



# Distributed Low Latency Queueing

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**Note**

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This feature was formerly called Low Latency Queueing for the Versatile Interface Processor and might be referred to as Low Latency Queueing for the Versatile Interface Processor (VIP) in some Cisco documentation.

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This feature module describes the distributed Low Latency Queueing feature. It includes information on the benefits of the new feature, supported platforms, related documents, and so forth.

This document includes the following sections:

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# Feature Overview

**Table 1**    *Feature History*

| Cisco IOS Release | Enhancement   |
|-------------------|---|
| 12.0(5)XE5        | This feature was introduced.  |
| 12.0(7)XE1        | Transmission ring limit tuning with the <b>tx-ring-limit</b> command was introduced.                                    |
| 12.0(9)S          | This feature was introduced for Release 12.0 S.   |
| 12.1(2)E          | The <i>bytes</i> argument was introduced for the <b>priority</b> command for Release 12.1 E.                            |
| 12.1(5)T          | This feature was introduced for Release 12.1 T.<br>The <b>percent</b> option for the priority command became available. |

The distributed Low Latency Queueing feature brings the ability to specify low latency behavior for a traffic class. Low Latency Queueing allows delay-sensitive data such as voice to be dequeued and sent first (before packets in other queues are dequeued), giving delay-sensitive data preferential treatment over other traffic.

The distributed Low Latency Queueing feature also introduces the ability to limit the depth of a device transmission ring. Before the introduction of distributed Low Latency Queueing, the maximum transmission ring depth was not a user-configurable parameter. Therefore, particles could accumulate on a transmission ring without limitation, which could result in unavoidable high latencies. The distributed Low Latency Queueing feature allows users to limit the number of particles that may exist on a transmission ring, effectively lowering the latency incurred by packets sitting on that transmission ring.

The **priority** command is used to allow delay-sensitive data to be dequeued and sent first. Low Latency Queueing enables use of a single priority queue within which individual classes of traffic can be placed. To enqueue class traffic to the priority queue, you configure the **priority** command for the class after you specify the named class within a policy map. The amount of bandwidth available for the priority queue can be specified either as a set amount of bandwidth in kbps or as a percentage of all available bandwidth (beginning in Cisco IOS Release 12.1(5)T).

Within a policy map, you can give one or more classes priority status. When multiple classes within a single policy map are configured as priority classes, all traffic from these classes is enqueued to the same, single, priority queue.

The **tx-ring-limit** command allows the user to specify the number of allowable particles on a transmission ring, effectively lowering the latency for that transmission ring. One packet can contain multiple particles, and a typical particle is 512 bytes in size (the size depends on the interface types. For some interface types, a typical particle size is 256 bytes). These particles can no longer accumulate on a transmission ring and cause unavoidable high latencies.

## Guaranteeing Bandwidth with the `priority` Command

One method of using the **priority** command for a traffic class is to specify a bandwidth argument that gives the maximum bandwidth in kilobits per second (kbps). The other method of using the **priority** command for a traffic class, which was introduced in Cisco IOS Release 12.1(5)T, is to specify a percentage of available bandwidth to be reserved for the priority queue. The bandwidth value or percentage guarantees the configured bandwidth to the priority class under worst-case congestion scenarios. If excess bandwidth is available, the priority class will be allowed to utilize the bandwidth. If no excess bandwidth is available, the priority traffic will be constrained to the configured rate via packet drops. Each individual class that is configured to a bandwidth value will have its traffic constrained to its individual rate. When a class is constrained to its individual rate, the traffic is permitted a certain amount of burstiness because of the token bucket mechanism policing the stream. This amount of burstiness is controlled by the optional *bytes* parameter in the **priority** command (this burstiness cannot be specified when specifying a priority queue based on a percentage of available bandwidth). The *bytes* parameter specifies, in bytes, the amount of traffic allowed to pass through the token bucket as a one-time burst in excess of the token bucket drop parameters. The default burst value is 200 milliseconds of traffic at the configured token bucket drop parameters.

It is important to note that because bandwidth for the priority class is specified as a parameter to the **priority** command, you cannot also configure the **bandwidth** command for a priority class. To do so is a configuration violation that introduces confusion in relation to the amount of bandwidth to allocate.

The bandwidth allocated for a priority queue always includes the Layer 2 encapsulation header. However, it does not include other headers, such as ATM cell tax overheads. When you calculate the amount of bandwidth to allocate for a given priority class, you must account for the fact that the Layer 2 headers are included. When ATM is used, you must account for the fact that ATM cell tax overhead is not included. You must also allow bandwidth for the possibility of jitter introduced by routers in the voice path.

Consider this case that uses ATM: Suppose a voice stream of 60 bytes emitting 50 packets per second is encoded using G.729. Prior to converting the voice stream to cells, the meter for the priority queue used for the voice stream assesses the length of the packet after the Layer logical link control (LLC) headers have been added.

Given the 8-byte Layer 2 LLC header, the meter will take into account a 68-byte packet. Because ATM cells are a standard 53 bytes long, before the 68-kbps packet is emitted on the line, it is divided into two 53-byte ATM cells. Thus, the bandwidth consumed by this flow is 106 bytes per packet.

For this case, then, you must configure the bandwidth to be at least 27.2 kbps ( $68 * 50 * 8 = 27.2$  kbps). However, recall that you must also allow for the ATM cell tax overhead, which is not accounted for by the configured bandwidth. In other words, the sum of the bandwidths for all classes must be less than the interface bandwidth by at least  $(106 - 68) * 50 * 8 = 15.2$  kbps. You should also remember to allow bandwidth for router-introduced jitter.

## Benefits

### Provides Priority Service on ATM VCs and Serial Interface

The priority queueing scheme allows delay-sensitive data such as voice to be dequeued and sent first—that is, before packets in other queues are dequeued. Delay-sensitive data is given preferential treatment over other traffic. This feature provides priority queueing on ATM virtual circuits (VCs);

### Admission Control

By configuring the maximum amount of bandwidth allocated for packets belonging to a class, you can avoid starving non-priority traffic.

### Limiting Particles on a Transmission Ring

The distributed Low Latency Queueing feature also introduces particle limiting for transmission rings. Before the introduction of distributed Low Latency Queueing, the transmission ring depth was not user-configurable. Therefore, a user could experience unavoidable high latencies on a transmission ring.

The distributed Low Latency Queueing feature allows users to limit the number of particles on a transmission ring to a predefined limit, effectively lowering the latency on transmission rings.

## Restrictions

- The distributed Low Latency Queueing feature does not function properly with some of the older port adapters. The following list charts the port adapters that don't function properly with distributed Low Latency Queueing and also recommends updated versions of these port adapters that support the distributed LLQ:

**Table 2** Port Adapters that do not Support Distributed LLQ

| Port Adapter that do not Support dLLQ | Updated Port Adapter that Supports dLLQ          |
|---------------------------------------|--|
| PA-4T                                 | PA-4T+   |
| PA-H (rev. A)                         | PA-H (rev. B) or PA-2H (rev. B)                  |
| PA-2H (rev A)                         | PA-2H (rev. B)                                   |
| PA-2CT1/PRI                           | PA-MC-2T1, PA-MC-4T1, PA-MC-8T1, and PA-MC-8DSX1 |
| CT3IP                                 | PA-MC-T3, PA-MC-E3                               |

- If you use access lists to configure matching port numbers, this feature provides priority matching for all port numbers. Because voice typically exists on even port numbers, and control packets are generated on odd port numbers, control packets are also given priority when using this feature. On very slow links, giving priority to both voice and control packets may produce degraded voice quality.
- The **priority** command can be used in conjunction with the **set** command. The **priority** command cannot be used in conjunction with any other command, including the **random-detect**, **queue-limit**, and **bandwidth** commands.
- The **priority** command can be configured in multiple traffic classes. If the traffic is not constant bit rate traffic, you must configure a large enough *bandwidth-kbps* parameter to absorb the data bursts.

- Because 1 percent of the available bandwidth is reserved for the default traffic class, the sum of the percentage for the **bandwidth percent** and **priority percent** reservations cannot exceed 99 percent.
- Priority queues can be reserved by either size or percentage values, but not both, in the same policy map. Therefore, if the **priority** command is used without the **percent** option in a policy map, the **bandwidth** command, if used, must also be used without the **percent** option, and vice versa. Similarly, if the **priority percent** command is used in a policy map, the **bandwidth percent** command must be used to specify bandwidth allocation for the class, and vice versa. The **priority** and **priority percent** commands can also not be used in the same policy map. For a list of commands that cannot be used in the same class and policy maps with one another, see the following paragraphs.

The **bandwidth** and **priority** commands cannot be used in the same class map. These commands can be used together in the same policy map, however.

The following commands cannot be used in the same class or policy map with the **priority** command:

- **priority percent**
- **bandwidth percent**

The following commands cannot be used in the same class or policy map with the **priority percentage** command:

- **priority** (without the **percent** option)
- **bandwidth** (without the **percent** option)
- The **tx-ring-limit** command can only affect a variable bit rate (VBR) virtual circuit on a PA-A3 port adapter. The **tx-ring-limit** command does not affect unspecified bit rate (UBR) virtual circuits.

## Related Features and Technologies

The distributed Low Latency Queueing feature is related to the following features:

- Low Latency Queueing
- distributed Class-Based Weighted Fair Queueing (dCBWFQ)
- Class-Based Weighted Fair Queueing (CBWFQ)
- Link Fragmentation and Interleaving (LFI)
- Weighted Fair Queueing (WFQ)

## Related Documents

- *Quality of Service Solutions Configuration Guide*, Cisco IOS Release 12.0
- *Quality of Service Solutions Command Reference*, Cisco IOS Release 12.0
- *Low Latency Queueing* feature module
- *Class-Based Weighted Fair Queueing* feature module

## Supported Platforms

- Cisco 7500/RSP series with a Versatile Interface Processor

## Supported Standards, MIBs, and RFCs

### Standards

None

### MIBs

*Class-Based Quality of Service MIB*

For descriptions of supported MIBs and how to use MIBs, see the Cisco MIB web site on CCO at <http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>.

### RFCs

None

## Prerequisites

To use this feature, you should be familiar with the following:

- Access control lists
- ATM permanent virtual circuits (PVCs)
- Bandwidth management
- Class-Based Weighted Fair Queueing (CBWFQ)
- Link Fragmentation and Interleaving (LFI)
- Virtual templates and virtual access interfaces

## Configuration Tasks

See the following sections for configuration tasks for the distributed Low Latency Queueing feature. Each task in the list indicates if the task is optional or required.

- Configuring a Priority Queue for an Amount of Available Bandwidth (Required)
- Configuring a Priority Queue for a Percentage of Available Bandwidth (Required)
- Configuring a Transmission Ring Limit (Optional)
- Verifying Low Latency Queueing (Optional)
- Verifying a Transmission Ring Limit (Optional)

## Configuring a Priority Queue for an Amount of Available Bandwidth

To give priority to a class based on the amount of available bandwidth within a policy map, use the following commands in the policy map class configuration mode:

| Command   | Purpose   |
|---|---|
| Router(config)# <b>policy-map</b> <i>policy-name</i>                | Specifies the name of the policy map to configure.  |
| Router(config-pmap)# <b>class-map</b> <i>class-name</i>             | Specifies the name of a predefined class included in the service policy.                    |
| Router(config-pmap-c)# <b>priority</b> <i>kpbs</i> [ <i>bytes</i> ] | Reserves a priority queue with a specified amount of available bandwidth for CBWFQ traffic. |

The service policy configured in this section is not yet attached to an interface. This command is applied when you attach a service policy to an interface. For information on attaching a service policy to an interface, see the *Modular Quality of Service Command-Line Interface* document.

## Configuring a Priority Queue for a Percentage of Available Bandwidth

To give priority to a class based on a percentage of available bandwidth, use the following commands in policy map class configuration mode:

| Command   | Purpose   |
|---|---|
| Router(config)# <b>policy-map</b> <i>policy-name</i>          | Specifies the name of the policy map to configure.  |
| Router(config-pmap)# <b>class-map</b> <i>class-name</i>       | Specifies the name of a predefined class included in the service policy.                        |
| Router(config-pmap-c)# <b>priority percent</b> <i>percent</i> | Reserves a priority queue with a specified percentage of available bandwidth for CBWFQ traffic. |

The service policy configured in this section is not yet attached to an interface. This command is applied when you attach a service policy to an interface. For information on attaching a service policy to an interface, see the *Modular Quality of Service Command-Line Interface* document.

## Configuring a Transmission Ring Limit

To limit the number of allowable particles on a transmission ring on an ATM interface, use the following commands:

| Command   | Purpose  |
|---|--|
| Router(config)# <b>interface atm</b> <i>interface-name</i>  | Specifies the name of the ATM interface to configure.  |
| Router(config-if)# <b>atm pvc</b> <i>VCD-number VPI-number VCI-number Encapsulation-type tx-ring-limit ring-limit</i> | Specifies the ATM PVC to configure, the encapsulation type, and the transmission ring limit value. |

To limit the number of allowable particles on a transmission ring on an ATM subinterface, use the following commands:

| Command  | Purpose  |
|--|--|
| Router(config)# <b>interface atm subinterface</b> <i>name</i>    | Specifies the name of the subinterface to configure. |
| Router(config-subif)# <b>pvc</b> <i>pvc-name</i>                 | Specifies the name of the PVC to configure.          |
| Router(config-if-atm-vc)# <b>tx-ring-limit</b> <i>ring-limit</i> | Specifies the transmission ring limit value.         |

## Verifying Low Latency Queueing

To view the contents of the priority queue (such as queue depth and the first packet queued), use the following commands in EXEC mode:

| Command   | Purpose   |
|---|---|
| Router# <b>show interfaces</b> [ <i>interface-type interface-number</i> ] <b>fair-queue</b> | Displays information and statistics about weighted fair queuing for a VIP-based interface.      |
| Router# <b>show policy-map</b> <i>policy-map-name</i>                                       | Displays the contents of a policy map, including the priority setting in a specific policy map. |

The priority queue is the queue in which the conversation ID is equal to the number of dynamic queues plus 8. The packets in the priority queue have a weight of 0.

## Verifying a Transmission Ring Limit

To see the contents of the interface or the PVC, use the following command in EXEC mode:

| Command                                   | Purpose  |
|---|--|
| Router# <b>show atm vc</b> <i>vc-name</i> | Displays the contents of a virtual circuit. The <b>show atm vc</b> command output will indicate the transmission ring limit value if the <b>tx-ring-limit</b> command is successfully enabled. |

# Monitoring and Maintaining Low Latency Queueing

To tune your Real-Time Transport Protocol (RTP) bandwidth or to decrease RTP traffic if the priority queue is experiencing drops, use one or more of the following commands:

| Command   | Purpose  |
|---|--|
| Router# <b>show interfaces</b> [ <i>interface-type interface-number</i> ] <b>fair-queue</b> | Displays information and statistics about weighted fair queuing for a VIP-based interface.   |
| Router# <b>show policy-map</b> <i>policy-map-name</i>                                       | Displays the contents of a policy map, including the priority setting in a specific policy map.  |
| Router# <b>show policy interface</b> <i>interface-name</i>                                  | Displays the configuration of all classes configured for all service policies on the specified interface. Shows if packets and bytes were discarded or dropped for the priority class in the service policy attached to the interface. |
| Router# <b>show atm vc</b> <i>vc-name</i>   | Displays the contents of a virtual circuit. The <b>show atm vc</b> command output will indicate the transmission ring limit value if the <b>tx-ring-limit</b> command is successfully enabled.   |

## Configuration Examples

This section provides the following configuration examples:

- Enabling Priority Queueing for an Amount of Available Bandwidth on an ATM Subinterface
- Enabling Priority Queueing for a Percentage of Available Bandwidth on an ATM Subinterface
- Limiting the Transmission Ring Limit on an ATM Interface
- Limiting the Transmission Ring Limit on an ATM PVC Subinterface

### Enabling Priority Queueing for an Amount of Available Bandwidth on an ATM Subinterface

The **priority** command can be enabled on an ATM subinterface, and that subinterface must have only one enabled ATM PVC. This configuration provides a sufficient amount of ATM PVC support.

In the following example, a priority queue (with a guaranteed allowed bandwidth of 50 kbps) is reserved for traffic that is sent from the source address (10.10.10.10) to the destination address (10.10.10.20), in the range of ports 16384 through 20000 and 53000 through 56000.

First, the following commands configure access list 102 to match the desired voice traffic:

```
router(config)# access-list 102 permit udp host 10.10.10.10 host 10.10.10.20 range 16384 20000
router(config)# access-list 102 permit udp host 10.10.10.10 host 10.10.10.20 range 53000 56000
```

Next, the class map voice is defined, and the policy map policy1 is created; a priority queue for the class voice is reserved (with a guaranteed allowed bandwidth of 50 kbps and an allowable burst size of 60 bytes), a bandwidth of 20 kbps is configured for the class bar, and the default class is configured for flow-based fair queuing. The **service-policy** command then attaches the policy map to subinterface atm1/0.1:

```
router(config)# class-map voice
router(config-cmap)# match access-group 102

router(config)# policy-map policy1
router(config-pmap)# class voice
router(config-pmap-c)# priority 50 60
router(config-pmap)# class bar
router(config-pmap-c)# bandwidth 20
router(config-pmap)# class class-default
router(config-pmap-c)# fair-queue

router(config)# interface atm1/0.1
router(config-subif)# service-policy output policy1
```

## Enabling Priority Queueing for a Percentage of Available Bandwidth on an ATM Subinterface

The **priority percent** command can be enabled on an ATM subinterface, and that subinterface must have only one enabled ATM PVC. This configuration provides a sufficient amount of ATM PVC support.

In the following example, a priority queue (with a guaranteed allowed bandwidth percentage of 15 percent) is reserved for traffic that is sent from the source address (10.10.10.10) to the destination address (10.10.10.20), in the range of ports 16384 through 20000 and 53000 through 56000.

First, the following commands configure access list 102 to match the desired voice traffic:

```
router(config)# access-list 102 permit udp host 10.10.10.10 host 10.10.10.20 range 16384 20000
router(config)# access-list 102 permit udp host 10.10.10.10 host 10.10.10.20 range 53000 56000
```

Next, the class map voice is defined, and the policy map policy1 is created; a priority queue for the class voice is reserved (with a guaranteed allowed bandwidth percentage of 15 percent), a bandwidth percentage of 20 percent is configured for the class bar, and the default class is configured for flow-based fair queuing. The **service-policy** command then attaches the policy map to subinterface atm1/0.1:

```
router(config)# class-map voice
router(config-cmap)# match access-group 102

router(config)# policy-map policy1
router(config-pmap)# class voice
router(config-pmap-c)# priority percent 15
router(config-pmap)# class bar
router(config-pmap-c)# bandwidth percent 20
router(config-pmap)# class class-default
router(config-pmap-c)# fair-queue

router(config)# interface atm1/0.1
router(config-subif)# service-policy output policy1
```

## Limiting the Transmission Ring Limit on an ATM Interface

In the following example, the number of particles on the transmission ring of an ATM interface is limited to seven particles:

```
router(config)# interface atm 1/0/0
router(config-if)# atm pvc 32 0 32 tx-ring-limit 7
```

## Limiting the Transmission Ring Limit on an ATM PVC Subinterface

In the following example, the number of particles on the transmission ring of an ATM PVC subinterface is limited to ten particles:

```
router(config)# interface ATM1/0/0.1 point-to-point  
router(config-subif)# pvc 2/200  
router(config-if-atm-vc)# tx-ring-limit 10
```

The **tx-ring-limit** command can be applied to several ATM PVC subinterfaces on a single interface. Every individual PVC can configure a transmission ring limit.

## Command Reference

This section documents the **priority** and the **tx-ring-limit** commands. All other commands used with this feature are documented in the Cisco IOS Release 12.1 command reference publications or Cisco IOS Release 12.1 T feature module publications.

# priority

To give priority to a class of traffic belonging to a policy map, use the **priority** policy-map class configuration command. To remove a previously specified priority specified for a class, use the **no** form of this command.

```
priority {kbps | percent percent} [bytes]
```

```
no priority {kbps | percent percent} [bytes]
```

## Syntax Description

|                   |   |
|-------------------|---|
| <i>kbps</i>       | (Required, except if the <b>percent</b> option is specified) Guaranteed allowed bandwidth (in kbps) for the priority traffic. Beyond the guaranteed bandwidth, the priority traffic will be dropped in the event of congestion to ensure that the nonpriority traffic is not starved. |
| <b>percent</b>    | (Required, unless the <i>kbps</i> option is specified) Specifies that the amount of guaranteed bandwidth will be specified by the percent of available bandwidth.   |
| <i>percentage</i> | (Required if the <b>percent</b> keyword is specified) Specifies the percentage of the total available bandwidth to be set aside for the priority class.   |
| <i>bytes</i>      | (Optional) Controls the size of the burst allowed to pass through the system without being considered to exceed the configured kpbs rate.   |

## Defaults

No default behavior or values.

## Command Modes

Policy map class configuration

## Command History

| Release    | Modification  |
|------------|---|
| 12.0(5)XE5 | This command was introduced for the Versatile Interface Processor.                    |
| 12.0(9)S   | This command was introduced for the Versatile Interface Processor for Release 12.0 S. |
| 12.1(2)E   | The <i>bytes</i> argument was introduced for this command.                            |
| 12.1(5)T   | This feature was introduced for Release 12.1 T.                                       |

## Usage Guidelines

Because 1 percent of the available bandwidth is reserved for the default traffic class, the sum of the percentage for bandwidth and priority percent bandwidth reservations cannot exceed 99 percent.

This command allows users to enable low latency behavior on a per-class basis. Low latency behavior allows delay-sensitive data such as voice to be dequeued and sent first (before packets in other queues are dequeued), giving delay-sensitive data preferential treatment over other traffic.

The **priority** command allows you to set up classes based on a variety of criteria (not just UDP ports) and assign priority to them, and is available for use on serial interfaces and ATM PVCs.

The default *bytes* value, which is computed as 200 milliseconds of traffic at the configured *kpbs* rate, is used when the *bytes* argument is not specified.

The *kpbs* argument is used to specify the maximum amount of bandwidth allocated for packets belonging to a class configured with the **priority** command. The *kpbs* parameter both guarantees bandwidth to the priority class and restrains the flow of packets from the priority class in congestive scenarios.

Priority queues can be reserved by either size or percentage values, but not both, in the same policy map. Therefore, if the **priority** command is used without the **percentage** option in a policy map, the **bandwidth** command, if used, must also be used without the **percentage** option, and vice versa. Similarly, if the **priority percentage** command is used in a policy map, the **bandwidth percent** command must be used to specify bandwidth allocation for the class, and vice versa. The **priority** and **priority percent** command can also not be used in the same policy map. For a list of commands that cannot be used in the same policy map with the priority percent command, see the following paragraph.

The **bandwidth** and **priority** commands cannot be used together in the same class map. These commands can be used together in the same policy map, however.

The following commands cannot be used in the same policy map with the **priority** command:

- **priority percent**
- **bandwidth percent**

The following commands cannot be used in the same policy map with the **priority percentage** command:

- **priority** (without the **percent** option)
- **bandwidth** (without the **percent** option)

Within a policy map, you can give one or more classes priority status. When multiple classes within a single policy map are configured as priority classes, all traffic from these classes is enqueued to the same, single, priority queue.

When the device is not congested, the priority class traffic is allowed to exceed its allocated bandwidth. When the device is congested, the priority class traffic above the allocated bandwidth is discarded.

Keep the following guidelines in mind when using the **priority** command:

- Layer 2 encapsulations are accounted for in the amount of bandwidth specified with the **priority** command. However, care must be taken to configure a bandwidth that has room for cell tax overhead and possible jitter introduced by the routers in the voice path.
- The **priority** command can be used for Voice over IP (VoIP) on serial links, Frame Relay links, and ATM PVCs.
- The **priority** command can be used in conjunction with the **set** command. The **priority** command cannot be used in conjunction with any other command, including the **random-detect**, **queue-limit**, and **bandwidth** commands.

- The **priority** command can be configured in multiple classes. If the traffic is not constant bit rate (CBR), you must configure a large enough *kpbs* parameter to absorb the data bursts.

Configuring the **priority** command in multiple classes provides the ability to police the priority classes individually. For an example, refer to the following configuration:

```
policy-map policy1
  class voice1
    priority 24
  class voice2
    priority 48
  class data
    bandwidth 20
```

In this example, voice1 and voice2 classes of traffic go into the high-priority queue and get priority queueing over data traffic. However, voice1 traffic will be rate-limited to 24 kbps and voice2 traffic will be rate-limited to 48 kbps.

## Examples

The following example configures priority queueing with a guaranteed bandwidth of 50 kbps and a one-time allowable burst size of 60 bytes for the policy map policy1:

```
router(config)# policy-map policy1
router(config-pmap)# class voice
router(config-pmap-c)# priority 50 60
```

In the following example, 10 percent of the available bandwidth is reserved for class voice on interfaces that have attached the policy1 policy map:

```
router(config)# policy-map policy1
router(config-pmap)# class voice
router(config-pmap-c)# priority percent 10
```

## Related Commands

| Command   | Description   |
|---|---|
| Router# <b>show interfaces</b><br>[ <i>interface-type</i><br><i>interface-number</i> ]<br><b>fair-queue</b> | Displays information and statistics about weighted fair queuing for a VIP-based interface.      |
| <b>show policy-map</b><br><i>policy-map-name</i>  | Displays the contents of a policy map, including the priority setting of a specific policy map. |

# tx-ring-limit

To limit the number of particles that can be used on a transmission ring on the PA-A3 port adapter, use the **tx-ring-limit** command. To disable the **tx-ring-limit** command, use the **no** form of the command.

**tx-ring-limit** *ring-limit*

**no tx-ring-limit** *ring-limit*

## Syntax Description

*ring-limit* Specifies the maximum number of allowable particles that can be placed on the transmission ring.

## Defaults

No default behavior or values.

## Command Modes

ATM Interface Configuration

ATM Subinterface Configuration

## Command History

| Release    | Modification  |
|------------|---|
| 12.0(7)XE1 | This command was introduced for Cisco IOS Release 12.0(7)XE1. |
| 12.0(9)S   | This command was introduced for Cisco IOS Release 12.0 S.     |
| 12.1(5)T   | This feature was introduced for Release 12.1 T.               |

## Usage Guidelines

This command can only be used on a PA-A3 port adapter.

The transmission ring limit value is limited to values that are between 3 and 6000.

## Examples

The following example configures the transmission ring limit to seven particles on an ATM interface:

```
router(config)# interface atm 1/0/0
router(config-if)# atm pvc 32 0 32 aal5snap 10000 8000 2000 tx-ring-limit 7
```

The following example configures the transmission ring limit to ten particles on an ATM PVC subinterface:

```
router(config)# interface ATM1/0/0.1 point-to-point
router(config-subif)# pvc 2/200
router(config-if-atm-vc)# tx-ring-limit 10
```

| Related Commands | Command                  | Description  |
|------------------|--------------------------|--|
|                  | <code>show atm vc</code> | Displays the contents of a virtual circuit. The <b>show atm vc</b> command output will indicate the transmission ring limit value if the <b>tx-ring-limit</b> command is successfully enabled. |

## Glossary

**CBWFQ**—Class-Based Weighted Fair Queueing. Extends the standard WFQ functionality to provide support for user-defined traffic classes.

**Class-Based Weighted Fair Queueing**—See CBWFQ.

**LLC**—logical link control. Higher of the two data link layer sublayers defined by the IEEE. The LLC sublayer handles error control, flow control, framing, and MAC-sublayer addressing. The most prevalent LLC protocol is IEEE 802.2, which includes both connectionless and connection-oriented variants.

**logical link control**—See LLC.

**PPP**—Point-to-Point Protocol. Successor to SLIP that provides router-to-router and host-to-network connections over synchronous and asynchronous circuits. Whereas SLIP was designed to work with IP, PPP was designed to work with several network layer protocols, such as IP, IPX, and ARA. PPP also has built-in security mechanisms, such as CHAP and PAP. PPP relies on two protocols: LCP and NCP.

**Random Early Detection**—See RED.

**RED**—Random Early Detection. A congestion avoidance mechanism that takes advantage of TCP's congestion control mechanism. By randomly dropping packets prior to periods of high congestion, RED tells the packet source to decrease its transmission rate. Assuming the packet source is using TCP, it will decrease its transmission rate until all the packets reach their destination, indicating that the congestion is cleared.

**RTP**—Real-Time Transport Protocol. One of the IPv6 protocols. RTP is designed to provide end-to-end network transport functions for applications sending real-time data such as audio, video, or simulation data over multicast or unicast network services. RTP provides services such as payload type identification, sequence numbering, time-stamping, and delivery monitoring to real-time applications.

**SNA**—Systems Network Architecture. Large, complex, feature-rich network architecture developed in the 1970s by IBM. Similar in some respects to the OSI reference model, but with a number of differences.

**UDP**—User Datagram Protocol. Connectionless transport layer protocol in the TCP/IP protocol stack. UDP is a simple protocol that exchanges datagrams without acknowledgments or guaranteed delivery, requiring that error processing and retransmission be handled by other protocols. UDP is defined in RFC 768.

**weighted fair queueing**—See WFQ.

**WFQ**—weighted fair queueing. Congestion management algorithm that identifies conversations (in the form of traffic streams), separates packets that belong to each conversation, and ensures that capacity is shared fairly between these individual conversations. WFQ is an automatic way of stabilizing network behavior during congestion and results in increased performance and reduced retransmission.

