QoS: Classification Configuration Guide, Cisco IOS XE Release 3SE (Catalyst 3850 Switches)

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CONTENTS

Class-Based Ethernet CoS Matching and Marking

The Class-Based Ethernet CoS Matching and Marking (801.1p and ISL CoS) feature allows you to mark and match packets using Class of Service (CoS) values.

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 at the end of this module.

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. An account on Cisco.com is not required.

Prerequisites for Class-Based Ethernet CoS Matching and Marking

When configuring this feature, you must first create a policy map (sometimes referred to as a service policy or a traffic policy) using the Modular QoS Command-Line Interface (CLI) (MQC). Therefore, you should be familiar with the procedure for creating a policy map using the MQC.

For more information about creating a policy map (traffic policy) using the MQC, see the "Applying QoS Features Using the MQC" module.

Information About Class-Based Ethernet CoS Matching and Marking

Layer 2 CoS Values

Layer 2 (L2) Class of Service (CoS) values are relevant for IEEE 802.1Q and Interswitch Link (ISL) types of frames. The Class-based Ethernet CoS Matching and Marking feature extends Cisco software capabilities to match packets by looking at the CoS value of the packet and marking packets with user-defined CoS values. This feature can be used for L2 CoS to L3 Terms of Service (TOS) mapping. CoS matching and marking can be configured via the Cisco Modular QoS CLI framework.

How to Configure Class-Based Ethernet CoS Matching and Marking

Configuring Class-Based Ethernet CoS Matching

In the following task, classes named voice and video-and-data are created to classify traffic based on the CoS values. The classes are configured in the CoS-based-treatment policy map, and the service policy is attached to all packets leaving Gigabit Ethernet interface 1/0/1.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map** *class-map-name*
4. **match cos** *cos-value*
5. **exit**
6. **class-map** *class-map-name*
7. **match cos** *cos-value*
8. **exit**
9. **policy-map** *policy-map-name*
10. **class** {*class-name* | **class-default**}
11. **priority level** *level*
12. **exit**
13. **class** {*class-name* | **class-default**}
14. **bandwidth remaining percent** *percentage*
15. **exit**
16. **exit**
17. **interface** *type number*
18. **service-policy** {**input**| **output**} *policy-map-name*
19. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**class-map** *class-map-name* **Example:** `Device(config)# class-map voice`	Specifies the name of the class map to be created and enters class-map configuration mode.

	Command or Action	**Purpose**
Step 4	**match cos** *cos-value* **Example:** Device(config-cmap)# match cos 7	Configures the class map to match traffic on the basis of the CoS value.
Step 5	**exit** **Example:** Device(config-cmap)# exit	(Optional) Exits class-map configuration mode.
Step 6	**class-map** *class-map-name* **Example:** Device(config)# class-map video-and-data	Specifies the name of the class map to be created and enters class-map configuration mode. • Enter the class map name.
Step 7	**match cos** *cos-value* **Example:** Device(config-cmap)# match cos 5	Configures the class map to match traffic on the basis of the CoS value.
Step 8	**exit** **Example:** Device(config-cmap)# exit	(Optional) Exits class-map configuration mode.
Step 9	**policy-map** *policy-map-name* **Example:** Device(config)# policy-map cos-based-treatment	Specifies the name of the policy map created earlier and enters policy-map configuration mode.
Step 10	**class** {*class-name* | **class-default**} **Example:** Device(config-pmap)# class voice	Specifies the name of the class whose policy you want to create and enters policy-map class configuration mode. This class is associated with the class map created earlier.
Step 11	**priority level** *level* **Example:** Device(config-pmap-c)# priority level 1	Specifies the level of the priority service.

		Command or Action	**Purpose**
Step 12		**exit** **Example:** Device(config-pmap-c)# exit	(Optional) Exits policy-map class configuration mode.
Step 13		**class** {*class-name* | **class-default**} **Example:** Device(config-pmap)# class video-and-data	Specifies the name of the class whose policy you want to create and enters policy-map class configuration mode. This class is associated with the class map created earlier.
Step 14		**bandwidth remaining percent** *percentage* **Example:** Device(config-pmap-c)# bandwidth remaining percent 20	Specifies the amount of bandwidth assigned to the class.
Step 15		**exit** **Example:** Device(config-pmap-c)# exit	(Optional) Exits policy-map class configuration mode.
Step 16		**exit** **Example:** Device(config-pmap)# exit	(Optional) Exits policy-map configuration mode.
Step 17		**interface** *type number* **Example:** Device(config)# interface gigabitethernet 1/0/1	Configures an interface (or subinterface) type and enters interface configuration mode.
Step 18		**service-policy** {**input**| **output**} *policy-map-name* **Example:** Device(config-if)# service-policy output cos-based-treatment	Specifies the name of the policy map to be attached to either the input or output direction of the interface. **Note** Policy maps can be configured on ingress or egress devices. They can also be attached in the input or output direction of an interface. The direction (input or output) and the device (ingress or egress) to which the policy map should be attached vary according your network configuration. When using the **service-policy** command to attach the policy map to an interface, be sure to choose the device and the interface direction that are appropriate for your network configuration.

	Command or Action	Purpose
Step 19	**end** **Example:** `Device(config-if)# end`	(Optional) Exits interface configuration mode and returns to privileged EXEC mode.

Configuring Class-Based Ethernet CoS Marking

In the following task, the policy map called cos-set is created to assign different CoS values for different types of traffic.

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Note   This task assumes that the class maps called voice and video-and-data have already been created.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-map-name*
4. **class** {*class-name* | **class-default**}
5. **set cos** *cos-value*
6. **exit**
7. **class** {*class-name* | **class-default**}
8. **set cos** *cos-value*
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	**Purpose**
Step 3	**policy-map** *policy-map-name* **Example:** Device(config)# policy-map cos-set	Specifies the name of the policy map created earlier and enters policy-map configuration mode.
Step 4	**class** {*class-name* | **class-default**} **Example:** Device(config-pmap)# class voice	Specifies the name of the class whose policy you want to create and enters policy-map class configuration mode. This class is associated with the class map created earlier.
Step 5	**set cos** *cos-value* **Example:** Device(config-pmap-c)# set cos 1	Sets the packet's CoS value.
Step 6	**exit** **Example:** Device(config-pmap-c)# exit	Exits policy-map class configuration mode.
Step 7	**class** {*class-name* | **class-default**} **Example:** Device(config-pmap)# class video-and-data	Specifies the name of the class whose policy you want to create and enters policy-map class configuration mode. This class is associated with the class map created earlier.
Step 8	**set cos** *cos-value* **Example:** Device(config-pmap-c)# set cos 2	Sets the packet's CoS value.
Step 9	**end** **Example:** Device(config-pmap-c)# end	(Optional) Exits policy-map class configuration mode and returns to privileged EXEC mode.

Configuration Examples for Class-Based Ethernet CoS Matching and Marking

Example: Configuring Class-Based Ethernet CoS Matching

This example creates two classes, voice and video-and-data, to classify traffic based on the CoS values. The CoS-based-treatment policy map is used to set priority and bandwidth values for the classes. The service policy is attached to all packets leaving interface Gigabit Ethernet1/0/1.

> **Note** The service policy can be attached to any interface that supports service policies.

```
Device(config)# class-map voice
Device(config-cmap)# match cos 7
Device(config-cmap)# exit
Device(config)# class-map video-and-data
Device(config-cmap)# match cos 5
Device(config-cmap)# exit
Device(config)# policy-map cos-based-treatment
Device(config-pmap)# class voice
Device(config-pmap-c)# priority level 1
Device(config-pmap-c)# exit
Device(config-pmap)# class video-and-data
Device(config-pmap-c)# bandwidth remaining percent 20
Device(config-pmap-c)# exit
Device(config-pmap)# exit
Device(config)#  interface gigabitethernet1/0/1
Device(config-if)# service-policy output cos-based-treatment
```

Example: Class-Based Ethernet CoS Marking

```
Device(config)# policy-map cos-set
Device(config-pmap)# class voice
Device(config-pmap-c)# set cos 1
Device(config-pmap-c)# exit
Device(config-pmap)# class video-and-data
Device(config-pmap-c)# set cos 2
Device(config-pmap-c)# end
```

Additional References for Class-Based Ethernet CoS Matching and Marking

Related Documents

Related Topic	Document Title
Cisco commands	Cisco IOS Master Command List, All Releases

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
Classifying network traffic	"Classifying Network Traffic" module
MQC	"Applying QoS Features Using the MQC" module
Marking network traffic	"Marking Network Traffic" module

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 Class-Based Ethernet CoS Matching & Marking

The following table provides release information about the feature or features described in this module. This 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.

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Table 1: Feature Information for Class-Based Ethernet CoS Matching and Marking

Feature Name	Releases	Feature Information
Class-Based Ethernet CoS Matching and Marking	12.2(5)T 15.0(1)S Cisco IOS XE Release 2.1 Cisco IOS XE Release 3.2SE	This feature allows you to mark and match packets using Class of Service (CoS) values. The following commands were introduced or modified: **match cos**, **set cos**.

Feature Name	Releases	Feature Information
User Priority Based QoS Marking for Wireless Deployments	Cisco IOS XE Release 3.2SE	This features allows you to mark and match packets on wireless deployments using the user-priority (CoS) vlaues.

QoS Group Match and Set for Classification and Marking

This feature provides the capability of matching and classifying traffic on the basis of the QoS group value.

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 at the end of this module.

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Prerequisites for QoS Group Match and Set for Classification and Matching

When configuring this feature, you must first create a policy map (sometimes referred to as a service policy or a traffic policy) using the Modular QoS CLI (MQC). Therefore, you should be familiar with the procedure

for creating a policy map using the MQC. For more information about creating a policy map (traffic policy) using the MQC, see the "Applying QoS Features Using the MQC" module.

Restrictions for QoS Group Match and Set for Classification and Marking

A policy map containing the **set qos-group** command can only be attached as an input traffic policy. QoS group values are not usable for traffic leaving a device.

Information About QoS Group Match and Set for Classification and Marking

QoS Group Values

The QoS group value is a number between 0 and 99 that is set using the **set qos-group** command. The group value can be used to classify packets into QoS groups based on a prefix, autonomous system, and community string. A packet is marked with a QoS group value only while it is being processed within the device. The QoS group value is not included in the packet's header when the packet is transmitted over the output interface. However, the QoS group value can be used to set the value of a Layer 2 or Layer 3 field that is included as part of the packet's headers (such as the MPLS EXP, CoS, and DSCP fields).

MQC and Traffic Classification and Marking Based on QoS Group Value

Use the MQC to enable packet classification and marking based on the QoS group value. The MQC is a CLI that allows you to create traffic classes and policies, enable a QoS feature (such as packet classification), and attach these policies to interfaces.

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

The MQC consists of the following three processes:

- Defining a traffic class using the **class-map** command.

- Creating a traffic policy by associating the traffic class with one or more QoS features (using the **policy-map** command).

- Attaching the traffic policy to the interface using the **service-policy** command.

A traffic class contains three major elements: a name, one or more **match** commands, and, if more than one **match** command exists in the traffic class, an instruction on how to evaluate these **match** commands. The traffic class is named in the **class-map** command line; for example, if you enter the **class-mapcisco** command while configuring the traffic class in the CLI, the traffic class would be named "cisco."

The **match** commands are used to specify various criteria for classifying packets. Packets are checked to determine whether they match the criteria specified in the **match** commands. If a packet matches the specified criteria, that packet is considered a member of the class and is forwarded according to the QoS specifications

set in the traffic policy. Packets that fail to meet any of the matching criteria are classified as members of the default traffic class.

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.

How to Configure QoS Group Match and Set for Classification and Marking

Configuring the Class Map to Match on the QoS Group Value

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map** *class-map-name*
4. **match qos-group** *qos-group-value*
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**class-map** *class-map-name* **Example:** `Device(config)# class-map class1`	Specifies the name of the class map to be created and enters class-map configuration mode.
Step 4	**match qos-group** *qos-group-value* **Example:** `Device(config-cmap)# match qos-group 30`	Configures the class map to match traffic on the basis of the QoS group value. • Enter the exact value from 0 to 99 used to identify a QoS group value.

	Command or Action	Purpose
Step 5	**end** **Example:** `Device(config-cmap)# end`	(Optional) Exits class-map configuration mode and returns to privileged EXEC mode.

Creating a Policy Map Using the QoS Group Value

The following example shows how to create a policy map (policy1) using a pre-configured class (class1) and how to set the QoS group value based on the packet's original 802.1P CoS value.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-map-name*
4. **class** {*class-name* | **class-default**}
5. **set qos-group cos**
6. **end**
7. **show policy-map**
8. **show policy-map** *policy-map* **class** *class-name*
9. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	**Purpose**
Step 3	**policy-map** *policy-map-name* **Example:** `Device(config)# policy-map policy1`	Specifies the name of the policy map created earlier and enters policy-map configuration mode.
Step 4	**class** {*class-name* | **class-default**} **Example:** `Device(config-pmap)# class class1`	Specifies the name of the class whose policy you want to create 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	**set qos-group cos** **Example:** `Device(config-pmap-c)# set qos-group cos`	Sets the QoS group value based on the packet's original 802.1P CoS value.
Step 6	**end** **Example:** `Device(config-pmap-c)# end`	Returns to privileged EXEC mode.
Step 7	**show policy-map** **Example:** `Device# show policy-map`	(Optional) Displays all configured policy maps.
Step 8	**show policy-map** *policy-map* **class** *class-name* **Example:** `Device# show policy-map policy1 class class1`	(Optional) Displays the configuration for the specified class of the specified policy map.
Step 9	**exit** **Example:** `Device# exit`	(Optional) Exits privileged EXEC mode.

Attaching the Policy Map to an Interface

Before You Begin

Before attaching the policy map to an interface, the policy map must be created using the MQC.

SUMMARY STEPS

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

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Device> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Device# configure terminal	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** Device(config)# interface serial4/0/0	Configures an interface (or subinterface) type and enters interface configuration mode
Step 4	**pvc** [*name*] *vpi/vci* [**ilmi**	**qsaal**	**smds**] **Example:** Device(config-if)# pvc cisco 0/16 ilmi	(Optional) Creates or assigns a name to an ATM PVC, specifies the encapsulation type on an ATM PVC, and enters ATM VC configuration mode. **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, skip this step.
Step 5	**service-policy** {**input**| **output**} *policy-map-name* **Example:** Device(config-if)# service-policy input policy1 **Example:** Device(config-if-atm-vc)# service-policy input policy1	Specifies the name of the policy map to be attached to either the input or output direction of the interface. **Note** Policy maps can be configured on ingress or egress devices. They can also be attached in the input or output direction of an interface. The direction (input or output) and the device (ingress or egress) to which the policy map should be attached vary according your network configuration. When using the **service-policy** command to attach the policy map to an interface, be sure to choose the device and the interface direction that are appropriate for your network configuration.

	Command or Action	Purpose
Step 6	**end** **Example:** Device(config-if)# end **Example:** Device(config-if-atm-vc)# end	(Optional) Exits interface configuration or ATM VC configuration mode and returns to privileged EXEC mode.

Configuration Examples for QoS Group Match and Set for Classification and Marking

Example: QoS Group Match and Set for Classification and Marking

The following example shows how to create a class map and policy map for QoS group values, and how to attach the policy to an interface.

```
Device> enable
Device# configure terminal
Device(config)# class-map class1
Device(config-cmap)# match qos-group 30
Device(config-cmap)# exit
Device(config)# policy-map policy1
Device(config-pmap)# class class1
Device(config-pmap-c)# set qos-group cos
Device(config-pmap-c)# exit
Device(config-pmap)# exit
Device(config)# interface serial4/0/0
Device(config-if)# service-policy input policy1
Device(config-if)# end
```

Additional References for QoS Group Match and Set for Classification and Marking

Related Documents

Related Topic	Document Title
Cisco commands	Cisco IOS Master Command List, All Releases

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
Classifying network traffic	"Classifying Network Traffic" module
MQC	"Applying QoS Features Using the MQC" module
Marking network traffic	"Marking Network Traffic" module

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 QoS Group Match and Set for Classification and Marking

The following table provides release information about the feature or features described in this module. This 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.

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Table 2: Feature Information for QoS Group Match and Set for Classification and Marking

Feature Name	Releases	Feature Information
QoS Group Match and Set for Classification and Marking	Cisco IOS XE Release 2.1 Cisco IOS XE Release 3.2SE	This feature provides the capability of matching and classifying traffic on the basis of the QoS group value. The following commands were introduced or modified: **match qos-group**, **set qos-group**.

CHAPTER **3**

Marking Network Traffic

Marking network traffic allows you to set or modify the attributes for traffic (that is, packets) belonging to a specific class or category. When used in conjunction with network traffic classification, marking 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 marking network traffic.

Finding Feature Information

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Prerequisites for Marking Network Traffic

In order to mark network traffic, Cisco Express Forwarding must be configured on both the interface receiving the traffic and the interface sending the traffic.

Restrictions for Marking Network Traffic

Traffic marking can be configured on an interface, a subinterface, or an ATM permanent virtual circuit (PVC). Marking network traffic is not supported on the following interfaces:

- ATM switched virtual circuit (SVC)

- Fast EtherChannel

- PRI

- Tunnel

Information About Marking Network Traffic

Purpose of Marking Network Traffic

Traffic marking is a method used to identify certain traffic types for unique handling, effectively partitioning network traffic into different categories.

After the network traffic is organized into classes by traffic classification, traffic marking allows you to mark (that is, set or change) a value (attribute) for the traffic belonging to a specific class. For instance, you may want to change the class of service (CoS) value from 2 to 1 in one class, or you may want to change the differentiated services code point (DSCP) value from 3 to 2 in another class. In this module, these values are referred to as attributes.

Attributes that can be set and modified include the following:

- Cell loss priority (CLP) bit

- CoS value of an outgoing packet

- Discard-class value

- Discard eligible (DE) bit setting in the address field of a Frame Relay frame

- DSCP value in the type of service (ToS) byte

- MPLS EXP field value in the topmost label on an input or output interface

- Multiprotocol Label Switching (MPLS) experimental (EXP) field on all imposed label entries

- Precedence value in the packet header

- QoS group identifier (ID)

- ToS bits in the header of an IP packet

Benefits of Marking Network Traffic

Improved Network Performance

Traffic marking allows you to fine-tune the attributes for traffic on your network. This increased granularity helps single out traffic that requires special handling and, thus, helps to achieve optimal application performance.

Traffic marking allows you to determine how traffic will be treated, based on how the attributes for the network traffic are set. It allows you to segment network traffic into multiple priority levels or classes of service based on those attributes, as follows:

- Traffic marking is often used to set the IP precedence or IP DSCP values for traffic entering a network. Networking devices within your network can then use the newly marked IP precedence values to determine how traffic should be treated. For example, voice traffic can be marked with a particular IP precedence or DSCP, and a queueing mechanism can then be configured to put all packets of that mark into a priority queue.

- Traffic marking can be used to identify traffic for any class-based QoS feature (any feature available in policy-map class configuration mode, although some restrictions exist).

- Traffic marking can be used to assign traffic to a QoS group within a device. The device can use the QoS groups to determine how to prioritize traffic for transmission. The QoS group value is usually used for one of the two following reasons:

    - To leverage a large range of traffic classes. The QoS group value has 100 different individual markings, as opposed to DSCP and IP precedence, which have 64 and 8, respectively.

    - If changing the IP precedence or DSCP value is undesirable.

- If a packet (for instance, in a traffic flow) that needs to be marked to differentiate user-defined QoS services is leaving a device and entering a switch, the device can set the CoS value of the traffic, because the switch can process the Layer 2 CoS header marking. Alternatively, the Layer 2 CoS value of the traffic leaving a switch can be mapped to the Layer 3 IP or MPLS value.

Two Methods for Marking Traffic Attributes

There are two methods for specifying and marking traffic attributes:

- You can specify and mark the traffic attribute by using a **set** command.

With this method, you configure individual **set** commands for the traffic attribute that you want to mark.

- You can specify and mark the traffic attribute by creating a mapping table (called a "table map").

With this method, you configure the traffic attributes that you want to mark once in a table map and then the markings can be propagated throughout the network.

These methods are further described in the sections that follow.

Method One Using a set Command

You specify the traffic attribute that you want to change with a **set**command configured in a policy map. The table below lists the available **set**commands and the corresponding attribute. The table also includes the network layer and the network protocol typically associated with the traffic attribute.

Table 3: set Commands and Corresponding Traffic Attribute, Network Layer, and Protocol

set Commands[1]	Traffic Attribute	Network Layer	Protocol
set atm-clp	CLP bit	Layer 2	ATM
set cos	Layer 2 CoS value of the outgoing traffic	Layer 2	ATM, Frame Relay
set discard-class	discard-class value	Layer 2	ATM, Frame Relay
set dscp	DSCP value in the ToS byte	Layer 3	IP
set fr-de	DE bit setting in the address field of a Frame Relay frame	Layer 2	Frame Relay
set ip tos (route-map)	ToS bits in the header of an IP packet	Layer 3	IP
set mpls experimental imposition	MPLS EXP field on all imposed label entries	Layer 3	MPLS
set mpls experimental topmost	MPLS EXP field value in the topmost label on either an input or an output interface	Layer 3	MPLS
set precedence	Precedence value in the packet header	Layer 3	IP
set qos-group	QoS group ID	Layer 3	IP, MPLS

[1] Cisco set commands can vary by release. For more information, see the command documentation for the Cisco release that you are using

If you are using individual **set** commands, those **set** commands are specified in a policy map. The following is a sample policy map configured with one of the **set** commands listed in the table above. In this sample configuration, the **set atm-clp**command has been configured in the policy map (policy1) to mark the CLP attribute.

```
policy-map policy1
 class class1
  set atm-clp
  end
```

Method Two Using a Table Map

You can create a table map that can be used to mark traffic attributes. A table map is a kind of two-way conversion chart that lists and maps one traffic attribute to another. A table map supports a many-to-one type of conversion and mapping scheme. The table map establishes a to-from relationship for the traffic attributes and defines the change to be made to the attribute. That is, an attribute is set *to* one value that is taken *from* another value. The values are based on the specific attribute being changed. For instance, the Precedence attribute can be a number from 0 to 7, while the DSCP attribute can be a number from 0 to 63.

The following is a sample table map configuration:

```
table-map table-map1
map from 0 to 1
map from 2 to 3
exit
```
The table below lists the traffic attributes for which a to-from relationship can be established using the table map.

Table 4: Traffic Attributes for Which a To-From Relationship Can Be Established

The "To" Attribute	The "From" Attribute
Precedence	CoS
	QoS group
DSCP	CoS
	QoS group
CoS	Precedence
	DSCP
QoS group	Precedence
	DSCP
	MPLS EXP topmost
MPLS EXP topmost	QoS group
MPLS EXP imposition	Precedence
	DSCP

Once the table map is created, you configure a policy map to use the table map. In the policy map, you specify the table map name and the attributes to be mapped by using the **table** keyword and the *table-map-name* argument with one of the commands listed in the table below.

Table 5: Commands Used in Policy Maps to Map Attributes

Command Used in Policy Maps	Maps These Attributes
set cos dscp table *table-map-name*	CoS to DSCP
set cos precedence table *table-map-name*	CoS to Precedence
set dscp cos table *table-map-name*	DSCP to CoS
set dscp qos-group table *table-map-name*	DSCP to qos-group
set mpls experimental imposition dscp table *table-map-name*	MPLS EXP imposition to DSCP
set mpls experimental imposition precedence table *table-map-name*	MPLS EXP imposition to precedence
set mpls experimental topmost qos-group table *table-map-name*	MPLS EXP topmost to QoS-group
set precedence cos table *table-map-name*	Precedence to CoS
set precedence qos-group table *table-map-name*	Precedence to QoS-group
set qos-group dscp table *table-map-name*	QoS-group to DSCP
set qos-group mpls exp topmost table *table-map-name*	QoS-group to MPLS EXP topmost
set qos-group precedence table *table-map-name*	QoS-group to Precedence

The following is an example of a policy map (policy2) configured to use the table map (table-map1) created earlier:

```
policy map policy2
class class-default
set cos dscp table table-map1
exit
```
In this example, a mapping relationship was created between the CoS attribute and the DSCP attribute as defined in the table map.

Traffic Marking Procedure Flowchart

The figure below illustrates the order of the procedures for configuring traffic marking.

Figure 1: Traffic Marking Procedure Flowchart
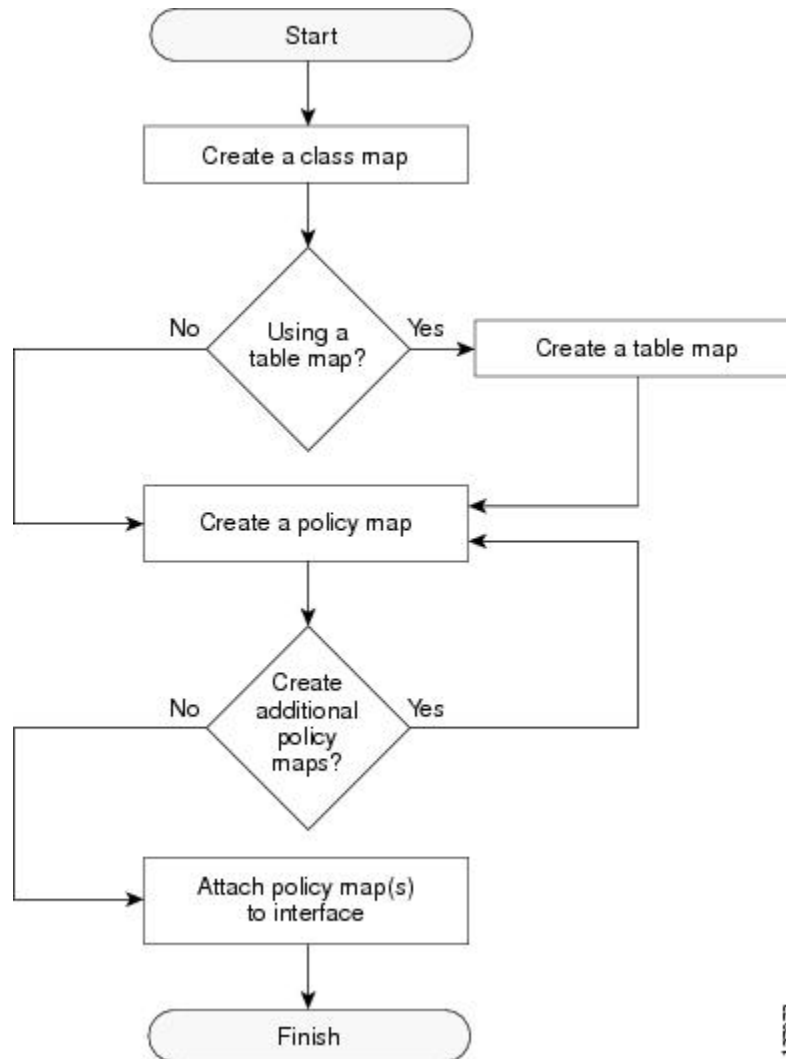
Method for Marking Traffic Attributes

You specify and mark the traffic attribute that you want to change by using a **set** command configured in a policy map.

With this method, you configure individual **set** commands for the traffic attribute that you want to mark.

Using a set Command

The table below lists the available **set** commands and the corresponding attribute. The table below also includes the network layer and the network protocol typically associated with the traffic attribute.

Table 6: set Commands and Corresponding Traffic Attribute, Network Layer, and Protocol

set Commands[2]	Traffic Attribute	Network Layer	Protocol
set cos	Layer 2 CoS value of the outgoing traffic	Layer 2	ATM, Frame Relay
set discard-class	discard-class value	Layer 2	ATM, Frame Relay
set dscp	DSCP value in the ToS byte	Layer 3	IP
set fr-de	DE bit setting in the address field of a Frame Relay frame	Layer 2	Frame Relay
set ip tos (route-map)	ToS bits in the header of an IP packet	Layer 3	IP
set mpls experimental imposition	MPLS EXP field on all imposed label entries	Layer 3	MPLS
set mpls experimental topmost	MPLS EXP field value in the topmost label on an input or output interface	Layer 3	MPLS
set precedence	Precedence value in the packet header	Layer 3	IP
set qos-group	QoS group ID	Layer 3	IP, MPLS

2 Cisco set commands can vary by release. For more information, see the command documentation.

If you are using individual **set** commands, those **set** commands are specified in a policy map. The following is a sample policy map configured with one of the **set** commands listed in the table above. In this sample configuration, the **set cos** command has been configured in the policy map (policy1) to mark the CoS value.

```
policy-map policy1
 class class1
  set cos 1
  end
```

For information on configuring a policy map, see the "Creating a Policy Map for Applying a QoS Feature to Network Traffic" section.

The final task is to attach the policy map to the interface. For information on attaching the policy map to the interface, see the "Attaching the Policy Map to an Interface" section.

MQC and Network Traffic Marking

To configure network traffic marking, you use the Modular QoS CLI (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 PVC by using the **service-policy** command.

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 a DSCP value of 3 is grouped into another class. The match criteria are 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.

The table below compares the features of traffic classification and traffic marking.

Table 7: Traffic Classification Compared with Traffic Marking

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

How to Mark Network Traffic

Creating a Class Map for Marking Network Traffic

✎

Note   The **match protocol** command is included in the steps below. The **match protocol** command is just an example of one of the **match** commands that can be used. See the command documentation for a complete list of **match** commands.

SUMMARY STEPS

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

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**class-map** *class-map-name* [**match-all**	**match-any**] **Example:** `Device(config)# class-map class1`	Creates a class map to be used for matching traffic to a specified class and enters class-map configuration mode.
Step 4	**match protocol** *protocol-name* **Example:** `Device(config-cmap)# match protocol ftp`	(Optional) Configures the match criterion for a class map on the basis of the specified protocol. **Note** The **match protocol** command is just an example of one of the **match** commands that can be used. The **match** commands vary by Cisco release. See the command documentation for a complete list of **match** commands.

	Command or Action	**Purpose**
Step 5	**end** **Example:** `Device(config-cmap)# end`	(Optional) Returns to privileged EXEC mode.

Creating a Table Map for Marking Network Traffic

✎

Note   If you are not using a table map, skip this procedure and advance to the "Creating a Policy Map for Applying a QoS Feature to Network Traffic".

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **table-map** *table-map-name* **map from** *from-value* **to** *to-value* [**default** *default-action-or-value*]
4. **end**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**table-map** *table-map-name* **map from** *from-value* **to** *to-value* [**default** *default-action-or-value*] **Example:**	Creates a table map using the specified name and enters tablemap configuration mode. • Enter the name of the table map you want to create. • Enter each value mapping on a separate line. Enter as many separate lines as needed for the values you want to map.

	Command or Action	Purpose

	Example:
	
	`Device(config)# table-map table-map1 map`
	`  from 2 to 1`
		• The **default** keyword and *default-action-or-value* argument set the default value (or action) to be used if a value is not explicitly designated.

Step 4	**end**
	
	Example:
	
	`Device(config-tablemap)#`
	
	`end`
		(Optional) Exits tablemap configuration mode and returns to privileged EXEC mode.

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

Before You Begin

The following restrictions apply to creating a QoS policy map:

- Before modifying the encapsulation type from IEEE 802.1 Q to ISL, or vice versa, on a subinterface, detach the policy map from the subinterface. After changing the encapsulation type, reattach the policy map.

- A policy map containing the **set qos-group** command can only be attached as an input traffic policy. QoS group values are not usable for traffic leaving a device.

- A policy map containing the **set cos** command can only be attached as an output traffic policy.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-map-name*
4. **class** {*class-name* | **class-default**}
5. **set cos** *cos-value*
6. **end**
7. **show policy-map**
8. **show policy-map** *policy-map* **class** *class-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	**Purpose**
	Example: Device> enable	• Enter your password if prompted.
Step 2	**configure terminal** **Example:** Device# configure terminal	Enters global configuration mode.
Step 3	**policy-map** *policy-map-name* **Example:** Device(config)# policy-map policy1	Specifies the name of the policy map and enters policy-map configuration mode.
Step 4	**class** {*class-name* | **class-default**} **Example:** Device(config-pmap)# class class1	Specifies the name of the class whose policy you want to create and enters policy-map class configuration mode. This class is associated with the class map created earlier.
Step 5	**set cos** *cos-value* **Example:** Device(config-pmap-c)# set cos 2	(Optional) Sets the CoS value in the type of service (ToS) byte. **Note** The **set cos** command is an example of one of the **set** commands that can be used when marking traffic. Other **set** commands can be used. For a list of other **set** commands, see "Information About Marking Network Traffic".
Step 6	**end** **Example:** Device(config-pmap-c)# end	Returns to privileged EXEC mode.
Step 7	**show policy-map** **Example:** Device# show policy-map	(Optional) Displays all configured policy maps.
Step 8	**show policy-map** *policy-map* **class** *class-name* **Example:** Device# show policy-map policy1 class class1	(Optional) Displays the configuration for the specified class of the specified policy map.

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. Then attach the policy maps to the appropriate interface, following the instructions in the "Attaching the Policy Map to an Interface" section.

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 permanent virtual circuit (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*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Device> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Device# configure terminal	Enters global configuration mode.
Step 3	**interface** *type* *number* [**name-tag**] **Example:** Device(config)# interface serial4/0/0	Configures an interface type and enters interface configuration mode.

	Command or Action	**Purpose**
Step 4	**pvc** [*name*] *vpi*/*vci* [**ilmi**	**qsaal**	**smds**	**l2transport**] **Example:** `Device(config-if)# pvc cisco 0/16`	(Optional) Creates or assigns a name to an ATM permanent virtual circuit (PVC), specifies the encapsulation type on an ATM PVC, and enters ATM virtual circuit configuration mode. **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 below.
Step 5	**exit** **Example:** `Device(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 above. If you are not attaching the policy map to an ATM PVC, advance to Step 6 below.
Step 6	**service-policy** {**input**	**output**} *policy-map-name* **Example:** `Device(config-if)# service-policy input policy1`	Attaches a policy map to an input or output interface. **Note** Policy maps can be configured on ingress or egress devices. They can also be attached in the input or output direction of an interface. The direction (input or output) and the device (ingress or egress) to which the policy map should be attached vary according your network configuration. When using the **service-policy** command to attach the policy map to an interface, be sure to choose the device and the interface direction that are appropriate for your network configuration.
Step 7	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.
Step 8	**show policy-map interface** *type number* **Example:** `Device# show policy-map interface serial4/0/0`	(Optional) Displays the traffic 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.

Configuration Examples for Marking Network Traffic

Example: Creating a Class Map for Marking Network Traffic

The following is an example of creating a class map to be used for marking network traffic. In this example, a class called class1 has been created. Ttraffic with a protocol type of FTP will be put in this class.

```
Device> enable
Device# configure terminal
```

```
Device(config)# class-map class1
Device(config-cmap)# match protocol ftp
Device(config-cmap)# end
```

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 the interface. In this example, the policy map called policy1 has been attached in the input direction to the serial interface 4/0/0.

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

Additional References for Marking Network Traffic

Related Documents

Related Topic	Document Title
Cisco 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

Related Topic	Document Title
Classifying network traffic	"Classifying Network Traffic" module

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 Marking Network Traffic

The following table provides release information about the feature or features described in this module. This 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.

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. An account on Cisco.com is not required.

Table 8: Feature Information for Marking Network Traffic

Feature Name	Software Releases	Feature Configuration Information
Class-Based Marking	12.2(2)T Cisco IOS XE Release 2.1 Cisco IOS XE Release 2.2 Cisco IOS XE Release 3.2SE	The Class-Based Packet Marking feature provides a user-friendly command-line interface (CLI) for efficient packet marking by which users can differentiate packets. This feature was implemented on Cisco ASR 1000 Series Routers. This feature was integrated into Cisco IOS XE Release 2.2.

Feature Name	Software Releases	Feature Configuration Information
Enhanced Packet Marking	12.2(13)T	The Enhanced Packet Marking feature allows you to map and convert the marking of a packet from one value to another by using a kind of conversion chart called a table map. The table map establishes an equivalency from one value to another. For example, the table map can map and convert the class of service (CoS) value of a packet to the precedence value of the packet. This value mapping can be propagated for use on the network, as needed.
QoS Packet Marking	12.2(8)T Cisco IOS XE Release 2.1 Cisco IOS XE Release 2.2 Cisco IOS XE Release 3.5S	The QoS Packet Marking feature allows you to mark packets by setting the IP precedence bit or the IP differentiated services code point (DSCP) in the Type of Service (ToS) byte, and to associate a local QoS group value with a packet. This feature was implemented on Cisco ASR 1000 Series Routers. This feature was integrated into Cisco IOS XE Software Release 2.2. In Cisco IOS XE Release 3.5S, support was added for the Cisco ASR 903 Router.
IP DSCP marking for Frame-Relay PVC	12.2(15)T Cisco IOS XE Release 2.1	This feature was implemented on Cisco ASR 1000 Series Routers.
PXF Based Frame Relay DE Bit Marking	12.2(31)SB2 15.0(1)S	PXF Based Frame Relay DE Bit Marking was integrated into the Cisco IOS Release 15.0(1)S release.