



Classifying Network Traffic

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Classifying network traffic allows you to organize traffic (that is, packets) into traffic classes or categories on the basis of whether the traffic matches specific criteria. Classifying network traffic is the foundation for enabling many quality of service (QoS) features on your network. This module contains conceptual information and the configuration tasks for classifying network traffic.

Finding Feature Information

For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the [“Feature Information for Classifying Network Traffic”](#) section on [page 15](#).

Use Cisco Feature Navigator to find information about platform support and Cisco IOS XE Software image support. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

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Information About Classifying Network Traffic

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Purpose of Classifying Network Traffic

Classifying network traffic allows you to organize traffic (that is, packets) into traffic classes or categories on the basis of whether the traffic matches specific criteria. Classifying network traffic is the foundation for enabling other QoS features such as traffic shaping and traffic policing on your network.

The goal of network traffic classification is to group traffic based on user-defined criteria so that the resulting groups of network traffic can then be subjected to specific QoS treatments. The QoS treatments might include faster forwarding by intermediate routers and switches or reduced probability of the traffic being dropped due to lack of buffering resources.

Identifying and categorizing network traffic into traffic classes (that is, classifying packets) enables distinct handling for different types of traffic, effectively separating network traffic into different categories. This classification can be associated with a variety of match criteria such as the IP Precedence value, differentiated services code point (DSCP) value, class of service (CoS) value, source and destination MAC addresses, input interface, or protocol type. You classify network traffic by using class maps and policy maps with the Modular Quality of Service Command-Line Interface (MQC). For example, you can configure class maps and policy maps to classify network traffic on the basis of the QoS group, Frame Relay DLCI number, Layer 3 packet length, or other criteria that you specify.

Benefits of Classifying Network Traffic

Classifying network traffic allows you to see what kinds of traffic you have, organize the various kinds of network traffic into traffic classes, and treat some types of traffic differently than others. Identifying and organizing network traffic is the foundation for applying the appropriate QoS feature to that traffic, enabling you to allocate network resources to deliver optimal performance for different types of traffic. For example, high-priority network traffic or traffic matching specific criteria can be singled out for special handling, and thus, help to achieve peak application performance.

MQC and Network Traffic Classification

To configure network traffic classification, you use the Modular Quality of Service Command-Line Interface (MQC).

The MQC is a CLI structure that allows you to complete the following tasks:

- Specify the matching criteria used to define a traffic class.
- Create a traffic policy (policy map). The traffic policy defines the QoS policy actions to be taken for each traffic class.
- Apply the policy actions specified in the policy map to an interface, subinterface, or ATM permanent virtual circuit (PVC) by using the **service-policy** command.

Network Traffic Classification match Commands and Match Criteria

Network traffic classification allows you to group or categorize traffic on the basis of whether the traffic meets one or more specific criteria. For example, network traffic with a specific IP precedence can be placed into one traffic class, while traffic with a specific DSCP value can be placed into another traffic class. The network traffic within that traffic class can be given the appropriate QoS treatment, which you can configure in a policy map later.

You specify the criteria used to classify traffic with a **match** command. [Table 1](#) lists the available **match** commands and the corresponding match criterion.

Table 1 *match Commands and Corresponding Match Criterion*

match Commands¹	Match Criterion
match access group	Access control list (ACL) number
match any	Any match criteria
match atm clp	ATM cell loss priority (CLP)
match class-map	Traffic class name
match cos	Layer 2 class of service (CoS) value
match destination-address mac	MAC address
match discard-class	Discard class value
match dscp	DSCP value
match field	Fields defined in the protocol header description files (PHDFs)
match fr-de	Frame Relay discard eligibility (DE) bit setting
match input-interface	Input interface name
match ip rtp	Real-Time Transport Protocol (RTP) port
match mpls experimental	Multiprotocol Label Switching (MPLS) experimental (EXP) value
match mpls experimental topmost	MPLS EXP value in the topmost label
match not	Single match criterion value to use as an unsuccessful match criterion
match packet length (class-map)	Layer 3 packet length in the IP header
match port-type	Port type

Table 1 *match Commands and Corresponding Match Criterion (continued)*

match Commands ¹	Match Criterion
match precedence	IP precedence values
match protocol	Protocol type
match protocol (NBAR)	Protocol type known to network-based application recognition (NBAR)
match protocol citrix	Citrix protocol
match protocol fasttrack	FastTrack peer-to-peer traffic
match protocol gnutella	Gnutella peer-to-peer traffic
match protocol http	Hypertext Transfer Protocol
match protocol rtp	RTP traffic
match qos-group	QoS group value
match source-address mac	Source Media Access Control (MAC) address
match start	Datagram header (Layer 2) or the network header (Layer 3)
match tag (class-map)	Tag type of class map
match vlan (QoS)	Layer 2 virtual local-area network (VLAN) identification number

1. Cisco IOS **match** commands can vary by release and platform. For more information, see the command documentation for the Cisco IOS release and platform that you are using.

Traffic Classification Compared with Traffic Marking

Traffic classification and traffic marking are closely related and can be used together. Traffic marking can be viewed as an additional action, specified in a policy map, to be taken on a traffic class.

Traffic classification allows you to organize into traffic classes on the basis of whether the traffic matches specific criteria. For example, all traffic with a CoS value of 2 is grouped into one class, and traffic with DSCP value of 3 is grouped into another class. The match criterion is user-defined.

After the traffic is organized into traffic classes, traffic marking allows you to mark (that is, set or change) an attribute for the traffic belonging to that specific class. For instance, you may want to change the CoS value from 2 to 1, or you may want to change the DSCP value from 3 to 2.

The match criteria used by traffic classification are specified by configuring a **match** command in a class map. The marking action taken by traffic marking is specified by configuring a **set** command in a policy map. These class maps and policy maps are configured using the MQC.

[Table 2](#) compares the features of traffic classification and traffic marking.

Table 2 *Traffic Classification Compared with Traffic Marking*

	Traffic Classification	Traffic Marking
Goal	Groups network traffic into specific traffic classes on the basis of whether the traffic matches the user-defined criteria.	After the network traffic is grouped into traffic classes, modifies the attributes for the traffic in a particular traffic class.

Table 2 **Traffic Classification Compared with Traffic Marking**

	Traffic Classification	Traffic Marking
Configuration Mechanism	Uses class maps and policy maps in the MQC.	Uses class maps and policy maps in the MQC.
CLI	In a class map, uses match commands (for example, match cos) to define the traffic matching criteria.	Uses the traffic classes and matching criteria specified by traffic classification. In addition, uses set commands (for example, set cos) in a policy map to modify the attributes for the network traffic. If a table map was created, uses the table keyword and <i>table-map-name</i> argument with the set commands (for example, set cos precedence table table-map-name) in the policy map to establish the to-from relationship for mapping attributes.

How to Classify Network Traffic

Creating a Class Map for Classifying Network Traffic



Note

In the following task, the **match fr-dlci** command is shown in Step 4. The **match fr-dlci** command matches traffic on the basis of the Frame Relay DLCI number. The **match fr-dlci** command is just an example of one of the **match** commands that can be used. For a list of other **match** commands, see [Table 1 on page 3](#).

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map** *class-map-name* [**match-all** | **match-any**]
4. **match fr-dlci** *dlci-number*
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	class-map <i>class-map-name</i> [match-all match-any] Example: Router(config)# class-map class1	Creates a class map to be used for matching traffic to a specified class, and enters class-map configuration mode. Enter the class map name.
Step 4	match fr-dlci <i>dlci-number</i> Example: Router(config-cmap)# match fr-dlci 500	(Optional) Specifies the match criteria in a class map. Note The match fr-dlci command classifies traffic on the basis of the Frame Relay DLCI number. The match fr-dlci command is just an example of one of the match commands that can be used. For a list of other match commands, see Table 1 on page 3 .
Step 5	end Example: Router(config-cmap)# end	(Optional) Returns to privileged EXEC mode.

Creating a Policy Map for Applying a QoS Feature to Network Traffic

**Note**

In the following task, the **bandwidth** command is shown at [Step 5](#). The **bandwidth** command configures the QoS feature class-based weighted fair queuing (CBWFQ). CBWFQ is just an example of a QoS feature that can be configured. Use the appropriate command for the QoS feature that you want to use.

**Note**

Configuring bandwidth on policies that have the class-default class is supported on physical interfaces such as Gigabit Ethernet (GigE), Serial, Mobile Location Protocol (MLP), and Multilink Frame-Relay (MFR), but it is not supported on logical interfaces such as Virtual Access Interface (VAI), Subinterface, and Frame-Relay on Virtual Circuits (FR-VC).

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-map-name*
4. **class** { *class-name* | **class-default** }

5. **bandwidth** { *bandwidth-kbps* | **remaining percent** *percentage* | **percent** *percentage* }
6. **end**
7. **show policy-map**
or
show policy-map *policy-map* **class** *class-name*
8. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	policy-map <i>policy-map-name</i> Example: Router(config)# policy-map policy1	Specifies the name of the policy map to be created and enters policy-map configuration mode. Enter the policy map name.
Step 4	class { <i>class-name</i> class-default } Example: Router(config-pmap)# class class1	Specifies the name of the class and enters policy-map class configuration mode. This class is associated with the class map created earlier. Enter the name of the class or enter the class-default keyword.
Step 5	bandwidth { <i>bandwidth-kbps</i> remaining percent <i>percentage</i> percent <i>percentage</i> } Example: Router(config-pmap-c)# bandwidth percent 50	(Optional) Specifies or modifies the bandwidth allocated for a class belonging to a policy map. Enter the amount of bandwidth as a number of kbps, a relative percentage of bandwidth, or an absolute amount of bandwidth. Note The bandwidth command configures the QoS feature class-based weighted fair queuing (CBWFQ). CBWFQ is just an example of a QoS feature that can be configured. Use the appropriate command for the QoS feature that you want to use.
Step 6	end Example: Router(config-pmap-c)# end	Returns to privileged EXEC mode.
Step 7	show policy-map or	(Optional) Displays all configured policy maps. or

Command or Action	Purpose
show policy-map <i>policy-map</i> class <i>class-name</i> Example: Router# show policy-map or Example: Router# show policy-map policy1 class class1	(Optional) Displays the configuration for the specified class of the specified policy map. Enter the policy map name and the class name.
Step 8 exit Example: Router# exit	(Optional) Exits privileged EXEC mode.

What to Do Next

Create and configure as many policy maps as you need for your network. To create and configure additional policy maps, repeat the steps in the [“Creating a Policy Map for Applying a QoS Feature to Network Traffic” section on page 6](#). Then attach the policy maps to the appropriate interface, following the instructions in the [“Attaching the Policy Map to an Interface” section on page 8](#).

Attaching the Policy Map to an Interface



Note

Depending on the needs of your network, policy maps can be attached to an interface, a subinterface, or an ATM PVC.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number* [**name-tag**]
4. **pvc** [*name*] *vpi/vci* [**ilmi** | **qsaal** | **smds** | **l2transport**]
5. **exit**
6. **service-policy** {**input** | **output**} *policy-map-name*
7. **end**
8. **show policy-map interface** *type number*
9. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	interface <i>type number</i> [name-tag] Example: Router(config)# interface serial4/0/0	Configures an interface type and enters interface configuration mode. Enter the interface type and number.
Step 4	pvc [<i>name</i>] <i>vpi/vci</i> [<i>ilmi</i> qsaal smds l2transport] Example: Router(config-if)# pvc cisco 0/16	(Optional) Creates or assigns a name to an ATM PVC, specifies the encapsulation type on an ATM PVC, and enters ATM virtual circuit configuration mode. Enter the PVC name, the ATM network virtual path identifier, and the network virtual channel identifier. Note This step is required only if you are attaching the policy map to an ATM PVC. If you are not attaching the policy map to an ATM PVC, advance to Step 6 .
Step 5	exit Example: Router(config-atm-vc)# exit	(Optional) Returns to interface configuration mode. Note This step is required only if you are attaching the policy map to an ATM PVC and you completed Step 4 . If you are not attaching the policy map to an ATM PVC, advance to Step 6 .
Step 6	service-policy { input output } <i>policy-map-name</i> Example: Router(config-if)# service-policy input policy1	Attaches a policy map to an input or output interface. Enter the policy map name. Note Policy maps can be configured on ingress or egress routers. They can also be attached in the input or output direction of an interface. The direction (input or output) and the router (ingress or egress) to which the policy map should be attached varies according your network configuration. When using the service-policy command to attach the policy map to an interface, be sure to choose the router and the interface direction that are appropriate for your network configuration.
Step 7	end Example: Router(config-if)# end	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 8	show policy-map interface <i>type number</i> Example: Router# show policy-map interface serial4/0/0	(Optional) Displays the traffic statistics of all traffic classes that are configured for all service policies either on the specified interface or subinterface or on a specific PVC on the interface. Enter the type and number.
Step 9	exit Example: Router# exit	(Optional) Exits privileged EXEC mode.

Configuring QoS When Using IPsec VPNs



Note

This task is required only if you are using IPsec Virtual Private Networks (VPNs). Otherwise, this task is not necessary. For information about IPsec VPNs, see the [“Configuring Security for VPNs with IPsec”](#) module.

Restrictions

This task uses the **qos pre-classify** command to enable QoS preclassification for the packet. QoS preclassification is not supported for all fragmented packets. If a packet is fragmented, each fragment might receive different preclassifications.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **crypto map** *map-name seq-num*
4. **exit**
5. **interface** *type number* [**name-tag**]
6. **qos pre-classify**
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	crypto map map-name seq-num Example: Router(config)# crypto map mymap 10	Enters crypto map configuration mode and creates or modifies a crypto map entry. Enter the crypto map name and sequence number.
Step 4	exit Example: Router(config-crypto-map)# exit	Returns to global configuration mode.
Step 5	interface type number [name-tag] Example: Router(config)# interface serial4/0/0	Configures an interface type and enters interface configuration mode. Enter the interface type and number.
Step 6	qos pre-classify Example: Router(config-if)# qos pre-classify	Enables QoS preclassification.
Step 7	end Example: Router(config-if)# end	(Optional) Returns to privileged EXEC mode.

Configuration Examples for Classifying Network Traffic

Example: Creating a Class Map for Classifying Network Traffic

The following is an example of creating a class map to be used for traffic classification. In this example, a traffic class called class1 has been created. Traffic with a Frame Relay DLCI value of 500 will be put in this traffic class.

```
Router> enable
Router# configure terminal
Router(config)# class-map class1
Router(config-cmap)# match fr-dlci 500
Router(config-cmap)# end
```

**Note**

This example uses the **match fr-dlci** command. The **match fr-dlci** command is just an example of one of the **match** commands that can be used. For a list of other **match** commands, see [Table 1 on page 3](#).

Example: Creating a Policy Map for Applying a QoS Feature to Network Traffic

The following is an example of creating a policy map to be used for traffic classification. In this example, a policy map called **policy1** has been created, and the **bandwidth** command has been configured for **class1**. The **bandwidth** command configures the QoS feature CBWFQ.

```
Router> enable
Router# configure terminal
Router(config)# policy-map policy1
Router(config-pmap)# class class1
Router(config-pmap-c)# bandwidth percent 50
Router(config-pmap-c)# end
Router# show policy-map policy1 class class1
Router# exit
```

**Note**

This example uses the **bandwidth** command. The **bandwidth** command configures the QoS feature class-based weighted fair queuing (CBWFQ). CBWFQ is just an example of a QoS feature that can be configured. Use the appropriate command for the QoS feature that you want to use.

Example: Attaching the Policy Map to an Interface

The following is an example of attaching the policy map to an interface. In this example, the policy map called **policy1** has been attached in the input direction of serial interface 4/0.

```
Router> enable
Router# configure terminal
Router(config)# interface serial4/0/0
Router(config-if)# service-policy input policy1
Router(config-if)# end
Router# show policy-map interface serial4/0/0
Router# exit
```

Example: Configuring QoS When Using IPsec VPNs

The following is an example of configuring QoS when using IPsec VPNs. In this example, the **crypto map** command specifies the IPsec crypto map (**mymap 10**) to which the **qos pre-classify** command is applied.

```
Router> enable
Router# configure terminal
Router(config)# crypto map mymap 10
Router(config-crypto-map)# exit
Router(config)# interface serial4/0/0
Router(config-if)# qos pre-classify
Router(config-if)# end
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	Cisco IOS Quality of Service Solutions Command Reference
MQC	“Applying QoS Features Using the MQC” module
Marking network traffic	“Marking Network Traffic” module
IPsec and VPNs	“Configuring Security for VPNs with IPsec” module
NBAR	“Classifying Network Traffic Using NBAR” module

Standards

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

MIBs

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

RFCs

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

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.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Classifying Network Traffic

Table 3 lists the features in this module.

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**Note**

Table 3 lists only the Cisco IOS XE Software release that introduced support for a given feature in a given Cisco IOS XE Software release train. Unless noted otherwise, subsequent releases of that Cisco IOS XE Software release train also support that feature.

Table 3 **Feature Information for Classifying Network Traffic**

Feature Name	Releases	Feature Information
Class-Based Ethernet CoS Matching & Marking (802.1p & ISL CoS)	Cisco IOS XE Release 2.1	This feature was introduced on Cisco ASR 1000 Series Routers. The following sections provide information about this feature: • Information About Classifying Network Traffic, page 2. • How to Classify Network Traffic, page 5.
Class-Based Marking	Cisco IOS XE Release 2.1	This feature was introduced on Cisco ASR 1000 Series Routers. The following sections provide information about this feature: • Information About Classifying Network Traffic, page 2. • How to Classify Network Traffic, page 5.
Packet Classification Using Frame Relay DLCI Number	Cisco IOS XE Release 2.1	The Packet Classification Using the Frame Relay DLCI Number feature allows customers to match and classify traffic based on the Frame Relay data-link connection identifier (DLCI) number associated with a packet. This new match criteria is in addition to the other match criteria, such as the IP Precedence, differentiated services code point (DSCP) value, class of service (CoS), currently available. The following sections provide information about this feature: • Information About Classifying Network Traffic, page 2. • How to Classify Network Traffic, page 5.

Table 3 **Feature Information for Classifying Network Traffic (continued)**

Feature Name	Releases	Feature Information
QoS: Local Traffic Matching Through MQC	Cisco IOS XE Release 2.1	This feature was introduced on Cisco ASR 1000 Series Routers. The following sections provide information about this feature: • Information About Classifying Network Traffic, page 2 • How to Classify Network Traffic, page 5.
QoS: Match ATM CLP	Cisco IOS XE Release 2.3	The QoS: Match ATM CLP features allows you to classify traffic on the basis of the ATM cell loss priority (CLP) value. The following sections provide information about this feature: • Information About Classifying Network Traffic, page 2. • How to Classify Network Traffic, page 5. The following command was introduced or modified: match atm-clp.
QoS: Match VLAN	Cisco IOS XE Release 2.1	This feature was introduced on Cisco ASR 1000 Series Routers. The following sections provide information about this feature: • Information About Classifying Network Traffic, page 2. • How to Classify Network Traffic, page 5.
QoS: MPLS EXP Bit Traffic Classification	Cisco IOS XE Release 2.3	The QoS: MPLS EXP Bit Traffic Classification feature allows you to classify traffic on the basis of the Multiprotocol Label Switching (MPLS) experimental (EXP) value. The following sections provide information about this feature: • Information About Classifying Network Traffic, page 2. • How to Classify Network Traffic, page 5. The following command was introduced or modified: match mpls experimental.

Table 3 **Feature Information for Classifying Network Traffic (continued)**

Feature Name	Releases	Feature Information
QoS: Traffic Pre-classification	Cisco IOS XE Release 2.1	This feature was introduced on Cisco ASR 1000 Series Routers. The following sections provide information about this feature: • Configuring QoS When Using IPsec VPNs, page 10.
QoS Group: Match and Set for Classification and Marking	Cisco IOS XE Release 2.1	This feature was introduced on Cisco ASR 1000 Series Routers. The following sections provide information about this feature: • Information About Classifying Network Traffic, page 2. • How to Classify Network Traffic, page 5

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