



# Configuring Ethernet-over-MPLS and Pseudowire Redundancy

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- [Configuring Ethernet-over-MPLS, on page 1](#)
- [Configuring Pseudowire Redundancy, on page 16](#)
- [Feature Information for Ethernet-over-MPLS and Pseudowire Redundancy, on page 31](#)

## Configuring Ethernet-over-MPLS

This section provides information about how to configure Ethernet over Multiprotocol Label Switching (EoMPLS).

### Prerequisites for Ethernet-over-MPLS

Before you configure EoMPLS, ensure that the network is configured as follows:

- Configure IP routing in the core so that the provider edge (PE) devices can reach each other through IP.
- Configure MPLS in the core so that a label switched path (LSP) exists between the PE devices.
- Configure the **no switchport**, **no keepalive**, and **no ip address** commands before configuring Xconnect on the attachment circuit.
- For load-balancing, configuring the **port-channel load-balance** command is mandatory.
- Subinterfaces must be supported to enable EoMPLS VLAN mode.
- The **mpls ldp graceful-restart** command must be configured to enable the device to protect LDP bindings and MPLS forwarding state during a disruption in service. We recommend you to configure this command (even if you do not want to preserve the forwarding state) to avoid device failure during SSO in a high availability setup with scale configurations.

### Restrictions for Ethernet-over-MPLS

The following sections list the restrictions for EoMPLS port mode and EoMPLS VLAN mode.

## Restrictions for Ethernet-over-MPLS Port Mode

- Ethernet Flow Point is not supported.
- Quality of Service (QoS): Customer differentiated services code point (DSCP) re-marking is not supported with virtual private wire service (VPWS) and EoMPLS.
- Virtual Circuit Connectivity Verification (VCCV) ping with explicit null is not supported.
- Layer 2 Protocol Tunneling CLI is not supported.
- Flow-Aware Transport (FAT) Pseudowire Redundancy is supported only in Protocol-CLI mode. Supported load-balancing parameters are Source IP, Source MAC address, Destination IP, and Destination MAC address.
- MPLS QoS is supported only in pipe and uniform mode. Default mode is pipe mode.
- Both legacy Xconnect and Protocol-CLI (interface pseudowire configuration) modes are supported.
- Xconnect mode cannot be configured on SVI.
- Xconnect and MACSec cannot be configured on the same interface.
- MACSec should be configured on CE devices and Xconnect should be configured on PE devices.
- A MACSec session should be available between CE devices.
- By default, EoMPLS PW tunnels all the protocols such as Cisco Discovery Protocol and Spanning Tree Protocol (STP). EoMPLS PW cannot perform selective protocol tunneling as part of L2 Protocol Tunneling CLI.

## Restrictions for EoMPLS VLAN Mode

- Virtual circuit will not work if the same interworking type is not configured on PE devices.
- Untagged traffic is not supported as incoming traffic.
- Xconnect mode cannot be enabled on Layer 2 subinterfaces because multiplexer user-network interface (MUX UNI) is not supported.
- Xconnect mode cannot be configured on subinterfaces if it is enabled on the main interface for port-to-port transport.
- FAT can be configured on Protocol CLI mode only.
- In VLAN mode EoMPLS, only those packets encrypted with the dot1q in clear by the CE device will be processed by the PE device.
- QoS: Customer DSCP Remarking is not supported with VPWS and EoMPLS.
- MPLS QoS is supported in pipe and uniform mode. Default mode is pipe mode.
- In VLAN mode EoMPLS, Cisco Discovery Protocol packets from the CE will be processed by the PE, but will not be carried over the EoMPLS virtual circuit, whereas in port mode, Cisco Discovery Protocol packets from the CE will be carried over the virtual circuit.
- Only Ethernet and VLAN interworking types are supported.
- L2 Protocol Tunneling CLI is not supported.

## Information About Ethernet-over-MPLS

EoMPLS is one of the Any Transport over MPLS (AToM) transport types. EoMPLS works by encapsulating Ethernet protocol data units (PDUs) in MPLS packets and forwarding them across the MPLS network. Each PDU is transported as a single packet.

The following modes are supported:

- **Port mode:** Allows all traffic on a port to share a single virtual circuit across an MPLS network. Port mode uses virtual circuit type 5.
- **VLAN mode:** Transports Ethernet traffic from a source 802.1Q VLAN to a destination 802.1Q VLAN through a single virtual circuit over an MPLS network. VLAN mode uses virtual circuit type 5 as the default (does not transport dot1q tag); however, uses virtual circuit type 4 (transports dot1 tag) if the remote PE does not support virtual circuit type 5 for subinterface-based (VLAN-based) EoMPLS.

Interworking between EoMPLS port mode and EoMPLS VLAN mode: If EoMPLS port mode is configured on a local PE and EoMPLS VLAN mode on a remote PE, then the customer edge (CE) Layer 2 switchport interface must be configured as an *access* on the port mode side and the Spanning Tree Protocol must be disabled on the VLAN mode side of the CE device.

The maximum transmission unit (MTU) of all the intermediate links between PEs must be able to carry the largest Layer 2 packet received on ingress PE.

Starting with the Cisco IOS XE Bengaluru 17.6.1 release, you can forward Link Aggregation Control Protocol (LACP) and Port Aggregation Protocol (PAgP) packets over Ethernet-over-MPLS Pseudowire in the Port mode.

## How to Configure Ethernet-over-MPLS

EoMPLS can be configured in the port mode or VLAN mode.

### Configuring Ethernet-over-MPLS Port Mode

EoMPLS port mode can be configured using either the Xconnect mode or protocol CLI method.

#### Xconnect Mode

To configure EoMPLS port mode in Xconnect mode, perform the following task:

#### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b>  Device> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b>	Enters global configuration mode.

	Command or Action	Purpose
	Device# <b>configure terminal</b>	
<b>Step 3</b>	<b>interface</b> <i>interface-id</i> <b>Example:</b> Device(config)# <b>interface</b> <b>TenGigabitEthernet1/0/36</b>	Defines the interface to be configured as a trunk, and enters interface configuration mode.
<b>Step 4</b>	<b>no switchport</b> <b>Example:</b> Device(config-if)# <b>no switchport</b>	Enters Layer 3 mode for physical ports only.
<b>Step 5</b>	<b>no ip address</b> <b>Example:</b> Device(config-if)# <b>no ip address</b>	Ensures that no IP address is assigned to the physical port.
<b>Step 6</b>	<b>no keepalive</b> <b>Example:</b> Device(config-if)# <b>no keepalive</b>	Ensures that the device does not send keepalive messages.
<b>Step 7</b>	<b>xconnect</b> <i>peer-device-id</i> <i>vc-id</i> <b>encapsulation mpls</b> <b>Example:</b> Device(config-if)# <b>xconnect 10.1.1.1 962 encapsulation mpls</b>	Binds the attachment circuit to a pseudowire virtual circuit (VC). The syntax for this command is the same as for all other Layer 2 transports.
<b>Step 8</b>	<b>end</b> <b>Example:</b> Device(config-if)# <b>end</b>	Exits interface configuration mode and returns to privileged EXEC mode.

## Protocol CLI Method

To configure EoMPLS port mode in protocol CLI mode, perform the following task:

**Procedure**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>enable</b> <b>Example:</b> <pre>Device&gt; enable</pre>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> <pre>Device# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<b>port-channel load-balance dst-ip</b> <b>Example:</b> <pre>Device(config)# port-channel load-balance dst-ip</pre>	Sets the load distribution method to the destination IP address.
<b>Step 4</b>	<b>interface <i>interface-id</i></b> <b>Example:</b> <pre>Device(config)# interface TenGigabitEthernet1/0/21</pre>	Defines the interface to be configured as a trunk, and enters interface configuration mode.
<b>Step 5</b>	<b>no switchport</b> <b>Example:</b> <pre>Device(config-if)# no switchport</pre>	Enters Layer 3 mode for physical ports only.
<b>Step 6</b>	<b>no ip address</b> <b>Example:</b> <pre>Device(config-if)# no ip address</pre>	Ensures that no IP address is assigned to the physical port.
<b>Step 7</b>	<b>no keepalive</b> <b>Example:</b> <pre>Device(config-if)# no keepalive</pre>	Ensures that the device does not send keepalive messages.

	Command or Action	Purpose
<b>Step 8</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-if)# exit</pre>	Exits interface configuration mode and returns to global configuration mode.
<b>Step 9</b>	<b>interface pseudowire <i>number</i></b> <b>Example:</b> <pre>Device(config)# interface pseudowire 17</pre>	Establishes a pseudowire interface with a value that you specify and enters pseudowire configuration mode.
<b>Step 10</b>	<b>encapsulation mpls</b> <b>Example:</b> <pre>Device(config-if)# encapsulation mpls</pre>	Specifies the tunneling encapsulation.
<b>Step 11</b>	<b>neighbor <i>peer-ip-addr vc-id</i></b> <b>Example:</b> <pre>Device(config-if)# neighbor 10.10.0.10 17</pre>	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
<b>Step 12</b>	<b>l2vpn xconnect context <i>context-name</i></b> <b>Example:</b> <pre>Device(config-if)# l2vpn xconnect context vps17</pre>	Creates an L2VPN cross connect context and enters Xconnect context configuration mode.
<b>Step 13</b>	<b>member <i>interface-id</i></b> <b>Example:</b> <pre>Device(config-if-xconn)# member TenGigabitEthernet1/0/21</pre>	Specifies interface that forms an L2VPN cross connect.
<b>Step 14</b>	<b>member pseudowire <i>number</i></b> <b>Example:</b> <pre>Device(config-if-xconn)# member pseudowire 17</pre>	Specifies the pseudowire interface that forms an L2VPN cross connect.

	Command or Action	Purpose
<b>Step 15</b>	<b>end</b> <b>Example:</b> <pre>Device(config-if-xconn)# end</pre>	Exits Xconnect interface configuration mode and returns to privileged EXEC mode.

## Configuring Ethernet-over-MPLS VLAN Mode

EoMPLS VLAN mode can be configured using either the Xconnect mode or protocol-CLI method.

### Xconnect Mode

To configure EoMPLS VLAN mode in Xconnect mode, perform the following task:

#### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> <pre>Device&gt; enable</pre>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> <pre>Device# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<b>interface <i>interface-id</i></b> <b>Example:</b> <pre>Device(config)# interface TenGigabitEthernet1/0/36</pre>	Defines the interface to be configured as a trunk, and enters interface configuration mode.
<b>Step 4</b>	<b>no switchport</b> <b>Example:</b> <pre>Device(config-if)# no switchport</pre>	Enters Layer 3 mode, for physical ports only.
<b>Step 5</b>	<b>no ip address</b> <b>Example:</b> <pre>Device(config-if)# no ip address</pre>	Ensures that there is no IP address assigned to the physical port.

	Command or Action	Purpose
<b>Step 6</b>	<b>no keepalive</b> <b>Example:</b> <pre>Device(config-if)# no keepalive</pre>	Ensures that the device does not send keepalive messages.
<b>Step 7</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-if)# exit</pre>	Exits interface configuration mode and returns to global configuration mode.
<b>Step 8</b>	<b>interface interface-id.subinterface</b> <b>Example:</b> <pre>Device(config)# interface TenGigabitEthernet1/0/36.1105</pre>	Defines the subinterface to be configured, and enters subinterface configuration mode.
<b>Step 9</b>	<b>encapsulation dot1Q vlan-id</b> <b>Example:</b> <pre>Device(config-subif)# encapsulation dot1Q 1105</pre>	Enables IEEE 802.1Q encapsulation of traffic on the subinterface.
<b>Step 10</b>	<b>xconnect peer-ip-addr vc-id encapsulation mpls</b> <b>Example:</b> <pre>Device(config-subif)# xconnect 10.0.0.1 1105 encapsulation mpls</pre>	Binds the attachment circuit to a pseudowire VC. The syntax for this command is the same as for all other Layer 2 transports.
<b>Step 11</b>	<b>end</b> <b>Example:</b> <pre>Device(config-subif-xconn)# end</pre>	Returns to privileged EXEC mode.

## Protocol CLI Method

To configure EoMPLS VLAN mode in protocol-CLI mode, perform the following task:



**Procedure**

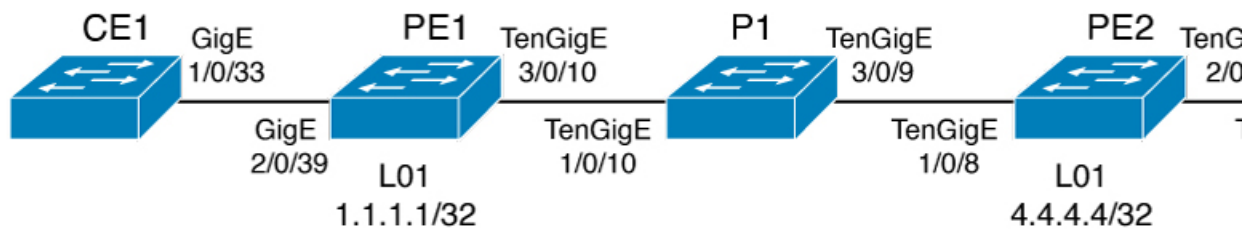
	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>enable</b> <b>Example:</b> <pre>Device&gt; enable</pre>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> <pre>Device# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<b>port-channel load-balance dst-ip</b> <b>Example:</b> <pre>Device(config)# port-channel load-balance dst-ip</pre>	Sets the load-distribution method to the destination IP address.
<b>Step 4</b>	<b>interface <i>interface-id</i></b> <b>Example:</b> <pre>Device(config)# interface TenGigabitEthernet1/0/36</pre>	Defines the interface to be configured as a trunk, and enters interface configuration mode.
<b>Step 5</b>	<b>no switchport</b> <b>Example:</b> <pre>Device(config-if)# no switchport</pre>	Enters Layer 3 mode, for physical ports only.
<b>Step 6</b>	<b>no ip address</b> <b>Example:</b> <pre>Device(config-if)# no ip address</pre>	Ensures that there is no IP address assigned to the physical port.
<b>Step 7</b>	<b>no keepalive</b> <b>Example:</b> <pre>Device(config-if)# no keepalive</pre>	Ensures that the device does not send keepalive messages.

	Command or Action	Purpose
<b>Step 8</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-if)# exit</pre>	Exits interface configuration mode and returns to global configuration mode.
<b>Step 9</b>	<b>interface</b> <i>interface-id.subinterface</i> <b>Example:</b> <pre>Device(config)# interface TenGigabitEthernet1/0/36.1105</pre>	Defines the subinterface to be configured, and enters subinterface configuration mode.
<b>Step 10</b>	<b>encapsulation dot1Q</b> <i>vlan-id</i> <b>Example:</b> <pre>Device(config-subif)# encapsulation dot1Q 1105</pre>	Enables IEEE 802.1Q encapsulation of traffic on the subinterface.
<b>Step 11</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-subif)# exit</pre>	Exits subinterface configuration mode and returns to interface configuration mode.
<b>Step 12</b>	<b>interface pseudowire</b> <i>number</i> <b>Example:</b> <pre>Device(config)# interface pseudowire 17</pre>	Establishes a pseudowire interface with a value that you specify and enters pseudowire configuration mode.
<b>Step 13</b>	<b>encapsulation mpls</b> <b>Example:</b> <pre>Device(config-if)# encapsulation mpls</pre>	Specifies the tunneling encapsulation.
<b>Step 14</b>	<b>neighbor</b> <i>peer-ip-addr vc-id</i> <b>Example:</b> <pre>Device(config-if)# neighbor 10.10.0.10 17</pre>	Specifies the peer IP address and VC ID value of a L2VPN pseudowire.

	Command or Action	Purpose
<b>Step 15</b>	<b>l2vpn xconnect context</b> <i>context-name</i> <b>Example:</b> <pre>Device(config-if)# l2vpn xconnect context vpws17</pre>	Creates a L2VPN cross connect context, and enters Xconnect context configuration mode.
<b>Step 16</b>	<b>member interface-id.subinterface</b> <b>Example:</b> <pre>Device(config-if-xconn)# member TenGigabitEthernet1/0/36.1105</pre>	Specifies the subinterface that forms a L2VPN cross connect.
<b>Step 17</b>	<b>member pseudowire number</b> <b>Example:</b> <pre>Device(config-if-xconn)# member pseudowire 17</pre>	Specifies pseudowire interface that forms a L2VPN cross connect.
<b>Step 18</b>	<b>end</b> <b>Example:</b> <pre>Device(config-if-xconn)# end</pre>	Exits Xconnect configuration mode and returns to privileged EXEC mode.

## Configuration Examples for Ethernet-over-MPLS

Figure 1: EoMPLS Topology



**Table 1: EoMPLS Port Mode Configuration**

PE Configuration	CE Configuration
<pre> mpls ip mpls label protocol ldp mpls ldp graceful-restart mpls ldp router-id loopback 1 force interface Loopback1 ip address 10.1.1.1 255.255.255.255 ip ospf 100 area 0 router ospf 100 router-id 10.1.1.1 nsf system mtu 9198 port-channel load-balance dst-ip ! interface gigabitethernet 2/0/39 no switchport no ip address no keepalive ! interface pseudowire101 encapsulation mpls neighbor 10.10.10.10 101 load-balance flow ip dst-ip load-balance flow-label both l2vpn xconnect context pw101 member pseudowire101 member gigabitethernet 2/0/39 ! interface tengigabitethernet 3/0/10 switchport trunk allowed vlan 142 switchport mode trunk channel-group 42 mode active ! interface Port-channel42 switchport trunk allowed vlan 142 switchport mode trunk ! interface Vlan142 ip address 10.11.11.11 255.255.255.0  ip ospf 100 area 0 mpls ip mpls label protocol ldp ! </pre>	<pre> interface gigabitethernet 1/0/33 switchport trunk allowed vlan 912 switchport mode trunk spanning-tree portfast trunk ! interface Vlan912 ip address 10.91.2.3 255.255.255.0 ! </pre>

**Table 2: EoMPLS VLAN Mode Configuration**

PE Configuration	CE Configuration
<pre> interface tengigabitethernet 1/0/36  no switchport  no ip address  no keepalive exit ! interface tengigabitethernet 1/0/36.1105  encapsulation dot1Q 1105 exit ! interface pseudowire1105  encapsulation mpls  neighbor 10.10.0.10 1105 exit ! l2vpn xconnect context vme1105  member tengigabitethernet 1/0/36.1105  member pseudowire1105 end !</pre>	<pre> interface fortygigabitethernet 1/9  switchport  switchport mode trunk  switchport trunk allowed vlan 1105  mtu 9216 end !</pre>

**Table 3: Interworking Between EoMPLS Port Mode and EoMPLS VLAN Mode Configuration**

PE Configuration: Port Mode	CE Configuration: Port Mode
<pre> interface tengigabitethernet 1/0/37  no switchport  no ip address  no keepalive exit ! interface pseudowire1105  encapsulation mpls  neighbor 10.11.11.11 1105 exit ! l2vpn xconnect context vme1105  member tengigabitethernet 1/0/37  member pseudowire1105 end !</pre>	<pre> interface fortygigabitethernet1/10  switchport  switchport mode access  switchport access vlan 1105 end  no spanning-tree vlan 1105 !</pre>

PE Configuration: VLAN Mode	CE Configuration: VLAN Mode
<pre> interface tengigabitethernet 1/0/36  no switchport  no ip address  no keepalive exit ! interface tengigabitethernet 1/0/36.1105   encapsulation dot1Q 1105 exit ! interface pseudowire1105  encapsulation mpls  neighbor 10.10.0.10 1105 exit ! l2vpn xconnect context vme1105  member tengigabitethernet 1/0/36.1105  member pseudowire1105 end ! </pre>	<pre> interface fortygigabitethernet 1/9  switchport  switchport mode trunk  switchport trunk allowed vlan 1105   mtu 9216 end  no spanning-tree vlan 1105 ! </pre>

Another scenario for interworking between EoMPLS port mode and EoMPLS VLAN mode is to configure the following commands on both CE devices:

- **switchport mode trunk**
- **switchport trunk allowed vlan *vlan-id***
- **spanning-tree vlan *vlan-id***

Data traffic will flow through by disabling STP on both CE devices, if the traffic sent is not double VLAN tagged.

The following is a sample output of the **show mpls l2 vc vcid *vc-id* detail** command:

```

Device# show mpls l2 vc vcid 1105 detail
Local interface: TenGigabitEthernet1/0/36.1105 up, line protocol up, Eth VLAN 1105 up
Interworking type is Ethernet
Destination address: 10.0.0.1, VC ID: 1105, VC status: up
Output interface: Po10, imposed label stack {33 10041}
Preferred path: not configured
Default path: active
Next hop: 10.10.0.1
Create time: 00:04:09, last status change time: 00:02:13
Last label FSM state change time: 00:02:12
Signaling protocol: LDP, peer 10.0.0.1:0 up
Targeted Hello: 10.0.0.10(LDP Id) -> 10.0.0.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Last local dataplane status rcvd: No fault
Last BFD dataplane status rcvd: Not sent
Last BFD peer monitor status rcvd: No fault
Last local AC circuit status rcvd: No fault
Last local AC circuit status sent: No fault
Last local PW i/f circ status rcvd: No fault

```

```

      Last local LDP TLV      status sent: No fault
      Last remote LDP TLV    status rcvd: No fault
      Last remote LDP ADJ    status rcvd: No fault
MPLS VC labels: local 124, remote 10041
Group ID: local 336, remote 352
MTU: local 9198, remote 9198
Remote interface description:
MAC Withdraw: sent:1, received:0
Sequencing: receive disabled, send disabled
Control Word: On (configured: autosense)
SSO Descriptor: 10.0.0.1/1105, local label: 124
Dataplane:
  SSM segment/switch IDs: 9465983/446574 (used), PWID: 109
VC statistics:
  transit packet totals: receive 0, send 0
  transit byte totals:   receive 0, send 0
  transit packet drops:  receive 0, seq error 0, send 0

```

The following is a sample output of the **show l2vpn atom vc vcid vc-id detail** command:

```

Device# show l2vpn atom vc vcid 1105 detail
pseudowire100109 is up, VC status is up PW type: Ethernet
  Create time: 00:04:17, last status change time: 00:02:22
  Last label FSM state change time: 00:02:20
  Destination address: 10.0.0.1 VC ID: 1105
  Output interface: Po10, imposed label stack {33 10041}
  Preferred path: not configured
  Default path: active
  Next hop: 10.10.0.1
Member of xconnect service TenGigabitEthernet1/0/36.1105-1105, group right
Associated member TenGigabitEthernet1/0/36.1105 is up, status is up
Interworking type is Ethernet
Service id: 0x1f000037
Signaling protocol: LDP, peer 10.0.0.1:0 up
Targeted Hello: 10.0.0.10(LDP Id) -> 10.0.0.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
PWid FEC (128), VC ID: 1105
Status TLV support (local/remote)      : enabled/supported
  LDP route watch                       : enabled
  Label/status state machine             : established, LruRru
  Local dataplane status received        : No fault
  BFD dataplane status received          : Not sent
  BFD peer monitor status received       : No fault
  Status received from access circuit    : No fault
  Status sent to access circuit          : No fault
  Status received from pseudowire i/f    : No fault
  Status sent to network peer            : No fault
  Status received from network peer      : No fault
  Adjacency status of remote peer        : No fault
Sequencing: receive disabled, send disabled
Bindings
  Parameter      Local      Remote
  -----
Label           124        10041
Group ID        336        352
Interface
MTU              9198        9198
Control word on (configured: autosense) on
PW type          Ethernet    Ethernet
VCCV CV type 0x02          0x02
                  LSPV [2]    LSPV [2]
VCCV CC type 0x06          0x06
                  RA [2], TTL [3]  RA [2], TTL [3]

```

```

Status TLV   enabled                               supported
SSO Descriptor: 10.0.0.1/1105, local label: 124
Dataplane:
  SSM segment/switch IDs: 9465983/446574 (used), PWID: 109
Rx Counters
  0 input transit packets, 0 bytes
  0 drops, 0 seq err
  0 MAC withdraw
Tx Counters
  0 output transit packets, 0 bytes
  0 drops
  1 MAC withdraw

```

The following is a sample output of the **show mpls forwarding-table** command:

```
Device# show mpls forwarding-table 10.0.0.1
```

Local Label	Outgoing Label	Prefix or Tunnel Id	Bytes Label Switched	Outgoing interface	Next Hop
2049	33	10.0.0.1/32	38540	Hu2/0/30/2.1	10.0.0.2
	33	10.0.0.1/32	112236	Hu2/0/30/2.2	10.0.0.6
	33	10.0.0.1/32	46188	Hu2/0/30/2.3	10.0.0.8

## Configuring Pseudowire Redundancy

This section provides information about how to configure pseudowire redundancy.

### Prerequisites for Pseudowire Redundancy

- Configure the **no switchport**, **no keepalive**, and **no ip address** before configuring Xconnect mode to connect the attachment circuit.
- For load-balancing, configure the **port-channel load-balance** command.
- Subinterfaces must be supported to enable pseudowire redundancy VLAN mode.

### Restrictions for Pseudowire Redundancy

The following sections list the restrictions for pseudowire redundancy port mode and pseudowire redundancy VLAN mode.

#### Restrictions for Pseudowire Redundancy Port Mode

- Ethernet Flow Point (EFP) and Internet Group Management Protocol (IGMP) Snooping is not supported.
- Flow Label for ECMP load balancing in a core network based on customer's source IP, destination IP, source MAC and destination MAC.
- MPLS QoS is supported in Pipe and Uniform Mode. Default mode is Pipe Mode.
- QoS: Customer DSCP Re-marking is not supported with VPWS and EoMPLS.
- VCCV Ping with explicit null is not supported.



- The **ip unnumbered** command is not supported in MPLS configuration.
- Not more than one backup pseudowire supported.
- PW redundancy group switchover is not supported

## Restrictions for Pseudowire Redundancy VLAN Mode

- Virtual circuit will not work if the same interworking type is not configured on PE devices.
- Untagged traffic is not supported as incoming traffic.
- Xconnect mode cannot be enabled on Layer 2 subinterfaces because multiplexer user-network interface (MUX UNI) is not supported.
- Xconnect mode cannot be configured on subinterfaces if it is enabled on the main interface for port-to-port transport.
- Flow Aware Transport (FAT) can be configured on Protocol CLI mode only.
- MACsec is not supported on pseudowire redundancy VLAN mode.
- QoS: Customer DSCP Remarking is not supported with VPWS and pseudowire redundancy.
- MPLS QoS is supported only in pipe and uniform mode. Default mode is pipe mode.
- In VLAN mode pseudowire redundancy, Cisco Discovery Protocol packets from the CE will be processed by the PE, but is not carried over the pseudowire redundancy virtual circuit, whereas in port mode, Cisco Discovery Protocol packets from the CE will be carried over the virtual circuit.
- Only Ethernet and VLAN interworking types are supported.
- L2 Protocol Tunneling CLI is not supported.

## Information About Pseudowire Redundancy

The L2VPN pseudowire redundancy feature enables you to configure your network to detect a failure in the network and reroute the Layer 2 service to another endpoint that can continue to provide service. This feature provides the ability to recover from a failure either of the remote provider edge (PE) device or of the link between the PE and customer edge (CE) devices.

The maximum transmission unit (MTU) of all the intermediate links between PEs must be able to carry the largest Layer 2 packet received on ingress PE.

Pseudowire redundancy can be configured using both the Xconnect and the protocol CLI method.

## How to Configure Pseudowire Redundancy

Pseudowire redundancy can be configured in the port mode or VLAN mode.

### Configuring Pseudowire Redundancy Port Mode

Pseudowire redundancy port-mode can be configured using either the Xconnect mode or protocol-CLI method.

## Xconnect Mode

To configure pseudowire redundancy port mode in Xconnect mode, perform the following task:



**Note** To enable load balance, use the corresponding **load-balance** commands from Xconnect Mode procedure of the 'How to Configure Ethernet-over-MPLS section.

## Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> Device> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> Device# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 3</b>	<b>interface <i>interface-id</i></b> <b>Example:</b> Device(config)# <b>interface</b> <b>GigabitEthernet1/0/44</b>	Defines the interface to be configured as a trunk, and enters interface configuration mode.
<b>Step 4</b>	<b>no switchport</b> <b>Example:</b> Device(config-if)# <b>no switchport</b>	Enters Layer 3 mode, for physical ports only.
<b>Step 5</b>	<b>no ip address</b> <b>Example:</b> Device(config-if)# <b>no ip address</b>	Ensures that there is no IP address assigned to the physical port.
<b>Step 6</b>	<b>no keepalive</b> <b>Example:</b> Device(config-if)# <b>no keepalive</b>	Ensures that the device does not send keepalive messages.

	Command or Action	Purpose
<b>Step 7</b>	<b>xconnect</b> <i>peer-device-id</i> <i>vc-id</i> <b>encapsulation mpls</b> <b>Example:</b> <pre>Device(config-if)# xconnect 10.1.1.1 117 encapsulation mpls</pre>	Binds the attachment circuit to a pseudowire VC. The syntax for this command is the same as for all other Layer 2 transports.
<b>Step 8</b>	<b>backup peer</b> <i>peer-router-ip-addr</i> <b>vcid</b> <i>vc-id</i> [ <b>priority</b> <i>value</i> ] <b>Example:</b> <pre>Device(config-if)# backup peer 10.11.11.11 118 priority 9</pre>	Specifies a redundant peer for a pseudowire VC.
<b>Step 9</b>	<b>end</b> <b>Example:</b> <pre>Device(config)# end</pre>	Exits interface configuration mode and returns to privileged EXEC mode.

## Protocol CLI Method

To configure pseudowire redundancy port mode in protocol CLI mode, perform the following task:

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> <pre>Device&gt; enable</pre>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> <pre>Device# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<b>port-channel load-balance dst-ip</b> <b>Example:</b> <pre>Device(config)# port-channel</pre>	Sets the load-distribution method to the destination IP address.

	Command or Action	Purpose
	<code>load-balance dst-ip</code>	
<b>Step 4</b>	<b>interface</b> <i>interface-id</i> <b>Example:</b> <pre>Device(config)# interface TenGigabitEthernet1/0/36</pre>	Defines the interface to be configured as a trunk, and enters interface configuration mode.
<b>Step 5</b>	<b>no switchport</b> <b>Example:</b> <pre>Device(config-if)# no switchport</pre>	Enters Layer 3 mode, for physical ports only.
<b>Step 6</b>	<b>no ip address</b> <b>Example:</b> <pre>Device(config-if)# no ip address</pre>	Ensures that there is no IP address assigned to the physical port.
<b>Step 7</b>	<b>no keepalive</b> <b>Example:</b> <pre>Device(config-if)# no keepalive</pre>	Ensures that the device does not send keepalive messages.
<b>Step 8</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-if)# exit</pre>	Exits interface configuration mode.
<b>Step 9</b>	<b>interface pseudowire</b> <i>number-active</i> <b>Example:</b> <pre>Device(config)# interface pseudowire 17</pre>	Establishes an active pseudowire interface with a value that you specify and enters pseudowire configuration mode.
<b>Step 10</b>	<b>encapsulation mpls</b> <b>Example:</b> <pre>Device(config-if)# encapsulation mpls</pre>	Specifies the tunneling encapsulation.

	Command or Action	Purpose
<b>Step 11</b>	<b>neighbor</b> <i>active-peer-ip-addr vc-id</i> <b>Example:</b> <pre>Device(config-if) # neighbor 10.10.0.10 17</pre>	Specifies the active peer IP address and VC ID value of a L2VPN pseudowire.
<b>Step 12</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-if) # exit</pre>	Exits interface configuration mode and returns to global configuration mode.
<b>Step 13</b>	<b>interface pseudowire</b> <i>number-standby</i> <b>Example:</b> <pre>Device(config) # interface pseudowire 18</pre>	Establishes a standby pseudowire interface with a value that you specify and enters pseudowire configuration mode.
<b>Step 14</b>	<b>encapsulation mpls</b> <b>Example:</b> <pre>Device(config-if) # encapsulation mpls</pre>	Specifies the tunneling encapsulation.
<b>Step 15</b>	<b>neighbor</b> <i>standby-peer-ip-addr vc-id</i> <b>Example:</b> <pre>Device(config-if) # neighbor 10.10.0.11 18</pre>	Specifies the standby peer IP address and VC ID value of a L2VPN pseudowire.
<b>Step 16</b>	<b>l2vpn xconnect context</b> <i>context-name</i> <b>Example:</b> <pre>Device(config-if) # l2vpn xconnect context vpws17</pre>	Creates a L2VPN cross connect context, and attaches the VLAN mode EoMPLS attachment circuit to the active and standby pseudowire interfaces.
<b>Step 17</b>	<b>member</b> <i>interface-id</i> <b>Example:</b> <pre>Device(config-if-xconn) # member TenGigabitEthernet1/0/36</pre>	Specifies interface that forms a L2VPN cross connect.

	Command or Action	Purpose
<b>Step 18</b>	<b>member pseudowire</b> <i>number-active</i> <b>group</b> <i>group-name</i> [ <b>priority</b> <i>value</i> ] <b>Example:</b> <pre>Device(config-if-xconn)# member pseudowire 17 group pwr10</pre>	Specifies active pseudowire interface that forms a L2VPN cross connect.
<b>Step 19</b>	<b>member pseudowire</b> <i>number-standby</i> <b>group</b> <i>group-name</i> [ <b>priority</b> <i>value</i> ] <b>Example:</b> <pre>Device(config-if-xconn)# member pseudowire 18 group pwr10 priority 6</pre>	Specifies standby pseudowire interface that forms a L2VPN cross connect.
<b>Step 20</b>	<b>end</b> <b>Example:</b> <pre>Device(config-if-xconn)# end</pre>	Exits Xconnect configuration mode and returns to privileged EXEC mode.

## Configuring Pseudowire Redundancy VLAN Mode

Pseudowire redundancy VLAN mode can be configured using either the Xconnect mode or the protocol CLI method.

### Xconnect Mode

To configure pseudowire redundancy VLAN mode in Xconnect mode, perform the following task:

#### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> <pre>Device&gt; enable</pre>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> <pre>Device# configure terminal</pre>	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 3</b>	<b>interface</b> <i>interface-id</i> <b>Example:</b> <pre>Device(config)# interface TenGigabitEthernet1/0/36</pre>	Defines the interface to be configured as a trunk, and enters interface configuration mode.
<b>Step 4</b>	<b>no switchport</b> <b>Example:</b> <pre>Device(config-if)# no switchport</pre>	Enters Layer 3 mode for physical ports only.
<b>Step 5</b>	<b>no ip address</b> <b>Example:</b> <pre>Device(config-if)# no ip address</pre>	Ensures that no IP address is assigned to the physical port.
<b>Step 6</b>	<b>no keepalive</b> <b>Example:</b> <pre>Device(config-if)# no keepalive</pre>	Ensures that the device does not send keepalive messages.
<b>Step 7</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-if)# exit</pre>	Exits interface configuration mode and returns to global configuration mode.
<b>Step 8</b>	<b>interface</b> <i>interface-id.subinterface</i> <b>Example:</b> <pre>Device(config)# interface TenGigabitEthernet1/0/36.1105</pre>	Defines the subinterface to be configured, and enters subinterface configuration mode.
<b>Step 9</b>	<b>encapsulation dot1Q</b> <i>vlan-id</i> <b>Example:</b> <pre>Device(config-subif)# encapsulation dot1Q 1105</pre>	Enables IEEE 802.1Q encapsulation of traffic on the subinterface.

	Command or Action	Purpose
<b>Step 10</b>	<b>xconnect</b> <i>peer-ip-addr</i> <i>vc-id</i> <b>encapsulation mpls</b> <b>Example:</b> <pre>Device(config-subif)# xconnect 10.0.0.1 1105 encapsulation mpls</pre>	Binds the attachment circuit to a pseudowire VC. The syntax for this command is the same as for all other Layer 2 transports.
<b>Step 11</b>	<b>backup peer</b> <i>peer-ip-addr</i> <i>vc-id</i> [ <b>priority value</b> ] <b>Example:</b> <pre>Device(config-subif-xconn)# backup peer 10.10.10.10 1105 priority 8</pre>	Specifies a redundant peer for the pseudowire VC.
<b>Step 12</b>	<b>end</b> <b>Example:</b> <pre>Device(config-subif-xconn)# end</pre>	Exits Xconnect configuration mode and returns to privileged EXEC mode.

## Protocol CLI Method

To configure pseudowire redundancy VLAN mode in protocol CLI mode, perform the following task:

## Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> <pre>Device&gt; enable</pre>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> <pre>Device# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<b>port-channel load-balance dst-ip</b> <b>Example:</b> <pre>Device(config)# port-channel load-balance dst-ip</pre>	Sets the load-distribution method to the destination IP address.



	Command or Action	Purpose
<b>Step 4</b>	<b>interface</b> <i>interface-id</i> <b>Example:</b> <pre>Device(config)# interface TenGigabitEthernet1/0/36</pre>	Defines the interface to be configured as a trunk, and enters interface configuration mode.
<b>Step 5</b>	<b>no switchport</b> <b>Example:</b> <pre>Device(config-if)# no switchport</pre>	Enters Layer 3 mode for physical ports only.
<b>Step 6</b>	<b>no ip address</b> <b>Example:</b> <pre>Device(config-if)# no ip address</pre>	Ensures that there is no IP address assigned to the physical port.
<b>Step 7</b>	<b>no keepalive</b> <b>Example:</b> <pre>Device(config-if)# no keepalive</pre>	Ensures that the device does not send keepalive messages.
<b>Step 8</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-if)# exit</pre>	Exits interface configuration mode.
<b>Step 9</b>	<b>interface</b> <i>interface-id.subinterface</i> <b>Example:</b> <pre>Device(config)# interface TenGigabitEthernet1/0/36.1105</pre>	Defines the subinterface to be configured, and enters subinterface configuration mode.
<b>Step 10</b>	<b>encapsulation dot1Q</b> <i>vlan-id</i> <b>Example:</b> <pre>Device(config-subif)# encapsulation dot1Q 1105</pre>	Enables IEEE 802.1Q encapsulation of traffic on the subinterface.

	Command or Action	Purpose
<b>Step 11</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-subif)# exit</pre>	Exits subinterface configuration mode.
<b>Step 12</b>	<b>interface pseudowire <i>number-active</i></b> <b>Example:</b> <pre>Device(config)# interface pseudowire 17</pre>	Establishes an active pseudowire interface with a value that you specify, and enters pseudowire configuration mode.
<b>Step 13</b>	<b>encapsulation mpls</b> <b>Example:</b> <pre>Device(config-if)# encapsulation mpls</pre>	Specifies the tunneling encapsulation.
<b>Step 14</b>	<b>neighbor <i>active-peer-ip-addr vc-id</i></b> <b>Example:</b> <pre>Device(config-if)# neighbor 10.10.0.10 17</pre>	Specifies the active peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
<b>Step 15</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-if)# exit</pre>	Exits interface configuration mode.
<b>Step 16</b>	<b>interface pseudowire <i>number-standby</i></b> <b>Example:</b> <pre>Device(config)# interface pseudowire 18</pre>	Establishes a standby pseudowire interface with a value that you specify, and enters pseudowire configuration mode.
<b>Step 17</b>	<b>encapsulation mpls</b> <b>Example:</b> <pre>Device(config-if)# encapsulation mpls</pre>	Specifies the tunneling encapsulation.

	Command or Action	Purpose
<b>Step 18</b>	<b>neighbor</b> <i>standby-peer-ip-addr</i> <i>vc-id</i> <b>Example:</b> <pre>Device(config-if)# neighbor 10.10.0.11 18</pre>	Specifies the standby peer IP address and VC ID value of an L2VPN pseudowire.
<b>Step 19</b>	<b>l2vpn xconnect context</b> <i>context-name</i> <b>Example:</b> <pre>Device(config-if)# l2vpn xconnect context vpws17</pre>	Creates an L2VPN cross-connect context, and attaches the VLAN mode EoMPLS attachment circuit to the active and standby pseudowire interfaces.
<b>Step 20</b>	<b>member</b> <i>interface-id.subinterface</i> <b>Example:</b> <pre>Device(config-if-xconn)# member TenGigabitEthernet1/0/36.1105</pre>	Specifies the interface that forms an L2VPN cross connect.
<b>Step 21</b>	<b>member pseudowire</b> <i>number-active</i> <b>group</b> <i>group-name</i> [ <i>priority value</i> ] <b>Example:</b> <pre>Device(config-if-xconn)# member pseudowire 17 group pwr10</pre>	Specifies the active pseudowire interface that forms an L2VPN cross connect.
<b>Step 22</b>	<b>member pseudowire</b> <i>number-standby</i> <b>group</b> <i>group-name</i> [ <i>priority value</i> ] <b>Example:</b> <pre>Device(config-if-xconn)# member pseudowire 18 group pwr10 priority 6</pre>	Specifies standby pseudowire interface that forms an L2VPN cross connect.
<b>Step 23</b>	<b>end</b> <b>Example:</b> <pre>Device(config-if-xconn)# end</pre>	Exits Xconnect configuration mode and returns to privileged EXEC mode.

## Configuration Examples for Pseudowire Redundancy

**Table 4: Pseudowire Redundancy Port Mode Configuration**

PE Configuration	CE Configuration
<pre> mpls ip mpls label protocol ldp mpls ldp graceful-restart mpls ldp router-id loopback 1 force ! interface Loopback1 ip address 10.1.1.1 255.255.255.255 ip ospf 100 area 0 router ospf 100 router-id 10.1.1.1 nsf ! interface gigabitethernet 2/0/39 no switchport no ip address no keepalive ! interface pseudowire101 encapsulation mpls neighbor 10.10.10.10 101 ! interface pseudowire102 encapsulation mpls neighbor 10.10.10.11 101 l2vpn xconnect context pw101 member pseudowire101 group pwgrp1 priority 1 member pseudowire102 group pwgrp1 priority 15  member GigabitEthernet2/0/39 ! interface tengigabitethernet 3/0/10 switchport trunk allowed vlan 142 switchport mode trunk channel-group 42 mode active ! interface Port-channel42 switchport trunk allowed vlan 142 switchport mode trunk ! interface Vlan142 ip address 10.11.11.11 255.255.255.0 ip ospf 100 area 0 mpls ip mpls label protocol ldp ! </pre>	<pre> interface gigabitethernet 1/0/33 switchport trunk allowed vlan 912 switchport mode trunk spanning-tree portfast trunk ! interface Vlan912 ip address 10.91.2.3 255.255.255.0 ! </pre>

**Table 5: Pseudowire Redundancy VLAN Mode Configuration**

PE Configuration	CE Configuration
<pre> interface tengigabitethernet 1/0/36 no switchport no ip address no keepalive exit ! interface tengigabitethernet 1/0/36.1105 encapsulation dot1Q 1105 exit ! interface pseudowire1105 encapsulation mpls neighbor 10.10.0.10 1105 exit ! interface pseudowire1106 encapsulation mpls neighbor 10.10.0.11 1106 ! l2vpn xconnect context vme1105 member tengigabitethernet 1/0/36.1105 member pseudowire1105 group pwr10 member pseudowire1106 group pwr10 priority 6 end !</pre>	<pre> interface fortygigabitethernet 1/9 switchport switchport mode trunk switchport trunk allowed vlan 1105  mtu 9216 end !</pre>

The following is a sample output of the **show mpls l2 vc vcid vc-id detail** command:

```

Device# show mpls l2 vc vcid 1105 detail
Local interface: TenGigabitEthernet1/0/36.1105 up, line protocol up, Eth VLAN 1105 up
  Interworking type is Ethernet
  Destination address: 10.11.11.11, VC ID: 1105, VC status: standby
  Output interface: Po10, imposed label stack {1616}
  Preferred path: not configured
  Default path: active
  Next hop: 10.10.0.1
  Create time: 00:04:09, last status change time: 00:02:13
  Last label FSM state change time: 00:02:15
  Signaling protocol: LDP, peer 10.11.11.11:0 up
  Targeted Hello: 10.10.0.10(LDP Id) -> 10.11.11.11, LDP is UP
  Graceful restart: configured and enabled
  Non stop routing: not configured and not enabled
  Status TLV support (local/remote)   : enabled/supported
    LDP route watch                    : enabled
    Label/status state machine         : established, LrdRru
    Last local dataplane               status rcvd: No fault
    Last BFD dataplane                 status rcvd: Not sent
    Last BFD peer monitor               status rcvd: No fault
    Last local AC circuit               status rcvd: DOWN(standby)
    Last local AC circuit               status sent: No fault
    Last local PW i/f circ              status rcvd: No fault
    Last local LDP TLV                  status sent: DOWN(standby)
    Last remote LDP TLV                 status rcvd: No fault
    Last remote LDP ADJ                 status rcvd: No fault
  MPLS VC labels: local 125, remote 1616
  Group ID: local 336, remote 0
```

```

MTU: local 9198, remote 9198
Remote interface description:
MAC Withdraw: sent:1, received:0
Sequencing: receive disabled, send disabled
Control Word: On (configured: autosense)
SSO Descriptor: 10.11.11.11/1105, local label: 125
Dataplane:
SSM segment/switch IDs: 96143/450671 (used), PWID: 110
VC statistics:
transit packet totals: receive 0, send 0
transit byte totals:   receive 0, send 0
transit packet drops:  receive 0, seq error 0, send 0

```

The following is a sample output of the **show l2vpn atom vc vcid vc-id detail** command:

```

Device# show l2vpn atom vc vcid 1105 detail
pseudowire100110 is up, VC status is standby PW type: Ethernet
Create time: 00:04:17, last status change time: 00:02:22
Last label FSM state change time: 00:02:24
Destination address: 10.11.11.11 VC ID: 1105
Output interface: Po10, imposed label stack {1616}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.1
Member of xconnect service TenGigabitEthernet1/0/36.1105-1105, group right
Associated member TenGigabitEthernet1/0/36.1105 is up, status is up
Interworking type is Ethernet
Service id: 0x1f000037
Signaling protocol: LDP, peer 10.11.11.11:0 up
Targeted Hello: 10.0.0.10(LDP Id) -> 10.11.11.11, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
PWid FEC (128), VC ID: 1105
Status TLV support (local/remote)      : enabled/supported
LDP route watch                        : enabled
Label/status state machine              : established, LrdRru
Local dataplane status received         : No fault
BFD dataplane status received           : Not sent
BFD peer monitor status received        : No fault
Status received from access circuit     : DOWN(standby)
Status sent to access circuit           : No fault
Status received from pseudowire i/f     : No fault
Status sent to network peer             : DOWN(standby)
Status received from network peer       : No fault
Adjacency status of remote peer         : No fault
Sequencing: receive disabled, send disabled
Bindings
  Parameter      Local      Remote
  -----
Label           125        1616
Group ID        336        0
Interface
MTU             9198        9198
Control word on (configured: autosense) on
PW type         Ethernet   Ethernet
VCCV CV type 0x02        0x02
                LSPV [2]    LSPV [2]
VCCV CC type 0x06        0x02
                RA [2], TTL [3]  RA [2]
Status TLV      enabled    supported
SSO Descriptor: 10.11.11.11/1105, local label: 125
Dataplane:
SSM segment/switch IDs: 96143/450671 (used), PWID: 110
Rx Counters

```

```

0 input transit packets, 0 bytes
0 drops, 0 seq err
0 MAC withdraw
Tx Counters
0 output transit packets, 0 bytes
0 drops
1 MAC withdraw

```

The following is a sample output of the **show mpls l2transport vc vc-id** command:

Device# **show mpls l2transport vc 101**

Local intf	Local circuit	Dest address	VC ID	Status
TenGigabitEthernet1/0/36.1105	Eth VLAN 1105	10.0.0.1	1105	UP
TenGigabitEthernet1/0/36.1105	Eth VLAN 1105	10.11.11.11	1105	STANDBY

## Feature Information for Ethernet-over-MPLS and Pseudowire Redundancy

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.

**Table 6: Feature Information for Ethernet-over-MPLS and Pseudowire Redundancy**

Feature Name	Releases	Feature Information
Ethernet-over-MPLS and Pseudowire Redundancy	Cisco IOS XE Everest 16.6.1	This feature was introduced. Port mode support was introduced.
Ethernet over MPLS and Pseudowire Redundancy	Cisco IOS XE Gibraltar 16.12.1	VLAN mode support was introduced.
Macsec over EoMPLS	Cisco IOS XE Amsterdam 17.1.1	In VLAN mode EoMPLS, only those packets configured with <b>macsec dot1q-in-clear 1</b> command on the CE device will be processed by the PE device.
LACP and PAGP packet forwarding over Ethernet-over-MPLS Pseudowire	Cisco IOS XE Gibraltar 17.6.1	Support for forwarding Link Aggregation Control Protocol (LACP) and Port Aggregation Protocol (PAGP) packets over Ethernet-over-MPLS Pseudowire in the Port mode was introduced.

