Configuring Pseudowire

This chapter describes static and dynamic pseudowires. This chapter also describes the configuration procedures of pseudowires.

Understanding Any Transport over MPLS

Any Transport over MPLS (AToM) feature provides the following capabilities:

- Transport data link layer (Layer 2) packets over an MPLS backbone.
- Enable service providers to connect customer sites with existing Layer 2 networks by using a single, integrated, packet–based network infrastructure — an MPLS network. Instead of using separate networks with network management environments, service providers can deliver Layer 2 connections over an MPLS backbone.
- Provide a common framework to encapsulate and transport supported Layer 2 traffic types over an MPLS network core.

Note CPT supports only Ethernet over MPLS as the transport type under AToM in this release.

Prerequisites

Before configuring AToM, ensure that the network is configured as follows:

- Configure IP routing in the core so that the provider edge (PE) routers can reach each other via IP.
- Configure MPLS in the core so that a Label Switched Path (LSP) exists between the PE routers.
- Enable Cisco Express Forwarding or distributed Cisco Express Forwarding before configuring any Layer 2 circuits.
- Configure a loopback interface for originating and terminating Layer 2 traffic. Ensure that the PE routers can access the loopback interface of the other router.

Restrictions

The following restrictions pertain to Ethernet over MPLS feature under AToM:

- Configure the Label Distribution Protocol (LDP) router ID on all the PE routers to be a loopback address with a /32 mask. Otherwise, some configurations might not function properly.
- Ethernet over MPLS supports VLAN packets that conform to the IEEE 802.1Q standard. The 802.1Q specification establishes a standard method for inserting VLAN membership information into Ethernet frames. The Inter–Switch Link (ISL) protocol is not supported between the PE and CE routers.
- The AToM control word is supported. However, if the peer PE does not support a control word, the control word is disabled. This negotiation is done by LDP label binding.
- Ethernet packets with hardware–level cyclic redundancy check (CRC) errors, framing errors, and runt packets are discarded on input.

Benefits

The following list explains some of the benefits of enabling Layer 2 packets to be sent in the MPLS network:

- AToM adheres to the standards developed for transporting Layer 2 packets over MPLS. This benefits the service provider that wants to incorporate industry–standard methodologies in the network. Other Layer 2 solutions are proprietary, which can limit the ability of the service provider to expand the network and can force the service provider to use the equipment of only one vendor.
- Upgrading to AToM is transparent to the customer. Because the service provider network is separate from the customer network, the service provider can upgrade to AToM without disruption of service to the customer. The customers assume that they are using a traditional Layer 2 backbone.

How AToM Transports Layer 2 Packets

AToM encapsulates Layer 2 frames at the ingress PE and sends them to a corresponding PE at the other end of a pseudowire, which is a connection between the two PE routers. The egress PE removes the encapsulation and sends out the Layer 2 frame.

The successful transmission of the Layer 2 frames between PE routers is due to the configuration of the PE routers. Set up the connection, called a pseudowire, between the routers. Pseudowire is the emulation of services over the MPLS network.

Specify the following information on each PE router:

- The type of Layer 2 data that is transported across the pseudowire, such as Ethernet.

- The IP address of the loopback interface of the peer PE router, which enables the PE routers to communicate.
- A unique combination of peer PE IP address and Virtual Circuit ID (VC ID) that identifies the pseudowire.

Understanding Ethernet over MPLS

You can configure Ethernet over MPLS in the following modes:

- Ethernet over MPLS in VLAN mode
- Ethernet over MPLS in Port mode
- Ethernet over MPLS in VLAN ID Rewrite mode

Ethernet over MPLS in VLAN Mode

A VLAN is a switched network that is logically segmented by functions, project teams, or applications regardless of the physical location of users. Ethernet over MPLS allows you to connect two VLAN networks that are in different locations. You can configure the PE routers at each end of the MPLS backbone and add a point-to-point VC. Only the two PE routers at the ingress and egress points of the MPLS backbone are aware of the VCs dedicated to transporting Layer 2 VLAN traffic. All other routers do not have table entries for those VCs. Ethernet over MPLS in VLAN mode transports Ethernet traffic from a source 802.1Q VLAN to a destination 802.1Q VLAN over a core MPLS network.

Note You must configure Ethernet over MPLS (VLAN mode) on the Ethernet Flow Points (EFPs).

Ethernet over MPLS in Port Mode

Port mode allows a frame coming into an interface to be packed into an MPLS packet and transported over the MPLS backbone to an egress interface. The entire Ethernet frame is transported as a single packet. You can configure port mode xconnect by using EFP mode with encapsulation default. You can then specify the destination address and the VC ID. Each interface is associated with one unique pseudowire VC label.

When configuring Ethernet over MPLS in port mode, use the following guidelines:

- The pseudowire VC type is set to Ethernet.
- The Port mode and VLAN mode are mutually exclusive. If you enable a main interface for port-to-port transport, you cannot enter commands on the EFP.

Ethernet over MPLS in VLAN ID Rewrite Mode

The VLAN ID rewrite mode enables you to use VLAN interfaces with different VLAN IDs at both ends of the tunnel.

NTP-J29 Configure Ethernet over MPLS

Purpose	This procedure configures Ethernet over MPLS using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J84 Configure Ethernet over MPLS in VLAN Mode Using Cisco IOS Commands, on page 4
- DLP-J85 Configure Ethernet over MPLS in Port Mode Using Cisco IOS Commands, on page 5
- DLP-J86 Configure Ethernet over MPLS with VLAN ID Rewrite Using Cisco IOS Commands, on page 7
- DLP-J87 Configure MTU for Ethernet over MPLS Using Cisco IOS Commands, on page 9

Stop. You have completed this procedure.

DLP-J84 Configure Ethernet over MPLS in VLAN Mode Using Cisco IOS Commands

Purpose	This procedure configures Ethernet over MPLS in VLAN mode using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite
Security Level	Provisioning or higher

Note You must configure Ethernet over MPLS in VLAN mode on the EFPs.

Procedure

	Command or Action	Purpose
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	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**serviceinstance** *serviceinstanceid* **ethernet** **Example:** Router(config-if)# serviceinstance 100 ethernet	Specifies the service instance to configure and enters service instance configuration mode. Ensure that the EFPs between the CE and PE routers that are running Ethernet over MPLS are in the same subnet.
Step 5	**encapsulation dot1q** *vlan-id* **Example:** Router(config-if-srv)# encapsulation dot1q 100	Enables the EFP to accept 802.1Q VLAN packets.
Step 6	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** Router(config-if-srv)# xconnect 10.0.0.1 123 encapsulation mpls	Binds the attachment circuit to a pseudowire VC.
Step 7	Return to your originating procedure (NTP).	—

DLP-J85 Configure Ethernet over MPLS in Port Mode Using Cisco IOS Commands

Purpose	This procedure configures Ethernet over MPLS in port mode using Cisco IOS commands.

Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
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	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**service instance** *serviceinstanceid* **ethernet** **Example:** Router(config-if)# service instance 100 ethernet	Specifies the service instance and enters service instance configuration mode. Ensure that the EFPs between the CE and PE routers that are running Ethernet over MPLS are in the same subnet.
Step 5	**encapsulation default** **Example:** Router(config-if-srv)# encapsulation default	Enables the EFP to accept all the packets (tagged and untagged).
Step 6	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** Router(config-if-srv)# xconnect 10.0.0.1 123 encapsulation mpls	Binds the attachment circuit to a pseudowire VC. The syntax for this command is the same as for all other Layer 2 transports.
Step 7	**exit** **Example:** Router(config-if-srv)# exit	Exits service instance configuration mode.

	Command or Action	Purpose
Step 8	**exit** **Example:** Router(config-if)# exit	Exits interface configuration mode.
Step 9	Return to your originating procedure (NTP).	—

DLP-J86 Configure Ethernet over MPLS with VLAN ID Rewrite Using Cisco IOS Commands

Purpose	This procedure configures Ethernet over MPLS with VLAN ID rewrite using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite
Security Level	Provisioning or higher

The VLAN ID rewrite feature enables you to use VLAN interfaces with different VLAN IDs at both ends of the tunnel.

Procedure

	Command or Action	Purpose
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	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.

	Command or Action	Purpose
Step 4	**service instance** *id* **ethernet** **Example:** Router(config-if)# service instance 100 ethernet	Configures an Ethernet service instance on an interface and enters service instance configuration mode. • Ensure that the EFPs between the CE and PE routers that are running Ethernet over MPLS are in the same subnet.
Step 5	**encapsulation dot1q** *vlan-id* **Example:** Router(config-if-srv)# encapsulation dot1q 100	Enables the EFP to accept 802.1Q VLAN packets.
Step 6	**rewrite ingress tag push | pop | translate** **Example:** Router(config-if-srv)# rewrite ingress tag push dot1q 20	Specifies the rewrite operation to be applied on the frame ingress to the service instance.
Step 7	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** Router(config-if-srv)# xconnect 10.0.0.1 123 encapsulation mpls	Binds the attachment circuit to a pseudowire VC and enters cross–connect configuration mode.
Step 8	**exit** **Example:** Router(config-if-srv-xconn)# exit	Exits cross–connect configuration mode.
Step 9	**exit** **Example:** Router(config-if-srv)# exit	Exits service instance configuration mode.
Step 10	**exit** **Example:** Router(config)# exit	Exits global configuration mode.
Step 11	Return to your originating procedure (NTP).	—

Example: Configure Ethernet over MPLS with VLAN ID Rewrite

The following example shows how to configure VLAN ID rewrite on peer PE routers.

PE1:

```
interface TenGigabitEthernet4/1
encapsulation dot1Q 2
no ip directed-broadcast
no cdp enable
rewrite ingress tag push dot1q 20
xconnect 10.5.5.5 2 encapsulation mpls
```

PE2:

```
interface TenGigabitEthernet4/2
encapsulation dot1Q 3
no ip directed-broadcast
no cdp enable
rewrite ingress tag push dot1q 30
xconnect 10.3.3.3 2 encapsulation mpls
```

DLP-J87 Configure MTU for Ethernet over MPLS Using Cisco IOS Commands

Purpose	This procedure configures MTU for Ethernet over MPLS using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
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	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface and enters interface configuration mode.

	Command or Action	Purpose
Step 4	**mtu** *mtu-value* **Example:** Router(config-if)# mtu 2000	Specifies the MTU value for the interface. The MTU value specified at the interface level can be inherited by a EFP.
Step 5	**service instance** *serviceinstanceid* **ethernet** **Example:** Router(config-if)# service instance 100 ethernet	Specifies the service instance and enters service instance configuration mode. Ensure the EFP on the adjoining CE router is on the same VLAN as this PE router.
Step 6	**encapsulation dot1q** *vlan-id* **Example:** Router(config-if-srv)# encapsulation dot1q 100	Enables the EFP to accept 802.1Q VLAN packets. The EFPs between the CE and PE routers that are running Ethernet over MPLS must be in the same subnet.
Step 7	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** Router(config-if-srv)# xconnect 10.0.0.1 123 encapsulation mpls	Binds the attachment circuit to a pseudowire VC.
Step 8	**end** **Example:** Router(config-if-srv)# end	Exits the cross-connect service instance configuration mode and returns to global configuration mode.
Step 9	**show mpls l2transport binding** **Example:** Router# show mpls l2transport binding	Displays the MTU values assigned to the local and remote interfaces.
Step 10	Return to your originating procedure (NTP).	—

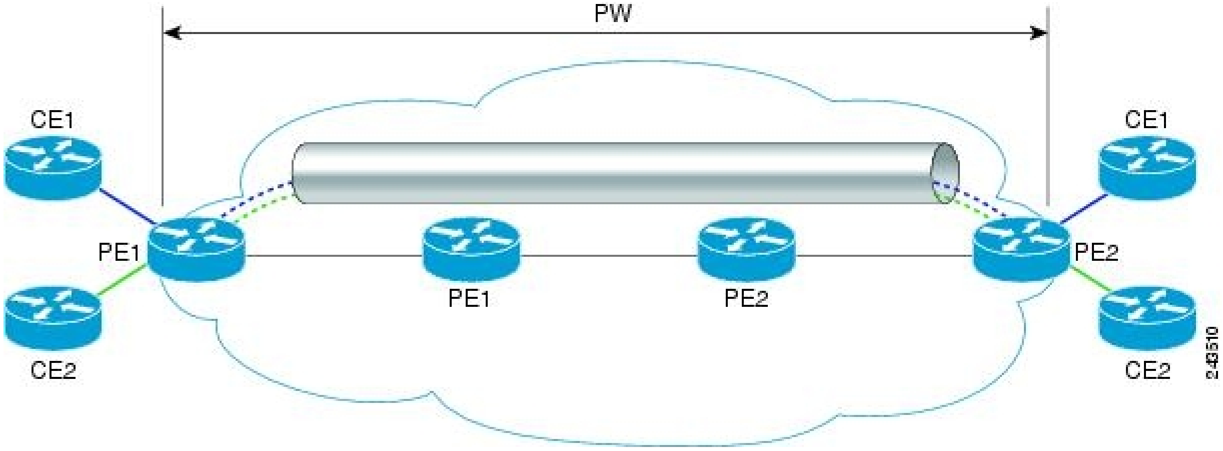
Understanding L2VPN Pseudowire

supports the forwarding of the Ethernet frames coming from the customer networks under AToM. The technique used to transport such a frame is called a pseudowire that is the emulation of a native service over the MPLS network.

Note You can create static and dynamic pseudowires. The static pseudowire can carry traffic over LDP, MPLS-TE tunnels, and MPLS-TP tunnels. The dynamic pseudowire can carry traffic over LDP and MPLS–TE tunnels.

An L2VPN pseudowire is a tunnel established between the two PE routers across the core carrying the Layer 2 payload encapsulated as MPLS data, as shown in Figure 1: An L2VPN Pseudowire, on page 11. This helps the carriers migrate from Layer 2 networks such as Ethernet over MPLS to an MPLS core. In the L2VPN pseudowire shown in Figure 2: A Multisegment Pseudowire, on page 12, the pseudowires between the two PE routers are located within the same autonomous system. The routers PE1 and PE2 are called terminating PE routers (T-PEs). The attachment circuits (AC) are bound to the pseudowire on these PE routers.

Figure 1: An L2VPN Pseudowire



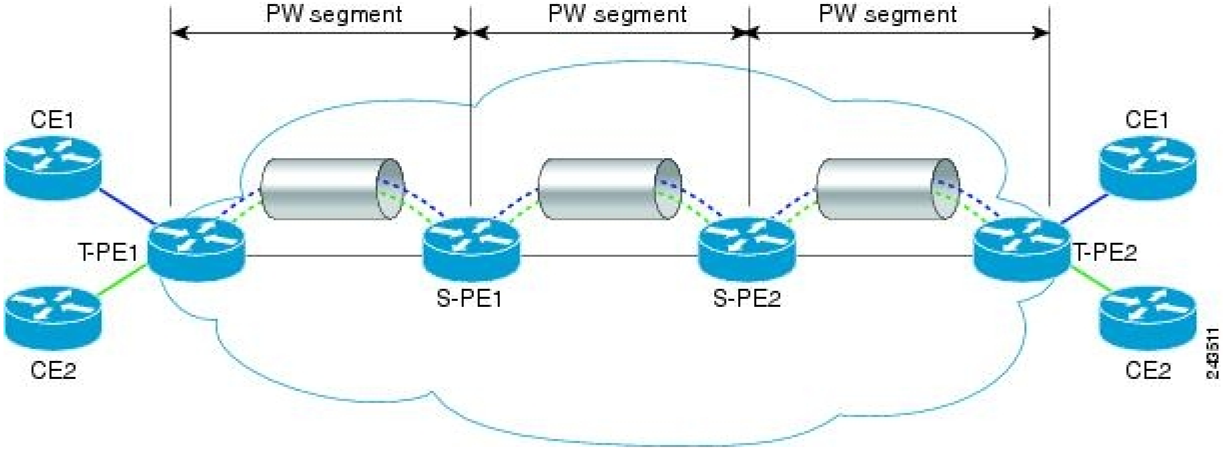
Dual homed pseudowire is a pseudowire protected circuit where the destination point is split on two different nodes. In Dual home pseudowire protection, the active AC port is up and the protect AC port is down. When the active AC port goes down, the protect AC port comes up.

Understanding L2VPN Multisegment Pseudowire

An L2VPN multisegment pseudowire is a set of two or more pseudowire segments that function as a single pseudowire. It is also known as stitched pseudowire. The multisegment pseudowires span multiple cores or autonomous systems of the same or different carrier networks. An L2VPN multisegment pseudowire can include up to 254 pseudowire segments.

The end routers are called terminating PE routers (T-PEs), and the switching routers are called S-PE routers. The S-PE router terminates the tunnels of the preceding and succeeding pseudowire segments in a multisegment pseudowire. The S-PE router can switch the control and data planes of the preceding and succeeding pseudowire segments of the multisegment pseudowire. A multisegment pseudowire is declared to be up when all the single-segment pseudowires are up.

Figure 2: A Multisegment Pseudowire



You can create both static segments and dynamic segments for a multisegment pseudowire. When you enable the control word on one segment, ensure that the control word is enabled on the other segments as well.

See Static and Dynamic Multisegment Pseudowires for MPLS–TP, on page 16 for information on multisegment pseudowires for MPLS–TP.

Restrictions for L2VPN Multisegment Pseudowires

- Only MPLS Layer 2 pseudowires are supported.
- The L2VPN Pseudowire Stitching feature is supported for pseudowires advertised with FEC 128. FEC 129 is not supported.
- The S-PE router is limited to 1600 pseudowires.

Supported Pseudowire Combinations

The following table lists the types of tunnels that are supported for static and dynamic single segment pseudowires.

Pseudowire Type	LDP	MPLS-TE Tunnel	MPLS-TP Tunnel with IP Address	MPLS-TP Tunnel without IP Address
Static	Yes	Yes	Yes	Yes
Dynamic	Yes	Yes	No	No

The following table lists the OAM protocols supported for static and dynamic single segment pseudowires.

Pseudowire Type	Targeted LDP	Static OAM	BFD over VCCV	BFD over VCCV with AC Status Signaling
Static pseudowire over MPLS-TP	No	Yes	Yes	Yes
Static pseudowire over LDP	No	Yes	Yes	Yes
Static pseudowire over MPLS-TE	No	Yes	Yes	Yes
Dynamic pseudowire over LDP	Yes	No	Yes	No
Dynamic pseudowire over MPLS-TE	Yes	No	Yes	No

The following table lists the OAM protocols supported for static and dynamic multisegment pseudowires.

Pseudowire Type	Targeted LDP	Static OAM	BFD over VCCV	BFD over VCCV with AC Status Signaling
Static-Static	No	Yes	Yes	Yes
Static-Dynamic	Yes	Yes	Yes	Yes
Dynamic-Dynamic	Yes	Not applicable	Yes	Not applicable

Rewrite Operations on Pseudowire

The following tables list the rewrite operations supported on pseudowire.

Table 1: Ingress Rewrite Operations on Pseudowire

EFP Encapsulation	Incoming Encapsulation Type	Ingress Rewrite Operation	Outgoing Encapsulation Type	Pseudowire Type
encapsulation dot1q *vlan id*	0x8100	• No rewrite • Pop 1 symmetric • Push 1 symmetric • 1:1 translate symmetric	0x8100	Ethernet and VLAN

EFP Encapsulation	Incoming Encapsulation Type	Ingress Rewrite Operation	Outgoing Encapsulation Type	Pseudowire Type
encapsulation dot1q *vlan id*	0x8100	• 1:1 translate symmetric e-type • Push 1 symmetric	0x8100	Ethernet
encapsulation dot1q *vlan id*	0x8100	• No rewrite	Not applicable	Ethernet and VLAN
encapsulation dot1q *vlan id*	0x8100	• Pop 1 symmetric	any	Ethernet and VLAN
encapsulation dot1q *vlan id*	0x8100	• Push 1 symmetric	any	Ethernet
encapsulation dot1q *vlan id*	0x8100	• 1:1 translate	any	Ethernet
encapsulation dot1q any	0x8100	• No rewrite	Not applicable	Ethernet and VLAN
encapsulation dot1q any	0x8100	• Push 1 symmetric	0x8100	Ethernet and VLAN
encapsulation dot1q any	0x8100	• No rewrite	Not applicable	Ethernet
encapsulation untagged	0x8100	• No rewrite • Push 1 symmetric	0x8100	Ethernet and VLAN
encapsulation untagged	0x8100	• Push 1 symmetric	0x8100	Ethernet
encapsulation default	Not applicable	• No rewrite	Not applicable	Ethernet and VLAN
encapsulation default	Not applicable	• Push 1 symmetric	0x8100	Ethernet and VLAN
encapsulation default	Not applicable	• Push 1 symmetric	0x8100	Ethernet
encapsulation double tagged	0x8100 and second 0x8100	• Pop 1 symmetric	0x8100	Ethernet and VLAN

EFP Encapsulation	Incoming Encapsulation Type	Ingress Rewrite Operation	Outgoing Encapsulation Type	Pseudowire Type
encapsulation double tagged	0x8100 and second 0x8100	• 1:1 translate symmetric	0x8100 and second 0x8100	Ethernet and VLAN
encapsulation double tagged	0x8100 and second 0x8100	• 1:1 translate symmetric	0x8100	Ethernet
encapsulation double tagged	0x8100 and second 0x8100	• 1:1 translate symmetric	any	Ethernet
encapsulation double tagged	0x8100 and second 0x8100	• Pop 1 symmetric	0x8100	Ethernet and VLAN
encapsulation double tagged	0x8100 and second 0x8100	• 2:2 translate symmetric	0x8100 and second 0x8100	Ethernet
encapsulation double tagged	0x88a8 and second 0x8100	• 2:2 translate symmetric	0x8100 and second 0x8100	Ethernet
encapsulation double tagged	0x8100 and second 0x8100	• 2:2 translate symmetric	0x88a8 and second 0x8100	Ethernet
encapsulation single tagged	0x8100	• 1:2 translate symmetric	0x8100 and second 0x8100	Ethernet
encapsulation untagged	untagged	• Push 2 symmetric	0x88a8 and 0x8100	Ethernet
encapsulation untagged	untagged	• Push 2 symmetric	0x8100 and second 0x8100	Ethernet
encapsulation single tagged	0x8100	• Push 1 symmetric	0x8100 and second 0x8100	Ethernet and VLAN
encapsulation double tagged	0x8100 and second 0x8100	• 1:1 translate symmetric	0x8100 and second 0x8100	Ethernet and VLAN

EFP Encapsulation	Incoming Encapsulation Type	Ingress Rewrite Operation	Outgoing Encapsulation Type	Pseudowire Type
encapsulation single tagged	0x88a8	• 1:2 translate symmetric	0x8100 and second 0x8100	Ethernet
encapsulation double tagged	0x8100 and second 0x8100	• 2:1 translate symmetric	0x8100	Ethernet
encapsulation double tagged	0x88a8 and 0x8100	• 2:1 translate symmetric	0x88a8	Ethernet
encapsulation double tagged	0x8100 and second 0x8100	• Pop 2 symmetric	untagged	Ethernet
encapsulation double tagged	0x88a8 and 0x8100	• Pop 2 symmetric	untagged	Ethernet
encapsulation single tagged	0x8100	• Pop 1 symmetric	untagged	Ethernet and VLAN
encapsulation dot1q range	0x8100	• No rewrite	Not applicable	Ethernet and VLAN
encapsulation dot1q range	0x8100	• Push 1 symmetric	0x8100	VLAN
encapsulation dot1q range	0x8100	• Push 1 symmetric	0x8100	Ethernet
encapsulation dot1ad any/range	0x8100	• No rewrite	0x8100	Ethernet and VLAN
encapsulation dot1ad any/range	0x8100	• Push 1 symmetric	any	Ethernet

Static and Dynamic Multisegment Pseudowires for MPLS–TP

MPLS-TP supports the following combinations of static and dynamic multisegment pseudowires:

- Static-static
- Static-dynamic

- Dynamic-static

MPLS–TP: Pseudowire Redundancy for Static and Dynamic Multisegment Pseudowires

MPLS-TP supports pseudowire redundancy for the following combinations of static and dynamic pseudowires:

- Static pseudowire with a static backup pseudowire
- Static pseudowire with a dynamic backup pseudowire
- Dynamic pseudowire with a static backup pseudowire

MPLS–TP: OAM Status for Static and Dynamic Multisegment Pseudowires

With static pseudowires, status notifications can be provided by BFD over VCCV or static pseudowire OAM protocol. However, BFD over VCCV sends only attachment circuit status code notifications. Hop-by-hop notifications of other pseudowire status codes are not supported. Therefore, static pseudowire OAM protocol is preferred. You can acquire per pseudowire OAM for attachment circuit/pseudowire notification over VCCV channel with or without the control word.

NTP-J30 Create a Pseudowire Class

Purpose	This procedure creates a pseudowire class.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J88 Create a Pseudowire Class Using Cisco IOS Commands, on page 17
- DLP-J89 Create a Pseudowire Class Using CTC, on page 20

Stop. You have completed this procedure.

DLP-J88 Create a Pseudowire Class Using Cisco IOS Commands

Purpose	This procedure creates a pseudowire class using Cisco IOS commands.

Tools/Equipment	None
Prerequisite Procedures	• DLP-J97 Create and Configure BFD Templates Using Cisco IOS Commands • NTP-J35 Configure BFD Control Channel over VCCV Using Cisco IOS Commands, on page 55
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

When you create the pseudowire class, you specify the parameters of the pseudowire, such as the use of control word, preferred path, OAM class, and VCCV BFD template.

Note To create a pseudowire for TDM SFP, pseudowire class should not has control-word, sequencing, OAM, BFDoVCC, Dynamic tunnel and Dynamic Protocol attributes.

Procedure

	Command or Action	Purpose
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	**pseudowire-class** *class-name* **Example:** Router(config)# pseudowire-class class1	Creates a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 4	**encapsulation** *type* **Example:** Router(config-pw-class)# encapsulation mpls	Specifies that MPLS is used as the encapsulation type for tunneling Layer 2 traffic over a pseudowire. You must specify MPLS encapsulation as part of the **xconnect** command or as part of a pseudowire class for the Virtual Circuits to work properly.
Step 5	**control-word** **Example:**	Enables the control word in a dynamic pseudowire connection.

	Command or Action	Purpose
	Router(config-pw-class)# control-word	
Step 6	**protocol** {**ldp** | **none**} **Example:** Router(config-pw-class)# protocol ldp	Specifies the signaling protocol to be used to manage the pseudowires created from this pseudowire class.
Step 7	**preferred-path** {**interface tunnel** *tunnel-number* | **peer** {*ip-address* | *host-name*}} [**disable-fallback**] **Example:** Router(config-pw-class)# preferred-path interface tunnel 1 disable-fallback	Specifies the MPLS–TP or MPLS–TE tunnel path that must be used by the pseudowire. **Note** If multiple MPLS-TP tunnels are exist between same pair of nodes, configure the preferred path using the MPLS-TP tunnel having highest cost.
Step 8	**status protocol notification static** *class-name* **Example:** Router(config-pw-class)# status protocol notification static oam-class1	Specifies a static OAM class.
Step 9	**vccv bfd template** *name* [**udp** | **raw-bfd**] **Example:** Router(config-pw-class)# vccv bfd template bfdtemplate1 raw-bfd	Enables BFD over VCCV for a pseudowire class.
Step 10	**exit** **Example:** Router(config-pw-class)# exit	Returns the router to the global configuration mode.
Step 11	—	Return to your originating procedure (NTP).

Example: Create a Pseudowire Class

The following example creates a pseudowire class using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# pseudowire-class class1
Router(config-pw-class)# encapsulation mpls
Router(config-pw-class)# control-word
Router(config-pw-class)# protocol ldp
Router(config-pw-class)# preferred-path interface tunnel 1 disable-fallback
Router(config-pw-class)# status protocol notification static oam-class1
Router(config-pw-class)# vccv bfd template bfdtemplate1 raw-bfd
Router(config-pw-class)# exit
```

DLP-J89 Create a Pseudowire Class Using CTC

Purpose	This procedure creates a pseudowire class using CTC.
Tools/Equipment	None
Prerequisite Procedures	• DLP-J102 Create a Static OAM Class Using CTC • DLP-J98 Create and Configure BFD Templates Using CTC
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note You can also create a pseudowire class automatically. Refer to the DLP-J107 Create an MPLS–TP Tunnel Using CTC procedure.

Note To create a pseudowire for TDM SFP, pseudowire class should not has control-word, sequencing, OAM, BFDoVCC, Dynamic tunnel and Dynamic Protocol attributes.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to create a pseudowire class.

Step 2 From the View menu, choose **Go to Home View**.

Step 3 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 4 Click the **Provisioning** tab.

Step 5 From the left pane, click **Pseudowire Class**.

Step 6 Click **Create**. The **Create Pseudowire Class** dialog box appears.

Step 7 Enter the name of the pseudowire class in the Name field.

The encapsulation type for tunneling Layer 2 traffic over a pseudowire is set to MPLS and cannot be changed.

Step 8 From the Interworking drop-down list, choose **VLAN** or **Ethernet**.

The Interworking option enables the translation between the different Layer 2 encapsulations.

Note To associate this pseudowire class with a VPLS circuit, choose NONE as the interworking. Otherwise, this pseudowire class will not be displayed in the VPLS Configuration screen.

Note If a pseudowire is to be created with same encapsulation at both the ends, create pseudowire class with interworking as "NONE", else with interworking as VLAN or Ethernet .

Step 9 If unchecked, check the **Control Word** check box to enable the control word in a dynamic pseudowire connection.

Step 10 Check the **Master Redundancy** check box to place the pseudowire redundancy group on this node in master mode.

Step 11 In the Preferred Path area, specify the MPLS–TP or MPLS–TE tunnel path that must be used by the pseudowire.

a) Check the **Enable** check box to enable the preferred path.
b) Choose **TP** or **TE** as the tunnel type for the preferred path.
c) Enter the tunnel ID in the Tunnel ID field.

Note If multiple MPLS-TP tunnels are exist between the same pair of nodes, configure the preferred path using the MPLS-TP tunnel having highest cost.

Note If a pseudowire class is associated with a VPLS circuit, the Tunnel ID field is disabled when editing the pseudowire class.

d) Check the **Disable Fallback** check box to disable the router from using the default path when the preferred path is unreachable.

Step 12 In the Protocol area, choose **LDP** or **NONE** to specify the signaling protocol to be used to manage the pseudowires created from this pseudowire class.

Note To associate this pseudowire class with a VPLS circuit, choose LDP as the signaling protocol. Otherwise, this pseudowire class will not be displayed in the VPLS Configuration screen.

Step 13 In the Sequencing area, specify the direction in which the sequencing of packets in a pseudowire is enabled.

a) Check the **Enable** check box to enable sequencing.
b) From the Sequencing drop-down list, choose **Transmit**, **Receive**, or **Both**.

- **Transmit—**This option updates the sequence number field in the headers of packets sent over the pseudowire according to the data encapsulation method that is used.
- **Receive—**This option keeps the sequence number field in the headers of packets received over the pseudowire. The packets that are not received in sequence are dropped.
- **Both—**This option enables both the transmit and receive options.

c) Enter a value in the Resync field. The Resync field is enabled when the protocol is chosen as **LDP**.

Step 14 In the BFDoVCCV area, enable BFD over VCCV for a pseudowire class.

a) Check the **Enable** check box to enable BFD over VCCV.
b) From the BFD Template drop-down list, choose a BFD template.
c) Check the **AC Status Signalling** check box to enable end-to-end attachment circuit status code notification using BFDoVCCV.

Step 15 In the Status OAM area:

a) Check the **Enable** check box to enable static OAM.
b) From the OAM Class drop-down list, choose a static OAM class.

Step 16 Click **OK** to create a pseudowire class.

Step 17 Return to your originating procedure (NTP).

NTP-J31 Configure a Pseudowire

Purpose	This procedure configures a pseudowire.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J90 Create a Pseudowire Using Cisco IOS Commands, on page 22
- DLP-J91 Create a Pseudowire Using CTC, on page 30
- DLP-J223 Edit a Pseudowire Using CTC, on page 35
- DLP-J92 Configure L2VPN Multisegment Pseudowires Using Cisco IOS Commands, on page 25
- DLP-J227 Configure Static-to-Static Multisegment Pseudowires for MPLS-TP Using Cisco IOS Commands, on page 27
- DLP-J228 Configure Static-to-Dynamic Multisegment Pseudowires for MPLS-TP Using Cisco IOS Commands, on page 28
- DLP-J93 Perform ping mpls and trace mpls Operations on L2VPN Multisegment Pseudowires Using Cisco IOS Commands, on page 36
- DLP-J94 Configure L2VPN Pseudowire Preferential Forwarding Using Cisco IOS Commands, on page 38

Stop. You have completed this procedure.

DLP-J90 Create a Pseudowire Using Cisco IOS Commands

Purpose	This procedure creates a static and dynamic pseudowire using Cisco IOS commands.
Tools/Equipment	None

Prerequisite Procedures	• DLP-J88 Create a Pseudowire Class Using Cisco IOS Commands, on page 17 • DLP-J163 Create a MPLS-TE Tunnel Using Cisco IOS Commands or DLP–J106 Configure Tunnel Endpoints Using Cisco IOS Commands or Configure LDP.
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

The successful transmission of the Layer 2 frames between the provider edge routers is due to the configuration of the PE routers. You set up the connection, called a pseudowire, between the routers.

Note Do not set labels to create a dynamic pseudowire.

Note If a VPWS is provisioned between two nodes where one node is running CPT version 9.7.0.2 and the other node is running older version. Before provisioning the pseudowire, edit the TDM SFP labels to the default values.

Procedure

	Command or Action	Purpose
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	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**xconnect** *peer-ip-address vcid* **encapsulation mpls pw-class** *pw-class-name* [**sequencing** {**transmit** | **receive** | **both**}]	Binds an attachment circuit to a pseudowire and configures a static pseudowire.

	Command or Action	Purpose
	Example: Router(config-if)# xconnect 10.131.191.252 100 encapsulation mpls pw-class class1	
Step 5	**mpls label** *local-pseudowire-label remote-pseudowire-label* **Example:** Router(config-if-xconn)# mpls label 100 150	Sets the local and remote labels for the static pseudowire. Do not set labels to create a dynamic pseudowire. • The label must be an unused static label within the static label range configured using the **mpls label** command. • The **mpls label** command checks the validity of the label entered and displays an error message if it is not valid. The label supplied for the *remote-pseudowire-label* argument must be the value of the peer PE's local pseudowire label.
Step 6	**mpls control-word** **Example:** Router(config-if-xconn)# no mpls control-word	Enables the MPLS control word. If you enable inclusion of the control word, it must be enabled on both ends of the connection for the circuit to work properly.
Step 7	**exit** **Example:** Router(config-if-xconn)# exit	Returns the router to interface configuration mode.
Step 8	**exit** **Example:** Router(config-if)# exit	Returns the router to global configuration mode. **Note** In scaled configuration, if shut or no shut operation performed on the core ports that have huge number of pseudowires configured, the CPT 50 may reboot due to high CPU utilization.
Step 9	Return to your originating procedure (NTP).	—

Example: Create a Pseudowire

The following example creates a static pseudowire using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# xconnect 10.131.191.251 100 encapsulation mpls pw-class class1
Router(config-if-xconn)# mpls label 100 150
Router(config-if-xconn)# no mpls control-word
   Router(config-if-xconn)# exit
   Router(config-if)# exit
```

DLP-J92 Configure L2VPN Multisegment Pseudowires Using Cisco IOS Commands

Purpose	This procedure configures L2VPN multisegment pseudowires using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	• DLP-J88 Create a Pseudowire Class Using Cisco IOS Commands, on page 17 • DLP-J163 Create a MPLS-TE Tunnel Using Cisco IOS Commands or DLP–J106 Configure Tunnel Endpoints Using Cisco IOS Commands or Configure LDP.
Required/As Needed	As needed
Onsite/Remote	Onsite
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
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	**mpls label protocol ldp** **Example:** Router(config)# mpls label protocol ldp	Configures the use of LDP on all the interfaces.
Step 4	**mpls ldp router-id** *interface* **force** **Example:** Router(config)# mpls ldp router-id loopback0 force	Specifies the preferred interface for determining the LDP router ID.

	Command or Action	Purpose
Step 5	**pseudowire-class** *name* **Example:** Router(config)# pseudowire-class atom	Establishes a pseudowire class with a name that you specify, and enters pseudowire class configuration mode. Ensure that the interworking and control word are the same.
Step 6	**encapsulation mpls** **Example:** Router(config-pw-class)# encapsulation mpls	Specifies the tunneling encapsulation. For MPLS L2VPNs, the encapsulation type is mpls.
Step 7	**switching tlv** **Example:** Router(config-pw-class)# switching tlv	(Optional) Enables the advertisement of the switching point type, length, value (TLV) in label binding. This command is enabled by default.
Step 8	**exit** **Example:** Router(config-pw-class)# exit	Exits pseudowire class configuration mode.
Step 9	**l2 vfi** *name* **point-to-point** **Example:** Router(config)# l2 vfi atomtunnel point-to-point	Creates a point-to-point Layer 2 virtual forwarding interface (VFI) and enters VFI configuration mode.
Step 10	**description** *string* **Example:** Router(config-vfi)# description segment1	Provides a description of the switching PE router for a multisegment pseudowire.
Step 11	**neighbor** *ip-address vcid* {**encapsulation mpls** | **pw-class** *pw-class-name*} **Example:** Router(config-vfi)# neighbor 10.0.0.1 100 pw-class mpls	Sets up an emulated VC. Specify the IP address and the VC ID of the peer router. Also, specify the pseudowire class to use for the emulated VC. **Note** Only two **neighbor** commands are allowed for each **l2 vfi point-to-point** command.
Step 12	exit **Example:** Router(config-vfi)# exit	Returns to global configuration mode.
Step 13	Return to your originating procedure (NTP).	—

DLP-J227 Configure Static-to-Static Multisegment Pseudowires for MPLS-TP Using Cisco IOS Commands

Purpose	This procedure configures static-to-static multisegment pseudowires for MPLS–TP using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
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	**l2 vfi** *name* **point-to-point** **Example:** Router(config)# l2 vfi atomtunnel point-to-point	Creates a point-to-point Layer 2 virtual forwarding interface (VFI) and enters VFI configuration mode.
Step 4	**neighbor** *ip-address vc-id* {**encapsulation mpls** | **pw-class** *pw-class-name*} **Example:** Router(config-vfi)# neighbor 10.0.0.1 100 pw-class mpls	Sets up an emulated VC. Specify the IP address and the VC ID of the peer router. Also, specify the pseudowire class to use for the emulated VC.
Step 5	**mpls label** *local-pseudowire-label remote-pseudowire-label* **Example:** Router(config-vfi-neighbor)# mpls label 100 150	Sets the local and remote labels for a static pseudowire.
Step 6	**mpls control-word**	Enables the MPLS control word.

	Command or Action	Purpose
	Example: Router(config-vfi-neighbor)# mpls control-word	**Note** Repeat steps 4, 5, and 6 for another static pseudowire.
Step 7	**exit** **Example:** Router(config-vfi-neighbor)# exit	Exits VFI neighbor configuration mode.
Step 8	Return to your originating procedure (NTP). **Example:** —	

DLP-J228ConfigureStatic-to-DynamicMultisegmentPseudowiresforMPLS-TP Using Cisco IOS Commands

Purpose	This procedure configures static-to-dynamic multisegment pseudowires for MPLS–TP using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note When you configure static-to-dynamic pseudowires, you configure the static pseudowire class with the **protocol none** command.

Procedure

	Command or Action	Purpose
Step 1	Configure the static pseudowire. **Example:** **1** enable	Configures the static pseudowire.

	Command or Action	Purpose
	2 configure terminal **3** pseudowire-class *class-name* **4** mpls control-word **5** protocol none **6** exit	
Step 2	Configure the dynamic pseudowire. **Example:** **1** enable **2** configure terminal **3** pseudowire-class *class-name* **4** mpls control-word	Configures the dynamic pseudowire.
Step 3	**enable** **Example:** Router> enable	Enables privileged EXEC mode. Perform the following steps to configure the static-to-dynamic multisegment pseudowire. • Enter your password if prompted.
Step 4	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 5	**l2 vfi** *name* **point-to-point** **Example:** Router(config)# l2 vfi atomtunnel point-to-point	Creates a point-to-point Layer 2 virtual forwarding interface (VFI) and enters VFI configuration mode.
Step 6	**neighbor** *ip-address vc-id* {**encapsulation mpls** | **pw-class** *pw-class-name*} **Example:** Router(config-vfi)# neighbor 10.0.0.1 100 pw-class mpls	Sets up an emulated VC. Specify the IP address and the VC ID of the peer router. Also, specify the pseudowire class to use for the emulated VC.
Step 7	**mpls label** *local-pseudowire-label remote-pseudowire-label* **Example:** Router(config-vfi-neighbor)# mpls label 100 150	Sets the local and remote labels for a static pseudowire.

	Command or Action	Purpose
Step 8	**mpls control-word** **Example:** Router(config-vfi-neighbor)# mpls control-word	Enables the MPLS control word.
Step 9	**local interface** *pseudowire-type* **Example:** Router(config-vfi-neighbor)# local interface 5	Specifies the pseudowire type when configuring static to dynamic pseudowires.
Step 10	**tlv template** *template-name* **Example:** Router(config-vfi-neighbor-interface)# tlv template net	Specifies a TLV template to use as part of the local interface configuration.
Step 11	**exit** **Example:** Router(config-vfi-neighbor-interface)# exit	Exits VFI neighbor interface configuration mode.
Step 12	Return to your originating procedure (NTP).	

Example: Configure Static-to-Dynamic Multisegment Pseudowires for MPLS-TP

The following example shows how to configure a TLV template:

```
Router(config)#pseudowire-tlv template tlv-template-name
Router(config-pw-tlv-template)#tlv mtu-value 1 4 dec 1500
Router(config-pw-tlv-template)#tlv vccv-flags C 4 hexstr 0108
Router(config-pw-tlv-template)#exit
```

The following example shows how to configure VFI at an SPE node:

```
Router(config)#l2 vfi vfi::1 point-to-point
Router(config-vfi)#neighbor 3.3.3.3 1 pw-class PW_LDP_VPWS
Router(config-vfi)#neighbor 1.1.1.1 1 pw-class PW_TP_1_VPWS
Router(config-vfi-neighbor)#mpls label 17 17
Router(config-vfi-neighbor)#local interface 5
Router(config-vfi-neighbor-interface)#tlv template tlv-template-name
Router(config-vfi-neighbor-interface)#exit
Router(config-vfi-neighbor)#exit
```

DLP-J91 Create a Pseudowire Using CTC

Purpose	This procedure allows you to do the following: • Create a pseudowire • Create a multisegment pseudowire • Create a backup pseudowire

Tools/Equipment	None
Prerequisite Procedures	• DLP-J89 Create a Pseudowire Class Using CTC, on page 20 • DLP–J166 Create an MPLS–TE Tunnel Using CTC or DLP-J107 Create an MPLS–TP Tunnel Using CTC or Configure LDP.
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

The pseudowire configuration can be EVC VLAN–based or EVC port–based. CPT supports only Ethernet over MPLS as the transport type for pseudowire.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to create a pseudowire.

Step 2 From the View menu, choose **Go to Network View**.

Step 3 Click the **Layer2+** tab.

Step 4 From the left pane, click **Circuits**.

Step 5 Click the **Pseudowire** tab.

Step 6 Click **Create**. The Circuit Creation wizard appears.

Step 7 In the AC Global Attributes area of the Circuit Attributes screen, specify the global attributes as follows:

a) Enter the name of the pseudowire that you want to create in the PW Name field.

b) Enter the description of the pseudowire in the PW Description field.

c) From the Admin State drop-down list, choose **UP** or **DOWN**. The default value is UP.

d) Enter the bandwidth value in Kbps, Mbps (default), or Gbps in the Bandwidth field.
The specified bandwidth is checked against the available bandwidth on the tunnel and the AC ports. If the specified bandwidth exceeds the available bandwidth on the tunnel or the AC ports, an error message is displayed.

Note The specified bandwidth is used only for accounting purposes when the core has a MPLS–TE or MPLS–TP tunnel. The specified bandwidth is not reserved by the CPT system for the actual traffic nor is it enforced on services. For example, if the actual traffic exceeds the bandwidth value, the CPT system carries the traffic and does not raise an alarm.

e) Enter the VPN ID in the VPN ID field.

Step 8 In the Redundancy area of the Circuit Attributes screen, specify the following to create a redundant pseudowire:

a) Check the **Enabled** check box to enable pseudowire redundancy.

b) Check the **Dual Homed Peer** check box to create a special case of pseudowire protection. In this case, there is an additional end point (T-PE3) for the pseudowire apart from T-PE1 and T-PE2.

c) Check the **Provision working go & return on primary path** check box to enable the user to configure working go and return path of a pseudowire on primary path. For example, if this checkbox is unchecked, a pseudowire A is primary pseudowire and pseudowire B is backup pseudowire on T-PE1 node, pseudowire A must be backup pseudowire and pseudowire B must be primary pseudowire on T-PE2 node.

d) Enter the delay timer in seconds in the Enable Delay field to specify how long the backup pseudowire must wait to take over after the primary pseudowire goes down. The range is from 0 to 180 seconds.

e) Enter the delay timer in seconds in the Disable Delay field to specify how long the primary pseudowire must wait after it becomes active to take over from the backup pseudowire. The range is from 0 to 180 seconds.

f) Click the **Never** radio button to specify that the primary pseudowire never takes over from the backup pseudowire.

g) Click **Next**.
The T-PE1 screen appears. Terminating Provider Edge (T-PE1) represents one of the end points of the pseudowire.

Step 9 To choose a non CPT source node for the pseudowire, complete the following steps:

a) Check the **Unmanaged Node** check box.
At least one node (T-PE or S-PE node) in the pseudowire must be a CPT node. The other nodes can be unmanaged nodes.

b) Enter the router IP address in the Router ID field.

c) Enter the VC ID in the VC ID field.

Step 10 To choose a CPT source node for the pseudowire, choose the CPT node from the Node drop-down list. The Router ID field is automatically populated.

Note If a VPWS is provisioned between two nodes where one node is running CPT version 9.7.0.2 and the other node is running older version. Before provisioning the pseudowire, set the TDM SFP labels to the default value.

Step 11 In the AC End Point area of the T-PE1 screen, identify the attachment circuit (AC) with the exact end point of the CPT node as follows:
The attachment circuit is the physical or virtual circuit attaching a CE to a PE.

a) If you want to choose a port or CPT 50 to serve as an end point for the pseudowire, complete the following:

1. Check the RING ID check box.
   Note This check box is enabled only if the service state of the ring is enabled.

2. From the RING ID drop-down list, choose a ring.

   Note This drop down list is enabled only if the RING ID check box is checked.

3. From the Slot/CPT 50 drop-down list, choose a slot or CPT 50.
   Note If you select the RING ID check box, a list of available CPT 50 is displayed. Otherwise, a list of available ports is displayed.

4. From the Port drop-down list, choose a port.

b) If you want to choose a channel group to serve as an end point for the pseudowire, complete the following:

1. Check the **CHGRP** check box.

2. From the CHGRP drop-down list, choose a channel group to serve as an end point.

3. Click **Manual Load Balancing** to configure manual load balancing on the ports of the channel group.

   The Manual Load Balancing dialog box appears.

4. From the Primary Loadbalanced Link list, choose a port.

5 Click **Apply**.

Step 12 In the AC Attributes area of the T-PE1 screen, specify the following:

a) From the AC Type drop-down list, choose **EVC Port Based** or **EVC VLAN Based**.

b) (For EVC VLAN Based AC Type) Click the **EFP Configuration** link. The EFP Configuration dialog box appears.

c) (For EVC VLAN Based AC Type) In the Outer VLAN Configuration area, choose the type of VLAN tagging:

- Double Tagged
- Single Tagged
- Untagged
- Default
- Any

d) (For EVC VLAN Based AC Type) From the TPID drop-down list, choose a TPID—dot1q, dot1ad, 0x9100, or 0x9200.

e) (For EVC VLAN Based AC Type) Enter a VLAN tag in the VLAN Tag field.

f) (For EVC VLAN Based AC Type) In the Inner VLAN Configuration area, enter the TPID and VLAN tag.

g) (For EVC VLAN Based AC Type) In the Rewrite Ingress Operation area, choose the rewrite operation:

- PUSH 1
- PUSH 2
- POP 1
- POP 2
- TRANSLATE 1-to-1
- TRANSLATE 1-to-2
- TRANSLATE 2-to-1
- TRANSLATE 2-to-2

See Rewrite Operations on Pseudowire, on page 13 to determine the supported ingress rewrite operations on pseudowire.

h) (For EVC VLAN Based AC Type) From the Outer VLAN TPID drop-down list, choose a TPID—dot1q, dot1ad, 0x9100, or 0x9200.

i) (For EVC VLAN Based AC Type) Enter the outer VLAN tag in the Outer VLAN Tag field.

j) Check the **Symmetric** check box to enable symmetric rewrite operations.

k) (For EVC VLAN Based AC Type) Enter the inner VLAN TPID in the Inner VLAN TPID field.

l) (For EVC VLAN Based AC Type) Enter the inner VLAN tag in the Inner VLAN Tag field.

m) (For EVC VLAN Based AC Type) In the Enable Statistics area, check the **Ingress** and **Egress** check boxes as needed.

n) (For EVC VLAN Based AC Type) Click **OK** to save this EFP configuration.

o) (For EVC Port Based and EVC VLAN Based AC Types) Click the **QoS Configuration** link. The QoS Configuration dialog box appears.

p) (For EVC Port Based and EVC VLAN Based AC Types) Specify the table map, ingress policy, and egress policy and click **OK**.

Step 13 In the PW Attributes area of the T-PE1 screen, specify the following:

a) From the PW class drop-down list, choose a pseudowire class.

b) Enter the VC ID used by the pseudowire in the VC ID field.

c) Check the **Static** check box to specify that the pseudowire segment starting from T-PE1 is static. Otherwise, the pseudowire segment is dynamic.

d) (For static pseudowire segment) Enter an unused static label in the Local Label field.

Step 14 In the Backup PW Attributes area of the T-PE1 screen, specify the following:

a) From the PW class drop-down list, choose a PW class for the backup pseudowire.

b) Enter the VC ID used by the backup pseudowire in the VC ID field.

c) Check the **Static** checkbox to specify that the backup pseudowire segment starting from T-PE1 is static. Otherwise, the backup pseudowire segment is dynamic.

d) (For static backup pseudowire segment) Enter an unused static label in the Local Label field.

e) Click **Next**.
The T-PE2 screen appears. T-PE2 represents one of the end points of the pseudowire.

Step 15 From the Node drop-down list, choose the destination node for the pseudowire.
You can choose a CPT or non CPT node as the destination node similar to the source node.

Step 16 Specify all the values in the T-PE2 screen similar to the previous T-PE1 screen.

Step 17 If you had checked the **Dual Homed Peer** check box in the Circuit Attributes screen, an additional screen appears to specify the settings for T-PE3.

Step 18 Click **Next**.
The PW Protected Circuit Path screen appears.

Step 19 In the PW Protected Circuit Path screen, specify the following for Switch Provider Edge (SPE) nodes to create a multisegment pseudowire.

Note Do not set the pseudowire class with the interworking at SPE nodes while creating a multisegment pseudowire. Setting this would corrupt the Label table.

a) Click the **SPEs Working** tab.

b) Select a node from the network map and click **Add**. The Add node dialog box appears.

c) From the Node drop-down list, choose a node and click **Apply**.

d) Enter the Neighbor ID and VC ID in the respective fields.

e) From the PW class drop-down list, choose a pseudowire class.

f) Check the **Static** check box to specify that the pseudowire segment is static. Otherwise, the pseudowire segment is dynamic.

g) (For static pseudowire segment) Enter an unused static label in the Local Label field.

h) Click the **Advanced Configuration** link. The **Advanced Configuration** link is enabled only when you stitch dynamic segment to static segment and vice versa.
The AC Advanced Configuration dialog box appears.

i) Specify the MTU, Requested VLAN, Interface Description, and VCCV Flags in the respective fields and click **OK**. You can specify a value from 64 to 9600 for MTU. The default value is 1500.
The MTU and Interface Description fields are applicable to dynamic segments. The Requested VLAN field is applicable to the static segment.

Note The MTU of a pseudowire can not be greater than the MTU of the LAG on which this pseudowire is configured.

Step 20 Click the **SPEs Backup** tab and specify all the values similar to the **SPEs Working** tab.

Step 21 Click **Finish** to create a pseudowire.

Note You cannot create a pseudowire successfully, if the TDM pluggable is already configured on the port and the pseudowire class has any of these configurations:

- TP as tunnel type
- Sequencing enabled
- BFD over VCCV enabled
- LDP as protocol
- Status OAM enabled

Note In scaled configuration, if shut or no shut operation performed on the core ports that have huge number of pseudowires configured, the CPT 50 may reboot due to high CPU utilization.

Step 22 Return to your originating procedure (NTP).

DLP-J223 Edit a Pseudowire Using CTC

Purpose	This procedure edits a pseudowire using CTC.
Tools/Equipment	None
Prerequisite Procedures	• DLP-J91 Create a Pseudowire Using CTC, on page 30
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to edit a pseudowire.

Step 2 From the View menu, choose **Go to Home View**.

Step 3 Click the **Layer2+** tab.

Step 4 Click **Pseudo Wire**.

Step 5 From the list of pseudowires, select a pseudowire to edit.

Step 6 Click **Edit**. The **Edit Circuit** screen appears.

Step 7 In the General tab, modify the following attributes of the pseudowire as required and click **Apply**:

- Description
- Bandwidth
- MTU
  You can enter a value from 64 to 9600 for MTU. The default value is 1500.

Step 8 In the T-PE Nodes tab, view the details of the terminating provider edge nodes that are the end points of this pseudowire.

a) In the T-PE Details area, click the **Show EFP Configuration** link to view the EFPs associated with this pseudowire.
b) In the PW Attributes area, view the attributes of this pseudowire.

Step 9 In the State tab, complete the following:

a) View the circuit status and service state of the pseudowire.
b) From the Target PW Admin State drop-down list, choose UP or DOWN to change the administrative state of the pseudowire.
c) Click **Apply**.

Step 10 In the QoS tab, modify the table map, ingress policy, and egress policy of the pseudowire as required and click **Apply**.

Step 11 Close the **Edit Circuit** screen.

Note You can not create a pseudowire on the channel group port on which destination port of a span is already configured.

Note In scaled configuration, if shut or no shut operation performed on the core ports that have huge number of pseudowires configured, the CPT 50 may reboot due to high CPU utilization.

Step 12 Return to your originating procedure (NTP).

DLP-J93 Perform ping mpls and trace mpls Operations on L2VPN Multisegment Pseudowires Using Cisco IOS Commands

Purpose	Use the **ping mpls** and **trace mpls** commands to verify that all the segments of the MPLS multisegment pseudowire are operating.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

You can use the **ping mpls** command to verify connectivity at the following pseudowire points:

- From one end of the pseudowire to the other

- From one of the pseudowires to a specific segment
- The segment between two adjacent S-PE routers

You can use the **trace mpls** command to verify connectivity at the following pseudowire points:

- From one end of the pseudowire to the other
- From one of the pseudowires to a specific segment
- The segment between two adjacent S-PE routers
- A range of segments

Note Enable **l2 router-id IP address** command for static pseudowire ping operation to work. It is recommended to set up the router-id to the loopback0 IP address. This IP address must be the same IP address that is used in the **mpls ldp router-id** LDP command.

Note The ping and trace operation for multisegment pseudowires that have one or more static pseudowire segments is not supported.

Procedure

	Command or Action	Purpose
Step 1	**ping mpls pseudowire** *destination-address vc-id* [**segment** *segment-number*] **Example:** Router# ping mpls pseudowire 10.10.10.9 220 segment 2	Performs a ping operation. • *destination-address* is the address of the S-PE router, which is the end of the segment from the direction of the source. • *vc-id* is the VC ID of the segment from the source to the next PE router. • *segment-number* is optional and specifies the segment you want to ping.
Step 2	**trace mpls pseudowire** *destination-address vc-id* **segment** *segment-number* [*segment-number*] **Example:** Router# trace mpls pseudowire 10.10.10.9 220 segment 1	Performs a trace operation. • *destination-address* is the address of the next S-PE router from the origin of the trace. • *vc-id* is the VC ID of the segment from which the trace command is issued. • *segment-number* indicates the segment on which the trace operation acts. If you enter the two segment numbers, the **traceroute** operation performs a trace on that range of routers.

	Command or Action	Purpose
Step 3	Return to your originating procedure (NTP).	—

DLP-J94 Configure L2VPN Pseudowire Preferential Forwarding Using Cisco IOS Commands

Purpose	This procedure configures L2VPN pseudowire preferential forwarding using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
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	**pseudowire-class** *class-name* **Example:** Router(config)# pseudowire-class atom	Establishes a pseudowire class with a name that you specify, and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** Router(config-pw)# encapsulation mpls	Specifies the tunneling encapsulation. For AToM, the encapsulation type is mpls.
Step 5	**status redundancy** {*master* | *slave*}	Specifies the pseudowire as the master or slave.

	Command or Action	Purpose
	Example: Router(config-pw)# status redundancy master	This enables the L2VPN Pseudowire Preferential Forwarding feature to display the status of the active and backup pseudowires. By default, the PE router is in slave mode. **Note** One pseudowire must be the master and the other must be assigned the slave. You cannot configure both the pseudowires as master or slave.
Step 6	**interworking** {*ethernet* | *vlan*} **Example:** Router(config-pw)# interworking vlan	(Optional) Enables the translation between the different Layer 2 encapsulations.
Step 7	**exit** **Example:** Router(config-pw)# exit	Returns to global configuration mode.
Step 8	Return to your originating procedure (NTP).	—

Example: Configure L2VPN Pseudowire Preferential Forwarding

The following example shows how to configure a PE router with the L2VPN Pseudowire Preferential Forwarding feature:

```
mpls ldp graceful-restart
mpls ip
mpls label protocol ldp
mpls ldp router-id Loopback0 force
mpls ldp advertise-labels
!
pseudowire-class mpls
 encapsulation mpls
 status redundancy master

interface TenGigabitEthernet4/1
 service instance 1 ethernet
 encapsulation dot1q 10
  xconnect 1.1.1.1 123 encapsulation mpls
   backup peer 1.1.1.2 123
end
```

Understanding L2VPN Pseudowire Redundancy

The L2VPN Pseudowire Redundancy feature enables you to set up backup pseudowires.

The L2VPN Pseudowire Redundancy feature lets you configure the network to detect a failure in the network and reroute the Layer 2 (L2) service to another end point that can continue to provide the service. This feature provides the ability to recover from a failure either of the remote PE router or of the link between the PE and CE routers.

The L2VPN Pseudowire Redundancy feature enables you to configure a backup pseudowire if the primary pseudowire fails. When the primary pseudowire fails, the PE router can switch to the backup pseudowire. You can have the primary pseudowire resume operation after it comes up.

Note The static pseudowire can be backed up by the dynamic pseudowire and vice versa.

Prerequisites

The L2VPN Pseudowire Redundancy feature requires the following mechanisms to detect a failure in the network:

- LSP ping/traceroute and Any Transport over MPLS Virtual Circuit Connection Verification (AToM VCCV)
- Operation, Administration, and Maintenance (OAM)

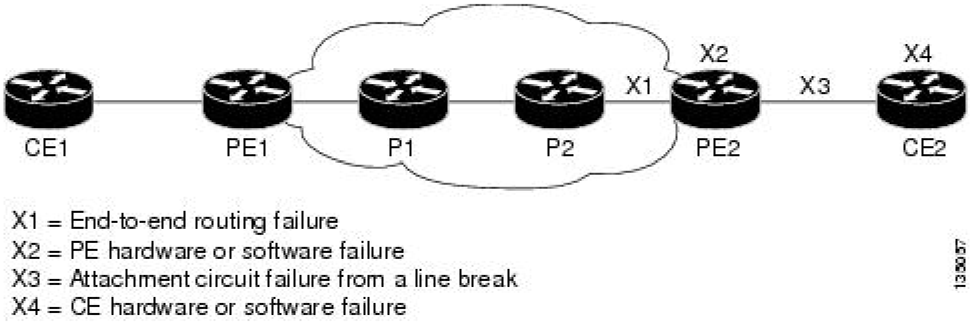
Restrictions

- The primary and backup pseudowires must run the same type of transport service. The primary and backup pseudowires must be configured with AToM.
- Only static, on-box provisioning is supported.
- If you use L2VPN Pseudowire Redundancy with L2VPN Interworking, the interworking method must be the same for the primary and backup pseudowires.
- Setting the experimental (EXP) bit on the MPLS pseudowire is supported.
- Different pseudowire encapsulation types on the MPLS pseudowire are not supported.
- The ability to have the backup pseudowire fully operational at the same time that the primary pseudowire is operational is not supported. The backup pseudowire becomes active only after the primary pseudowire fails.
- The AToM VCCV feature is supported only on the active pseudowire. The AToM VCCV feature is used for fault detection, isolation, and verification at both ends of the pseudowire.
- More than one backup pseudowire is not supported.

Pseudowire Redundancy

L2VPNs can provide pseudowire resiliency through their routing protocols. When connectivity between end-to-end PE routers fails, an alternative path to the directed LDP session and the user data can take over. However, there are some parts of the network where this rerouting mechanism does not protect against interruptions in service. Figure 3: Points of Potential Failure in an L2VPN Network, on page 41 shows those parts of the network that are vulnerable to an interruption in service.

Figure 3: Points of Potential Failure in an L2VPN Network


X2
X4
X1
X3
CE1
PE1
P1
P2
PE2
CE2
X1 = End-to-end routing failure
X2 = PE hardware or software failure
X3 = Attachment circuit failure from a line break
X4 = CE hardware or software failure
133057

The L2VPN Pseudowire Redundancy feature provides the ability to ensure that the CE2 router in Figure 3: Points of Potential Failure in an L2VPN Network, on page 41 can always maintain network connectivity, even if one or all the failures in the figure occur.

Note In this release, a pseudowire can be protected by only one backup pseudowire.

You can configure the network with redundant pseudowires and redundant network elements, which are shown in Figure 4: L2VPN Network with Redundant PWs and Attachment Circuits, on page 41, Figure 5: L2VPN Network with Redundant PWs, Attachment Circuits, and CE Routers, on page 42, and Figure 6: L2VPN Network with Redundant PWs, Attachment Circuits, CE Routers, and PE Routers, on page 42.

Figure 4: L2VPN Network with Redundant PWs and Attachment Circuits, on page 41 shows a network with redundant pseudowires and redundant attachment circuits.

Figure 4: L2VPN Network with Redundant PWs and Attachment Circuits

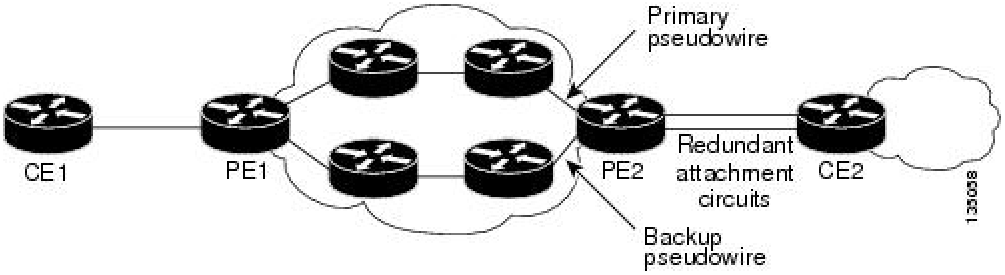


Figure 5: L2VPN Network with Redundant PWs, Attachment Circuits, and CE Routers, on page 42 shows a network with redundant pseudowires, attachment circuits, and CE routers.

Figure 5: L2VPN Network with Redundant PWs, Attachment Circuits, and CE Routers

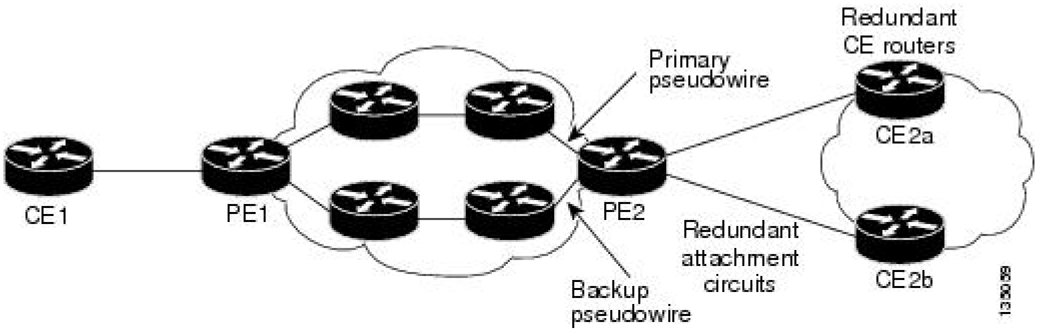
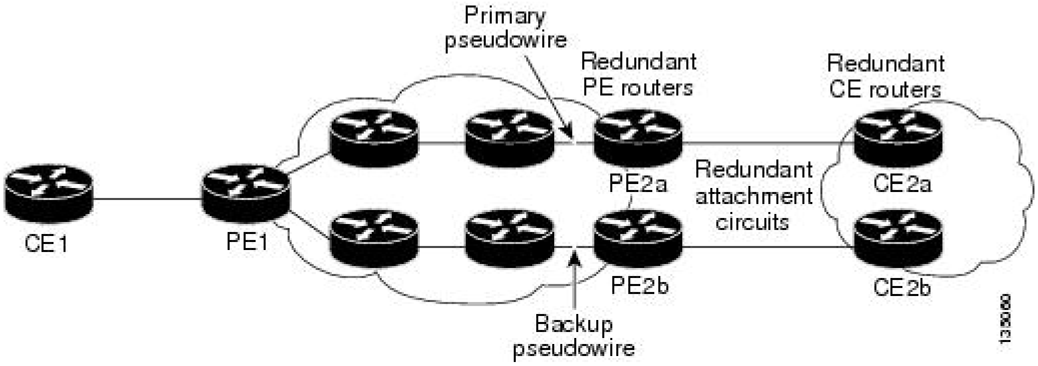


Figure 6: L2VPN Network with Redundant PWs, Attachment Circuits, CE Routers, and PE Routers, on page 42 shows a network with redundant pseudowires, attachment circuits, CE routers, and PE routers.

Figure 6: L2VPN Network with Redundant PWs, Attachment Circuits, CE Routers, and PE Routers



NTP-J32 Configure the Pseudowire Redundancy Using Cisco IOS Commands

Purpose	This procedure configures the L2VPN pseudowire redundancy feature using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
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	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**service instance** *serviceinstanceid* **ethernet** **Example:** Router(config-if)# service instance 100 ethernet	Specifies the service instance and enters service instance configuration mode. Ensure that the EFP on the adjoining CE router is on the same VLAN as this PE router.
Step 5	**encapsulation dot1q** *vlan-id* **Example:** Router(config-if-srv)# encapsulation dot1q 100	Enables the EFP to accept 802.1Q VLAN packets. The EFPs between the CE and PE routers that are running Ethernet over MPLS must be in the same subnet.
Step 6	**xconnect** *peer-router-id vcid* {**encapsulation mpls** | **pw-class** *pw-class-name*} **Example:** Router(config-if-srv)# xconnect 10.0.0.1 123 pw-class atom	Binds the attachment circuit to a pseudowire VC and enters xconnect configuration mode.
Step 7	**backup peer** *peer-router-ip-addr vcid* [**pw-class** *pw-class-name*] **Example:** Router(config-if-srv-xconn)# backup peer 10.0.0.3 125 pw-class atom	Specifies a redundant peer for the pseudowire VC. The pseudowire class name must match the name you specified when you created the pseudowire class, but you can use a different pw-class in the **backup peer** command than the name that you used in the primary **xconnect** command.
Step 8	**backup delay** *enable-delay* {*disable-delay* | **never**} **Example:**	Specifies the period, in seconds, the backup pseudowire VC must wait to take over after the primary pseudowire VC goes down. The range is from 0 to 180 seconds. If you specify the **never** keyword, the primary pseudowire VC never takes over from the backup pseudowire VC.

	Command or Action	Purpose
	Router(config-if-srv-xconn)# backup delay 5 never	
Step 9	**exit** **Example:** Router(config-if-srv-xconn)# exit	Returns to service instance configuration mode.
Step 10	**exit** **Example:** Router(config-if-srv)# exit	Returns to global configuration mode.
Step 11	Return to your originating procedure (NTP).	—

Examples

The following example shows an Ethernet attachment circuit cross-connect with L2VPN IP interworking and a backup pseudowire:

```
Router> enable
Router# configure terminal
Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# service instance 100 ethernet
Router(config-if-srv)# encapsulation dot1q 100
Router(config-if-srv)# xconnect 10.0.0.1 123 pw-class mpls-ip
Router(config-if-srv-xconn)# backup peer 10.0.0.3 125 pw-class mpls-ip
```

Understanding MPLS Pseudowire Status Signaling

The MPLS Pseudowire Status Signaling feature enables you to configure the router to send the pseudowire status to a peer router, even when the attachment circuit (AC) is down. The MPLS Pseudowire Status Signaling feature enables the AC status to be sent to the peer through LDP. The pseudowire status messages are sent in label advertisement and label notification messages if the peer router also supports the MPLS Pseudowire Status Signaling feature.

Restrictions

- Both peer routers must support the ability to send and receive pseudowire status messages in label advertisement and label notification messages. If both peer routers do not support pseudowire status messages, it is recommended that you disable the messages with the **no status** command.
- This feature is not integrated with AToM Virtual Circuit Connection Verification (VCCV).

NTP-J33 Configure MPLS Pseudowire Status Signaling Using Cisco IOS Commands

Purpose	This procedure configures MPLS pseudowire status signaling using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite
Security Level	Provisioning or higher

Use this procedure to enable the router to send pseudowire status to a peer router even when the attachment circuit is down. If both routers do not support pseudowire status messages, then disable the messages with the **no status** command.

Procedure

	Command or Action	Purpose
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	**pseudowire-class** *class-name* **Example:** Router(config)# pseudowire-class atom	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 4	**status** **Example:** Router(config-pw)# status	(Optional) Enables the router to send pseudowire status messages to the peer router through label advertisement and label notification messages. By default, the status messages are enabled. This step is included only if status messages have been disabled. If both routers do not support pseudowire status messages, then disable the messages with the **no status** command.

	Command or Action	Purpose
Step 5	**encapsulation mpls** **Example:** Router(config-pw)# encapsulation mpls	Specifies the tunneling encapsulation.
Step 6	**exit** **Example:** Router(config-pw)# exit	Exits pseudowire class configuration mode.
Step 7	**exit** **Example:** Router(config)# exit	Exits global configuration mode.
Step 8	**show mpls l2transport vc detail** **Example:** Router# show mpls l2transport vc detail	Validates that pseudowire messages can be sent and received.
Step 9	Return to your originating procedure (NTP).	—

Example: Configure MPLS Pseudowire Status Signaling

The following example shows how to configure the MPLS Pseudowire Status Signaling feature using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# pseudowire-class atom
Router(config-pw)# status
Router(config-pw)# encapsulation mpls
Router(config-pw)# exit
Router(config)# exit
```

Understanding L2VPN Pseudowire Stitching

L2VPN Pseudowire Stitching defines a static or dynamically configured set of two or more pseudowire segments that behave and function as a single point-to-point pseudowire. L2VPN Pseudowire Stitching enables L2VPN pseudowires to extend across two separate MPLS networks or across an inter-AS boundary, as shown in Figure 7: L2VPN Pseudowire Stitching in an Intra-AS Topology, on page 47 and Figure 8: L2VPN Pseudowire Stitching in an Inter-AS Topology, on page 47.

L2VPN Pseudowire Stitching connects two or more contiguous pseudowire segments to form an end-to-end multihop pseudowire. This end-to-end pseudowire functions as a single point-to-point pseudowire.

As shown in Figure 8: L2VPN Pseudowire Stitching in an Inter-AS Topology, on page 47, L2VPN Pseudowire Stitching enables you to keep the IP addresses of the edge PE routers private across inter-AS boundaries. You can use the IP address of the Autonomous System Boundary Routers (ASBRs) and treat them as pseudowire aggregation (PE-agg) routers. The ASBRs join the pseudowires of the two domains.

Figure 7: L2VPN Pseudowire Stitching in an Intra-AS Topology

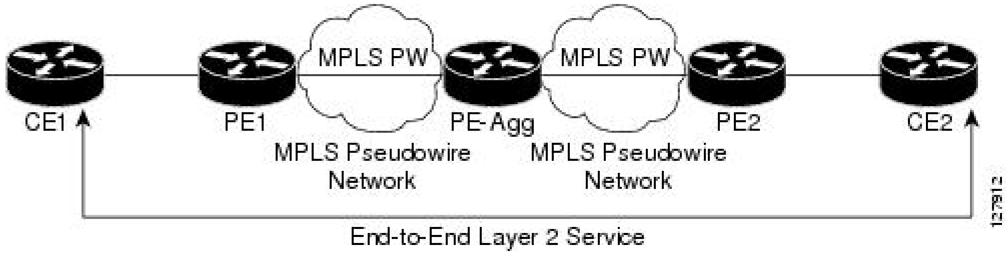
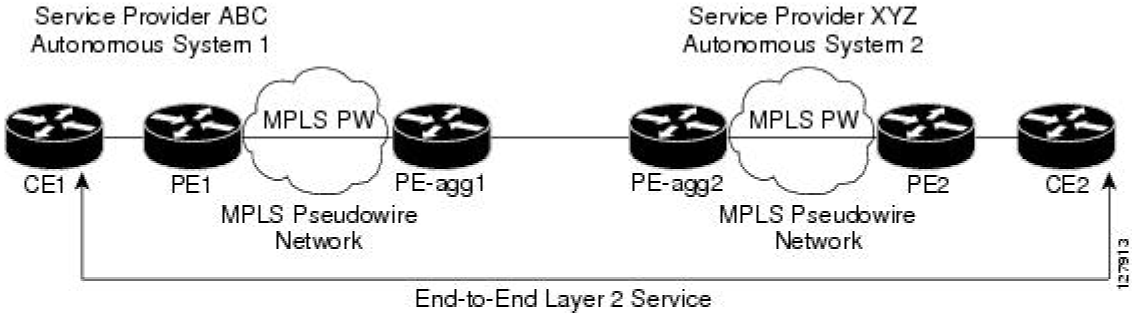


Figure 8: L2VPN Pseudowire Stitching in an Inter-AS Topology


Service Provider ABC Autonomous System 1
Service Provider XYZ Autonomous System 2
MPLS PW
MPLS PW
CE1
PE1
PE-agg1
PE-agg2
PE2
CE2
MPLS Pseudowire Network
MPLS Pseudowire Network
127913
End-to-End Layer 2 Service

Restrictions for L2VPN Pseudowire Stitching

- L2VPN Pseudowire Stitching is supported with AToM.
- Only static, on-box provisioning is supported.
- Sequencing numbers in AToM packets are not processed by L2VPN Pseudowire Stitching. The feature passes the sequencing data through the cross-connect packet paths, a process that is called transparent sequencing. The end point PE to CE connections enforce the sequencing.
- You can ping the adjacent next-hop PE router. End-to-end LSP pings are not supported.
- Do not configure IP or Ethernet interworking on a router where L2VPN Pseudowire Stitching is enabled. Instead, configure interworking on the routers at the edge PEs of the network.
- The control word negotiation results must match. If either segment does not negotiate the control word, the control word is disabled for both segments.
- AToM Graceful Restart is negotiated independently on each pseudowire segment. If there is a transient loss of the LDP session between two AToM PE routers, packets continue to flow.
- Per-pseudowire QoS is not supported. The TE tunnel selection is supported.
- Attachment circuit interworking is not supported.

NTP-J34 Configure the Pseudowire Stitching Using Cisco IOS Commands

Purpose	This procedure configures L2VPN Pseudowire Stitching on each of the PE routers.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite
Security Level	Provisioning or higher

This procedure assumes that you have configured the basic AToM L2VPNs.

Procedure

	Command or Action	Purpose
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	**l2 vfi** *name* **point-to-point** **Example:** Router(config)# l2 vfi atomtunnel point-to-point	Creates a point-to-point Layer 2 VFI and enters VFI configuration mode.
Step 4	**neighbor** *ip-address vcid* [**encapsulation mpls** | **pw-class** *pw-class-name*] **Example:** Router(config-vfi)# neighbor 10.0.0.1 100 pw-class mpls	Configures an emulated VC. • Specify the IP address and the VC ID of the remote router. • Specify the pseudowire class to use for the emulated VC. **Note** Only two **neighbor** commands are allowed for each **l2 vfi point-to-point** command.
Step 5	**exit** **Example:** Router(config-vfi)# exit	Exits VFI configuration mode.

	Command or Action	Purpose
Step 6	**exit** **Example:** Router(config)# exit	Exits global configuration mode.
Step 7	**show mpls l2transport vc** [**vcid** [*vc-id* | *vc-id-min vc-id-max*]] [**interface** *name* [*local-circuit-id*]] [**destination** *ip-address* | *name*] [**detail**] **Example:** Router# show mpls l2transport vc	Verifies that the L2VPN Pseudowire Stitching session has been established.
Step 8	**show vfi** [*vfi-name*] **Example:** Router# show vfi atomtunnel	Verifies that a point-to-point VFI has been established.
Step 9	**ping** [*protocol*] [**tag**] {*host-name* | *system-address*} **Example:** Router# ping 10.1.1.1	Verifies end-to-end connectivity when this command is issued from the CE routers.
Step 10	Return to your originating procedure (NTP).	—

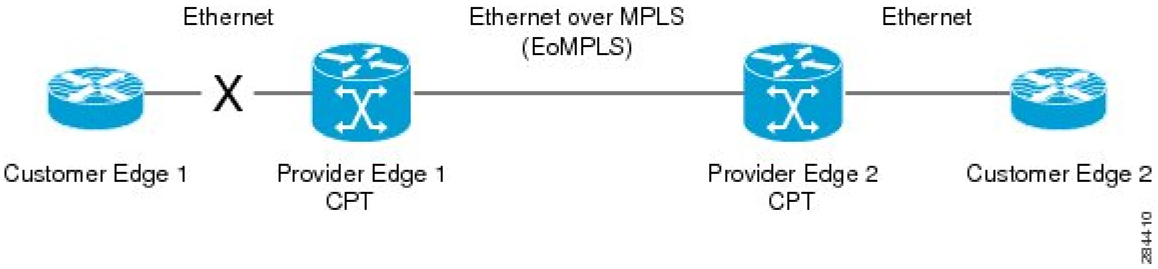
Understanding Remote Ethernet Port Shutdown

The Remote Ethernet Port Shutdown feature allows a service provider edge router on the local end of an Ethernet over MPLS (EoMPLS) pseudowire to detect a remote link failure and cause the shutdown of the Ethernet port on the local customer edge router. Shutting down the Ethernet port on the local customer edge router prevents or mitigates a condition where that router would otherwise lose data by forwarding traffic continuously to the remote failed link, especially if the link was configured as a static IP route.

The Remote Ethernet Port Shutdown feature is available for both GE and 10GE UNIs (User Network Interfaces). If a UNI port connected to a pseudowire detects the failure, then the opposite UNI port connected to the same pseudowire performs a laser shutdown. If both the working or protect LSPs go down, then both the UNI ports connected to the Multiprotocol Label Switching – Traffic Engineering (MPLS-TE) or Multiprotocol Label Switching – Transport Profile (MPLS-TP) tunnel perform a laser shutdown.

The following figure illustrates a condition in an EoMPLS network, with a down Layer 2 tunnel link between a customer edge router (Customer Edge 1) and the service provider edge (Provider Edge 1). A customer edge router on the far side of the Layer 2 tunnel (Customer Edge 2), continues to forward traffic to Customer Edge 1 through the L2 tunnel.

Figure 9: Remote Link Outage in EoMPLS Network



Prior to this feature, the Provider Edge 2 router could not detect a failed remote link. The traffic forwarded from Customer Edge 2 to Customer Edge 1 would be lost.

With the Remote Ethernet Port Shutdown feature, the Provider Edge 2 router detects the remote link failure and causes a shutdown of the local Customer Edge 2 Ethernet port. When the remote L2 tunnel link is restored, the local interface is automatically restored as well. The possibility of data loss is thus diminished.

With reference to the above figure, the Remote Ethernet Port Shutdown sequence is generally described as follows:

1. The remote link between Customer Edge 1 and Provider Edge 1 fails.
2. The Provider Edge 2 running Cisco CPT detects the remote link failure and disables the transmit laser on the card interface connected to Customer Edge 2.
3. A remote alarm or local fault alarm is received by Customer Edge 2 causing Customer Edge 2 to bring down the interface.
4. Provider Edge 2 maintains its interface with Customer Edge 2 in an Up state.
5. When the remote link and EoMPLS connection is restored, the Provider Edge 2 router enables the transmit laser.
6. The Customer Edge 2 router brings up its interface.

The Remote Ethernet Port Shutdown feature is enabled by default for EoMPLS, and can be disabled using **no remote link failure notification** command in the xconnect sub–mode. Use the **show ip interface brief** command in privileged EXEC mode to display the status of all remote Layer 2 tunnel links. Use the **show interface** command in privileged EXEC mode to show the status of the Layer 2 tunnel on a specific interface.

Note The **no remote link failure notification** command does not notify clients when the remote attachment circuit status is down.

Restrictions

The following restrictions apply to the Remote Ethernet Port Shutdown feature:

- Applies only to xconnect that is configured under default encapsulation Ethernet Flow Point (EFP).

- Applies only to Virtual Private Wired Service (VPWS) and not Virtual Private LAN Service (VPLS) circuits.
- Applies to attachment circuit failures only on VPWS port-based pseudowire; VLAN-based pseudowires do not support this feature.
- Supports only when the pseudowire class type is Ethernet.
- Requires fault detection protocol like LDP or BFD to be enabled for static or dynamic pseudowire.
- Requires OAM, BFD over VCCV, or BFD over VCCV AC signaling to be enabled if the pseudowire is configured over the MPLS–TP tunnel.

Soak Time

The soak time is the duration when the interface that failed does not restore operation even when the failure is rectified. Soak time can be configured even if the Remote Ethernet Port Shutdown feature is disabled. The soak time will be effective only when the Remote Ethernet Port Shutdown feature is enabled. The default value of soak time is 10 seconds. The range is from 0 to 300 seconds.

The soak time applies only to the individual ports. The soak time does not apply to the ports of a channel group if the channel group is configured as an attachment circuit.

DLP-J325 Configure Remote Ethernet Port Shutdown for Ports Using Cisco IOS Commands

Purpose	This procedure configures Remote Ethernet Port Shutdown for ports using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	DLP-J90 Create a Pseudowire Using Cisco IOS Commands, on page 22
Required/As Needed	As needed
Onsite/Remote	Onsite
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**local link notification soak-duration** *duration* **Example:** Router(config-if)# local link notification soak-duration 30	Specifies the soak time for this interface in seconds. The default value of soak time is 10 seconds. The range is from 0 to 300 seconds.
Step 5	**service instance** *serviceinstanceid* **ethernet** **Example:** Router(config-if)# service instance 100 ethernet	Specifies the Ethernet service instance and enters service instance configuration mode.
Step 6	**encapsulation default** **Example:** Router(config-if-srv)# encapsulation default	Enables the EFP to accept all the packets (tagged and untagged).
Step 7	**xconnect** *peer-ip-address vcid* **encapsulation mpls pw-class** *pw-class-name* [**sequencing** {**transmit** | **receive** | **both**}] **Example:** Router(config-if-srv)# xconnect 10.131.191.252 100 encapsulation mpls pw-class class1	Binds an attachment circuit to a pseudowire VC.
Step 8	**remote link failure notification** **Example:** Router(config-if-ether-vc-xconn)# remote link failure notification	Enables Remote Ethernet Port Shutdown on this interface. The **no** version of this command disables Remote Ethernet Port Shutdown on this interface.
Step 9	**exit** **Example:** Router(config-if-ether-vc-xconn)# exit	Exits xconnect configuration mode.
Step 10	**exit** **Example:** Router(config-if-srv)# exit	Exits service instance configuration mode.

	Command or Action	Purpose
Step 11	**exit** **Example:** Router(config-if)# exit	Exits interface configuration mode.
Step 12	Return to your originating procedure (NTP).	—

DLP-J326 Configure Remote Ethernet Port Shutdown for Ports Using CTC

Purpose	This procedure configures Remote Ethernet Port Shutdown for ports using CTC.
Tools/Equipment	None
Prerequisite Procedures	DLP-J91 Create a Pseudowire Using CTC, on page 30
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to configure Remote Ethernet Port Shutdown for ports.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **Port Configuration**.

Step 5 In the Port Configurations area, expand the slot of the fabric card or line card, or the FOG of the CPT 50 panel to view the port configurations.

Step 6 Check the **Remote Link Failure Notification Enable** check box against the ports to enable Remote Ethernet Port Shutdown for the ports.

Note The **Remote Link Failure Notification** check box is disabled by default on all the ports. If the pseudowire is created for a port by enabling **Remote Link Failure Notification** check box, the check box would remain enabled even after deleting that pseudowire.

Step 7 Enter the soak duration in the Soak Time field for each port.
The default value of Soak Time is 10 seconds. The range is from 0 to 300 seconds.

Step 8 Click **Apply**.

Step 9 Return to your originating procedure (NTP).

Understanding BFD Control Channel over VCCV

MPLS pseudowires enable Layer 2 traffic to be carried over an IP/MPLS core network. The Bidirectional Forwarding Detection (BFD) control channel over Virtual Circuit Connection Verification (VCCV) feature provides OAM functions for MPLS pseudowires.

You can enable BFD control channel over VCCV feature using the NTP-J35 Configure BFD Control Channel over VCCV Using Cisco IOS Commands, on page 55 or DLP-J89 Create a Pseudowire Class Using CTC, on page 20.

Note This feature provides support only for VCCV type 1. VCCV type 1 is in-band VCCV and can be used only for MPLS pseudowires that use a control word.

The BFD protocol can be used to provide OAM functionality to the MPLS protocol. The VCCV provides a control channel associated with the pseudowire to provide OAM functions over that pseudowire. BFD can use the VCCV control channel as a pseudowire fault mechanism to detect data plane failures. BFD can also use the VCCV control channel to carry the fault status of an attachment circuit (AC).

MPLS pseudowires can dynamically signal or statically configure virtual circuit (VC) labels. In dynamically signaled pseudowires, the control channel (CC) types and connection verification (CV) types are also signaled. In statically configured pseudowires, the CC and CV types must be configured on both ends of the pseudowire.

The CC types define whether VCCV packets are in-band or out-of-band for the pseudowire. The CV types define whether BFD monitoring is required for the pseudowire. If BFD monitoring is required for the pseudowire, the CV types also define how the BFD packets are encapsulated and whether BFD provides status signaling functionality.

Any protocol that requires BFD monitoring must register with BFD as a client. For example, the the Xconnect protocol registers as a BFD client, and BFD assigns a client ID to Xconnect. The Xconnect uses this client ID to create the BFD sessions that monitor the pseudowire.

BFD can detect forwarding failures (end-to-end) in the pseudowire path. When BFD detects a failure in the pseudowire forwarding path, it notifies the Xconnect client that created the session. In addition, BFD can signal the status in any concatenated path or AC, to the remote device where the BFD session is terminated.

Restrictions of BFD Control Channel over VCCV

- The BFD Control Channel over VCCV feature supports only VCCV type 1 without IP/User Datagram Protocol (UDP) encapsulation.
- Any Transport over Multiprotocol Label Switching (AToM) is the only transport protocol supported by the BFD Control Channel over VCCV.
- Layer 2 Transport Protocol version 3 (L2TPv3) is not supported.
- Pseudowire redundancy is not supported.

NTP-J35 Configure BFD Control Channel over VCCV Using Cisco IOS Commands

Purpose	This procedure configures VCCV BFD to run on pseudowires.
Tools/Equipment	None
Prerequisite Procedures	• DLP-J97 Create and Configure BFD Templates Using Cisco IOS Commands • DLP-J88 Create a Pseudowire Class Using Cisco IOS Commands, on page 17
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
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	**pseudowire-class** *name* **Example:** Router(config)# pseudowire-class vccv-bfd1	Specifies the name of the pseudowire class and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** Router(config-pw-class)# encapsulation mpls	Specifies that the MPLS is used as the data encapsulation method for tunneling Layer 2 traffic over the pseudowire. You must specify MPLS encapsulation as part of the **xconnect** command or as part of a pseudowire class for the virtual circuits to work properly.
Step 5	**protocol** {**ldp** | **none**} **Example:** Router(config-pw-class)# protocol none	Specifies that no signaling is configured and that manually configured sessions are used. To configure static pseudowires, you must specify the **none** keyword.

	Command or Action	Purpose
Step 6	**vccv** {**control-word** | **router-alert** | **ttl**} **Example:** Router(config-pw-class)# vccv control-word	Sets the MPLS pseudowire control channel (CC) type. For MPLS pseudowires that use a connection verification (CV) type that does not include IP/UDP headers, you must set the CC type to CC type 1: pseudowire control word.
Step 7	**vccv bfd template** *name* {**udp** | **raw-bfd**} **Example:** Router(config-pw-class)# vccv bfd template bfdtemplate1 raw-bfd	Enables BFD over VCCV for the pseudowire class.
Step 8	**vccv bfd status signaling** **Example:** Router(config-pw-class)# vccv bfd status signaling	Enables status signaling for BFD over VCCV.
Step 9	**exit** **Example:** Router(config-pw-class)# exit	Exits pseudowire class configuration mode and returns to global configuration mode.
Step 10	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 11	**service instance** *serviceinstanceid* **ethernet** **Example:** Router(config-if)# service instance 100 ethernet	Specifies the service instance and enters service instance configuration mode.
Step 12	**encapsulation dot1q** *vlan-id* **Example:** Router(config-if-srv)# encapsulation dot1q 100	Enables the Ethernet Flow Point (EFP) to accept 802.1Q VLAN packets.
Step 13	**xconnect** *peer-ip-address vc-id* {**encapsulation mpls** [**manual**] | **pw-class** *pw-class-name* } [**pw-class** *pw-class-name*] [**sequencing** {**transmit** | **receive** | **both**}] **Example:** Router(config-if-srv)# xconnect 10.0.0.7 100 pw-class vccv-bfd1	Binds an attachment circuit (AC) to a pseudowire, configures a static pseudowire, and specifies the pseudowire class.
Step 14	Return to your originating procedure (NTP).	

	Command or Action	Purpose
	Example: —	