slot 4) =====
```

```
Active VPs: 0, VCs: 4
```

VCID	VPI	VCI	ChID	Type	PCR	SCR	MBS	OutInfo	MacString
1	10	10	0104	VBR	2000	1000	256	10001910	0103014000000000AAAA0300000008000000000
3	10	12	0099	VBR	1000	500	94	10001918	0099014000000100AAAA0300000008000000000
8	10	17	00A3	UBR	0	0	94	10001921	00A3014000000000AAAA0300000008000000000
4	10	13	010F	VBR	5000	2500	94	10001948	010D014000000200AAAA0300000008000000000

The following is sample output from the **show controller atm vcconfig** command where the vcid is specified:

```
Router#exec slot 1 show controller atm 0 vcconfig 1
```

```
===== Line Card (Slot 1) =====
```

VCID	VPI	VCI	ChID	Type	PCR	SCR	MBS	OutInfo	MacString
1	1	1	010F	VBR	5000	2500	94	10001948	010D014000000200AAAA030000000800
			010D					10001948	010D014000000200AAAA030000000800
			010D					10001949	010D014000000300AAAA030000000800
			010D					1000194A	010D014000000400AAAA030000000800
			010D					1000194B	010D014000000500AAAA030000000800
			010E					1000194C	010E014000000600AAAA030000000800
			010E					1000194D	010E014000000700AAAA030000000800
			010F					1000194E	010F014000000000AAAA030000000800
			010F					1000194F	010F014000000000AAAA030000000800
								00000000	
			010D					00000000	
			010D					00000000	
			010D					00000000	
			010D					00000000	
			010E					00000000	
			010E					00000000	
			010F					00000000	
			010F					00000000	

The following is sample output from the **show controller atm traffic** command:

```
Router#exec slot 1 show controller atm 0 traffic
```

```
===== Line Card (Slot 1) =====
```

VCID	InPkts	InBytes	PktsInSW	InOams	OutPkts	OutBytes
1	0	0	0	0	0	0
3	2221086	239503824	2214417	6669	939262	101440296
8	0	0	0	0	0	0
4	0	0	0	0	0	0

SAR Counters:

tx_packets	:	939262	tx_bytes	:	101440296
tx_total_resource_errs:		1275155	tx_total_other_errs :		0
tx_wred_thresh_drops :		0	tx_wred_random_drops :		1275155
rx_packets	:	2221086	rx_bytes	:	239503824
rx_total_resource_errs:		0	rx_total_other_errs :		17475
rx_buffer_exhaust_errs:		0	rx_CRC32_errors :		0
rx_packet_abort_errs :		0	rx_trailer_len_errs :		12138
rx_mps_errors :		0	rx_reassembly_timeout:		0

The following are per-SAR counters:

sys_rx_unopen_vc_cls :		132	sys_tx_unopen_vc_cls :		0
sys_ecc_errors :		0	sys_ecc_and_addr :		0xFFFFFFFF
sys_ecc_or_addr :		0x00000000			

The following is sample output from the **show controller atm traffic** command where the vcid is specified:

```
Router#exec slot 1 slot controller atm 0 traffic 1

===== Line Card (Slot 1) =====

VCID: 1, VPI: 1, VCI: 1

Rx Total Stats:
  rx_packets      :          0  rx_bytes      :          0
  rx_resource_err :          0  rx_other_err :          0
  rx_sw_packets   :          0  rx_oam_cells :          0

Tx Stats:
COSQ #0 (ChID=010D)
  tx_packets      :          0  tx_bytes      :          0
  tx_resource_err :          0  tx_other_err   :          0
  tx_queue_depth  :          0  tx_avg_q_depth:      0.0000

COSQ #1 (ChID=010E)
  tx_packets      :          0  tx_bytes      :          0
  tx_resource_err :          0  tx_other_err   :          0
  tx_queue_depth  :          0  tx_avg_q_depth:      0.0000

COSQ #7 (ChID=010F)
  tx_packets      :          0  tx_bytes      :          0
  tx_resource_err :          0  tx_other_err   :          0
  tx_queue_depth  :          0  tx_avg_q_depth:      0.0000

Tx Total Stats:
  tx_packets      :          0  tx_bytes      :          0
  tx_resource_err :          0  tx_other_err   :          0
```

[Table 3](#) describes per-interface counters displayed by the **show controller atm** command.

Table 3 *show controller atm Per-Interface Counters*

Counter	Description
tx_packets	A 64-bit counter of the number of packets transmitted on this interface, including OAM cells. This should be approximately equal to the sum of the number of packets on all the VCs on this interface. (If traffic stops for a few seconds, these numbers should be exactly equal.)
tx_bytes	A 64-bit counter of the bytes transmitted on this interface, including OAM cells and AAL5 header encapsulations (such as AAL5SNAP). This should be approximately equal to the sum of the bytes transmitted on each of the VCs.

Table 3 *show controller atm Per-Interface Counters (continued)*

Counter	Description
tx_total_resource_errs	The total number of packets that were not transmitted due to any resource exhaustion error. This does not necessarily imply an error, because this counter includes tx_wred_thresh_drops and tx_wred_random_drops, as well as packet drops due to complete buffer exhaustion on the SAR. This should be approximately equal to the sum of the number of resource errors that occur on all the VCs.  Note Buffer exhaustion should not occur if you have not oversubscribed the queue thresholds on the interface.
tx_total_other_errs	The total number of packets that were not transmitted due to any error other than resource exhaustion, but not including "no-vc" drops. This includes malformed packets, CRC errors, and so on. This should be approximately equal to the sum of the number of tx_other_errors that occur on all the VCs on this interface.
tx_wred_thresh_drops	The total number of WRED maximum threshold drops on this interface. This counter is not available as a per-VC counter. This counter is included in the tx_total_resource_errs counter.
tx_wred_random_drops	The total number of WRED random drops on this interface. This counter is not available as a per-VC counter. This counter is included in the tx_total_resource_errs counter.
rx_packets	The total number of packets reassembled on this interface by the SAR, including OAM cells.
rx_bytes	The total number of bytes reassembled on this interface by the SAR, including AAL5 encapsulation bytes.
rx_total_resource_errs	The total number of packet reassemblies that failed due to resource exhaustion. This error should not occur if the queue thresholds are not oversubscribed. This error includes rx_buffer_exhaust_errs.
rx_total_other_errs	The total number of packet reassemblies that failed due to errors besides resource exhaustion (not including "no-vc" cells), including rx_crc32_errors, rx_packet_abort_errs, rx_trailer_len_errs, rx_mps_errors, and rx_reassembly_timeout.
rx_buffer_exhaust_errs	The total number of packet reassemblies that failed due to complete buffer exhaustion on the SAR. This error should not occur if the queue thresholds are not oversubscribed. This is included in rx_total_resource_errs.
rx_crc32_errors	The number of packet reassemblies that failed due to an invalid AAL5 CRC32 trailer. This is included in rx_total_other_errs.
rx_packet_abort_errs	The number of packet reassemblies that failed due to receiving a trailer length of 0. This is included in rx_total_other_errs.
rx_trailer_len_errs	The number of packet reassemblies that failed due to a packet whose AAL5 trailer had an invalid trailer length. This is included in rx_total_other_errs.

Table 3 *show controller atm Per-Interface Counters (continued)*

Counter	Description
rx_mps_errors	The number of packet reassemblies that failed due to a packet size greater than the maximum allowed packet size. This is included in rx_total_other_errs.
rx_reassembly_timeout	The number of packet reassemblies that failed due to timing out before receiving the last cell of a packet. This is included in rx_total_other_errs.

ubr

To select Unspecified Bit Rate (UBR) QOS and configure the output peak cell rate for an ATM PVC, SVC, or VC class, use the **ubr** command in the appropriate command mode. Use the **no** form of this command to remove the UBR parameter.

ubr *pcr*

no ubr *pcr*

Syntax Description

<i>pcr</i>	The output peak cell rate in kilobits per second (includes layer 2 ATM and AAL5 overhead, but does not include layer 1 SONET overhead).
------------	---

Defaults

UBR QOS at the maximum line rate of the physical interface.

Command Modes

Interface-ATM-VC configuration (for an ATM PVC or SVC)
VC-class configuration (for a VC class)

Command History

Release	Modification
11.3	This command was introduced.
12.0(13)S	This command was modified to support the 4-Port OC-3 STM-1 ATM line card for the Cisco 12000 series Internet Routers. Because the 4-Port OC-3 STM-1 ATM line card did not support the <i>pcr</i> parameter, that parameter was removed from this command for only the Cisco 12000 series Internet Routers.
12.0(22)S	This command was modified to support the 8-Port OC-3 STM-1 ATM line card for the Cisco 12000 series Internet Routers. The 8-Port OC-3 STM-1 ATM line card supports the output peak cell rate functionality. Because the 8-Port OC-3 STM-1 ATM line card does not support the optional <i>input-pcr</i> parameter for SVCs, that parameter does not appear in this command.

Usage Guidelines

Configure QOS parameters using the **ubr** or **vbr-nrt** command. The last command you enter will apply to the PVC or SVC you are configuring.

If the **ubr** command is not explicitly configured on an ATM PVC or SVC, the VC inherits the following default configuration (listed in order of next highest precedence):

- Configuration of any QOS command (**ubr** or **vbr-nrt**) in a VC class assigned to the PVC or SVC itself.
- Configuration of any QOS command (**ubr** or **vbr-nrt**) in a VC class assigned to the PVC's or SVC's ATM subinterface.
- Configuration of any QOS command (**ubr** or **vbr-nrt**) in a VC class assigned to the PVC's or SVC's ATM main interface.

- Global default: UBR QoS at the maximum line rate of the PVC or SVC.

Examples

The following example specifies the *pcr* for an ATM PVC to be 100,000 Kbps:

```
pvc 1/32
ubr 100000
```

The following example specifies the *pcr* for an ATM SVC to be 10,000 Kbps:

```
svc lion nsap 47.0091.81.000000.0040.0B0A.2501.ABC1.3333.3333.05
ubr 10000
```

Related Commands

Command	Description
pvc	Creates a PVC.
vbr-nrt	Configures the VBR-NRT QoS and specifies output peak cell rate, output sustainable cell rate, and output maximum burst cell size for an ATM PVC, SVC, or VC class.

debug lc atm cos

Use the **debug lc atm cos EXEC** command to display information about a VC that is using per-VC ATM class of service (COS) features. The **no** form of this command disables debugging output.

[no] **debug lc atm cos**

Command History

Release	Modification
12.0(22)S	This command was introduced to support the 8-Port OC-3 STM-1 ATM line card.

Usage Guidelines

This command displays information about the setup, teardown, and modification of a VC with per-VC WRED, per-VC MDRR, or per-VC queue limits (a PVC with a service policy attached). Use the **debug lc atm cos** command to verify mapping of precedences to per-VC MDRR queues, mapping of precedences to WRED packs, and mapping of policy maps and MDRR weights to queues. The output of this command depends on the configuration of the VC(s).

Examples

The following is sample output from the **debug lc atm cos** command:

```
Router# exec slot 1 debug lc atm cos

SLOT 4:1d19h: cos_queue_group command received: slot=4, port=7, vcid=2
SLOT 4:1d19h: no wred configured.
SLOT 4:1d19h: mdrd configured.
SLOT 4:1d19h: prec=0, red_label=7, queue=1
SLOT 4:1d19h: prec=1, red_label=7, queue=2
SLOT 4:1d19h: prec=2, red_label=7, queue=3
SLOT 4:1d19h: prec=3, red_label=7, queue=4
SLOT 4:1d19h: prec=4, red_label=7, queue=5
SLOT 4:1d19h: prec=5, red_label=7, queue=6
SLOT 4:1d19h: prec=6, red_label=7, queue=0
SLOT 4:1d19h: prec=7, red_label=7, queue=0
SLOT 4:1d19h: prec_all_config = 0, prec_all_red_label = 7
SLOT 4:1d19h: red_label=0, min=-1, max=-1, drop=65535, weight=1
SLOT 4:1d19h: red_label=1, min=-1, max=-1, drop=65535, weight=1
SLOT 4:1d19h: red_label=2, min=-1, max=-1, drop=65535, weight=1
SLOT 4:1d19h: red_label=3, min=-1, max=-1, drop=65535, weight=1
SLOT 4:1d19h: red_label=4, min=-1, max=-1, drop=65535, weight=1
SLOT 4:1d19h: red_label=5, min=-1, max=-1, drop=65535, weight=1
SLOT 4:1d19h: red_label=6, min=-1, max=-1, drop=65535, weight=1
SLOT 4:1d19h: red_label=7, min=-1, max=-1, drop=65535, weight=1
SLOT 4:1d19h: queue=0, weight=122, qlimit=262144, no priority
SLOT 4:1d19h: queue=1, weight=113, qlimit=262144, no priority
SLOT 4:1d19h: queue=2, weight=216, qlimit=262144, no priority
SLOT 4:1d19h: queue=3, weight=103, qlimit=262144, no priority
SLOT 4:1d19h: queue=4, weight=150, qlimit=262144, no priority
SLOT 4:1d19h: queue=5, weight=94, qlimit=262144, no priority
SLOT 4:1d19h: queue=6, weight=141, qlimit=262144, no priority
SLOT 4:1d19h: queue=7, weight=0, qlimit=262144, strict priority
```

This is the output for a VC that has per-VC MDRR, per-VC WRED, or queue limits configured. Each line begins with a slot number and timestamp.

The first line indicates that some form of COS is configured on the VC (either MDRR, WRED, or queue limits). The next two lines show that MDRR is configured, but WRED is not. Because WRED is not configured, this VC is using the default of queue limits with default values.

The next eight lines provide information about which queue number and RED label are matched to each precedence. This tells you which queue will receive traffic for a given precedence and what RED label will be applied to traffic for that precedence.

The next eight lines give more information about each RED label (values of -1 mean that this RED label is not used). The line that contains prec_all_config should be ignored.

The last eight lines describe the weights, queue limits, and priority of each queue. The weight is the number of consecutive ATM cells that are transmitted from a given queue before transmitting any cells from the other queues on this VC.

The qlimit is the maximum number of ATM cells that are allowed to queue up before tail-dropping packets destined to this queue. If this value is 262144, it is ignored and the default queue limit is applied to this queue. Also, if WRED is applied to this queue, the queue limit will be ignored. Notice that queue 7 has a weight of 0. This is because this is the priority or low latency queue. It is always allowed to empty its queue whenever it gets a turn.

debug lc atm sar

Use the **debug lc atm sar** EXEC command if you are experiencing problems with your line card.. The **no** form of this command disables debugging output.

[no] **debug lc atm sar**

Command History

Release	Modification
12.0(22)S	This command was introduced to support the 8-Port OC-3 STM-1 ATM line card.

Usage Guidelines

Under normal conditions, this does not give any output. If you experience problems with your line card, turn this debug on and provide any output to your technical support representative. To use this command, you must use the **execute-on** command, as follows:

```
exec slot 1 debug lc atm sar
```