Classifying and Marking MPLS EXP

The QoS EXP Matching feature allows you to classify and mark network traffic by modifying the Multiprotocol Label Switching (MPLS) experimental bits (EXP) field in IP packets. This module contains conceptual information and the configuration tasks for classifying and marking network traffic using the MPLS EXP field.

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Finding Feature Information

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

- The router must be configured as an MPLS provider edge (PE) or provider (P) router, which can include the configuration of a valid label protocol and underlying IP routing protocols.

Restrictions for Classifying and Marking MPLS EXP

- MPLS classification and marking can only occur in an operational MPLS Network.
MPLS EXP classification and marking is supported on the main router interfaces for MPLS packet switching and imposition (simple IP imposition and Ethernet over MPLS (EoMPLS) imposition) and on Ethernet virtual circuits (EVCs) or Ethernet flow points (EFPs) for EoMPLS imposition.

MPLS EXP classification or marking for bridged MPLS packets on EVCs or EFPs is not supported.

MPLS EXP marking is supported only in the ingress direction.

If a packet is classified by IP type of service (ToS) or class of service (CoS) at ingress, it cannot be reclassified by MPLS EXP at egress (imposition case). However, if a packet is classified by MPLS at ingress it can be reclassified by IP ToS, CoS, or Quality of Service (QoS) group at egress (disposition case).

If a packet is encapsulated in MPLS, the MPLS payload cannot be checked for other protocols such as IP for classification or marking. Only MPLS EXP marking affects packets encapsulated by MPLS.

Information About Classifying and Marking MPLS EXP

Classifying and Marking MPLS EXP Overview

The QoS EXP Matching feature allows you to organize network traffic by setting values for the MPLS EXP field in MPLS packets. By choosing different values for the MPLS EXP field, you can mark packets so that packets have the priority that they require during periods of congestion. Setting the MPLS EXP value allows you to:

- Classify traffic

  The classification process selects the traffic to be marked. Classification accomplishes this by partitioning traffic into multiple priority levels, or classes of service. Traffic classification is the primary component of class-based QoS provisioning. For more information, see the “Classifying Network Traffic” module.

- Police and mark traffic

  Policing causes traffic that exceeds the configured rate to be discarded or marked to a different drop level. Marking traffic is a way to identify packet flows to differentiate them. Packet marking allows you to partition your network into multiple priority levels or classes of service. For more information, see the “Marking Network Traffic” module.

MPLS Experimental Field

The MPLS experimental bits (EXP) field is a 3-bit field in the MPLS header that you can use to define the QoS treatment (per-hop behavior) that a node should give to a packet. In an IP network, the DiffServ Code Point (DSCP) (a 6-bit field) defines a class and drop precedence. The EXP bits can be used to carry some of the information encoded in the IP DSCP and can also be used to encode the dropping precedence.

By default, Cisco IOS Software copies the three most significant bits of the DSCP or the IP precedence of the IP packet to the EXP field in the MPLS header. This action happens when the MPLS header is initially imposed on the IP packet. However, you can also set the EXP field by defining a mapping between the DSCP or IP precedence and the EXP bits. This mapping is configured using the set mpls experimental or police commands. For more information, see the “How to Classify and Mark MPLS EXP” section.
Benefits of MPLS EXP Classification and Marking

If a service provider does not want to modify the value of the IP precedence field in packets transported through the network, they can use the MPLS EXP field value to classify and mark IP packets.

By choosing different values for the MPLS EXP field, you can mark critical packets so that those packets have priority if network congestion occurs.

How to Classify and Mark MPLS EXP

Classifying MPLS Encapsulated Packets

| Note | MPLS EXP topmost classification is not supported for bridged MPLS packets on Ethernet virtual circuits (EVC) or Ethernet flow points (EFP). |

SUMMARY STEPS

1. enable
2. configure terminal
3. class-map [match-all | match-any] class-map-name
4. match mpls experimental topmost mpls-exp-value
5. 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: Router&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: Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> class-map [match-all</td>
<td>match-any] class-map-name</td>
</tr>
<tr>
<td>Example: Router(config)# class-map exp3</td>
<td>• Enter the class map name.</td>
</tr>
<tr>
<td><strong>Step 4</strong> match mpls experimental topmost mpls-exp-value</td>
<td>Specifies the match criteria.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Router(config-cmap)# match mpls experimental topmost 3</td>
<td>Note: The <code>match mpls experimental topmost</code> command classifies traffic on the basis of the EXP value in the topmost label header.</td>
</tr>
<tr>
<td>Step 5 end</td>
<td>(Optional) Returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>

**Marking MPLS EXP on All Imposed Labels**

Perform this task to set the value of the MPLS EXP field on all imposed label entries.

**Before you begin**

The router supports MPLS EXP marking only in the ingress direction.

In typical configurations, marking MPLS packets at imposition is used with ingress classification on IP ToS or CoS fields. However, generic matching with the class default value is supported with other ingress attributes such as `vlan`.

---

**Note**

For IP imposition marking, the IP precedence value is copied to the MPLS EXP value by default.

**Note**

For EVC configuration, a policy map that performs matching based on the CoS and that sets the EXP imposition value should be used to copy CoS values to the EXP value.

**Note**

The `set mpls experimental imposition` command works only on packets that have new or additional MPLS labels added to them.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `policy-map policy-map-name`
4. `class class-map-name`
5. `set mpls experimental imposition mpls-exp-value`
6. `end`
### Marking MPLS EXP on Label Switched Packets

Perform this task to set the MPLS EXP field on label switched packets.

#### Before you begin

- **Note**
  - The `set mpls experimental topmost` command works only on packets that are already MPLS encapsulated.

- **Note**
  - The router supports MPLS EXP marking in the ingress direction only, and does not support MPLS EXP classification or marking for bridged MPLS packets on EVCs or EFPs.

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable Example: Router> enable | Enables privileged EXEC mode.  
  - Enter your password if prompted. |
| **Step 2** configure terminal Example: Router# configure terminal | Enters global configuration mode. |
| **Step 3** policy-map policy-map-name Example: Router(config)# policy-map mark-up-exp-2 | Specifies the name of the policy map to be created and enters policy-map configuration mode.  
  - Enter the policy map name. |
| **Step 4** class class-map-name Example: Router(config-pmap)# class prec012 | Creates a class map to be used for matching traffic to a specified class, and enters class-map configuration mode.  
  - Enter the class map name. |
| **Step 5** set mpls experimental imposition mpls-exp-value Example: Router(config-pmap-c)# set mpls experimental imposition 2 | Sets the value of the MPLS EXP field on all imposed label entries. |
| **Step 6** end Example: Router(config-pmap-c)# end | (Optional) Returns to privileged EXEC mode. |
**SUMMARY STEPS**

1. enable
2. configure terminal
3. policy-map *policy-map-name*
4. class *class-map-name*
5. set mpls experimental topmost *mpls-exp-value*
6. 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: Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong> Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> policy-map <em>policy-map-name</em></td>
<td>Specifies the name of the policy map to be created and enters policy-map configuration mode.</td>
</tr>
<tr>
<td>Example: Router(config)# policy-map mark-up-exp-2</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> class <em>class-map-name</em></td>
<td>Creates a class map to be used for matching traffic to a specified class, and enters class-map configuration mode.</td>
</tr>
<tr>
<td>Example: Router(config-pmap)# class-map exp012</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> set mpls experimental topmost <em>mpls-exp-value</em></td>
<td>Sets the MPLS EXP field value in the topmost label on the output interface.</td>
</tr>
<tr>
<td>Example: Router(config-pmap-c)# set mpls experimental topmost 2</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> end</td>
<td>(Optional) Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Router(config-pmap-c)# end</td>
<td></td>
</tr>
</tbody>
</table>

**Configuring Conditional Marking**

To conditionally set the value of the MPLS EXP field on all imposed label, perform the following task:
Before you begin

Note
The set-mpls-exp-topmost-transmit action affects MPLS encapsulated packets only. The set-mpls-exp-imposition-transmit action affects any new labels that are added to the packet.

SUMMARY STEPS

1. enable
2. configure terminal
3. policy-map policy-map-name
4. class class-map-name
5. police cir bps bc pir bps be
8. violate-action drop
9. 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: Router&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: Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> policy-map policy-map-name</td>
<td>Specifies the name of the policy map to be created and enters policy-map configuration mode.</td>
</tr>
<tr>
<td>Example: Router(config)# policy-map ip2tag</td>
<td>• Enter the policy map name.</td>
</tr>
<tr>
<td><strong>Step 4</strong> class class-map-name</td>
<td>Creates a class map to be used for matching traffic to a specified class, and enters policy-map class configuration mode.</td>
</tr>
<tr>
<td>Example: Router(config-pmap)# class iptcp</td>
<td>• Enter the class map name.</td>
</tr>
<tr>
<td><strong>Step 5</strong> police cir bps bc pir bps be</td>
<td>Defines a policer for classified traffic and enters policy-map class policer configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
</tbody>
</table>
Configuration Examples for Classifying and Marking MPLS EXP

Example: Classifying MPLS Encapsulated Packets

Defining an MPLS EXP Class Map

The following example defines a class map named exp3 that matches packets that contains MPLS experimental value 3:

Router(config)# class-map exp3
Router(config-cmap)# match mpls experimental topmost 3
Router(config-cmap)# exit
Defining a Policy Map and Applying the Policy Map to an Ingress Interface

The following example uses the class map created in the example above to define a policy map. This example also applies the policy map to a physical interface for ingress traffic.

```
Router(config)# policy-map change-exp-3-to-2
Router(config-pmap)# class exp3
Router(config-pmap-c)# set mpls experimental topmost 2
Router(config-pmap-c)# exit
Router(config)# interface GigabitEthernet 0/0/0
Router(config-if)# service-policy input change-exp-3-to-2
Router(config-if)# exit
```

Defining a Policy Map and Applying the Policy Map to an Egress Interface

The following example uses the class map created in the example above to define a policy map. This example also applies the policy map to a physical interface for egress traffic.

```
Router(config)# policy-map WAN-out
Router(config-pmap)# class exp3
Router(config-pmap-c)# shape average 10000000
Router(config-pmap-c)# exit
Router(config-pmap)# exit
Router(config)# interface GigabitEthernet 0/0/0
Router(config-if)# service-policy output WAN-out
Router(config-if)# exit
```

Example: Marking MPLS EXP on All Imposed Labels

Defining an MPLS EXP Imposition Policy Map

The following example defines a policy map that sets the MPLS EXP imposition value to 2 based on the IP precedence value of the forwarded packet:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# class-map prec012
Router(config-cmap)# match ip prec 0 1 2
Router(config-cmap)# exit
Router(config)# policy-map mark-up-exp-2
Router(config-pmap)# class prec012
Router(config-pmap-c)# set mpls experimental imposition 2
Router(config-pmap-c)# exit
Router(config-pmap)# exit
```

Applying the MPLS EXP Imposition Policy Map to a Main Interface

The following example applies a policy map to Gigabit Ethernet interface 0/0/0:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface GigabitEthernet 0/0/0
Router(config-if)# service-policy input mark-up-exp-2
Router(config-if)# exit
```
Applying the MPLS EXP Imposition Policy Map to an EVC

The following example applies a policy map to the Ethernet Virtual Connection specified by the 
 serviço instance command:

Example: Marking MPLS EXP on Label Switched Packets

Defining an MPLS EXP Label Switched Packets Policy Map

The following example defines a policy map that sets the MPLS EXP topmost value to 2 according 
to the MPLS EXP value of the forwarded packet:

Example: Configuring Conditional Marking

The example in this section creates a policer for the iptcp class, which is part of the ip2tag policy 
map, and attaches the policy map to the Gigabit Ethernet interface.
Router(config-pmap-c-police)# violate-action drop
Router(config-pmap-c-police)# exit
Router(config-pmap-c)# exit
Router(config-pmap)# exit
Router(config)# interface GigabitEthernet 0/0/1
Router(config-if)# service-policy input ip2tag

Additional References

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
</tr>
<tr>
<td>QoS commands</td>
<td>Cisco IOS Quality of Service Solutions Command Reference</td>
</tr>
<tr>
<td>Classifying network traffic</td>
<td>“Classifying Network Traffic” module</td>
</tr>
<tr>
<td>Marking network traffic</td>
<td>“Marking Network Traffic” module</td>
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</table>

Standards and RFCs

<table>
<thead>
<tr>
<th>Standard/RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No new or modified standards are supported, and support for existing standards has not been modified.</td>
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</tbody>
</table>

MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
<tr>
<td></td>
<td>No new or modified MIBs are supported, and support for existing MIBs has not been modified.</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 Classifying and Marking MPLS EXP

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 1: Feature Information for Classifying and Marking MPLS EXP

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>QoS EXP Matching</td>
<td>Cisco IOS XE Release 3.5S</td>
<td>QoS EXP matching allows you to classify and mark packets using the MPLS EXP field.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In Cisco IOS XE Release 3.5S, this feature was introduced on the Cisco ASR 903 Router.</td>
</tr>
</tbody>
</table>