



# Multi-Level Priority Queues

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The Multi-Level Priority Queues (MPQ) feature allows you to configure multiple priority queues for multiple traffic classes by specifying a different priority level for each of the traffic classes in a single service policy map. You can configure multiple service policy maps per router. Having multiple priority queues enables the router to place delay-sensitive traffic (for example, voice) on the outbound link before delay-insensitive traffic. As a result, high-priority traffic receives the lowest latency possible on the router.

## **Finding Feature Information in This Module**

Your Cisco IOS software release may not support all of the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the “[Feature Information for Multi-Level Priority Queues](#)” section on page 10.

## **Finding Support Information for Platforms and Cisco IOS and Catalyst OS Software Images**

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## Prerequisites for Multi-Level Priority Queues

You must configure traffic classes using the **class-map** command.

## Restrictions for Multi-Level Priority Queues

- You cannot configure both the **priority** command and the **priority level** command for two different classes in the same policy map.
- You cannot specify the same priority level for two different classes in the same policy map.
- You cannot configure the default queue as a priority queue at any level. For example, the router rejects the following configuration:

```
policy-map P1
  class class-default
    priority level 1
```

- You cannot configure the **bandwidth** command and multi-level priority queuing on the same class. For example, the router rejects the following configuration:

```
policy-map P1
  class C1
    priority level 1
    bandwidth 200
```

- You cannot configure the **shape** command and multi-level priority queuing on the same class. For example, the router rejects the following configuration:

```
policy-map P1
  class C1
    priority level 1
    shape average 56000
```

- To convert a one-level (flat) service policy with multiple priority queuing configured to a hierarchical multi-level priority queuing service policy, you must first detach the flat service policy from the interface using the **no service-policy** command and then add a child policy map to it.

## Information About Multi-Level Priority Queues

To configure multi-level priority queues, you need to understand the following concepts:

- [Benefits of Multi-Level Priority Queues, page 2](#)
- [Multi-Level Priority Queues Functionality, page 3](#)

## Benefits of Multi-Level Priority Queues

The Multi-Level Priority Queues (MPQ) feature allows you to configure multiple priority queues for multiple traffic classes by specifying a different priority level for each of the traffic classes in a single service policy map. You can configure multiple service policy maps per router.

Previously, routers based on Cisco IOS software could have only one strict priority queue per policy map for all delay-sensitive traffic—the router associated all priority traffic with this one single priority queue. However, having only one priority queue can cause significant delay in delivering traffic, especially if

the router sends high-priority traffic (for example, voice) behind low-priority traffic (for example, video). Using class-based weighted fair queueing (CBWFQ) to reduce delay by heavily weighting one queue can affect the granularity of bandwidth allocations to the other queues. The MPQ feature addresses these issues and improves latency.

## Multi-Level Priority Queues Functionality

The **priority** command is used to specify that a class of traffic has latency requirements with respect to other classes. For multiple priority queues, you can use the **priority level** command to configure a level of priority service on a class in a policy map. Currently, the router supports two priority levels: level 1 (high) and level 2 (low). The router places traffic with a high-priority level on the outbound link ahead of traffic with a low-priority level. High-priority packets, therefore, are not delayed behind low-priority packets.

The router associates a single priority queue with all of the traffic enabled with the same priority level and services the high-level priority queues until empty before servicing the next-level priority queues and non-priority queues. While the router services a queue, the service rate is as fast as possible and is constrained only by the rate of the underlying link or parent node in a hierarchy. If a rate is configured and the router determines that a traffic stream has exceeded the configured rate, the router drops the exceeding packets during periods of congestion. If the link is currently not congested, the router places the exceeding packets onto the outbound link.

When configuring MPQ on different traffic classes in a policy map, you must specify different priority levels for the traffic classes. For example, configure one traffic class to have priority level 2 and another class to have level 1.

If high-priority traffic is not policed appropriately, bandwidth starvation of low-priority traffic can occur. Therefore, though not required, we recommend that you configure a policer for high-priority traffic using the **police** command. If you configure the **police** command for priority queues, the traffic rate is policed to the police rate for each of the priority queues.

You cannot configure the **priority** command and the **priority level** command on different classes in the same policy map.

## How to Configure Multi-Level Priority Queues

To configure the Multi-Level Priority Queues (MPQ) feature, perform the following tasks:

- [Configuring Multi-Level Priority Queues in a Policy Map, page 3](#) (required)
- [Verifying Multi-Level Priority Queues, page 5](#) (optional)

## Configuring Multi-Level Priority Queues in a Policy Map

To configure MPQ in a policy map, complete the following steps.

### Prerequisites

The traffic classes, class maps, and policy maps must exist. To create traffic classes, class maps, and policy maps, use the Modular Quality of Service (QoS) Command-Line Interface (CLI) (MQC). For information about using the MQC, see the “[Applying QoS Features Using the MQC](#)” module.

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-name*
4. **class** *class-name*
5. **priority level** *level*
6. **police cir** *bps*  
or
7. **police cir percent** *percent*
8. **end**

**DETAILED STEPS**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>policy-map</b> <i>policy-name</i>  <b>Example:</b> Router(config)# policy-map Premium	Creates or modifies a policy map and enters policy-map configuration mode. <ul style="list-style-type: none"> <li>• Enter the name of the policy map.</li> </ul>
<b>Step 4</b>	<b>class</b> <i>class-name</i>  <b>Example:</b> Router(config-pmap)# class business	Specifies a traffic class and enters policy-map class configuration mode. <ul style="list-style-type: none"> <li>• Enter the name of a previously configured traffic class.</li> </ul>
<b>Step 5</b>	<b>priority level</b> <i>level</i>  <b>Example:</b> Router(config-pmap-c)# priority level 2	Assigns priority to a traffic class at the priority level specified. <ul style="list-style-type: none"> <li>• Enter the level of priority assigned to the priority class. Valid values are 1 (high priority) and 2 (low priority). The default is 1.</li> </ul> <p><b>Note</b> Do not specify the same priority level for two different classes in the same policy map.</p>

	Command or Action	Purpose
Step 6	<p><code>police cir bps</code></p> <p><b>Example:</b>  Router(config-pmap-c)# <code>police cir 8000</code></p>	<p>(Optional) Configures traffic policing based on a bits per second (bps) rate.</p> <ul style="list-style-type: none"> <li>Enter the <b>cir</b> keyword and a value for the <i>bps</i> argument. Note the following: <ul style="list-style-type: none"> <li><b>cir</b> is the committed information rate and is based on the interface shape rate. This keyword indicates an average rate at which the policer meters traffic.</li> <li><i>bps</i> specifies the average rate in bits per second (bps). Valid values are from 8000 to 2488320000 bps.</li> </ul> </li> </ul>
	or	
Step 7	<p><code>police cir percent percent</code></p> <p><b>Example:</b>  Router(config-pmap-c)# <code>police cir percent 20</code></p>	<p>(Optional) Configures traffic policing based on a percentage of bandwidth available on the interface.</p> <ul style="list-style-type: none"> <li>Enter the <b>cir</b> keyword, the <b>percent</b> keyword, and a value for the <i>percent</i> argument. Note the following: <ul style="list-style-type: none"> <li><b>cir</b> is the committed information rate and is based on the interface shape rate. Indicates an average rate at which the policer meters traffic.</li> <li><b>percent percent</b> indicates to use the percentage of available bandwidth specified in <i>percent</i> to calculate the CIR. Valid values are from 1 to 100.</li> </ul> </li> </ul>
Step 8	<p><code>end</code></p> <p><b>Example:</b>  Router(config-pmap-c)# <code>end</code></p>	<p>(Optional) Exits policy-map class mode.</p>

## Verifying Multi-Level Priority Queues

To verify the configuration of multi-level priority queues and to display statistical information for each priority level, complete the following steps.

### SUMMARY STEPS

- `enable`
- `show policy-map interface type number`
- `exit`

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
Step 2	<b>show policy-map interface</b> <i>type number</i>  <b>Example:</b> Router# show policy-map interface serial4/0	Displays the packet statistics of all classes that are configured for all service policies either on the specified interface or subinterface or on a specific PVC on the interface. <ul style="list-style-type: none"> <li>Enter the interface type and number.</li> </ul>
Step 3	<b>exit</b>  <b>Example:</b> Router# exit	(Optional) Exits privileged EXEC mode.

## Configuration Examples for Multi-Level Priority Queues

This section provides the following examples:

- [Configuring Multi-Level Priority Queues: Example, page 6](#)
- [Unacceptable MPQ Configurations: Examples, page 7](#)
- [Verifying Multi-Level Priority Queues: Example, page 7](#)

### Configuring Multi-Level Priority Queues: Example

The following example shows how to configure multiple priority queues. The policy map named Business has two traffic classes: Bronze and Gold. Bronze traffic has a level 2 (low) priority, while Gold traffic has level 1 (high) priority. To prevent bandwidth starvation of Bronze traffic, the Gold traffic is policed at 30 percent of the interface bandwidth.

```
Router> enable
Router# configure terminal
Router(config)# policy-map Business
Router(config-pmap)# class Bronze
Router(config-pmap-c)# priority level 2
Router(config-pmap-c)# police cir 1000
Router(config-pmap-c)# exit
Router(config-pmap)# class Gold
Router(config-pmap-c)# priority level 1
Router(config-pmap-c)# police cir percent 30
Router(config-pmap-c)# end
```



#### Note

Although a policer is not required, configure policing for priority traffic to prevent bandwidth starvation of low priority traffic. When policing is configured, the traffic rate is policed to the police rate for each of the priority queues.

## Unacceptable MPQ Configurations: Examples

You cannot specify both the **priority** command and the **priority level** command for two different classes in the same policy map. For example, the router does not accept the following configuration:

```
Router> enable
Router# configure terminal
Router(config)# policy-map Map1
Router(config-pmap)# class Bronze
Router(config-pmap-c)# priority level 1
Router(config-pmap-c)# exit
Router(config-pmap)# class Gold
Router(config-pmap-c)# priority rate 1000
Router(config-pmap-c)# end
```

You cannot specify the same priority level for two different classes in the same policy map. For example, the router does not accept the following configuration:

```
Router> enable
Router# configure terminal
Router(config)# policy-map Map1
Router(config-pmap)# class Bronze
Router(config-pmap-c)# priority level 1
Router(config-pmap-c)# police cir percent 30
Router(config-pmap-c)# exit
Router(config-pmap)# class Gold
Router(config-pmap-c)# priority level 1
Router(config-pmap-c)# police cir 10000
Router(config-pmap-c)# end
```

## Verifying Multi-Level Priority Queues: Example

The following sample is output from the **show policy-map interface** command.

```
Router# show policy-map interface serial2/1/0

Serial2/1/0
Service-policy output: P1
Queue statistics for all priority classes:
.
.
.
Class-map: Gold (match-all)
0 packets, 0 bytes/*Updated for each priority level configured.*/
5 minute offered rate 0 bps, drop rate 0 bps
Match: ip precedence 2
Priority: 0 kbps, burst bytes 1500, b/w exceed drops: 0
Priority Level 2:
0 packets, 0 bytes
```

## Additional References

The following sections provide references related to multi-level priority queues.

## Related Documents

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	<a href="#">Cisco IOS Quality of Service Solutions Command Reference</a>
Allocating bandwidth, LLQ	“Configuring Weighted Fair Queueing” module
Priority queues	“Configuring Priority Queueing” module
Congestion management	“Congestion Management Overview” module
Creating classes, class maps, and policy maps	“Applying QoS Features Using the MQC” module

## Standards

Standard	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

## MIBs

MIB	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

## RFCs

RFC	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—



## Technical Assistance

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

## Command Reference

The following commands are introduced or modified in the feature or features documented in this module. For information about these commands, see the *Cisco IOS Quality of Service Solutions Command Reference* at [http://www.cisco.com/en/US/docs/ios/qos/command/reference/qos\\_book.html](http://www.cisco.com/en/US/docs/ios/qos/command/reference/qos_book.html). For information about all Cisco IOS commands, use the Command Lookup Tool at <http://tools.cisco.com/Support/CLILookup> or the *Cisco IOS Master Command List, All Releases*, at [http://www.cisco.com/en/US/docs/ios/mcl/allreleasemcl/all\\_book.html](http://www.cisco.com/en/US/docs/ios/mcl/allreleasemcl/all_book.html).

- **priority level**
- **show policy-map interface**

# Feature Information for Multi-Level Priority Queues

Table 1 lists the release history for this feature.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

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**Note**

Table 1 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

**Table 1** Feature Information for Multi-Level Priority Queues

Feature Name	Releases	Feature Information
Multi-Level Priority Queues	12.2(31)SB2	<p>The Multi-Level Priority Queues (MPQ) feature allows you to configure multiple priority queues for multiple traffic classes by specifying a different priority level for each of the traffic classes in a single service policy map. You can configure multiple service policy maps per router. Having multiple priority queues enables the router to place delay-sensitive traffic (for example, voice) on the outbound link before delay-insensitive traffic. As a result, high-priority traffic receives the lowest latency possible on the router.</p> <p>In Release 12.2(31)SB2, this feature was introduced on the PRE3 for the Cisco 10000 series router.</p> <p>The following commands were introduced or modified:  <b>priority level, show policy-map interface.</b></p>

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