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, on page 1
- Prerequisites for Marking Network Traffic, on page 1
- Restrictions for Marking Network Traffic, on page 1
- Information About Marking Network Traffic, on page 2
- How to Mark Network Traffic, on page 6
- Configuration Examples for Marking Network Traffic, on page 11
- Additional References for Marking Network Traffic, on page 12
- Feature Information for Marking Network Traffic, on page 13

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 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

-
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:

- CoS value of an outgoing packet
- Discard-class value
- 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 queuing 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.

• 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.

How to Mark 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. This method is further described in the section that follows.

Mark Traffic Attributes 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 1: set Commands and Corresponding Traffic Attribute, Network Layer, and Protocol

<table>
<thead>
<tr>
<th>set Commands</th>
<th>Traffic Attribute</th>
<th>Network Layer</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>set cos</td>
<td>Layer 2 CoS value of the outgoing traffic</td>
<td>Layer 2</td>
<td></td>
</tr>
<tr>
<td>set discard-class</td>
<td>discard-class value</td>
<td>Layer 2</td>
<td></td>
</tr>
<tr>
<td>set dscp</td>
<td>DSCP value in the ToS byte</td>
<td>Layer 3</td>
<td>IP</td>
</tr>
<tr>
<td>set mpls experimental imposition</td>
<td>MPLS EXP field on all imposed label entries</td>
<td>Layer 3</td>
<td>MPLS</td>
</tr>
<tr>
<td>set mpls experimental topmost</td>
<td>MPLS EXP field value in the topmost label on either an input or an output interface</td>
<td>Layer 3</td>
<td>MPLS</td>
</tr>
<tr>
<td>set precedence</td>
<td>Precedence value in the packet header</td>
<td>Layer 3</td>
<td>IP</td>
</tr>
<tr>
<td>set qos-group</td>
<td>QoS group ID</td>
<td>Layer 3</td>
<td>IP, MPLS</td>
</tr>
</tbody>
</table>

1 Cisco set commands can vary by release. For more information, see the command documentation for the Cisco release that you are using.
The `set qos-group` can be used for L2 traffic on the Cisco ASR 900 RSP3 Module.

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

**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

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 2: Traffic Classification Compared with Traffic Marking

<table>
<thead>
<tr>
<th>Feature</th>
<th>Traffic Classification</th>
<th>Traffic Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal</strong></td>
<td>Groups network traffic into specific traffic classes on the basis of whether the traffic matches the user-defined criterion.</td>
<td>After the network traffic is grouped into traffic classes, modifies the attributes for the traffic in a particular traffic class.</td>
</tr>
<tr>
<td><strong>Configuration Mechanism</strong></td>
<td>Uses class maps and policy maps in the MQC.</td>
<td>Uses class maps and policy maps in the MQC.</td>
</tr>
<tr>
<td><strong>CLI</strong></td>
<td>In a class map, uses <strong>match</strong> commands (for example, <strong>match cos</strong>) to define the traffic matching criteria.</td>
<td>Uses the traffic classes and matching criteria specified by traffic classification. In addition, uses <strong>set</strong> commands (for example, <strong>set cos</strong>) in a policy map to modify the attributes for the network traffic.</td>
</tr>
</tbody>
</table>

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**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**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>
### Creating a Table Map for Marking Network Traffic

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**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

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.

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Marking Network Traffic

Creating a Table Map for Marking Network Traffic

Purpose

**Step 2**

Configure `terminal` Example:

Device# configure terminal

**Step 3**

Configure `class-map class-map-name [match-all | match-any]` Example:

Device(config)# class-map class1

**Step 4**

Configure `match protocol protocol-name` Example:

Device(config-cmap)# match protocol ftp

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.

**Step 5**

Configure `end` Example:

Device(config-cmap)# end

(Conditional) Returns to privileged EXEC mode.

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---
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3 table-map table-map-name map from from-value to to-value [default default-action-or-value]</td>
<td>Creates a table map using the specified name and enters tablemap configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# table-map table-map1 map from 2 to 1</td>
<td></td>
</tr>
<tr>
<td>Step 4 end</td>
<td>(Optional) Exits tablemap configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config-tablemap)# end</td>
<td></td>
</tr>
</tbody>
</table>

**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:

- 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

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** | enable | Enables privileged EXEC mode.  
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

SUMMARY STEPS

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

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface type number [name-tag]</td>
<td>Configures an interface type and enters interface configuration mode.</td>
</tr>
<tr>
<td>Example: Device(config)# interface serial4/0/0</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> pvc [name] vpi/vci [ilmii</td>
<td>qsaal</td>
</tr>
<tr>
<td>Example: Device(config-if)# pvc cisco 0/16</td>
<td><strong>Note</strong> 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.</td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td>5</td>
<td>exit</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td>Device(config-atm-vc)# exit</td>
</tr>
<tr>
<td>6</td>
<td>service-policy {input</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# service-policy input policy1</td>
</tr>
<tr>
<td>7</td>
<td>end</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# end</td>
</tr>
<tr>
<td>8</td>
<td>show policy-map interface type number</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td>Device# show policy-map interface serial4/0/0</td>
</tr>
</tbody>
</table>

## 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. Traffic 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 Ethernet interface 0.

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

Additional References for Marking Network Traffic

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
</tr>
<tr>
<td>QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples</td>
<td>Cisco IOS Quality of Service Solutions Command Reference</td>
</tr>
<tr>
<td>MQC</td>
<td>“Applying QoS Features Using the MQC” module</td>
</tr>
<tr>
<td>Classifying network traffic</td>
<td>“Classifying Network Traffic” module</td>
</tr>
</tbody>
</table>
Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>

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 3: Feature Information for Marking Network Traffic

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Software Releases</th>
<th>Feature Configuration Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class-Based Marking</td>
<td>Cisco IOS XE Release 2.1</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>Cisco IOS XE Release 2.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cisco IOS XE Release 3.2SE</td>
<td></td>
</tr>
<tr>
<td>Enhanced Packet Marking</td>
<td>Cisco IOS XE Release 3.9S</td>
<td>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. In Cisco IOS XE Release 3.9S, support was added for the Cisco CSR 1000V Series Routers In Cisco IOS XE Release 3.14S, support was added for the Cisco 4000 Series Integrated Services Routers.</td>
</tr>
<tr>
<td></td>
<td>Cisco IOS XE Release 3.14S</td>
<td></td>
</tr>
</tbody>
</table>
## Feature Information for Marking Network Traffic

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Software Releases</th>
<th>Feature Configuration Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>QoS Packet Marking</td>
<td>Cisco IOS XE Release 2.1, 2.2, 3.5S, 3.9S, 3.14S</td>
<td>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. In Cisco IOS XE Release 3.9S, support was added for the Cisco CSR 1000V Series Routers. In Cisco IOS XE Release 3.14S, support was added for the Cisco 4000 Series Integrated Services Routers.</td>
</tr>
<tr>
<td>IP DSCP marking for Frame-Relay PVC</td>
<td>Cisco IOS XE Release 2.1</td>
<td>This feature was implemented on Cisco ASR 1000 Series Routers.</td>
</tr>
<tr>
<td>PXF Based Frame Relay DE Bit Marking</td>
<td>12.2(31)SB2, 15.0(1)S</td>
<td>PXF Based Frame Relay DE Bit Marking was integrated into the Cisco IOS Release 15.0(1)S release.</td>
</tr>
</tbody>
</table>