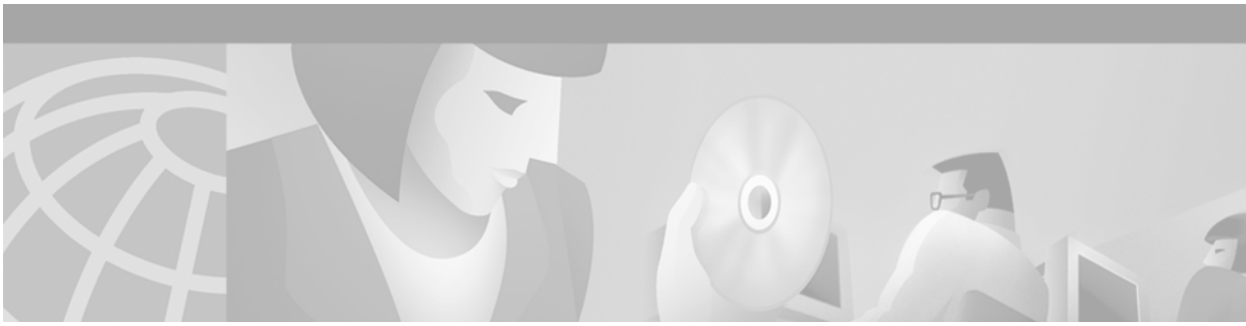


Ethernet over MPLS for the Cisco 7600 Series Internet Router

This feature module describes the Ethernet over Multiprotocol Label Switching (MPLS) feature, which transports Layer 2 VLAN packets across an MPLS backbone. This document contains information about the benefits of Ethernet over MPLS (EoMPLS) and lists supported platforms. It also provides configuration tasks, examples and related commands.

This document includes the following sections:

Feature Overview

This feature allows you to connect two VLAN networks that are in different locations, without using expensive bridges, routers, or switches at the VLAN locations. You can enable the MPLS backbone network to accept Layer 2 VLAN traffic by configuring the label edge routers (LERs) at the both ends of the MPLS backbone.

Adding a point-to-point virtual circuit (VC) requires you to configure the two VC endpoints at the two label edge routers. Only the two LERs at the ingress/egress points of the MPLS backbone know about the VCs dedicated to transporting Layer 2 VLAN traffic. All other routers do not have table entries for the VCs dedicated to transporting layer 2 VLAN traffic.

Multilevel Labeling

Label edge routers (LERs) connected to the MPLS backbone perform label imposition and disposition. The imposition LER encapsulates the Layer 2 VLAN packet into an MPLS PDU to transport it across the backbone to the disposition LER. The disposition LER takes the MPLS PDU, de-encapsulates the Layer 2 VLAN packet, and delivers it to the correct interface.

When the imposition LER encapsulates a Layer 2 VLAN packet to route it across the MPLS backbone, it includes a label stack with two levels of labels:

- An Internal Gateway Protocol (IGP) stack, also known as a tunnel label
- A VC-based label

The MPLS backbone uses the IGP labels to transport the VLAN packet from the ingress to the egress LER. The egress LSR uses the VC-based label to select the outgoing interface for the VLAN packet.

Quality of Service Support

Ethernet over MPLS provides Quality of Service (QoS) using the three experimental bits in a label to determine the priority of packets. To support QoS between LERs, you set the experimental bits in both the VC and tunnel labels. The experimental bits need to be set in the VC label because the tunnel label is popped at the penultimate router.

Benefits

As Internet service providers (ISPs) begin to deploy IP/MPLS backbones, services including frame switching must be supported. The Ethernet over MPLS feature allows an ISP to transport Layer 2 VLAN frames over an MPLS backbone.

Restrictions

The following services are not supported with the Ethernet over MPLS feature:

- **Fragmentation and Reassembly:** Because Ethernet over MPLS does not allow packets to be fragmented and reassembled, ensure that the maximum transmission unit (MTU) of all intermediate links between endpoints is sufficient to carry the largest Layer 2 VLAN cell received.
- **MPLS:** Full MPLS support is not available on the Cisco 7600 Series Internet Router, except as described in this document. MPLS is enabled to the extent that it allows the use of LDP to negotiate next hop and VC labels required for Ethernet over MPLS.The ability to transfer packets from IP to MPLS, MPLS to MPLS, and MPLS to IP is not supported.
- **Implicit Null Labels:** Ethernet over MPLS supports implicit null labels only. Explicit null labels are not supported.
- **Address Format:** When OSPF is used as the IGP, all loopback addresses on PE routers must be configured with 32-bit masks to ensure proper operation of MPLS forwarding between PE routers.
- **Packet Format:** EoMPLS supports VLAN packets that conform to the IEEE's 802.1Q standard. The 802.1Q specification establishes a standard method for inserting virtual LAN (VLAN) membership information into Ethernet frames.

- **Preserving 802.1 P bits and IP precendence bits:** In order to preserve both 802.1q P bits and IP precedence bits, disable QoS globally. Once the QoS is enabled on a Layer 2 port, either 802.1q P bits or IP precedence bits can be preserved with the trusted configuration. However, the unpreserved bits are automatically overwritten by the value of preserved bits. For instance, If you preserve the P bits, the IP precedence bits are overwritten with the value of the P bits.
- **Private VLANs:** EoMPLS is not supported with private VLANs.
- **Ethernet over MPLS and Trunks:** The following restrictions apply to using trunks with Ethernet over MPLS. For more information, see the Cisco 7600 Series Internet Router software documentation at the following URL: (http://www.cisco.com/univercd/cc/td/doc/product/core/cis7600/index.htm)
  - **Spanning Tree:** To support Ethernet spanning tree bridge protocol data units (BPDUs) across an EoMPLS cloud, you must disable the supervisor engine spanning tree for the Ethernet over MPLS VLAN. This ensures that the EoMPLS VLANs are carried only on the trunk to the customer switch. Otherwise, the BPDUs are directed to the supervisor engine and not to the EoMPLS cloud.
  - **Native VLAN:** The native VLAN of a trunk must not be configured as an EoMPLS VLAN.

Related Documents

Refer to the following documents for more information:

- *MPLS Label Distribution Protocol*
- Cisco 7600 Series Internet Router Hardware and Software documentation
- *Configuring the Modular Quality of Service Command-Line Interface*
- *Modular Quality of Service Command-Line Interface Overview*

Supported Platforms

The Ethernet over MPLS feature is supported on the following router at the edge:

- Cisco 7600 Series Internet Router with 4-port Gigabit Ethernet WAN modules

Supported Standards, MIBs, and RFCs

Standards

This feature supports the following IETF draft documents:

- *Transport of Layer 2 Frames Over MPLS*, draft-martini-l2circuit-trans-mpls-05.txt. This document can be accessed at the following URL:

  http://search.ietf.org/internet-drafts/draft-martini-l2circuit-trans-mpls-05.txt
- *Encapsulation Methods for Transport of Layer 2 Frames Over MPLS*, draft draft-martini-l2circuit-encap-mpls-01.txt. This document can be accessed at the following URL:

  http://search.ietf.org/internet-drafts/draft-martini-l2circuit-encap-mpls-01.txt

MIBs

None.

RFCs

This feature supports the following RFCs:

- *RFC 3032: MPLS Label Stack Encoding*. The document can be accessed at the following URL:

  http://www2.ietf.org/rfc/rfc3032.txt
- *RFC 3036: LDP Specification*. The document can be accessed at the following URL:

  http://www2.ietf.org/rfc/rfc3036.txt

Prerequisites

The following list outlines the prerequisites for this feature:

- You must enable dynamic IP labeling (through the command **mpls ip**) on all paths between the imposition and disposition LERs.
- You must enable VLANs on the switch portion of the router. For instructions, see the *Cisco 7600 OSR IOS Software Configuration Guide*, the chapter called "Configuring VLANs."
- You must association the VLAN to a physical Interface. See *Configuring LAN Ports for Layer 2 Switching* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/lan/cat6000/121_8aex/swconfig/layer2.htm

Configuration Tasks

Perform the following configuration tasks to enable Ethernet over MPLS:

1. **Enabling Ethernet Over MPLS** (Required)
2. **Verifying The Configuration** (Optional)
3. **Enabling Quality of Service** (Optional)

Enabling Ethernet Over MPLS

To configure MPLS to transport Layer 2 VLAN packets between two endpoints, perform the following steps on the provider edge (PE) routers.

Note When OSPF is used as the IGP, all loopback addresses on PE routers must be configured with 32-bit masks to ensure proper operation of MPLS forwarding between PE routers.

	Command	Purpose
Step 1	`Router(config)# mpls label protocol ldp`	Enables the label distribution protocol (LDP) for all interfaces. By default, tag distribution protocol is enabled. This command, although optional, causes all interfaces to use LDP.
Step 2	`Router(config)# interface vlan`*vlan-number*	Creates a VLAN interface and enters the interface configuration mode.
Step 3	`Router(config-if)# mpls l2transport route` *int-num vc-id*	Specifies the VC to use to transport the Layer 2 VLAN packets. The argument *int-num* specifies the loopback address of the remote router. The argument *vc-id* is a value you supply. It must be unique for each VC. The VC ID is used to connect the endpoints of the VC.

Verifying The Configuration

To verify and display the configuration of Layer 2 VLAN transport over MPLS tunnels, perform the following steps:

Step 1 To display a brief summary of IP status and configuration for all interfaces, issue the **show ip interface brief** command. If the interface can provide two-way communication, the Protocol field is marked "up." If the interface hardware is usable, the Status field is marked "up."

```
Router# show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
Vlan2                      10.1.2.58       YES NVRAM  up                    up
Vlan4                      unassigned      YES NVRAM  up                    up
Vlan101                    unassigned      YES NVRAM  up                    up
GigabitEthernet6/1         172.31.255.255  YES NVRAM  administratively down down
GigabitEthernet6/2         unassigned      YES NVRAM  administratively down down
GigabitEthernet6/3         172.31.255.255  YES NVRAM  up                    up
GigabitEthernet6/4         unassigned      YES NVRAM  administratively down down
Loopback0                  172.16.0.0      YES NVRAM  up
```

Step 2 To make sure the PE router endpoints have discovered each other, issue the **show mpls ldp discovery** command. The LDP targeted hello is for the router with address 153.20.0.1.When an PE router receives an LDP Hello message from another PE router, it considers that router and the specified label space to be "discovered."

```
Router# show mpls ldp discovery
Local LDP Identifier:
    172.31.255.255:0
Discovery Sources:
    Interfaces:
        GigabitEthernet6/3 (ldp): xmit/recv
        LDP Id: 192.168.2.10:0
    Targeted Hellos:
        172.16.0.1 -> 172.20.0.1 (ldp): active/passive, xmit/recv
        LDP Id: 172.20.0.1:0
```

Step 3 To make sure the label distribution session has been established, issue the **show mpls ldp neighbors** command. The third line of the output shows that the state of the LDP session is operational and shows that messages are being sent and received.

```
Router# show mpls ldp neighbors
Peer LDP Ident: 192.168.2.10:0; Local LDP Ident 172.16.0.1:0
    TCP connection: 192.168.2.10.646 - 172.16.0.1.11001
    State: Oper; Msgs sent/rcvd: 246/256; Downstream
    Up time: 01:36:12
    LDP discovery sources:
    GigabitEthernet6/3
Addresses bound to peer LDP Ident:
    172.16.0.22     172.20.0.1    192.168.2.68    172.22.0.2
    172.28.0.2
Peer LDP Ident: 172.20.0.1:0; Local LDP Ident 172.16.0.1:0
    TCP connection: 172.20.0.1.11002 - 172.16.0.1.646
    State: Oper; Msgs sent/rcvd: 127/125; Downstream
    Up time: 01:35:23
    LDP discovery sources:
    Targeted Hello 153.10.0.1 -> 153.20.0.1, active, passive
    Addresses bound to peer LDP Ident:
    172.16.0.22     172.20.0.1    192.168.2.68    172.22.0.2
    172.28.0.2
```

Step 4 To make sure the label forwarding table is built correctly, issue the **show mpls forwarding-table** command. The output shows the following data:

- Local tag—Label assigned by this router.
- Outgoing tag or VC—Label assigned by next hop, or VPI/VCI used to get to next hop.
- Prefix or Tunnel Id—Address or tunnel to which packets with this label are going.
- Bytes tag switched— Number of bytes switched with this incoming label.
- Outgoing interface—Interface through which packets with this label are sent.
- Next Hop—IP address of neighbor that assigned the outgoing label.

```
Router# show mpls forwarding-table
Local  Outgoing    Prefix              Bytes tag  Outgoing   Next Hop
tag    tag or VC   or Tunnel Id        switched   interface
16     Untagged    10.255.254.254/32   0          Vl2        192.168.0.1
17     Pop tag     172.30.0.0/16       0          Gi6/3      172.16.0.1
18     Pop tag     172.20.0.0/16       0          Gi6/3      172.16.0.1
19     148         172.29.0.0/16       0          Gi6/3      172.16.0.1
20     77          172.20.0.1/32       6308338115 Gi6/3      172.16.0.1
23     Untagged    EoMPLS(4)           94538      Vl4        point2point
24     Untagged    EoMPLS(101)         847        Vl101      point2point
```

Step 5 To view the state of the currently routed VCs issue the **show mpls l2transport vc** command.

```
Router# show mpls l2transport vc

Transport Client     VC       Local       Remote      Tunnel
VC ID     Intf       State    VC Label    VC Label    Label
4         Vl4        UP       23          21          77
101         Vl101    UP       24          22          77
```

Step 6 Add the keyword **detail** to see detailed information about each VC.

```
Router# show mpls l2transport vc detail

VC ID: 4, Local Group ID: 25, Remote Group ID: 17 (VC is up)
Client Intf: Vl4 is up, Destination: 172.21.0.1, Peer LDP Ident: 172.20.0.1:0
Local VC Label: 23, Remote VC Label: 21, Tunnel Label: 77
Outgoing Interface: Gi6/3, Next Hop: 153.1.0.1
Local MTU: 1500, Remote MTU: 1500
Imposition: LC Programmed
Current Imposition/Last Disposition Slot: 6/32
Packet Totals(in/out): 1334/1337
Byte Totals(in/out): 95248/100812

VC ID: 101, Local Group ID: 27, Remote Group ID: 19 (VC is up)
Client Intf: Vl101 is up, Destination: 172.21.0.1, Peer LDP Ident: 172.20.0.1:0
Local VC Label: 24, Remote VC Label: 22, Tunnel Label: 77
Outgoing Interface: Gi6/3, Next Hop: 153.1.0.1
Local MTU: 1500, Remote MTU: 1500
Imposition: LC Programmed
Current Imposition/Last Disposition Slot: 6/32
Packet Totals(in/out): 11/6211757
Byte Totals(in/out): 847/2065861499
```

Enabling Quality of Service

Ethernet over MPLS supports a limited set of QoS features. The following sections detail the Modular QoS CLI commands for enabling QoS on the ingress PE router.

Note Only the **shape** and **set mpls experimental** commands are supported. Within the **shape average** command, only the *cir* argument is valid for EoMPLS.

For more information on the commands used to enable Quality of Service, see the following documents:

- *Modular Quality of Service Command-Line Interface*

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fqos_c/fqcprt8/index.htm
- *Cisco IOS Quality of Service Solutions Command Reference*, Release 12.2

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fqos_r/index.htm

Setting the Priority of Packets with the Experimental Bits

Ethernet over MPLS provides Quality of Service (QoS) using the three experimental bits in a label to determine the priority of packets. To support QoS between LERs, set the experimental bits in both the VC and tunnel labels. If you do not assign values to the experimental bits, the priority bits in the 802.1q header's “tag control information” field and are written into the experimental bit fields.

Perform the following steps to set the experimental bits:

	Command	Purpose
Step 1	`Router(config)# class-map class-name`	Specifies the user-defined name of the traffic class.
Step 2	`Router(config-cmap)# match any`	Specifies that all packets will be matched. In this release, use only the **any** keyword for EoMPLS. Other keywords might cause unexpected results.
Step 3	`Router(config-cmap)# policy-map policy-name`	Specifies the name of the traffic policy to configure.
Step 4	`Router(config-pmap)# class class-name`	Specifies the name of a predefined traffic class, which was configured with the class-map command, used to classify traffic to the traffic policy.
Step 5	`Router (config-pmap-c)# set mpls experimental value`	Designates the value to which the MPLS bits are set if the packets match the specified policy map.
Step 6	`Router(config)# interface vlanvlan-number`	Enters the VLAN interface.
Step 7	`Router(config-if)# service-policy input policy-name`	Attaches a traffic policy to an interface.

Note You can enable traffic shaping and set experimental bits in the same policy-map.

Enabling Traffic Shaping

Traffic shaping limits the rate of transmission of data. Average rate shaping limits the transmission rate to the committed information rate (CIR). To add traffic shaping, issue the following commands:

	Command	Purpose
Step 1	`Router(config)# class-map class-name`	Specifies the user-defined name of the traffic class.
Step 2	`Router(config-cmap)# match any`	Specifies that all packets will be matched. In this release, use only the **any** keyword for EoMPLS. Other keywords might cause unexpected results.
Step 3	`Router(config-cmap)# policy-map policy-name`	Specifies the name of the traffic policy to configure.
Step 4	`Router(config-pmap)# class class-name`	Specifies the name of a predefined traffic class, which was configured with the class-map command, used to classify traffic to the traffic policy.
Step 5	`Router (config-pmap-c)# shape average bit-rate`	Shapes traffic according to the bit rate you specify.
Step 6	`Router(config)# interface vlanvlan-number`	Enters the VLAN interface.
Step 7	`Router(config-if)# service-policy input policy-name`	Assigns a traffic policy to an interface.

Displaying the Traffic Policy Assigned to an Interface

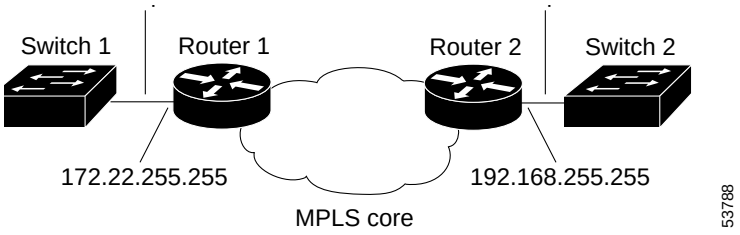
To display the traffic policy attached to an interface, issue the following command:

```
Router# show policy-map vlan50

service-policy input: badger

        class-map: blue (match-all)
          0 packets, 0 bytes
          30 second offered rate 0 bps, drop rate 0 bps
          match: any
          queue size 0, queue limit 2
          packets input 0, packet drops 0
          tail/random drops 0, no buffer drops 0, other drops 0
          shape: cir 2000000,  Bc 8000,  Be 8000
            output bytes 0, shape rate 0 bps

        class-map: class-default (match-any)
          0 packets, 0 bytes
          30 second offered rate 0 bps, drop rate 0 bps
          match: any
            0 packets, 0 bytes
            30 second rate 0 bps
```

Configuration Examples

The following sections list the commands for enabling MPLS to transport Layer 2 VLAN packets between two endpoints. Figure 1 illustrates the network configuration that the configuration commands reference.

Figure 1 Configuring Ethernet Over MPLS



Configuring Ethernet over MPLS

The commands for router 2 and router 3 configure Ethernet over MPLS to transport Layer 2 VLAN packets between two endpoints. The example includes the following assumptions:

- Dynamic MPLS switching is enabled between router 2 and router 3. Dynamic MPLS switching is should be enabled throughout the MPLS core.
- The sample configurations assume OSPF is used within the MPLS core to ensure that routers 2 and 3 have routes to the endpoints.

- In this example, each router has one loopback address. If you have multiple loopback addresses, the following commands are optional:
  - **mpls ldp discovery targeted-hello**
  - **passive-interface**
  - **ip access-list**

  The **mpls ldp discovery targeted-hello** command enables the router to respond to requests for targeted Hello messages. By default, the router ignores these requests from other routers. The argument *vlan-edge-acl* is an access list
- Operation of Ethernet over MPLS between router 1 and router 2 requires an LDP session between the two routers. Establishment of the LDP session requires that the IP address used by each router as its LDP router ID be IP-reachable from the other. The optional **mpls ldp router-id** command provides the means to control the selection of the LDP router ID by specifying an interface whose IP address should be used. You can use the comamnd without the optional **force** keyword if the specified interface is up and has an IP address. When the router ID is selected, that IP address is selected as the router ID. You can use the optional **force** keyword with the command to ensure that the IP address of the specified interface is used when that interface is up and has an IP address. See the *MPLS Label Distribution Protocol* feature module's explanation of the **force** keyword at the following URL:

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121limit/121e/121e8/8e_ldp.htm#xtocid1125353

Router 1 Configuration

```
interface Loopback0                             !Configure a loopback interface.
ip address 172.22.255.255 255.255.255.255

mpls label protocol ldp                         !Use LDP label distribution.
mpls ldp router-id loopback0
mpls ldp discovery targeted-hello accept from vlan-edge-acl

interface vlan1                                 !Configure a VLAN interface and specify
mpls l2transport route 192.168.255.255 50       !the VC ID for traffic over the VLAN.

interface gigabitethernet1/0                    !Configure interface to MPLS core.
ip address 172.16.2.2 255.255.255.0
no negotiation auto

router ospf 10                                  !Configure OSPF routing.
passive-interface Loopback0
network 172.22.255.255 0.0.0.0 area 0
network 192.16.255.255 0.0.0.255 area 0

ip access-list standard vlan-edge-acl           !Targeted hello access list
permit 192.168.255.255
```

Router 2 Configuration

```
interface Loopback0                             !Configure a loopback interface.
ip address 192.168.255.255 255.255.255.255

mpls label protocol ldp                         !Use LDP label distribution.
mpls ldp router-id loopback0
mpls ldp discovery targeted-hello accept from vlan-edge-acl

interface vlan2                                 !Configure a VLAN interface and specify
mpls l2transport route 172.22.255.255 50        !the VC ID for traffic over the VLAN.

interface gigabitethernet1/0                    !Configure interface to MPLS core.
ip address 172.16.7.3 255.255.255.0
no negotiation auto

router ospf 10                                  !Configure OSPF routing.
passive-interface Loopback0
network 192.168.255.255 0.0.0.0 area 0
network 172.16.255.255 0.0.0.255 area 0

ip access-list standard vlan-edge-acl           !Targeted hello access list
permit 172.22.255.255
```

Configuring Quality of Service

The following example show how to configure QoS on the VLAN.

```
class-map blue
match any
!
policy-map badger
class blue
set mpls experimental 1
shape average 2000000 8000 8000
!
interface vlan50
no ip address
no ip mroute-cache
load-interval 30
mpls l2transport route 192.168.255.255 50
service-policy input badger
no cdp enable
```

Command Reference

This section describes the following new commands:

- **mpls l2transport route**
- **show mpls l2transport vc**

mpls l2transport route

To enable routing of Layer 2 VLAN packets over a specified VC, use the **mpls l2transport route** interface command. To disable routing over the specified VC, use the **no** form of this command.

mpls l2transport route *destination vc-id*

no mpls l2transport route *destination vc-id*

Syntax Description

destination	Specifies IP address of the router to which the VC is destined.
vc-id	Assigns a VC ID to a router. The VC ID must be unique to each VC.

Defaults

No default behavior or values.

Command Modes

Interface configuration

Command History

Release	Modification
12.1(8a)E	This command was introduced.

Usage Guidelines

An MPLS Layer 2 VLAN VC runs across an MPLS cloud to connect VLAN interfaces on two PE routers.

Use this command on the VLAN interface of each PE router to route Layer 2 VLAN packets across the MPLS cloud to the VLAN interface of the other PE router. Specify the IP address of the other PE router for the *destination* parameter. Do not specify the IP address of the router from which you are issuing the command.

You can choose any number for the VC ID. However, the VC ID must be unique to the VC. Therefore, in large networks, it may be necessary to track the VC ID assignments to ensure that a VC ID does not get assigned twice.

Routed VCs are supported on main interfaces, not subinterfaces.

Examples

In the following example, two routers are named PE1 and PE2. The example shows how they establish a VC to transport Layer 2 VLAN packets. PE1 has IP address 172.16.0.1. PE2 has IP address 192.168.0.1. The VC ID is 50.

At PE1, you issue the following commands:

```
PE1_router (config)# interface vlan3
PE1_router(config-if)# mpls l2transport route 172.16.0.1 50
```

At PE2, you issue the following commands:

```
PE2_router (config)# interface vlan4
PE2_router(config-if)# mpls l2transport route 192.168.0.1 50
```

show mpls l2transport vc

To display the state of VCs on a router, use the **show mpls l2transport vc** EXEC command.

show mpls l2transport vc {**summary**} | {*vc-id* } | {{*vc-id-min*} {*vc-id-max*}} [**detail**]

Syntax Description

summary	Display a summary of the active VCs on a PE router's MPLS interfaces
vc-id	Displays information about the VC specified.
vc-id-min and *vc-id-max*	Displays information about a range of VC IDs that you specify. The range is from 0 to 429,467,295.
detail	(Optional) Displays detailed information about the VCs on a PE router.

Defaults

No default behavior or values.

Command Modes

EXEC

Command History

Release	Modification
12.1(8a)E	This command was introduced.

Examples

The following example shows the status of the VCs on the router.

```
Router# show mpls l2transport vc

Transport Client     VC       Local       Remote      Tunnel
VC ID     Intf       State    VC Label    VC Label    Label
4         Vl4        UP       23          21          77
101       Vl101      UP       24          22          77
```

Table 1describes the significant fields displayed in the output.

Table 1 show mpls l2transport vc Field Descriptions

Field	Description
Transport VC ID	The virtual circuit identifier assigned to one of the interfaces on the router.
Client Intf	The ingress or egress interface through which the Layer 2 VLAN packet travels. For Ethernet over MPLS, VLAN interfaces are used.

Field	Description
VC State	The status of the VC. The status can be one of the following: UP—VC is in a state where it can carry traffic between the two VC end points. A VC is up when both imposition and disposition interfaces are programmed. • The disposition interfaces is programmed if the VC has been configured and the client interface is up. • The imposition interface is programmed if the disposition interface is programmed and we have a remote VC label and an IGP label. The IGP label can be implicit null in a back- to- back configuration. (An IGP label means there is a LSP to the peer.) DOWN—The VC is not ready to carry traffic between the two VC end points.
Local VC Label	The VC label that a router signals to its peer router, which is used by the peer router during imposition. The local VC label is a disposition label. The local VC label determine the egress interface of an arriving packet from the MPLS backbone.
Remote VC Label	The disposition VC label of the remote peer router.
Tunnel Label	An IGP label used to route the packet over the MPLS backbone to the destination router with the egress interface.

The following example shows the output of the **summary** keyword. The first part of the example shows VC information for the interfaces on the PE router. The second part of the example shows how many VCs have been configured for destination 13.0.0.1.

```
Router# show mpls l2transport vc summary
MPLS interface VC summary:
  interface: Gi8/1, programmed imposition vcs: 1
  interface: Gi8/3, programmed imposition vcs: 1

VC summary (active/non-active) by destination:
  destination: 13.0.0.1, Number of locally configured vc(s): 2
```

The following example shows detailed information about currently routed VCs on the router interfaces:

```
Router# show mpls l2transport vc detail
VC ID: 2, Local Group ID: 8, Remote Group ID: 8 (VC is up)
Client Intf: Vl2 is up, Destination: 172.21.0.1, Peer LDP Ident: 172.20.0.1:0
Local VC Label: 23, Remote VC Label: 21, Tunnel Label: 19
Outgoing Interface: Gi8/1, Next Hop: 2.0.0.1
Local MTU: 1500, Remote MTU: 1500
Imposition: LC Programmed,
Current Imposition/Last Disposition Slot: 8/32
Packet Totals(in/out): 0/0
Byte Totals(in/out): 0/0

VC ID: 3, Local Group ID: 9, Remote Group ID: 9 (VC is up)
Client Intf: Vl3 is up, Destination: 172.21.0.1, Peer LDP Ident: 172.20.0.1:0
Local VC Label: 24, Remote VC Label: 22, Tunnel Label: 19
Outgoing Interface: Gi8/3, Next Hop: 3.0.0.1
Local MTU: 1500, Remote MTU: 1500
Imposition: LC Programmed,
Current Imposition/Last Disposition Slot: 8/32
Packet Totals(in/out): 0/0
Byte Totals(in/out): 0/0
```

The following example shows the detailed VC information for a specified VC:

```
Router# show mpls l2transport vc 2 detail
VC ID: 2, Local Group ID: 8, Remote Group ID: 8 (VC is up)
Client Intf: Vl2 is up, Destination: 172.21.0.1,  Peer LDP Ident: 172.20.0.1:0
Local VC Label: 21, Remove VC Label: 21, Tunnel Label: 22
Outgoing Interface: Gi3/2, Next Hop: 4.0.0.1
Local MTU: 1500, Remote MTU: 1500
Imposition: LC Programmed,
Current Imposition/Disposition Slot: 3/32
Packet Totals(in/out): 803713123/802954183
Byte Totals(in/out): 2067870672/942882144
```

Table 2describes the significant fields displayed in the output.

Table 2 show mpls l2transport vc detail Field Descriptions

Field	Description
VC ID	The virtual circuit identifier assigned to one of the interfaces on the router.
Local Group ID	The ID used to group VCs locally. Ethernet over MPLS groups VCs by the hardware port, which is unique for each port on a router.
Remote Group ID	The ID used by the peer to group several VCs.
VC is up or VC is down	The status of the VC. The status can be one of the following: UP—VC is in a state where it can carry traffic between the two VC end points. A VC is up when both imposition and disposition interfaces are programmed. • The disposition interfaces is programmed if the VC has been configured and the client interface is up. • The imposition interface is programmed if the disposition interface is programmed and we have a remote VC label and an IGP label. The IGP label can be implicit null in a back- to- back configuration. (An IGP label means there is a LSP to the peer.) DOWN—The VC is not ready to carry traffic between the two VC end points.
Client	The ingress or egress interface through which the Layer 2 VLAN packet travels. For Ethernet over MPLS, VLAN interfaces are used.
Destination	The destination specified for this VC. You specify the destination ip address as part of the **mpls l2transport route** command.
Peer LDP ID	The targetted peer's LDP IP address.
Local VC Label	The VC label that a router signals to its peer router, which is used by the peer router during imposition. The local VC label is a disposition label. The local VC label determine the egress interface of an arriving packet from the MPLS backbone.
Remote VC Label	The disposition VC label of the remote peer router.
Tunnel Label	An IGP label used to route the packet over the MPLS backbone to the destination router with the egress interface.
Outgoing Interface	The egress interface that of the VC.
Next Hop	The IP address of the next hop.
Local MTU	The maximum transmission unit specified for the client interface.

Field	Description
Remote MTU	The maximum transmission unit specified for the remote router's client interface.
Imposition	The status of the line card: • LC programmed • LC not programmed.
Current Imposition/Last Disposition Slot	The current imposition is the outgoing interface used for imposition. The last disposition slot is the interface where packets for this VC arrive.
Packet Totals (in/out)	The total number of packets forwarded in each direction.
Byte Totals (in/out)	The total number of bytes forwarded in each direction

Debug Commands

This section describes the new **debug** commands.

- **debug mpls l2transport vlan control**
- **debug mpls l2transport vlan distributed**

debug mpls l2transport vlan control

To enable debug messages about the control of traffic transported between Layer 2 VLAN and MPLS, use the **debug mpls l2transport vlan control** EXEC command. To disable the debug messages about transport control, use the **no** form of this command.

[no] debug mpls l2transport vlan control

Syntax Description

This command has no arguments or keywords.

Defaults

No default behavior or values.

Command History

Release	Modification
12.1(8a)E	This command was introduced.

Examples

The following example enables debug messages about the control of traffic between Layer 2 VLANs and MPLS:

```
Router# debug mpls l2transport vlan control
Ethernet VLAN transport over MPLS, Control interactions debugging is on
Router# config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# int vlan2
Router(config-if)# shut
Router(config-if)#
*May 25 12:18:33: ATOM_TRANS: atom_if_state_change from Vlan2
*May 25 12:18:33: ATOM_TRANS: Withdrawing all EoMPLS vcs for lgroupid 8
*May 25 12:18:33: ATOM_TRANS: sending extended withdraw_bind for vcid 0
to 12.0.0.1, local groupid 8
*May 25 12:18:33: ATOM_TRANS: holding down local label 21
*May 25 12:18:33: ATOM_TRANS: clearing imp. rewrite for vcid = 2
Router(config-if)#
*May 25 12:18:35: ATOM_TRANS: freeing held label 21
Router(config-if)#
*May 25 12:18:35: %LINK-5-CHANGED: Interface Vlan2, changed state to
administratively down
*May 25 12:18:36: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2,
changed state to down

Router(config-if)# no shut
Router(config-if)#
*May 25 12:19:57: ATOM_TRANS: atom_if_state_change from Vlan2
*May 25 12:19:57: ATOM_TRANS: Withdrawing all EoMPLS vcs for lgroupid 8
*May 25 12:19:57: ATOM_TRANS: sending extended withdraw_bind for vcid 0
to 12.0.0.1, local groupid 8
Router(config-if)#
*May 25 12:19:59: %LINK-3-UPDOWN: Interface Vlan2, changed state to up
Router(config-if)#
*May 25 12:19:59: ATOM_TRANS: sending bind for vcid 2 to 12.0.0.1, local
groupid 8
*May 25 12:19:59: ATOM_TRANS: sending request_bind for vcid 2 to
12.0.0.1, local groupid 8
```

```
*May 25 12:19:59: ATOM_TRANS: Stale tfib event discarded (12.0.0.1)
*May 25 12:19:59: ATOM_TRANS: Stale tfib event discarded (12.0.0.1)
*May 25 12:19:59: ATOM_TRANS: Stale tfib event discarded (12.0.0.1)
*May 25 12:19:59: ATOM_TRANS: processing tfib event for 12.0.0.1
*May 25 12:19:59: ATOM_TRANS: received BIND from 12.0.0.1:0 remote group id: 8 vc_id: 2
label: 21
*May 25 12:19:59: ATOM_TRANS: Done setting imp.rewrite for vcid = 2
parent dest 12.0.0.1
*May 25 12:20:00: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2,
changed state to up
```

debug mpls l2transport vlan distributed

To enable the debug messages about label imposition and label disposition on line cards, use the **debug mpls l2transport vlan distributed** EXEC command. To disable the debug messages about label imposition and label disposition on line cards, use the **no** form of this command.

[no] debug mpls l2transport vlan distributed

Syntax Description

This command has no arguments or keywords.

Defaults

No default behavior or values.

Command History

Release	Modification
12.1(8a)E	This command was introduced.

Examples

The following example enables debug messages related to the process of label imposition/disposition:

```
Router# debug mpls l2transport vlan distributed
Ethernet VLAN transport over MPLS, Distributed switching debugging is on
Router# config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# int vlan2
Router(config-if)# shut
Router(config-if)#
*May 25 12:22:04: ETH_TRANS: removing label disposition info for vcid:0
from all slots
*May 25 12:22:04: ETH_TRANS: slot(3) Client(Vlan2)'s if_number(10)
*May 25 12:22:04: ETH_TRANS: label(0) outlabel(0)
*May 25 12:22:04: ETH_TRANS: clear_vc(1), vcid(2), vc label(8388611),
dest(12.0.0.1)
Router(config-if)#
*May 25 12:22:06: %LINK-5-CHANGED: Interface Vlan2, changed state to
administratively down
*May 25 12:22:07: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2,
changed state to down
Router(config-if)# no shut
Router(config-if)#
*May 25 12:22:15: %LINK-3-UPDOWN: Interface Vlan2, changed state to up
*May 25 12:22:15: ETH_TRANS: disposition change dest:12.0.0.1 vcid:2,
(none) -> (all) (queued)
*May 25 12:22:15: ETH_TRANS: sending label (21) disposition info for
vcid:2 vlan:2 to all slots
*May 25 12:22:15: taginfo flag(20), ti_max_index(16), remote_label(22)
*May 25 12:22:15: GigabitEthernet3/3
*May 25 12:22:15: GigabitEthernet3/2
*May 25 12:22:15: GigabitEthernet3/3
*May 25 12:22:15: GigabitEthernet3/2
*May 25 12:22:15: GigabitEthernet3/3
*May 25 12:22:15: GigabitEthernet3/2
*May 25 12:22:15: GigabitEthernet3/3
*May 25 12:22:15: GigabitEthernet3/2
*May 25 12:22:15: GigabitEthernet3/3
*May 25 12:22:15: GigabitEthernet3/2
```

```
*May 25 12:22:15: GigabitEthernet3/3
*May 25 12:22:15: GigabitEthernet3/2
*May 25 12:22:15: GigabitEthernet3/3
*May 25 12:22:15: GigabitEthernet3/2
*May 25 12:22:15: GigabitEthernet3/3
*May 25 12:22:15: GigabitEthernet3/2
*May 25 12:22:15: ETH_TRANS: output slot (3), port (3)
*May 25 12:22:15: ETH_TRANS: slot(3) Client(Vlan2)'s
if_number(10)
*May 25 12:22:15: ETH_TRANS: label(18) outlabel(18)
*May 25 12:22:15: ETH_TRANS: clear_vc(0), vcid(2), vc label(22),
dest(12.0.0.1)
*May 25 12:22:16: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2,
changed state to up
Router(config-if)#
```