



# Modular Quality of Service Command-Line Interface QoS

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This module contains the concepts about applying QoS features using the Modular Quality of Service (QoS) Command-Line Interface (CLI) (MQC) and the tasks for configuring the MQC. The MQC allows you to define a traffic class, create a traffic policy (policy map), and attach the traffic policy to an interface. The traffic policy contains the QoS feature that will be applied to the traffic class.

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## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

# Hardware Compatibility Matrix for Cisco cBR Series Routers


**Note**

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

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

Cisco CMTS Platform	Processor Engine	Interface Cards
Cisco cBR-8 Converged Broadband Router	<b>Cisco IOS-XE Release 3.15.0S and Later Releases</b> Cisco cBR-8 Supervisor: <ul style="list-style-type: none"> <li>• PID—CBR-CCAP-SUP-160G</li> <li>• PID—CBR-CCAP-SUP-60G<sup>1</sup></li> <li>• PID—CBR-SUP-8X10G-PIC</li> </ul>	<b>Cisco IOS-XE Release 3.15.0S and Later Releases</b> Cisco cBR-8 CCAP Line Cards: <ul style="list-style-type: none"> <li>• PID—CBR-LC-8D30-16U30</li> <li>• PID—CBR-LC-8D31-16U30</li> <li>• PID—CBR-RF-PIC</li> <li>• PID—CBR-RF-PROT-PIC</li> </ul> Cisco cBR-8 Downstream PHY Modules: <ul style="list-style-type: none"> <li>• PID—CBR-D30-DS-MOD</li> <li>• PID—CBR-D31-DS-MOD</li> </ul> Cisco cBR-8 Upstream PHY Modules: <ul style="list-style-type: none"> <li>• PID—CBR-D30-US-MOD</li> </ul>

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

## Restrictions for Applying QoS Features Using the MQC

The MQC-based QoS does not support classification of legacy Layer 2 protocol packets such as Internetwork Packet Exchange (IPX), DECnet, or AppleTalk. When these types of packets are being forwarded through a generic Layer 2 tunneling mechanism, the packets can be handled by MQC but without protocol classification. As a result, legacy protocol traffic in a Layer 2 tunnel is matched only by a "match any" class or class-default.

The number of QoS policy maps and class maps supported varies by platform and release.

**Note**

The policy map limitations do not refer to the number of applied policy map instances, only to the definition of the policy maps.

## About Applying QoS Features Using the MQC

### The MQC Structure

The MQC (Modular Quality of Service (QoS) Command-Line Interface (CLI)) enables you to set packet classification and marking based on a QoS group value. MQC CLI allows you to create traffic classes and policies, enable a QoS feature (such as packet classification), and attach these policies to interfaces.

Within the MQC, we use the **class-map** command to define a traffic class that is used to classify traffic (which is then associated with a traffic policy).

The MQC structure consists of the following three high-level steps:

- 1 Classify traffic into classes (**traffic classes**) that may receive differing treatment (i.e., define a **class-map**).
- 2 Specify the treatment to be applied to each class (i.e., define the **service-policy** or **policy-map**). A policy map contains a traffic class and one or more QoS features that will be applied to that class. The QoS features in the traffic policy determine how to treat the classified traffic.
- 3 Attach the **service-policy** to a target (physical interface, logical interface, etc.) thus defining treatment for all traffic through that target (service-policy).

A policy map also contains three major elements: a name, a traffic class to associate with one or more QoS features, and any individual **set** commands you want to use to mark the network traffic.

**Note**

The MQC supports a maximum of 256 classes in a single policy map.

The MQC structure allows you to create the traffic policy (policy map) once and then apply it to as many traffic classes as needed. You can also attach the traffic policies to as many interfaces as needed.

**Note**

(The terms *service policy*, *traffic policy* and *policy map* are often synonymous.)

### Elements of a Traffic Class

A traffic class contains three major elements: a traffic class name, a series of **match** commands, and, if more than one **match** command is used in the traffic class, instructions on how to evaluate these **match** commands.

The **match** commands are used for classifying packets. Packets are checked to determine whether they meet the criteria specified in the **match** commands; if a packet meets the specified criteria, that packet is considered a member of the class. Packets that fail to meet the matching criteria are classified as members of the default traffic class.

### Available match Commands

The table below lists *some* of the available **match** commands that can be used with the MQC. The available **match** commands vary by Cisco IOS XE release. For more information about the commands and command syntax, see the *Cisco IOS Quality of Service Solutions* Command Reference.

**Table 2: match Commands That Can Be Used with the MQC**

Command	Purpose
<b>match access-group</b>	Configures the match criteria for a class map on the basis of the specified access control list (ACL).
<b>match any</b>	Configures the match criteria for a class map to be successful match criteria for all packets.
<b>match cos</b>	Matches a packet based on a Layer 2 class of service (CoS) marking.
<b>match destination-address mac</b>	Uses the destination MAC address as a match criterion.
<b>match discard-class</b>	Matches packets of a certain discard class.
<b>match [ip] dscp</b>	Identifies a specific IP differentiated service code point (DSCP) value as a match criterion. Up to eight DSCP values can be included in one match statement.
<b>match input-interface</b>	Configures a class map to use the specified input interface as a match criterion.
<b>match ip rtp</b>	Configures a class map to use the Real-Time Transport Protocol (RTP) port as the match criterion.
<b>match mpls experimental</b>	Configures a class map to use the specified value of the Multiprotocol Label Switching (MPLS) experimental (EXP) field as a match criterion.
<b>match mpls experimental topmost</b>	Matches the MPLS EXP value in the topmost label.

Command	Purpose
<b>match not</b>	<p>Specifies the single match criterion value to use as an unsuccessful match criterion.</p> <p><b>Note</b> The <b>match not</b> command, rather than identifying the specific match parameter to use as a match criterion, is used to specify a match criterion that prevents a packet from being classified as a member of the class. For instance, if the <b>match not qos-group 6</b> command is issued while you configure the traffic class, QoS group 6 becomes the only QoS group value that is not considered a successful match criterion. All other QoS group values would be successful match criteria.</p>
<b>match packet length</b>	Specifies the Layer 3 packet length in the IP header as a match criterion in a class map.
<b>match port-type</b>	Matches traffic on the basis of the port type for a class map.
<b>match [ip] precedence</b>	Identifies IP precedence values as match criteria.
<b>match protocol</b>	<p>Configures the match criteria for a class map on the basis of the specified protocol.</p> <p><b>Note</b> A separate <b>match protocol</b> (NBAR) command is used to configure network-based application recognition (NBAR) to match traffic by a protocol type known to NBAR.</p>
<b>match protocol fasttrack</b>	Configures NBAR to match FastTrack peer-to-peer traffic.
<b>match protocol gnutella</b>	Configures NBAR to match Gnutella peer-to-peer traffic.
<b>match protocol http</b>	Configures NBAR to match Hypertext Transfer Protocol (HTTP) traffic by URL, host, Multipurpose Internet Mail Extension (MIME) type, or fields in HTTP packet headers.
<b>match protocol rtp</b>	Configures NBAR to match RTP traffic.
<b>match qos-group</b>	Identifies a specific QoS group value as a match criterion.
<b>match source-address mac</b>	Uses the source MAC address as a match criterion.

### Multiple match Commands in One Traffic Class

If the traffic class contains more than one **match** command, you need to specify how to evaluate the **match** commands. You specify this by using either the **match-any** or **match-all** keyword of the **class-map** command. Note the following points about the **match-any** and **match-all** keywords:

- If you specify the **match-any** keyword, the traffic being evaluated by the traffic class must match *one* of the specified criteria.
- If you specify the **match-all** keyword, the traffic being evaluated by the traffic class must match *all* of the specified criteria.
- If you do not specify either keyword, the traffic being evaluated by the traffic class must match *all* of the specified criteria (that is, the behavior of the **match-all** keyword is used).

## Elements of a Traffic Policy

A traffic policy contains three elements: a traffic policy name, a traffic class (specified with the **class** command), and the command used to enable the QoS feature.

The traffic policy (policy map) applies the enabled QoS feature to the traffic class once you attach the policy map to the interface (by using the **service-policy** command).



#### Note

A packet can match only *one* traffic class within a traffic policy. If a packet matches more than one traffic class in the traffic policy, the *first* traffic class defined in the policy will be used.

### Commands Used to Enable QoS Features

The commands used to enable QoS features vary by Cisco IOS XE release. The table below lists *some* of the available commands and the QoS features that they enable. For complete command syntax, see the *Cisco IOS QoS Command Reference*.

For more information about a specific QoS feature that you want to enable, see the appropriate module of the Cisco IOS XE Quality of Service Solutions Configuration Guide.

**Table 3: Commands Used to Enable QoS Features**

Command	Purpose
<b>bandwidth</b>	Configures a minimum bandwidth guarantee for a class.
<b>bandwidth remaining</b>	Configures an excess weight for a class.
<b>fair-queue</b>	Enables the flow-based queueing feature within a traffic class.
<b>drop</b>	Discards the packets in the specified traffic class.
<b>police</b>	Configures traffic policing.

Command	Purpose
<b>police (percent)</b>	Configures traffic policing on the basis of a percentage of bandwidth available on an interface.
<b>police (two rates)</b>	Configures traffic policing using two rates, the committed information rate (CIR) and the peak information rate (PIR).
<b>priority</b>	Gives priority to a class of traffic belonging to a policy map.
<b>queue-limit</b>	Specifies or modifies the maximum number of packets the queue can hold for a class configured in a policy map.
<b>random-detect</b>	Enables Weighted Random Early Detection (WRED).
<b>random-detect discard-class</b>	Configures the WRED parameters for a discard-class value for a class in a policy map.
<b>random-detect discard-class-based</b>	Configures WRED on the basis of the discard class value of a packet.
<b>random-detect exponential-weighting-constant</b>	Configures the exponential weight factor for the average queue size calculation for the queue reserved for a class.
<b>random-detect precedence</b>	Configure the WRED parameters for a particular IP Precedence for a class policy in a policy map.
<b>service-policy</b>	Specifies the name of a traffic policy used as a matching criterion (for nesting traffic policies [hierarchical traffic policies] within one another).
<b>set atm-clp</b>	Sets the cell loss priority (CLP) bit when a policy map is configured.
<b>set cos</b>	Sets the Layer 2 class of service (CoS) value of an outgoing packet.
<b>set discard-class</b>	Marks a packet with a discard-class value.
<b>set [ip] dscp</b>	Marks a packet by setting the differentiated services code point (DSCP) value in the type of service (ToS) byte.
<b>set fr-de</b>	Changes the discard eligible (DE) bit setting in the address field of a Frame Relay frame to 1 for all traffic leaving an interface.

Command	Purpose
<b>set mpls experimental</b>	Designates the value to which the MPLS bits are set if the packets match the specified policy map.
<b>set precedence</b>	Sets the precedence value in the packet header.
<b>set qos-group</b>	Sets a QoS group identifier (ID) that can be used later to classify packets.
<b>shape</b>	Shapes traffic to the indicated bit rate according to the algorithm specified.

## Nested Traffic Classes

The MQC does not necessarily require that you associate only one traffic class to one traffic policy. When packets meet more than one match criterion, multiple traffic classes can be associated with a single traffic policy.

Similarly, using the **match class-map** command, the MQC allows you to configure multiple traffic classes (also termed nested traffic classes, nested class maps, or MQC Hierarchical class maps) as a single traffic class. This command provides the only method of combining match-any and match-all characteristics within a single traffic class.

For an example, please refer to [Establishing Traffic Class as a Match Criterion \(Nested Traffic Classes\)](#), on page 16 .

## match-all and match-any Keywords of the class-map Command

One of the commands used when you create a traffic class is the **class-map** command. The command syntax for the **class-map** command includes two keywords: **match-all** and **match-any**. The **match-all** and **match-any** keywords need to be specified only if more than one match criterion is configured in the traffic class. Note the following points about these keywords:

- The **match-all** keyword is used when *all* of the match criteria in the traffic class must be met in order for a packet to be placed in the specified traffic class.
- The **match-any** keyword is used when only *one* of the match criterion in the traffic class must be met in order for a packet to be placed in the specified traffic class.
- If neither the **match-all** keyword nor **match-any** keyword is specified, the traffic class will behave in a manner consistent with the **match-all** keyword.

## input and output Keywords of the service-policy Command

As a general rule, the QoS features configured in the traffic policy can be applied to packets entering the interface or to packets leaving the interface. Therefore, when you use the **service-policy** command, you need to specify the direction of the traffic policy by using the **input** or **output** keyword.



For instance, the **service-policy output policy-map1** command would apply the QoS features in the traffic policy to the interface in the output direction. All packets leaving the interface (output) are evaluated according to the criteria specified in the traffic policy named policy-map1.

**Note**

For Cisco IOS XE Release 2.1 and later releases, queueing mechanisms are not supported in the input direction. Nonqueueing mechanisms (such as traffic policing and traffic marking) are supported in the input direction. Also, classifying traffic on the basis of the source MAC address (using the **match source-address mac** command) is supported in the input direction only.

## Benefits of Applying QoS Features Using the MQC

The MQC structure allows you to create the traffic policy (policy map) once and then apply it to as many traffic classes as needed. You can also attach the traffic policies to as many interfaces as needed.

## How to Apply QoS Features Using the MQC

### Creating a Traffic Class

To create a traffic class, use the **class-map** command to specify the traffic class name. Then use one or more **match** commands to specify the appropriate match criteria. Packets matching the criteria that you specify are placed in the traffic class. For more information about the **match-all** and **match-any** keywords of the class-map command, see the “match-all and match-any Keywords of the class-map Command” section.

**Note**

The **match cos** command is shown in Step 4. The **match cos** command is simply an example of one of the **match** commands that you can use. For information about the other available **match** commands, see the “match-all and match-any Keywords of the class-map Command” section.

#### Procedure

	Command or Action	Purpose
<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.

	Command or Action	Purpose
<b>Step 3</b>	<b>class-map</b> [ <b>match-all</b>   <b>match-any</b> ] <i>class-map-name</i>  <b>Example:</b>  <pre>Router(config)# class-map match-any class1</pre>	<p>Creates a class to be used with a class map and enters class-map configuration mode.</p> <ul style="list-style-type: none"> <li>• The class map is used for matching packets to the specified class.</li> <li>• Enter the class name.</li> </ul> <p><b>Note</b> The <b>match-all</b> keyword specifies that all match criteria must be met. The <b>match-any</b> keyword specifies that one of the match criterion must be met. Use these keywords only if you will be specifying more than one <b>match</b> command.</p>
<b>Step 4</b>	<b>match cos</b> <i>cos-number</i>  <b>Example:</b>  <pre>Router(config-cmap)# match cos 2</pre>	<p>Matches a packet on the basis of a Layer 2 class of service (CoS) number.</p> <ul style="list-style-type: none"> <li>• Enter the CoS number.</li> </ul> <p><b>Note</b> The <b>match cos</b> command is an example of the <b>match</b> commands you can use. For information about the other <b>match</b> commands that are available, see the “match-all and match-any Keywords of the class-map Command” section.</p>
<b>Step 5</b>	Enter additional match commands, if applicable; otherwise, continue with step 6.	--
<b>Step 6</b>	<b>end</b>  <b>Example:</b>  <pre>Router(config-cmap)# end</pre>	(Optional) Exits QoS class-map configuration mode and returns to privileged EXEC mode.

## Creating a Traffic Policy



### Note

The **bandwidth** command is shown in Step 5. The **bandwidth** command is an example of the commands that you can use in a policy map to enable a QoS feature (in this case, Class-based Weighted Fair Queuing (CBWFQ)). For information about other available commands, see the “Elements of a Traffic Policy” section.

## Procedure

	Command or Action	Purpose
<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 <i>policy-map-name</i></b>  <b>Example:</b> Router(config)# policy-map policy1	Creates or specifies the name of the traffic policy and enters QoS policy-map configuration mode.  <ul style="list-style-type: none"> <li>• Enter the policy map name.</li> </ul>
<b>Step 4</b>	<b>class {<i>class-name</i>   class-default}</b>  <b>Example:</b> Router(config-pmap)# class class1	Specifies the name of a traffic class and enters QoS policy-map class configuration mode.  <b>Note</b> This step associates the traffic class with the traffic policy.
<b>Step 5</b>	<b>bandwidth {<i>bandwidth-kbps</i>   percent <i>percent</i>}</b>  <b>Example:</b> Router(config-pmap-c)# bandwidth 3000	(Optional) Specifies a minimum bandwidth guarantee to a traffic class in periods of congestion.  <ul style="list-style-type: none"> <li>• A minimum bandwidth guarantee can be specified in kb/s or by a percentage of the overall available bandwidth.</li> </ul> <b>Note</b> The <b>bandwidth</b> command enables CBWFQ. The <b>bandwidth</b> command is an example of the commands that you can use in a policy map to enable a QoS feature. For information about the other commands available, see the “Elements of a Traffic Policy” section.
<b>Step 6</b>	Enter the commands for any additional QoS feature that you want to enable, if applicable; otherwise, continue with Step 7.	--
<b>Step 7</b>	<b>end</b>  <b>Example:</b> Router(config-pmap-c)# end	(Optional) Exits QoS policy-map class configuration mode and returns to privileged EXEC mode.

## Attaching a Traffic Policy to an Interface Using the MQC

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> <pre>Router&gt; enable</pre>	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> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<b>interface type number</b>  <b>Example:</b> <pre>Router(config)# interface TenGigabitEthernet 4/1/0</pre>	Configures an interface type and enters interface configuration mode. <ul style="list-style-type: none"> <li>• Enter the interface type and interface number.</li> </ul>
<b>Step 4</b>	<b>service-policy {input   output} policy-map-name</b>  <b>Example:</b> <pre>Router(config-if)# service-policy input policy1</pre>	Attaches a policy map to an interface. <ul style="list-style-type: none"> <li>• Enter either the <b>input</b> or <b>output</b> keyword and the policy map name.</li> </ul>
<b>Step 5</b>	<b>end</b>  <b>Example:</b> <pre>Router(config-if)# end</pre>	(Optional) Exits interface configuration mode and returns to privileged EXEC mode.

## Verifying the Traffic Class and Traffic Policy Information

The show commands described in this section are optional and can be entered in any order.

**Procedure**

	<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>show class-map</b>  <b>Example:</b> Router# show class-map	(Optional) Displays all class maps and their matching criteria.
<b>Step 3</b>	<b>show policy-map <i>policy-map-name</i> class <i>class-name</i></b>  <b>Example:</b> Router# show policy-map policy1 class class1	(Optional) Displays the configuration for the specified class of the specified policy map.  <ul style="list-style-type: none"> <li>• Enter the policy map name and the class name.</li> </ul>
<b>Step 4</b>	<b>show policy-map</b>  <b>Example:</b> Router# show policy-map	(Optional) Displays the configuration of all classes for all existing policy maps.
<b>Step 5</b>	<b>show policy-map interface <i>type number</i></b>  <b>Example:</b> Router# show policy-map interface TengigabitEthernet 4/1/0	(Optional) Displays the statistics and the configurations of the input and output policies that are attached to an interface.  <ul style="list-style-type: none"> <li>• Enter the interface type and number.</li> </ul>
<b>Step 6</b>	<b>exit</b>  <b>Example:</b> Router# exit	(Optional) Exits privileged EXEC mode.

# Configuration Examples for Applying QoS Features Using the MQC

## Creating a Traffic Class

In the following example, we create traffic classes and define their match criteria. For the first traffic class ([class1](#)), we use access control list (ACL) 101 as match criteria; for the second traffic class ([class2](#)), ACL 102. We check the packets against the contents of these ACLs to determine if they belong to the class.

```
class-map class1
  match access-group 101
  exit
class-map class2
  match access-group 102
  end
```

## Creating a Policy Map

In the following example, we define a traffic policy ([policy1](#)) containing the QoS features that we will apply to two classes: [class1](#) and [class2](#). The match criteria for these classes were previously defined in [Creating a Traffic Class, on page 14](#).

For class1, the policy includes a bandwidth allocation request and a maximum packet count limit for the queue reserved for that class. For class2, the policy specifies only a bandwidth allocation request.

```
policy-map policy1
  class class1
    bandwidth 3000
    queue-limit 30
    exit
  class class2
    bandwidth 2000
  end
```

## Example: Attaching a Traffic Policy to an Interface

The following example shows how to attach an existing traffic policy to an interface. After you define a traffic policy with the **policy-map** command, you can attach it to one or more interfaces by using the **service-policy** command in interface configuration mode. Although you can assign the same traffic policy to multiple interfaces, each interface can have only one traffic policy attached in the input direction and only one traffic policy attached in the output direction.

```
Router(config)# interface TengigabitEthernet 4/1/0
Router(config-if)# service-policy output policy1
Router(config-if)# exit
Router(config)# interface TengigabitEthernet 4/1/0
Router(config-if)# service-policy output policy1
Router(config-if)# end
```

## Using the match not Command

Use the **match not** command to specify a QoS policy value that is not used as a match criterion. All other values of that QoS policy become successful match criteria. For instance, if you issue the **match not qos-group 4** command in QoS class-map configuration mode, the specified class will accept all QoS group values except 4 as successful match criteria.

In the following traffic class, all protocols except IP are considered successful match criteria:

```
class-map noip
  match not protocol ip
end
```

## Configuring a Default Traffic Class

Traffic that does not meet the match criteria specified in the traffic classes (i.e., *unclassified traffic*) is treated as belonging to the default traffic class.

If you do not configure a default class, packets are still treated as members of that class. The default class has no QoS features enabled so packets belonging to this class have no QoS functionality. Such packets are placed into a first-in, first-out (FIFO) queue managed by tail drop, which is a means of avoiding congestion that treats all traffic equally and does not differentiate between classes of service. Queues fill during periods of congestion. When the output queue is full and tail drop is active, packets are dropped until the congestion is eliminated and the queue is no longer full.

The following example configures a policy map (policy1) for the default class (always called class-default) with these characteristics: 10 queues for traffic that does not meet the match criteria of other classes whose policy is defined by class policy1, and a maximum of 20 packets per queue before tail drop is enacted to handle additional queued packets.

```
policy-map policy1
  class class-default
    fair-queue
    queue-limit 20
```

In the following example, we configure a policy map (policy1) for the default class (always termed class-default) with these characteristics: 10 queues for traffic that does not meet the match criterion of other classes whose policy is defined by the traffic policy policy1.

```
policy-map policy1
  class class-default
    shape average 100m
```

## How Commands "class-map match-any" and "class-map match-all" Differ

This example shows how packets are evaluated when multiple match criteria exist. It illustrates the difference between the **class-map match-any** and **class-map match-all** commands. Packets must meet either all of the match criteria (**match-all**) or one of the match criteria (**match-any**) to be considered a member of the traffic class.

The following examples show a traffic class configured with the **class-map match-all** command:

```
class-map match-all cisco1
```

```
match protocol ip
match qos-group 4
match access-group 101
```

If a packet arrives on a router with traffic class `cisco1` configured on the interface, we assess whether it matches the IP protocol, QoS group 4, and access group 101. If all of these match criteria are met, the packet is classified as a member of the traffic class `cisco1` (a logical AND operator; Protocol IP AND QoS group 4 AND access group 101).

```
class-map match-all vlan
  match vlan 1
  match vlan inner 1
```

The following example illustrates use of the **class-map match-any** command. Only one match criterion must be met for us to classify the packet as a member of the traffic class (i.e., a logical OR operator; protocol IP OR QoS group 4 OR access group 101):

```
class-map match-any cisco2
  match protocol ip
  match qos-group 4
  match access-group 101
```

In the traffic class `cisco2`, the match criterion are evaluated consecutively until a successful match is located. The packet is first evaluated to determine whether the IP protocol can be used as a match criterion. If so, the packet is matched to traffic class `cisco2`. If not, then QoS group 4 is evaluated as a match criterion and so on. If the packet matches none of the specified criteria, the packet is classified as a member of the default traffic class (*class default-class*).

## Establishing Traffic Class as a Match Criterion (Nested Traffic Classes)

There are two reasons to use the **match class-map** command. One reason is maintenance; if a large traffic class currently exists, using the traffic class match criterion is easier than retyping the same traffic class configuration. The second and more common reason is to mix match-all and match-any characteristics in one traffic policy. This enables you to create a traffic class using one match criterion evaluation instruction (either match-any or match-all) and then use that traffic class as a match criterion in a traffic class that uses a different match criterion type.

Consider this likely scenario: Suppose A, B, C, and D were all separate match criterion, and you wanted traffic matching A, B, or C and D (i.e., A or B or [C and D]) to be classified as belonging to a traffic class. Without the nested traffic class, traffic would either have to match all four of the match criterion (A and B and C and D) or match any of the match criterion (A or B or C or D) to be considered part of the traffic class. You would not be able to combine “and” (match-all) and “or” (match-any) statements within the traffic class; you would be unable to configure the desired configuration.

The solution: Create one traffic class using match-all for C and D (which we will call criterion E), and then create a new match-any traffic class using A, B, and E. The new traffic class would have the correct evaluation sequence (A or B or E, which is equivalent to A or B or [C and D]).

### Example: Nested Traffic Class for Maintenance

In the following example, the traffic class called `class1` has the same characteristics as the traffic class called `class2`, with the exception that traffic class `class1` has added a destination address as a match criterion. Rather than configuring traffic class `class1` line by line, you can enter the **match class-map class2** command. This command allows all of the characteristics in the traffic class called `class2` to be included in the traffic class



called `class1`, and you can add the new destination address match criterion without reconfiguring the entire traffic class.

```
Router(config)# class-map match-any class2
Router(config-cmap)# match protocol ip
Router(config-cmap)# match qos-group 3
Router(config-cmap)# match access-group 2
Router(config-cmap)# exit
Router(config)# class-map match-all class1
Router(config-cmap)# match class-map class2
Router(config-cmap)# match destination-address mac 0000.0000.0000
Router(config-cmap)# exit
```

## Example: Nested Traffic Class to Combine match-any and match-all Characteristics in One Traffic Class

The only method of including both match-any and match-all characteristics in a single traffic class is to use the **match class-map** command. To combine match-any and match-all characteristics into a single class, use the match-any instruction to create a traffic class that uses a class configured with the match-all instruction as a match criterion (through the **match class-map** command).

The following example shows how to combine the characteristics of two traffic classes, one with match-any and one with match-all characteristics, into one traffic class with the **match class-map** command. The result requires a packet to match one of the following three match criteria to be considered a member of traffic class `class4`: IP protocol *and* QoS group 4, destination MAC address 00.00.00.00.00.00, or access group 2.

In this example, only the traffic class called `class4` is used with the traffic policy called `policy1`.

```
Router(config)# class-map match-all class3
Router(config-cmap)# match protocol ip
Router(config-cmap)# match qos-group 4
Router(config-cmap)# exit
Router(config)# class-map match-any class4
Router(config-cmap)# match class-map class3
Router(config-cmap)# match destination-address mac 00.00.00.00.00.00
Router(config-cmap)# match access-group 2
Router(config-cmap)# exit
Router(config)# policy-map policy1
Router(config-pmap)# class class4
Router(config-pmap-c)# police 8100 1500 2504 conform-action transmit exceed-action
set-qos-transmit 4
Router(config-pmap-c)# end
```

## Example: Traffic Policy as a QoS Policy (Hierarchical Traffic Policies)

A traffic policy can be included in a QoS policy when the **service-policy** command is used in QoS policy-map class configuration mode. A traffic policy that contains a traffic policy is called a hierarchical traffic policy.

A hierarchical traffic policy contains a child policy and a parent policy. The child policy is the previously defined traffic policy that is being associated with the new traffic policy through the use of the **service-policy** command. The new traffic policy using the preexisting traffic policy is the parent policy. In the example in this section, the traffic policy called `child` is the child policy and traffic policy called `parent` is the parent policy.

Hierarchical traffic policies can be attached to subinterfaces. When hierarchical traffic policies are used, a single traffic policy (with a child and parent policy) can be used to shape and priority traffic on subinterfaces.

```
Router(config)# policy-map child
Router(config-pmap)# class voice
```

```

Router(config-pmap-c) # priority 50
Router(config) # policy-map parent
Router(config-pmap) # class class-default
Router(config-pmap-c) # shape average 10000000
Router(config-pmap-c) # service-policy child

```

The value used with the **shape** command is provisioned from the committed information rate (CIR) value from the service provider.

## Additional References

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	<i>Cisco IOS Quality of Service Solutions Command Reference</i>
Packet classification	“Classifying Network Traffic” module
Frame Relay Fragmentation (FRF) PVCs	“FRF .20 Support” module
Selective Packet Discard	“IPv6 Selective Packet Discard” module
Scaling and performance information	“Broadband Scalability and Performance” module of the <a href="#">Cisco ASR 1000 Series Aggregation Services Routers Software Configuration Guide</a> .

### Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

# Feature Information for Modular Quality of Service Command-Line Interface QoS

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to <http://tools.cisco.com/ITDIT/CFN/>. An account on <http://www.cisco.com/> is not required.

**Note**

The below table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

**Table 4: Feature Information for Modular Quality of Service Command-Line Interface QoS**

Feature Name	Releases	Feature Information
Modular Quality of Service Command-Line Interface QoS	IOS-XE 3.15.0S	This feature was introduced on the Cisco cBR Series Routers.

