# 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.

### Module History

This module was first published on May 2, 2005, and last updated on May 2, 2005.

### Finding Feature Information in This Module

Your Cisco IOS software release may not support all features. To find information about feature support and configuration, use the "Feature Information for Marking Network Traffic" section on page 23.

## Contents



## Prerequisites for Marking Network Traffic

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


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# 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:
  - Fast EtherChannel
  - Tunnel
  - PRI
  - ATM switched virtual circuit (SVC)
  - Any interface that does not support CEF

# Information About Marking Network Traffic

To mark network traffic, you should understand the following concepts:

- Purpose of Marking Network Traffic, page 2
- Benefits of Marking Network Traffic, page 3
- Two Methods for Marking Traffic Attributes, page 3
- MQC and Network Traffic Marking, page 8
- Traffic Classification Compared with Traffic Marking, page 8

## 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
- DSCP value in the type of service (ToS) byte
- Discard eligible (DE) bit setting in the address field of a Frame Relay frame
- ToS bits in the header of an IP packet
- Multiprotocol Label Switching (MPLS) experimental (EXP) field on all imposed label entries
- MPLS EXP field value in the topmost label on either an input or an output interface
- Precedence value in the packet header
- QoS group identifier (ID)

# 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 low latency queuing (LLQ) can then be configured to put all packets of that mark into a priority queue. In this case, the marking was used to identify traffic for LLQ.
- 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 router. The router 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 Precedence, which have 64 and 8, respectively.
  - If changing the Precedence or DSCP value is undesirable.
- If a packet (for instance, in a traffic flow) needs to be marked to differentiate user-defined QoS services is leaving a router and entering a switch, the router 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.
- Weighted random early detection (WRED) uses precedence values or DSCP values to determine the probability that the traffic will be dropped. Therefore, the Precedence and DSCP can be used in conjunction with WRED.

# Two Methods for Marking Traffic Attributes

There are two methods for specifying and marking traffic attributes:

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

  With this method you configure individual **set** commands for the traffic attribute 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 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 you want to change with a **set** command configured in a policy map. Table 1 lists the available **set** commands and the corresponding attribute. Table 1 also includes the network layer and the network protocol typically associated with the traffic attribute.

***Table 1 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 IOS **set** commands can vary by release. See the command documentation for the Cisco IOS release you are using for more information.

If you are using individual **set** commands, those **set** commands are specified in a policy map. The following is a sample of a policy map configured with one of the **set** commands listed in Table 3.

In this sample configuration, the **set atm-clp** command has been configured in the policy map (policy1) to mark the CLP attribute.

```
enable
configure terminal
 policy-map policy1
  class class1
  set atm-clp
  end
```

For information on configuring a policy map, see the "Creating a Policy Map for Applying a QoS Feature to Network Traffic" section on page 11.

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 on page 14.

## 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
```

Table 2 lists the traffic attributes for which a to-from relationship can be established using the table map.

***Table 2 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 |

For information on creating a table map, see the "Creating a Table Map for Marking Network Traffic" section on page 10.

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 Table 3.

***Table 3 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 |

*Table 3 Commands Used in Policy Maps to Map Attributes (continued)*

| Command Used in Policy Maps | Maps These Attributes |
|---|---|
| **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.

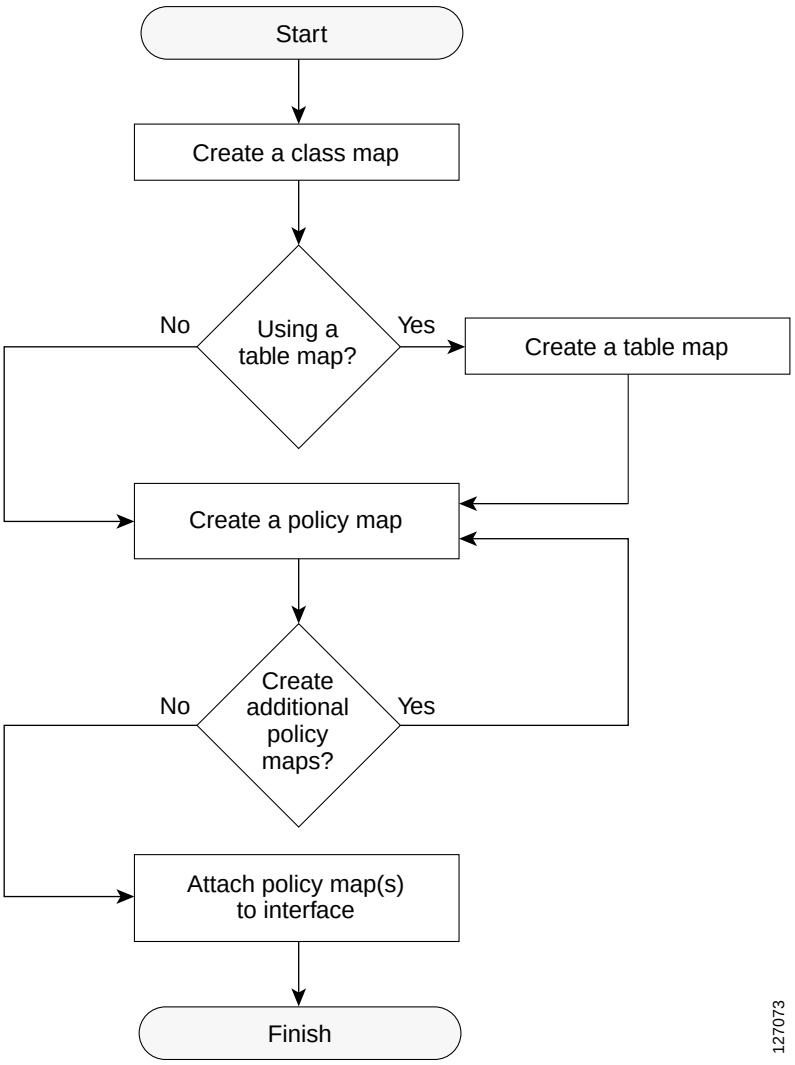
For information on configuring a policy map to use a table map, see the "Creating a Policy Map for Applying a QoS Feature to Network Traffic" section on page 11.

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 on page 14.

## Traffic Marking Procedure Flowchart

Figure 1 illustrates the order of the procedures for configuring traffic marking.

***Figure 1 Traffic Marking Procedure Flowchart***




For more information on class maps and policy maps, see the "MQC and Network Traffic Marking" section on page 8.

For more information on table maps, see the "Creating a Table Map for Marking Network Traffic" section on page 10.

For more information on completing the processes shown in this flow chart, see the "How to Mark Network Traffic" section on page 9.

# MQC and Network Traffic Marking

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

For more information about the MQC, see the "Modular Quality of Service Command-Line Interface" section of the *Cisco IOS Quality of Service Solutions Configuration Guide*, Release 12.3.

# 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 4 compares the features of traffic classification and traffic marking.

***Table 4 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 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 criterion | Uses the traffic classes and matching criterion specified by traffic classification<br><br>In addition, uses **set** commands (for example, **set cos**) in a policy map to modify the attributes for the network traffic.<br><br>If a table map was created, uses the **table** keyword and *table-map-name* 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 Mark Network Traffic

This section contains the following procedures.

- Creating a Class Map for Marking Network Traffic, page 9 (required)
- Creating a Table Map for Marking Network Traffic, page 10 (optional)
- Creating a Policy Map for Applying a QoS Feature to Network Traffic, page 11 (required)
- Attaching the Policy Map to an Interface, page 14 (required)
- Configuring QoS When Using IPSec VPNs, page 16 (optional)

## Creating a Class Map for Marking Network Traffic

In this procedure, you create a class map to define traffic classes. Within the class map, the appropriate **match** command is used to specify the matching criteria for the traffic classes.

To create the class map and specify the matching criteria, complete the following steps.

### SUMMARY STEPS

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

**Note** The **match fr-dlci** command is just an example of one of the **match** commands that can be used. See the command documentation for the Cisco IOS release you are using for a complete list of **match** commands.

5. **end**

### DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | `enable`<br><br>**Example:**<br>`Router> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | `configure terminal`<br><br>**Example:**<br>`Router# configure terminal` | Enters global configuration mode. |
| **Step 3** | `class-map` *class-map-name* `[match-all \| match-any]`<br><br>**Example:**<br>`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.<br>• Enter the class map name. |

| | Command or Action | Purpose |
|---|---|---|
| Step 4 | **match fr-dlci** *dlci-number*<br><br>**Example:**<br>`Router(config-cmap)# match fr-dlci 500` | (Optional) Specifies the Frame Relay DLCI number as a match criterion in a class map.<br><br>**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. The **match** commands vary by Cisco IOS release. See the command documentation for the Cisco IOS release you are using for a complete list of **match** commands. |
| Step 5 | **end**<br><br>**Example:**<br>`Router(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 "Creating a Policy Map for Applying a QoS Feature to Network Traffic" section on page 11.

The table map contains the mapping scheme used for establishing the to-from relationship and equivalency between one traffic-marking value and another.

The table map can be configured for use with *multiple* policy maps. The policy maps can then be configured to convert and propagate the traffic-marking values defined in the table map. Then the policy maps can be attached to the input or output interface of either the ingress or egress router, as appropriate to serve the QoS requirements of your network.

To create and configure the table map, complete the following steps.

## 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. **exit**

**DETAILED STEPS**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br><br>**Example:**<br>`Router> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br><br>**Example:**<br>`Router# 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*]<br><br>**Example:**<br>`Router(config)# table-map table-map1 map from 2 to 1` | Creates a table map using the specified name and enters tablemap configuration mode.<br>• Enter the name of the table map you want to create.<br>• Enter each value mapping on a separate line. Enter as many separate lines as needed for the values you want to map.<br>• The **default** keyword and *default-action-or-value* argument sets the default value (or action) to be used if a value is not explicitly designated. |
| **Step 4** | **exit**<br><br>**Example:**<br>`Router(config-tablemap)# exit` | (Optional) Exits tablemap configuration mode. |

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

In this procedure, you create and configure a policy map to use the class map (or the table map). The policy map applies the appropriate QoS feature to the network traffic based on the traffic classification.

To create a policy map, complete the following steps.

## Restrictions

- The **set atm-clp** command is supported on the following adapters only:
  - Enhanced ATM Port Adapter (PA-A3)
  - ATM Inverse Multiplexer over ATM Port Adapter with 8 T1 Ports (PA-A3-8T1IMA)
  - ATM Inverse Multiplexer over ATM Port Adapter with 8 E1 Ports (PA-A3-8E1IMA)
- 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 router.

- A policy map containing the **set cos** command can only be attached as an output traffic policy.
- A policy map containing the **set atm-clp** command can be attached as an output traffic policy only. The **set atm-clp** command does not support traffic that originates from the router.

## SUMMARY STEPS

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

   **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 Table 1 on page 4.

   or

   **set cos dscp table** *table-map-name*

   **Note** The **set cos dscp table** *table-map-name* command is an example of one of the commands that can be used. For a list of other commands, see Table 3 on page 5.
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`<br><br>**Example:**<br>`Router> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | `configure terminal`<br><br>**Example:**<br>`Router# configure terminal` | Enters global configuration mode. |
| **Step 3** | `policy-map` *policy-map-name*<br><br>**Example:**<br>`Router(config)# policy-map policy1` | Specifies the name of the policy map created earlier and enters policy-map configuration mode.<br>• Enter the policy map name. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 4** | **class** {*class-name* \| **class-default**}<br><br>**Example:**<br>`Router(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.<br>• Enter the name of the class or enter the **class-default** keyword. |
| **Step 5** | **set cos** *cos-value*<br><br>or<br>**set cos dscp table** *table-map-name*<br><br>**Example:**<br>`Router(config-pmap-c)# set cos 2`<br><br>or<br>**Example:**<br>`Router(config-pmap-c)# set cos dscp table table-map1` | (Optional) Sets the CoS value in the type of service (ToS) byte.<br>**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 Table 1 on page 4.<br>or<br>(Optional) If a table map has been created earlier, sets the CoS value based on the DSCP value (or action) defined in the table map.<br>**Note** The **set cos dscp table** *table-map-name* command is an example of one of the commands that can be used. For a list of other commands, see Table 3 on page 5. |
| **Step 6** | **end**<br><br>**Example:**<br>`Router(config-pmap-c)# end` | Returns to privileged EXEC mode. |

| | Command or Action | Purpose |
|---|---|---|
| Step 7 | **show policy-map**<br><br>or<br>**show policy-map** *policy-map* **class** *class-name*<br><br>**Example:**<br>`Router# show policy-map`<br><br>or<br>**Example:**<br>`Router# show policy-map policy1 class class7` | (Optional) Displays all configured policy maps.<br><br>or<br>(Optional) Displays the configuration for the specified class of the specified policy map.<br>• Enter the policy map name and the class name. |
| Step 8 | **exit**<br><br>**Example:**<br>`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 11. Then attach the policy maps to the appropriate interface, following the instructions in the "Attaching the Policy Map to an Interface" section on page 14.

# Attaching the Policy Map to an Interface

After you create the policy map, you must attach it to an interface. Policy maps can be attached to either the input or output direction of the 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).

To attach the policy map, complete the following steps.

### 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** *interface-name*
9. **exit**

## DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br><br>**Example:**<br>`Router> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br><br>**Example:**<br>`Router# configure terminal` | Enters global configuration mode. |
| **Step 3** | **interface** *type number* [**name-tag**]<br><br>**Example:**<br>`Router(config)# interface serial4/0` | Configures an interface type and enters interface configuration mode.<br>• Enter the interface type and number. |
| **Step 4** | **pvc** [*name*] *vpi*/*vci* [**ilmi** \|**qsaal** \|**smds** \| **l2transport**]<br><br>**Example:**<br>`Router(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.<br>• Enter the PVC name, the ATM network virtual path identifier, and the network virtual channel identifier.<br>**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**<br><br>**Example:**<br>`Router(config-atm-vc)# exit` | (Optional) Returns to interface configuration mode.<br>**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**} *policy-map-name*<br><br>**Example:**<br>`Router(config-if)# service-policy input policy1` | Attaches a policy map to an input or output interface.<br>• Enter the policy map name.<br>**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. |

| | Command or Action | Purpose |
|---|---|---|
| Step 7 | **end**<br><br>**Example:**<br>`Router(config-if)# end` | Returns to privileged EXEC mode. |
| Step 8 | **show policy-map interface** *interface-name*<br><br>**Example:**<br>`Router# show policy-map interface serial4/0` | (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.<br>• Enter the interface name. |
| Step 9 | **exit**<br><br>**Example:**<br>`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 *Cisco IOS Security Configuration Guide*, Release 12.3.

To configure QoS when using IPSec VPNs, complete the following steps.

## 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. **exit**

## DETAILED STEPS

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

# Configuration Examples for Marking Network Traffic

This section contains the following examples:



## Creating a Class Map for Marking Network Traffic: Example

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. The traffic with a Frame Relay DLCI value of 500 will be put in this class.

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

## Creating a Table Map for Marking Network Traffic: Example

In the following example, the **table-map** (value mapping) command has been used to create and configure a table map called table-map1. This table map will be used to establish a to-from relationship between one traffic-marking value and another.

In table-map1, a traffic-marking value of 0 will be mapped to a value of 1.

```
Router> enable
Router# configure terminal
Router(config)# table-map table-map1 map from 0 to 1
Router(config-tablemap)# exit
```

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

### Policy Map Configured to Use set Command

The following is an example of creating a policy map to be used for traffic marking. In this example, a policy map called policy1 has been created, and the **set dscp** command has been configured for class1.

```
Router> enable
Router# configure terminal
Router(config)# policy-map policy1
Router(config-pmap)# class class1
Router(config-pmap-c)# set dscp 2
Router(config-pmap-c)# end
Router# show policy-map class1
Router# exit
```

### Policy Map Configured to Use a Table Map

A policy map called policy2 has been created and configured to use table-map1 for setting the precedence value. In this example, the CoS value will be set according to the DSCP value defined in table-map1 created previously.

```
Router(config)# policy map policy1
Router(config-pmap)# class class-default
Router(config-pmap-c)# set cos dscp table table-map1
Router(config-pmap-c)# exit
```

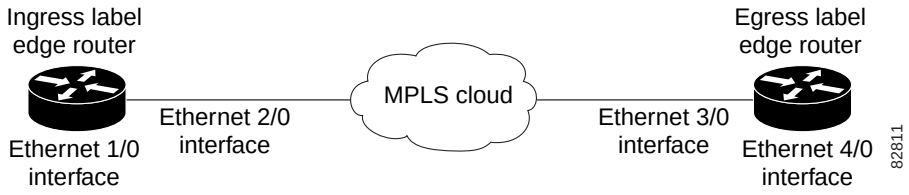
**Note** As an alternative to configuring the **set cos dscp table table-map1** command shown in the example, you could configure the command without specifying the **table** keyword and the applicable *table-map-name* argument (that is, you could configure the **set cos dscp** command). When the command is configured without the **table** keyword and applicable table map name, the values are copied from the specified categories. In this case, the DSCP value is copied and used to set the CoS value.

When the DSCP value is copied and used for the CoS value only the *first 3 bits* (that is, the class selector bits) of the DSCP value will be used to set the CoS value. For example, if the DSCP value is EF (101110), the first 3 bits of this DSCP value will be used to set the CoS value, resulting in a CoS value of 5 (101).

### Policy Map Configured to Use a Table Map for Mapping MLSP EXP Values

This section contains an example of a policy map configured to map MPLS experimental (EXP) values. Figure 2 illustrates the network topology for this configuration example.

***Figure 2 Network Topology for Mapping MPLS EXP Value***




For this configuration example, traffic arrives at the input interface (an Ethernet 1/0 interface) of the ingress label edge router (LER). The precedence value is copied and used as the MPLS EXP value of the traffic when the MPLS label is imposed. This label imposition takes place at the ingress LER.

The traffic leaves the ingress LER through the output interface (an Ethernet 2/0 interface), traverses through the network backbone into the MPLS cloud, and enters the egress LER.

At the input interface of the egress LER (an Ethernet 3/0 interface), the MPLS EXP value is copied and used as the QoS group value. At the output interface of the egress LER (an Ethernet 4/0 interface), the QoS group value is copied and used as the precedence value.

To accomplish configuration described above, three separate policy maps were required—policy1, policy2, and policy3. Each policy map is configured to convert and propagate different traffic-marking values.

The first policy map, policy1, is configured to copy the precedence value of the traffic and use it as the MPLS EXP value during label imposition.

```
Router(config)# policy map policy1
Router(config-pmap)# class class-default
Router(config-pmap-c)# set mpls experimental imposition precedence
Router(config-pmap-c)# exit
```

When the traffic leaves the LER through the output interface (the Ethernet 2/0 interface), the MPLS EXP value is copied from the precedence value during MPLS label imposition. Copying the MPLS EXP value from the precedence value ensures that the MPLS EXP value reflects the appropriate QoS treatment. The traffic now proceeds through the MPLS cloud into the egress LER.

A second policy map called policy2 has been configured to copy the MPLS EXP value in the incoming MPLS traffic to the QoS group value. The QoS group value is used for internal purposes only. The QoS group value can be used with output queueing on the output interface of the egress router. The QoS group value can also be copied and used as the precedence value, as traffic leaves the egress LER through the output interface (the Ethernet 4/0 interface).

```
Router(config)# policy map policy2
Router(config-pmap)# class class-default
Router(config-pmap-c)# set qos-group mpls experimental topmost
Router(config-pmap-c)# exit
```

A third policy map called policy3 has been configured to copy the internal QoS group value (previously based on the MPLS EXP value) to the precedence value. The QoS group value will be copied to the precedence value as the traffic leaves the egress LER through the output interface.

```
Router(config)# policy map policy3
Router(config-pmap)# class class-default
Router(config-pmap-c)# set precedence qos-group
Router(config-pmap-c)# exit
```

Configuring these policy maps as shown (and attaching them to interfaces as shown in "Attaching the Policy Map to an Interface: Example" section on page 21), causes the appropriate quality of service treatment to be preserved for the traffic as the traffic progresses along an IP network, through an MPLS cloud, and back again into an IP network.

**Note** This configuration could also have been accomplished by first creating a table map (used to map one value to another) and then specifying the **table** keyword and *table-map-name* argument in each of the **set** commands (for example, **set precedence qos-group table tablemap1**).

In the MPLS configuration example, a table map was not created, and the **set** commands were configured without specifying the **table** keyword and *table-map-name* argument (for example, **set precedence qos-group)**.

When the **set** commands are configured without specifying the **table** keyword and *table-map-name* argument, the values are copied from the specified categories. In this case, the QoS group value was copied and used to set the precedence value.

When the DSCP value is copied and used for the MPLS EXP value, only the *first 3 bits* (that is, the class selector bits) of the DSCP value will be used to set the MPLS value.

## Attaching the Policy Map to an Interface: Example

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 of the Serial4/0 interface.

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

## Configuring QoS When Using IPSec VPNs: Example

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 will be applied.

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

# Additional References

The following sections provide references related to marking network traffic.

## Related Documents

| 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*, Release 12.3 T |
| MQC | "Modular Quality of Service Command-Line Interface" section of the *Cisco IOS Quality of Service Solutions Configuration Guide*, Release 12.3 |
| CEF | *Cisco IOS Switching Services Configuration Guide*, Release 12.3 |
| Classifying network traffic | "Classifying Network Traffic" module |
| IPSec and VPNs | *Cisco IOS Security Configuration Guide*, Release 12.3 |
| Committed Access Rate (CAR) | "Classification" section of the *Cisco IOS Quality of Service Solutions Configuration Guide*, Release 12.3 |

| Related Topic | Document Title |
|---|---|
| Policy-based routing | *Cisco IOS Quality of Service Solutions Configuration Guide*, Release 12.3 |
| QoS policy propagation via Border Gateway Protocol (BGP) | *Cisco IOS Quality of Service Solutions Configuration Guide*, Release 12.3 |

## 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 releases, and feature sets, use Cisco MIB Locator found at the following URL:<br>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 Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content. | http://www.cisco.com/techsupport |

# Glossary

**ATM**—Asynchronous Transfer Mode. The international standard for cell relay in which multiple service types (such as voice, video, or data) are conveyed in fixed-length (53-byte) cells. Fixed-length cells allow cell processing to occur in hardware, thereby reducing transit delays. ATM is designed to take advantage of high-speed transmission media, such as E3, SONET, and T3.

**CoS**—class of service. An indication of how an upper-layer protocol requires a lower-layer protocol to treat its messages. A CoS definition comprises a virtual route number and a transmission priority field.

**DLCI**—data-link connection identifier. A value that specifies a PVC or a switched virtual circuit (SVC) in a Frame Relay network. In the basic Frame Relay specification, DLCIs are locally significant (connected devices might use different values to specify the same connection). In the Local Management Interface (LMI) extended specification, DLCIs are globally significant (DLCIs specify individual end devices).

**IPSec**—IP Security. A framework of open standards that provides data confidentiality, data integrity, and data authentication between participating peers. IPSec provides these security services at the IP layer. IPSec uses Internet Key Exchange (IKE) to handle the negotiation of protocols and algorithms based on local policy and to generate the encryption and authentication keys to be used by IPSec. IPSec can protect one or more data flows between a pair of hosts, between a pair of security gateways, or between a security gateway and a host.

**LER—**label edge router. LERs are typically used in a Multiprotocol Label Switching network.

**MPLS**—Multiprotocol Label Switching. A switching method that forwards IP traffic using a label. This label instructs the routers and the switches in the network where to forward the packets based on preestablished IP routing information

**PVC**—permanent virtual circuit (or connection). A virtual circuit that is permanently established. PVCs save bandwidth associated with circuit establishment and tear down in situations where certain virtual circuits must exist all the time. In ATM terminology, called a permanent virtual connection.

**VPN**—Virtual Private Network. A network that enables traffic to travel securely over a public or shared network. An IPSec VPN uses encryption and tunneling, encapsulating private IP packets into IPSec-encrypted packets to protect information at the IP level.

**Note** See *Internetworking Terms and Acronyms* for terms not included in this glossary.

# Feature Information for Marking Network Traffic

Table 5 lists the features in this module and provides links to specific configuration information. Only features that were introduced or modified in Cisco IOS Releases 12.2(1)T or later appear in the table.

Not all commands may be available in your Cisco IOS software release. For details on when support for specific commands was introduced, see the command reference documents.

Cisco IOS software images are specific to a Cisco IOS software release, a feature set, and a platform. Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

**Note** Table 5 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

***Table 5 Feature Information for Marking Network Traffic***

| 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.<br>The following sections provide information about this feature:<br>• Information About Marking Network Traffic, page 2<br>• How to Mark Network Traffic, page 9 |
| QoS Packet Marking | 12.2(8)T | 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 associate a local QoS group value with a packet.<br>The following sections provide information about this feature:<br>• Information About Marking Network Traffic, page 2<br>• How to Mark Network Traffic, page 9 |

*Table 5 Feature Information for Marking Network Traffic*

| Feature Name | Software Releases | Feature Configuration Information |
|---|---|---|
| Class-Based Marking | 12.2(2)T | The Class-Based Packet Marking feature provides users with a user-friendly command-line interface (CLI) for efficient packet marking by which users can differentiate packets based on the designated markings.<br>The following sections provide information about this feature:<br>• Information About Marking Network Traffic, page 2<br>• How to Mark Network Traffic, page 9 |
| Quality of Service for Virtual Private Networks | 12.2(2)T | The QoS for VPNs feature provides a solution for making Cisco IOS QoS services operate in conjunction with tunneling and encryption on an interface. Cisco IOS software can classify packets and apply the appropriate QoS service before the data is encrypted and tunneled. The QoS for VPN feature allows users to look inside the packet so that packet marking can be done based on original port numbers and based on source and destination IP addresses. This allows the service provider to treat mission critical or multi-service traffic with higher priority across their network.<br>The following sections provide information about this feature:<br>• Configuring QoS When Using IPSec VPNs, page 16<br>• Configuring QoS When Using IPSec VPNs: Example, page 21 |


This module first published May 2, 2005. Last updated May 2, 2005.