L2VPN Interworking

Interworking is a transforming function that is required to interconnect two heterogeneous attachment circuits (ACs). Several types of interworking functions exist. The function that is used would depend on the type of ACs being used, the type of data being carried, and the level of functionality required. The two main Layer 2 Virtual Private Network (L2VPN) interworking functions supported in Cisco IOS XE software are bridged and routed interworking.

Layer 2 (L2) transport over multiprotocol label switching (MPLS) and IP already exists for like-to-like ACs, such as Ethernet-to-Ethernet or Point-to-Point Protocol (PPP)-to-PPP. L2VPN Interworking builds on this functionality by allowing disparate ACs to be connected. An interworking function facilitates the translation between different L2 encapsulations.

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- Information About L2VPN Interworking, page 6
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Finding Feature Information

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for L2VPN Interworking

Before you configure L2VPN interworking on a device you must enable Cisco Express Forwarding.

HDLC-to-Ethernet Interworking

- Ensure that the serial controller and interface on the High-Level Data Link Control (HDLC) customer edge (CE) and provider edge (PE) devices are configured.

```
enable
 configure terminal
  controller e1 2/0
   channel-group 0 timeslots 1
   no shutdown
!
interface Serial 2/0:0
 no shutdown
end
```

- Before configuring HDLC-to-Ethernet bridged interworking, ensure that bridging is configured on the HDLC CE device.

```
enable
 configure terminal
  bridge irb
  bridge 1 protocol ieee
  bridge 1 route ip
!
interface Serial 2/0:0
 no bridge-group 1
 no ip address
!
interface BVI1
 no ip address
 ip address 192.0.2.1 255.255.255.0
 no shutdown
!
interface Serial 2/0:0
 no ip address
 encapsulation hdlc
 bridge-group 1
  no shutdown
end
```

- Before configuring HDLC-to-Ethernet routed interworking, ensure that an IP address is configured on the HDLC CE device.

```
interface Serial 2/0:0
 ip address 192.0.2.1 255.255.255.0
 encapsulation hdlc
 no shutdown
end
```

Restrictions for L2VPN Interworking

General Restrictions for L2VPN Interworking

This section lists general restrictions that apply to L2VPN interworking. Other restrictions that are platform-specific or device-specific are listed in the following sections.

- MTU configured on the AC should not exceed the MTU in the core of the network because fragmentation is not supported.
- The interworking type on one provider edge (PE) router must match the interworking type on the peer PE router.
- IP interworking with native VLANs is not supported.
- Ethernet VLAN (Type 4) interworking is not supported.
- Only the following quality of service (QoS) features are supported with L2VPN interworking:
  - Static IP type of service (ToS) or MPLS experimental bit (EXP) setting in tunnel header
  - One-to-one mapping of VLAN priority bits to MPLS EXP bits

Restrictions for Routed Interworking

Routed interworking has the following restrictions:

- Multipoint Frame Relay (FR) is not supported.
- QoS classification on IP ToS, DSCP and other IP header fields is not supported.
- Security access control list (ACL) and other features based on IP header fields parsing are not supported.
- In routed mode, only one customer edge (CE) router can be attached to an Ethernet PE router.
- There must be a one-to-one relationship between an AC and the pseudowire. Point-to-multipoint or multipoint-to-point configurations are not supported.
- You must configure routing protocols for point-to-point operation on the CE routers when configuring an Ethernet to non-Ethernet setup.
- In the IP interworking mode, the IPv4 (0800) translation is supported. The PE router captures Address Resolution Protocol (ARP) (0806) packets and responds with its own MAC address (proxy ARP). Everything else is dropped.
- The Ethernet must contain only two IP devices: PE router and CE router. The PE router performs proxy ARP and responds to all ARP requests it receives. Therefore, only one CE router and one PE router should be on the Ethernet segment.
- If the CE routers are doing static routing, you can perform the following tasks:
  - The PE router needs to learn the MAC address of the CE router to correctly forward traffic to it. The Ethernet PE router sends an Internet Control Message Protocol (ICMP) Router Discovery Protocol (RDP) solicitation message with the source IP address as zero. The Ethernet CE router responds to this solicitation message. To configure the Cisco CE router's Ethernet interface to respond to the ICMP RDP solicitation message, issue the **ip irdp** command in interface configuration mode. If you do not configure the CE router, traffic is dropped until the CE router sends traffic toward the PE router.
  - To disable the CE routers from running the router discovery protocol, issue the **ip irdp maxadvertinterval 0** command in interface configuration mode.

- When you change the interworking configuration on an Ethernet PE router, clear the ARP entry on the adjacent CE router so that it can learn the new MAC address. Otherwise, you might experience traffic drops.

Restrictions for PPP Interworking

The following restrictions apply to PPP interworking:

- There must be a one-to-one relationship between a PPP session and the pseudowire. Multiplexing of multiple PPP sessions over the pseudowire is not supported.
- Only IP (IPv4 (0021) interworking is supported. Link Control Protocol (LCP) packets and Internet Protocol Control Protocol (IPCP) packets are terminated at the PE router. Everything else is dropped.
- By default, the PE router assumes that the CE router knows the remote CE router's IP address.
- Password Authentication Protocol (PAP) and Challenge-Handshake Authentication Protocol (CHAP) authentication are supported.

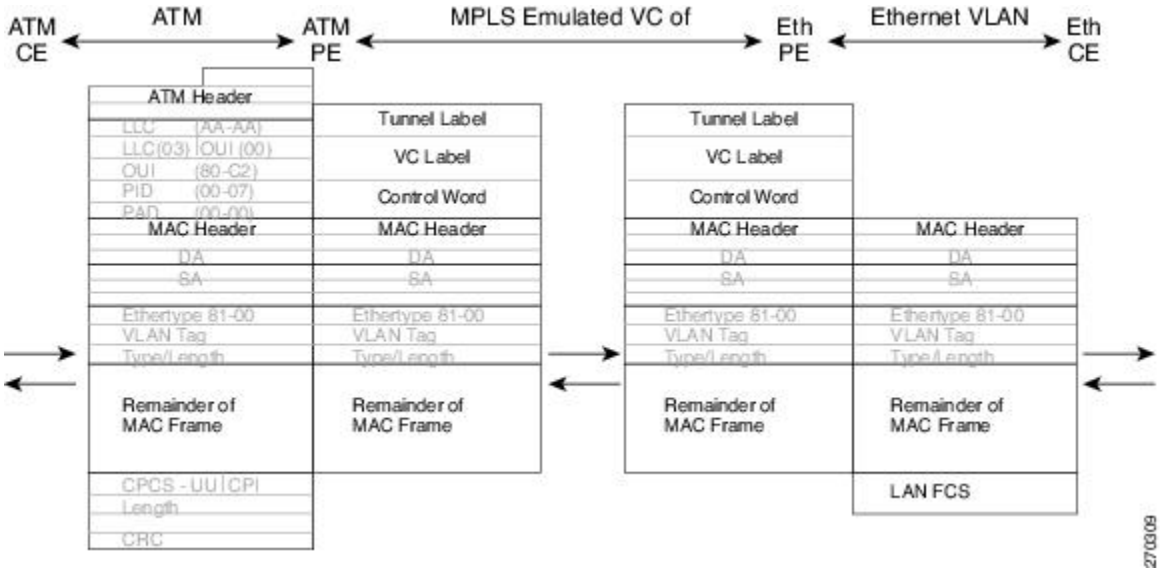
Restrictions for Ethernet/VLAN-to-ATM AAL5 Interworking

The Ethernet/VLAN to ATM AAL5 Any Transport over MPLS (AToM) has the following restrictions:

- Only the following translations are supported; other translations are dropped:
  - Ethernet without LAN FCS (AAAA030080C200070000)
  - Spanning tree (AAAA030080C2000E)
- The ATM encapsulation type supported for bridged interworking is aal5snap. However, ATM encapsulation types supported for routed interworking are aal5snap and aal5mux.
- The existing QoS functionality for ATM is supported, including setting the ATM CLP bit.
- Only ATM AAL5 VC mode is supported. ATM VP and port mode are not supported.
- SVCs are not supported.
- Individual AAL5 ATM cells are assembled into frames before being sent across the pseudowire.
- Non-AAL5 traffic, (such as Operation, Administration, and Maintenance (OAM) cells) is punted to be processed at the route processor (RP) level. A VC that has been configured with OAM cell emulation on the ATM PE router (using the **oam-ac emulation-enable** CLI command) can send end-to-end F5 loopback cells at configured intervals toward the CE router.
- When the pseudowire is down, an F5 end-to-end segment alarm indication signal/remote defect indication (AIS/RDI) is sent from the PE router to the CE router.

- If the Ethernet frame arriving from the Ethernet CE router includes a 802.1Q header (VLAN header), due to the type of endpoint attachment (Ethernet port mode), the VLAN header stays in the frame across the pseudowire (see the figure below).

Figure 1: Protocol Stack for ATM-to-Ethernet AToM Bridged Interworking--with VLAN Header



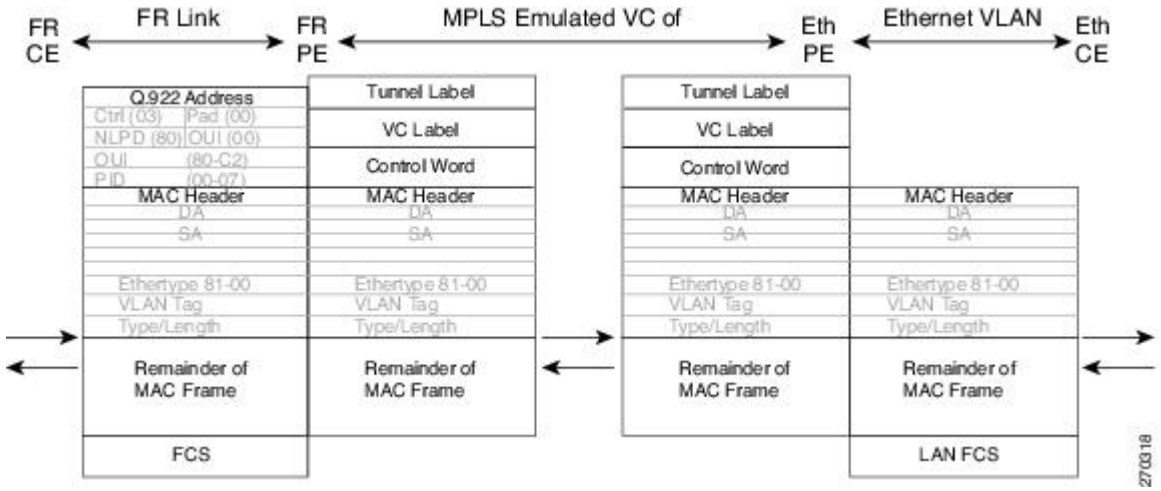
Restrictions for Ethernet/VLAN-to-Frame Relay Interworking

The Ethernet/VLAN-to-Frame Relay AToM has the following restrictions:

- Only the following translations are supported; other translations are dropped:
  - Ethernet without LAN FCS (0300800080C20007)
  - Spanning tree (0300800080C2000E)
- The PE router automatically supports translation of both Cisco and IETF Frame Relay encapsulation types coming from the CE router, but translates only to IETF when sending to the CE router. This is not a problem for the Cisco CE router, because it can manage IETF encapsulation upon receipt even if it is configured to send a Cisco encapsulation.
- The PVC status signaling works the same way as in the like-to-like case. The PE router reports the PVC status to the CE router based upon the availability of the pseudowire.
- The AC maximum transmission unit (MTU) must be within the supported range of MTUs when connected over MPLS.
- Only Frame Relay DLCI mode is supported. Frame Relay port mode is not supported.
- If the Ethernet frame includes a 802.1Q header (VLAN header), due to the type of endpoint attachment (Ethernet port mode), the VLAN header stays in the frame across the pseudowire (see the figure below).

- Frame Relay encapsulation types supported for routed interworking are Cisco and IETF for incoming traffic. However, IETF is also supported for outgoing traffic traveling to the CE router.

Figure 2: Protocol Stack for Frame Relay-to-Ethernet AToM Bridged Interworking--with VLAN Header



Restrictions for HDLC-to-Ethernet Interworking

- The “none CISCO” High-Level Data Link Control (HDLC) encapsulation is not supported.
- IPv6 is not supported in routed mode.

Information About L2VPN Interworking

Overview of L2VPN Interworking

L2 transport over MPLS and IP already exists for like-to-like ACs, such as Ethernet-to-Ethernet or PPP-to-PPP. L2VPN Interworking builds on this functionality by allowing disparate ACs to be connected. An interworking function facilitates the translation between the different L2 encapsulations.

Only the following interworking combinations are supported:

- ATM-to-Ethernet - Routed interworking
- ATM-to-Ethernet - Bridged interworking
- Frame relay-to-Ethernet - Bridged interworking
- PPP-to-Ethernet - Routed interworking
- HDLC-to-Ethernet - Bridged and Routed interworking

L2VPN Interworking Modes

L2VPN interworking works in either Ethernet (bridged) mode or IP (routed) mode. L2VPN interworking does not support Ethernet VLAN (Type 4) mode. You specify the mode in the following ways:

- If using the older legacy CLI commands, you can use the **interworking** {**ethernet** | **ip**} command in pseudowire-class configuration mode.
- If using the newer L2VPN protocol-based CLI commands, you can use the **interworking** {**ethernet** | **ip**} command in xconnect configuration mode.

The **interworking** command causes the ACs to be terminated locally. The two keywords perform the following functions:

- The **ethernet** keyword causes Ethernet frames to be extracted from the AC and sent over the pseudowire. Ethernet end-to-end transmission is resumed. AC frames that are not Ethernet are dropped. In the case of VLAN, the VLAN tag is removed, leaving an untagged Ethernet frame.
- The **ip** keyword causes IP packets to be extracted from the AC and sent over the pseudowire. AC frames that do not contain IPv4 packets are dropped.

The following sections explain more about Ethernet and IP interworking modes.

Ethernet or Bridged Interworking

Ethernet interworking is also called bridged interworking. Ethernet frames are bridged across the pseudowire. The CE routers could be natively bridging Ethernet or could be routing using a bridged encapsulation model, such as Bridge Virtual Interface (BVI) or Routed Bridge Encapsulation (RBE). The PE routers operate in Ethernet like-to-like mode.

This mode is used to offer the following services:

- LAN services--An example is an enterprise that has several sites, where some sites have Ethernet connectivity to the service provider (SP) network and others have ATM connectivity. If the enterprise wants LAN connectivity to all its sites, traffic from the Ethernet or VLAN of one site can be sent through the IP/MPLS network and encapsulated as bridged traffic over an ATM VC of another site.
- Connectivity services--An example is an enterprise that has different sites that are running an Internal Gateway Protocol (IGP) routing protocol, which has incompatible procedures on broadcast and nonbroadcast links. The enterprise has several sites that are running an IGP, such as Open Shortest Path First (OSPF) or Intermediate System-to-Intermediate System (IS-IS), between the sites. In this scenario, some of the procedures (such as route advertisement or designated router) depend on the underlying L2 protocol and are different for a point-to-point ATM connection versus a broadcast Ethernet connection. Therefore, the bridged encapsulation over ATM can be used to achieve homogenous Ethernet connectivity between the CE routers running the IGP.

IP or Routed Interworking

IP interworking is also called routed interworking. The CE routers encapsulate the IP on the link between the CE router and PE router. A new VC type is used to signal the IP pseudowire in MPLS. Translation between the L2 and IP encapsulations across the pseudowire is required. Special consideration needs to be given to

the address resolution and routing protocol operation, because these are handled differently on different L2 encapsulations.

This mode is used to provide IP connectivity between sites, regardless of the L2 connectivity to these sites. It is different from a Layer 3 VPN because it is point-to-point in nature and the service provider does not maintain any customer routing information.

Address resolution is encapsulation dependent:

- Ethernet uses Address Resolution Protocol (ARP)
- ATM uses inverse ARP
- PPP uses IP Control Protocol (IPCP)
- HDLC uses Serial Line ARP (SLARP)

Therefore, address resolution must be terminated on the PE router. End-to-end address resolution is not supported. Routing protocols operate differently over broadcast and point-to-point media. For Ethernet, the CE routers must either use static routing or configure the routing protocols to treat the Ethernet side as a point-to-point network.

In routed interworking, IP packets that are extracted from the ACs are sent over the pseudowire. The pseudowire works in the IP Layer 2 transport (VC type 0x000B) like-to-like mode. The interworking function at network service provider's (NSP) end performs the required adaptation based on the AC technology. Non-IPv4 packets are dropped.

In routed interworking, the following considerations are to be kept in mind:

- Address resolution packets (ARP), inverse ARP, and IPCP are punted to the routing protocol. Therefore, NSP at the PE router must provide the following functionality for address resolution:
  - Ethernet--PE device acts as a proxy-ARP server to all ARP requests from the CE router. The PE router responds with the MAC address of its local interface.
  - ATM and Frame Relay point-to-point--By default, inverse ARP does not run in the point-to-point Frame Relay or ATM subinterfaces. The IP address and subnet mask define the connected prefix; therefore, configuration is not required in the CE devices.
- Interworking requires that the MTUs in both ACs match for the pseudowire to come up. The default MTU in one AC should match with the MTU of other AC. The table below lists the range of MTUs that can be configured for different ACs.

Table 1: Range of MTUs for Different ACs

AC type	Range of MTUs supported
ATM	64 to 17940
Gigabit Ethernet	1500 to 4470
POS	64to 9102
Fast Ethernet	64to 9192

Note The MTU configured on the AC should not exceed the MTU in the core network. This ensures that the traffic is not fragmented.

- The CE routers with Ethernet attachment VCs running OSPF must be configured with the **ospfIfType**option so that the OSPF protocol treats the underlying physical broadcast link as a P2P link.

Ethernet VLAN-to-ATM AAL5 Interworking

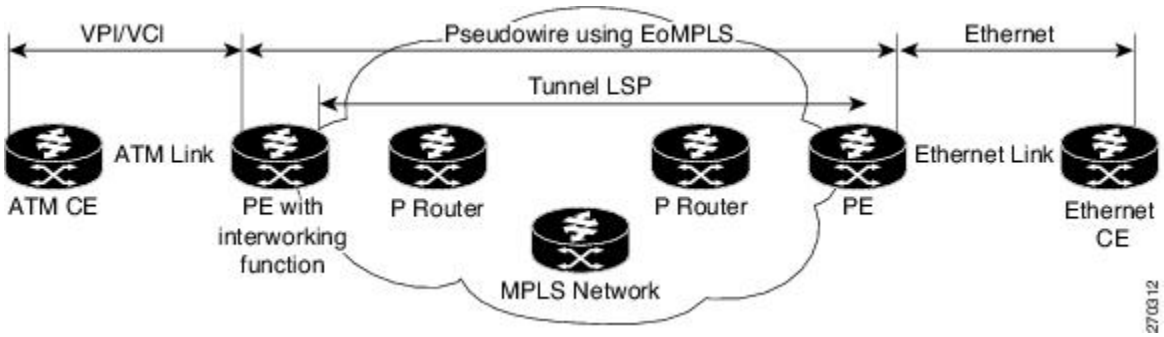
The following topics are covered in this section:

ATM AAL5-to-Ethernet Port AToM--Bridged Interworking

This interworking type provides interoperability between the ATM attachment VC and Ethernet attachment VC connected to different PE routers. Bridged encapsulation corresponding to the bridged (Ethernet) interworking mechanism is used.

The interworking function is performed at the PE router connected to the ATM attachment VC based on multiprotocol encapsulation over ATM AAL5 (see the figure below).

Figure 3: Network Topology for ATM-to-Ethernet AToM Bridged Interworking



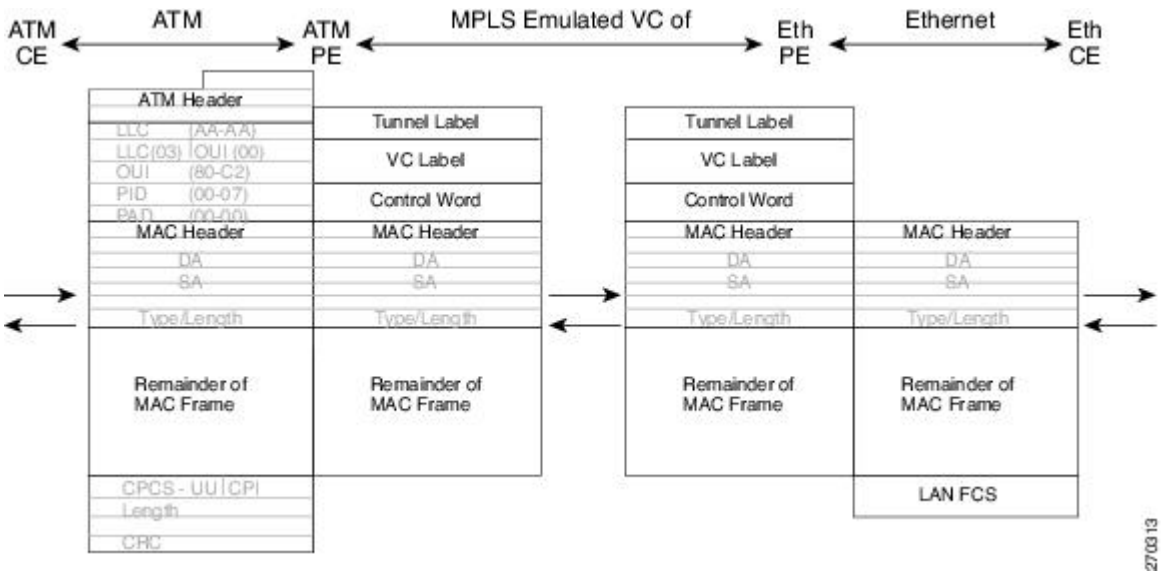
The advantage of this architecture is that the Ethernet PE router (connected to the Ethernet segment) operates similarly to Ethernet like-to-like services.

On the PE router with interworking function, in the direction from the ATM segment to MPLS cloud, the bridged encapsulation (ATM/subnetwork access protocol (SNAP) header) is discarded and the Ethernet frame is encapsulated with the labels required to go through the pseudowire using the VC type 5 (Ethernet) (see the figure below).

In the opposite direction, after the label disposition from the MPLS cloud, Ethernet frames are encapsulated over AAL5 using bridged encapsulation.

The figure below shows the protocol stack for ATM-to-Ethernet AToM bridged interworking. The ATM side has an encapsulation type of aal5snap.

Figure 4: Protocol Stack for ATM-to-Ethernet AToM Bridged Interworking--without VLAN Header



ATM AAL5-to-Ethernet VLAN 802.1Q AToM--Bridged Interworking

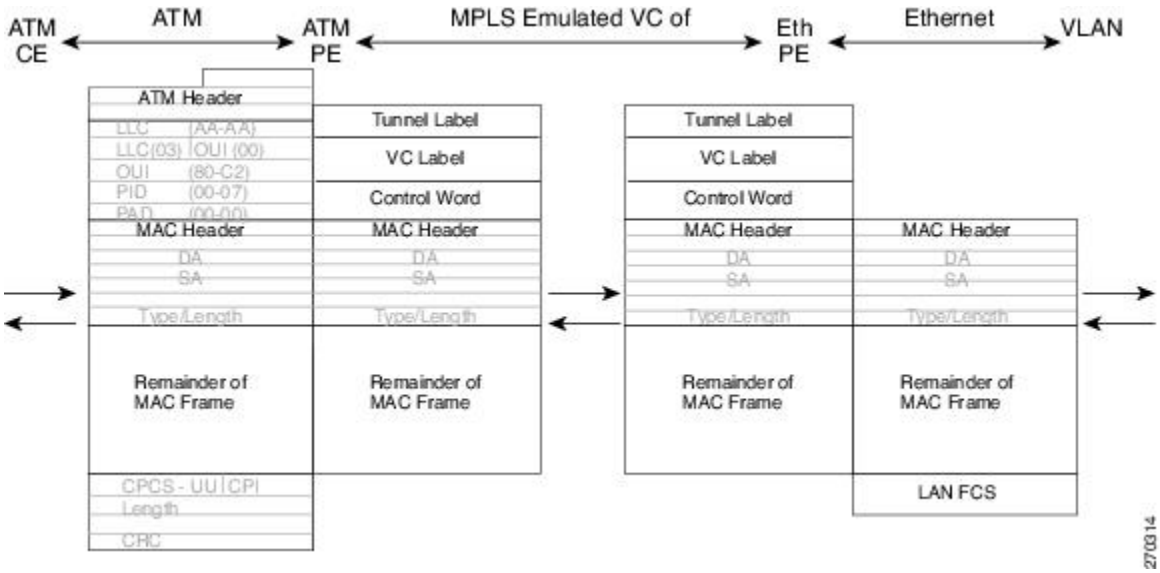
This interworking type provides interoperability between the ATM attachment VC and Ethernet VLAN attachment VC connected to different PE routers. Bridged encapsulation corresponding to the bridged (Ethernet) interworking mechanism is used.

The interworking function is performed in the same way as for the ATM-to-Ethernet port case, implemented on the PE router connected to the ATM attachment VC. The implementation is based on multiprotocol encapsulation over ATM AAL5 (see the figure below).

For the PE router connected to the Ethernet side, one major difference exists due the existence of the VLAN header in the incoming packet. The PE router discards the VLAN header of the incoming frames from the VLAN CE router, and the PE router inserts a VLAN header into the Ethernet frames traveling from the MPLS cloud. The frames sent on the pseudowire (with VC type 5) are Ethernet frames without the VLAN header.

Encapsulation over ATM AAL5 is shown in the figure below.

Figure 5: Protocol Stack for ATM -to-VLAN AToM Bridged Interworking



ATM-to-Ethernet--Routed Interworking

To perform routed interworking, both the ATM PE router and Ethernet PE router must be configured. The figure below shows the routed interworking between ATM to Ethernet. The IP encapsulation over the pseudowire is performed on the ATM packets arriving from the ATM CE router.

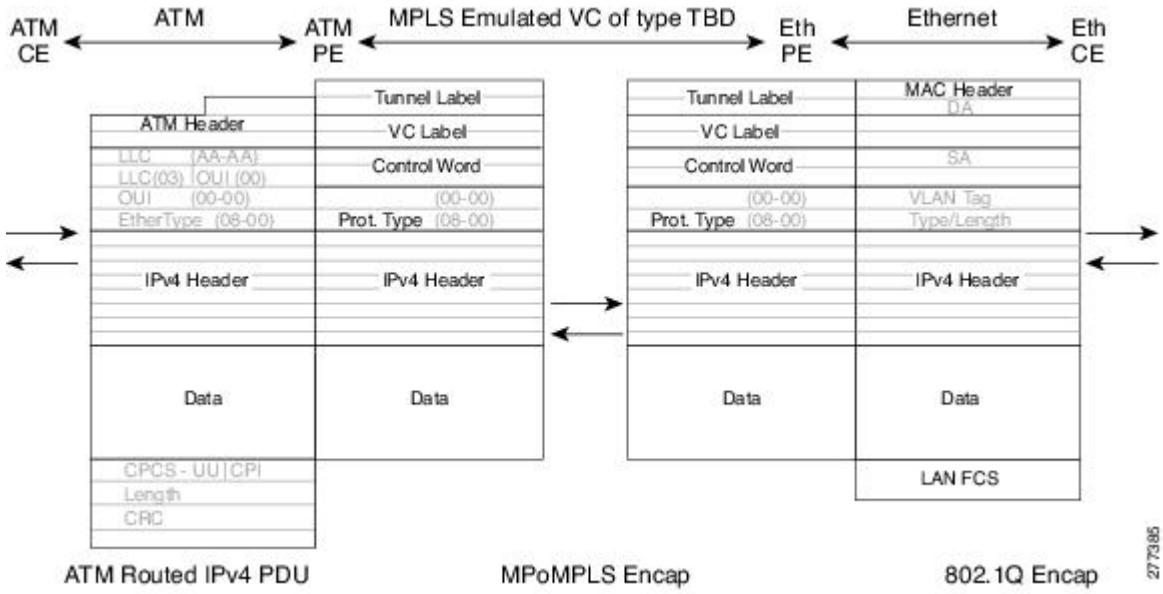
The address resolution is done at the ATM PE router; it is required when the ATM CE router does an inverse ARP. It is not required when the ATM CE router is configured using Point-to-Point (P2P) subinterfaces or static maps.

When packets arrive from the Ethernet CE router, the Ethernet PE router removes the L2 frame tag, and then forwards the IP packet to the egress PE router, using IPoMPLS encapsulation over the pseudowire. The Ethernet PE router makes the forwarding decision based on the L2 circuit ID, the VLAN ID, or port ID, of the incoming L2 frame. At the ATM PE router, after label disposition, the IP packets are encapsulated over the AAL5 using routed encapsulation based on RFC 2684.

The address resolution at the Ethernet PE router can be done when the Ethernet CE router configures the static ARP, or by the proxy ARP on the Ethernet PE router. If the proxy ARP is used, the IP address of the remote CE router can be learned dynamically.

Routing protocols need to be configured to operate in the P2P mode on the Ethernet CE router.

Figure 6: Protocol Stack for ATM-to-Ethernet--Routed Interworking



Ethernet VLAN-to-Frame Relay Interworking

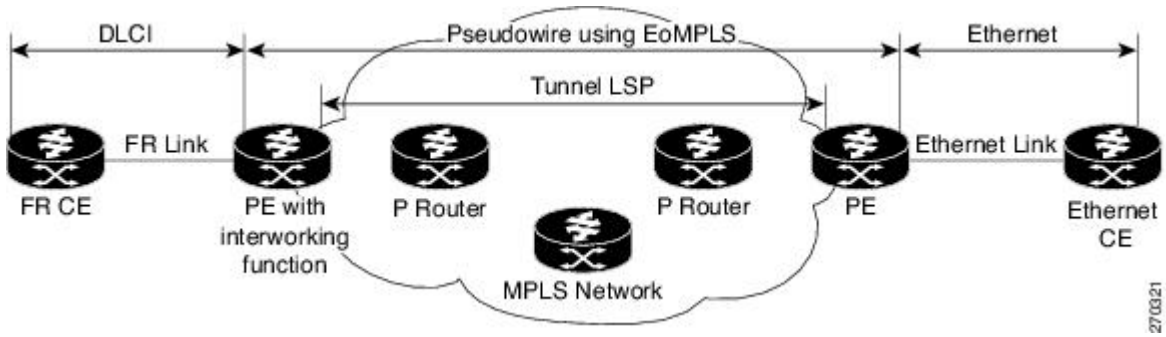
The following topics are covered in this section:

Frame Relay DLCI-to-Ethernet Port AToM--Bridged Interworking

This interworking type provides interoperability between the Frame Relay attachment VC and Ethernet attachment VC connected to different PE routers. Bridged encapsulation corresponding to the bridged (Ethernet) interworking mechanism is used.

For an FR-to-Ethernet port case, the interworking function is performed at the PE router connected to the FR attachment VC based on multiprotocol interconnect over Frame Relay (see the figure below). The interworking is implemented similar to an ATM-to-Ethernet case.

Figure 7: Network Topology for FR-to-Ethernet AToM Bridged Interworking



The advantage of this architecture is that the Ethernet PE router (connected to the Ethernet segment) operates similar to Ethernet like-to-like services: a pseudowire label is assigned to the Ethernet port and then the remote Label Distribution Protocol (LDP) session distributes the labels to its peer PE router. Ethernet frames are carried through the MPLS network using Ethernet over MPLS (EoMPLS).

On the PE router with interworking function, in the direction from the Frame Relay segment to the MPLS cloud, the bridged encapsulation (FR/SNAP header) is discarded and the Ethernet frame is encapsulated with the labels required to go through the pseudowire using the VC type 5 (Ethernet) (see the figure below).

In the opposite direction, after the label disposition from the MPLS cloud, Ethernet frames are encapsulated over Frame Relay using bridged encapsulation.

The following translations are supported:

- Ethernet without LAN FCS (0300800080C20007)
- Spanning tree (0300800080C2000E)

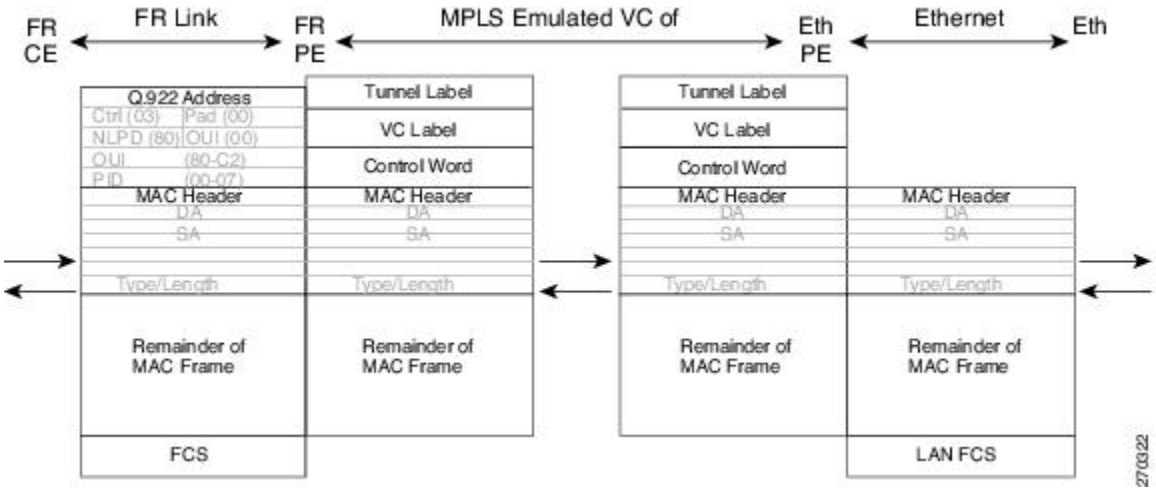
The PE router automatically supports translation of both Cisco and IETF Frame Relay encapsulation types coming from the CE, but translates only to IETF when sending to the CE router. This is not a problem for the Cisco CE router, because it can handle IETF encapsulation on receipt even if it is configured to send Cisco encapsulation.

The existing QoS functionality for Frame Relay is supported. The PVC status signaling works the same way as in the like-to-like case. The PE router reports the PVC status to the CE router, based on the availability of the pseudo wire.

The AC MTU must match when connected over MPLS. Only Frame Relay DLCI mode is supported; Frame Relay port mode is not supported in the bridged interworking.

The figure below shows the protocol stack for FR-to-Ethernet bridged interworking.

Figure 8: Protocol Stack for FR-to-Ethernet AToM Bridged Interworking--without VLAN Header



Frame Relay DLCI-to-Ethernet VLAN 802.1Q AToM--Bridged Interworking

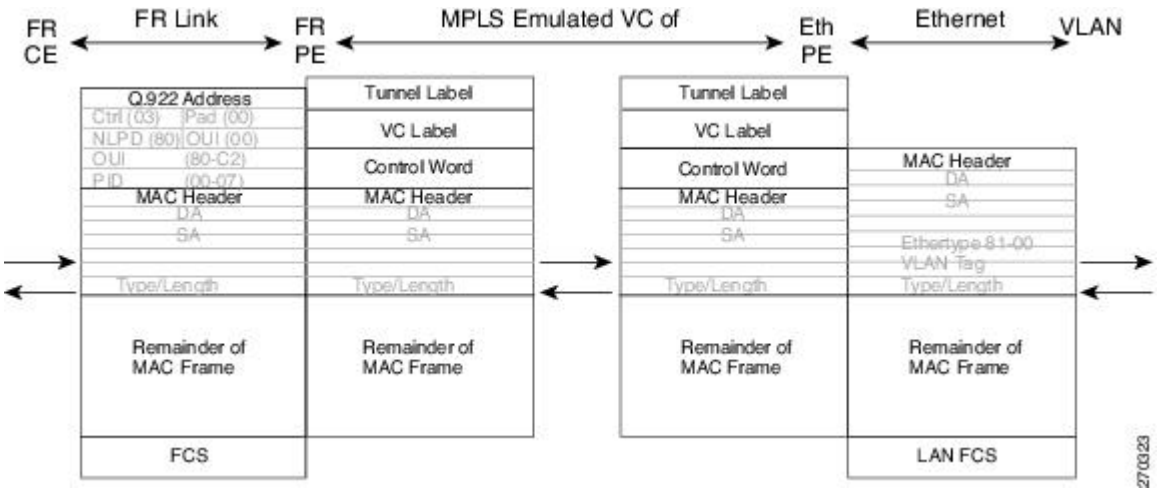
This interworking type provides interoperability between the Frame Relay attachment VC and Ethernet VLAN Attachment VC connected to different PE routers. The bridged encapsulation corresponding to the bridged (Ethernet) interworking mechanism is used.

The interworking function is performed in the same way as it is done for the Frame Relay to Ethernet port case; it is implemented on the PE router connected to the Frame Relay attachment VC, based upon a multiprotocol interconnect over Frame Relay (see the figure above).

As in the ATM-to-VLAN case, one difference exists on the Ethernet side due the existence of the VLAN header in the incoming packet. The PE router on the VLAN side discards the VLAN header of the incoming frames from the VLAN CE router, and the PE router inserts a VLAN header into the Ethernet frames traveling from the MPLS cloud. The frames sent on the pseudowire (with VC type 5) are Ethernet frames without the VLAN header.

The figure below shows the protocol stack for FR-to-VLAN AToM bridged interworking.

Figure 9: Protocol Stack for FR-to-VLAN AToM Bridged Interworking



Frame Relay DLCI-to-Ethernet VLAN Qot1Q QinQ AToM - Bridged Interworking

This interworking type provides interoperability between the Frame Relay Attachment VC and Ethernet VLAN Attachment VC connected to different PE routers. The bridged encapsulation corresponding to bridged (Ethernet) interworking mechanism is used.

The interworking function is done in the same way as it is done for FR-to-Ethernet port case; it is implemented on the PE router connected to the Frame Relay attachment VC, based on RFC 2427(Multiprotocol Interconnect over Frame Relay).

When compared with Frame Relay DLCI-to-Ethernet port AToM, there is one major difference on the Ethernet access side, due the existence of the VLAN header in the incoming packet. The PE router on the VLAN side will discard the VLAN header of the incoming frames form the VLAN CE router, and it will insert a VLAN header into the Ethernet frames coming from the MPLS cloud. So the frames sent on the pseudo wire (with VC type 5) will be Ethernet frames without the VLAN header.

The following translations are supported on the Frame Relay PE router:

- Ethernet without LAN FCS (0300800080C20007)
- Spanning tree (0300800080C2000E)

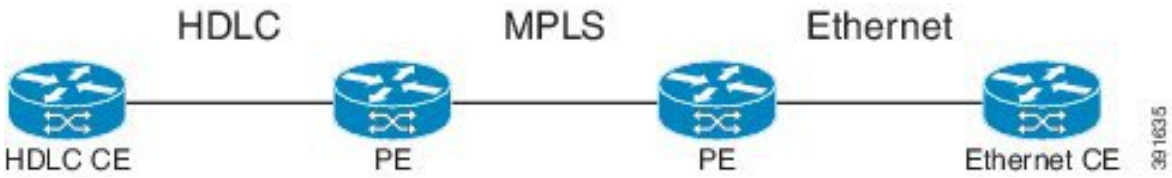
Frame Relay encapsulation types supported for bridged interworking: Cisco and IETF for incoming traffic, IETF only for outgoing traffic towards CE router.

HDLC-to-Ethernet Interworking

High-Level Data Link Control (HDLC) and Ethernet are two independent data link layer transport protocols that utilize the Any Transport over MPLS (AToM) framework to communicate with each other. The interworking function enables translation between two heterogeneous Layer 2 encapsulations over a Multiprotocol Label Switching (MPLS) backbone.

The figure below depicts a simple HDLC-to-Ethernet interworking topology.

Figure 10: HDLC-to-Ethernet interworking topology



HDLC-to-Ethernet interworking supports the following:

- Ethernet or bridged interworking
- IP or routed interworking
- HDLC encapsulation type: CISCO
- Ethernet encapsulation types: IEEE 802.1Q, QinQ, port mode

The HDLC pass-through feature is not affected in any way by HDLC-to-Ethernet interworking.

HDLC-to-Ethernet interworking supports two interworking modes:

- HDLC-to-Ethernet — Ethernet or Bridged interworking
- HDLC-to-Ethernet — IP or Routed interworking

HDLC-to-Ethernet — Ethernet or Bridged Interworking

HDLC-to-Ethernet bridged interworking provides interoperability between the HDLC attachment virtual circuit (VC) and Ethernet VLAN attachment VC connected to different provider edge (PE) devices. Bridged encapsulation corresponding to the bridged (Ethernet) interworking mechanism is used.

When packets arrive from the HDLC customer edge (CE) device, they consist of the HDLC header, the Ethernet MAC header, and the payload. At the HDLC PE device, the HDLC header is removed, and MPLS labels are inserted. The frames are then routed over the pseudowire to the Ethernet PE device, where the MPLS labels are removed. On the Ethernet side, there are two possibilities. The attachment circuit (AC) is either Ethernet or VLAN.

For an Ethernet attachment circuit (AC), the packets are forwarded to the Ethernet CE device, as is. For a VLAN AC, VLAN headers are added at the VLAN/QinQ subinterface's AC. The Ethernet VLAN frame is then forwarded to the VLAN CE device.

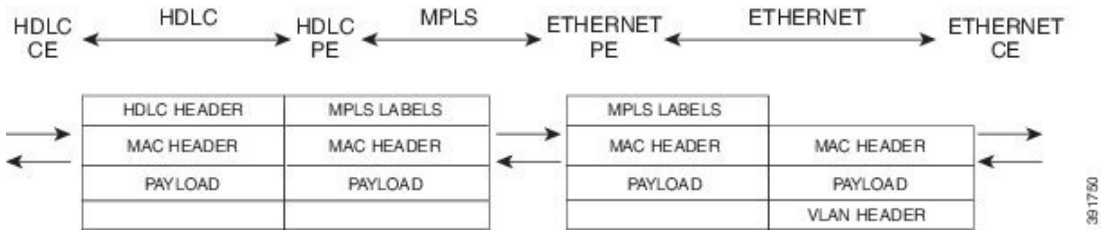
In the opposite direction (Ethernet / VLAN to HDLC), the VLAN header is present in the incoming packet, if the AC is VLAN. So, when packets arrive from the VLAN CE device, they consist of the VLAN header, the Ethernet MAC header, and the payload. At the Ethernet PE device, the VLAN header is removed at the

VLAN/QinQ subinterface's AC, and MPLS labels are inserted. The frames are then routed over the pseudowire to the HDLC PE device, where the MPLS labels are removed. The HDLC header is added before the Ethernet MAC header. The HDLC frame is then forwarded to the HDLC CE device.

If the AC is Ethernet, packets arriving from the Ethernet CE device consist of the Ethernet MAC header and the payload. At the Ethernet PE device, MPLS labels are inserted at the VLAN/QinQ subinterface's AC. The frames are then routed over the pseudowire to the HDLC PE device, where the MPLS labels are removed. The HDLC header is added before the Ethernet MAC header. The HDLC frame is then forwarded to the HDLC CE device.

The figure below shows the bridged interworking mode of HDLC-to-Ethernet interworking, with a VLAN AC on the Ethernet side.

Figure 11: HDLC-to-Ethernet — Ethernet or Bridged Interworking



HDLC-to-Ethernet — IP or Routed Interworking

To perform routed interworking, both the HDLC PE device and Ethernet PE device must be configured. The IP encapsulation over the pseudowire is performed on HDLC packets that arrive from the HDLC CE device. The address resolution is done at the HDLC PE device.

When packets arrive from the HDLC CE device, they consist of the HDLC header, the IPv4 header, and the payload. At the HDLC PE device, the HDLC header is removed, and MPLS labels are inserted. The frames are then routed over the pseudowire to the Ethernet PE device, where the MPLS labels are removed. On the Ethernet side, there are two possibilities. The attachment circuit (AC) is either Ethernet or VLAN.

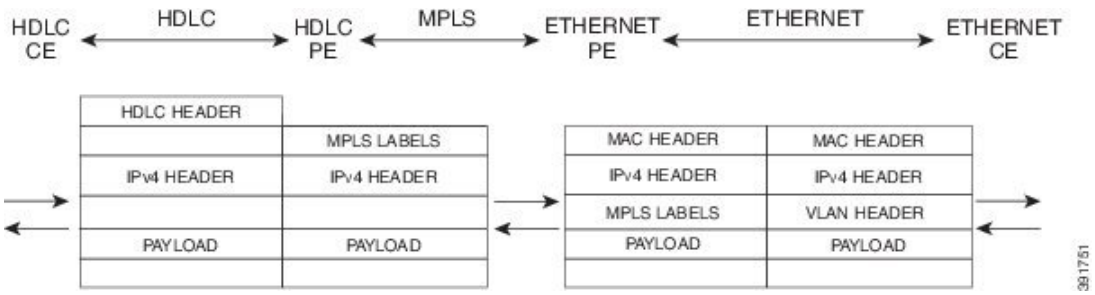
For an Ethernet attachment circuit (AC), the packets are forwarded to the Ethernet CE device, as is. For a VLAN AC, VLAN headers are added at the VLAN/QinQ subinterface's AC. The Ethernet VLAN frame is then forwarded to the VLAN CE device.

In the opposite direction (Ethernet / VLAN to HDLC), the VLAN header is present in the incoming packet, if the AC is VLAN. So, when packets arrive from the VLAN CE device, they consist of the VLAN header, the Ethernet MAC header, and the payload. At the Ethernet PE device, the MAC header is removed, the VLAN header is removed at the VLAN/QinQ subinterface's AC, and MPLS labels are inserted. The frames are then routed over the pseudowire to the HDLC PE device, where the MPLS labels are removed. The HDLC header is added before the IPv4 header. The HDLC frame is then forwarded to the HDLC CE device.

If the AC is Ethernet, packets arriving from the Ethernet CE device consist of the Ethernet MAC header and the payload. At the Ethernet PE device, the MAC header is removed, and MPLS labels are inserted. The frames are then routed over the pseudowire to the HDLC PE device, where the MPLS labels are removed. The HDLC header is added before the IPv4 header. The HDLC frame is then forwarded to the HDLC CE device.

The figure below shows the routed interworking mode of HDLC-to-Ethernet interworking, with a VLAN AC on the Ethernet side.

Figure 12: HDLC-to-Ethernet — IP or Routed interworking



ATM Local Switching

- ATM like-to-like local switching allows switching data between two physical interfaces where both the segments are of ATM type. The two interfaces must be on the same PE router. The table below lists the supported ATM local switching combinations.

Table 2: ATM local switching - supported combinations

	Same port Point-to-Point	Different port Point-to-Point	Same Port Multipoint	Different Port Multipoint
Port Mode	No	No	No	No
VC-to-VC AAL0	Yes	Yes	Yes	Yes
VC-to-VC AAL5	Yes	Yes	Yes	Yes
VP-to-VP AAL0	No	No	Yes	Yes
VP-to-VP AAL5	No	No	No	No

VC-to-VC Local Switching

VC-to-VC local switching transports cells between two ATM attachment VCs on the same or different port on the PE router. The cells coming to the PE router can be AAL0 or AAL5 encapsulated ATM packets. ATM VC-to-VC local switching can be configured either on point-to-point interface or on multipoint interface.

There are two operation modes for managing OAM cells over ATM local switching interfaces:

- OAM transparent mode: In this mode, the PE router transports F5 OAM cells transparently across local switching interfaces.
- OAM local emulation mode: In this mode, the PE router does not transport OAM cells across local switching interfaces. Instead, the interfaces locally terminate and process F5 OAM cells.

In ATM single cell relay AAL0, the ATM virtual path identifier/virtual channel identifier (VPI/VCI) values of the ingress and egress ATM interfaces of a router must match. If L2 local switching is desired between two ATM VPIs and VCIs, which are on two different interfaces and have values that do not match, ATM AAL5 should be selected. However, if ATM AAL5 uses OAM transparent mode, the VPI and VCI values must match.

ATM OAM can be configured on ATM VC mode local switching AC using the **oam-ac emulation-enable**and **oam-pvc manage** commands. When emulation is enabled on the AC, all OAM cells going through the AC are punted to RP for local processing. The ATM common component processes OAM cells and forwards the cells towards the local CE router. This helps to detect the failures on the PE router by monitoring the response at the CE router end. When the **oam-pvc manage** command is enabled on the AC, the PVC generates end-to-end OAM loopback cells that verify connectivity on the VC.

The following example shows a sample configuration on the ATM PE router:

```
configure terminal
interface atm 4/0.50 multipoint
 no ip address
  no atm enable-ilmi-trap
pvc 100/100 l2transport
 encapsulation aal5
 oam-ac emulation-enable
 oam-pvc manage
interface atm 5/0.100 multipoint
 no ip address
 no atm enable-ilmi-trap
 pvc 100/100 l2transport
  encapsulation aal5
  oam-ac emulation-enable
  oam-pvc manage
connect atm_ls atm 4/0 100/100 atm 5/0 100/100
```

VP-to-VP Local Switching

VP-to-VP local switching transports cells between two VPs on the same port or different ports on the PE router. The cells coming to the PE router can be AAL0 encapsulated ATM packets only. ATM VP-to-VP local switching can be configured only on multipoint interfaces.

There are two operation modes for managing OAM cells over ATM local switching interfaces:

- OAM transparent mode: In this mode, the PE router transports F4 OAM cells transparently across local switching interfaces.
- OAM local emulation mode: In this mode, the PE router do not transport OAM cells across local switching interfaces. Instead, the interfaces locally terminate and process F4 OAM cells.

In ATM single cell relay AAL0, the ATM VPI values of the ingress and egress ATM interfaces on a router must match. If L2 switching is desired between two ATM VPIs which are on two different interfaces and have values that do not match, ATM AAL5 should be selected. If ATM AAL5 uses OAM transparent mode, the VPI value must match. Currently, the ATM VP-to-VP local switching supports only AAL0 encapsulation.

The following example shows a sample configuration on the ATM PE router:

```
configure terminal
interface atm 4/0.100 multipoint
 no ip address
 no atm enable-ilmi-trap
atm pvp 100 l2transport
interface atm 5/0.100 multipoint
 no ip address
 no atm enable-ilmi-trap
```

```
atm pvp 100 l2transport
connect atm_ls atm 4/0 100 atm 5/0 100
```

PPP-to-Ethernet AToM-Routed Interworking

In this interworking type, one of the ACs is Ethernet and the other is PPP. Each link is terminated locally on the corresponding PE routers and the extracted layer 3 (L3) packets are transported over a pseudowire.

The PE routers connected to Ethernet and PPP ACs terminate their respective L2 protocols. The PPP session is terminated for both the LCP and the Network Control Protocol (NCP) layers. On the ingress PE router, after extracting L3 packets, each PE router forwards the packets over the already established pseudowire using MPoMPLS encapsulation. On the egress PE router, after performing label disposition, the packets are encapsulated based on the corresponding link layer and are sent to the respective CE router. This interworking scenario requires the support of MPoMPLS encapsulation by the PE routers.

In PPP-to-Ethernet AToM routed interworking mode IPCP is supported. Proxy IPCP is automatically enabled on the PE router when IP interworking is configured on the pseudowire. By default, the PE router gets the IP address it needs to use from the CE router. The PE router accomplishes this by sending an IPCP confreq with the IP address 0.0.0.0. The local CE router has the remote CE router's IP address configured on it. The following example shows a sample configuration on the PPP CE router:

```
interface serial2/0
 ip address 168.65.32.13 255.255.255.0
 encapsulation ppp
peer default ip address 168.65.32.14  *
```

If the remote CE router's IP address cannot be configured on the local CE router, then the remote CE router's IP address can be configured on the PE router using the **ppp ipcp address proxy** *ip address* command on the xconnect PPP interface of PE router. The following example shows a sample configuration on the PPP PE router:

```
pseudowire-class mp
 encapsulation mpls
 protocol ldp
 interworking ip
!
int se2/0
 encap ppp
 xconnect 10.0.0.2 200 pw-class mp
 ppp ipcp address proxy 168.65.32.14
```

PPP-to-Ethernet AToM-Routed Interworking using the commands associated with the L2VPN Protocol-Based CLIs feature

In this interworking type, one of the ACs is Ethernet and the other is PPP. Each link is terminated locally on the corresponding PE routers and the extracted layer 3 (L3) packets are transported over a pseudowire.

The PE routers connected to Ethernet and PPP ACs terminate their respective L2 protocols. The PPP session is terminated for both the LCP and the Network Control Protocol (NCP) layers. On the ingress PE router, after extracting L3 packets, each PE router forwards the packets over the already established pseudowire using MPoMPLS encapsulation. On the egress PE router, after performing label disposition, the packets are encapsulated based on the corresponding link layer and are sent to the respective CE router. This interworking scenario requires the support of MPoMPLS encapsulation by the PE routers.

In PPP-to-Ethernet AToM routed interworking mode IPCP is supported. Proxy IPCP is automatically enabled on the PE router when IP interworking is configured on the pseudowire. By default, the PE router gets the IP address it needs to use from the CE router. The PE router accomplishes this by sending an IPCP confreq with the IP address 0.0.0.0. The local CE router has the remote CE router's IP address configured on it. The following example shows a sample configuration on the PPP CE router:

```
interface serial2/0
 ip address 168.65.32.13 255.255.255.0
 encapsulation ppp
peer default ip address 168.65.32.14  *
```

If the remote CE router's IP address cannot be configured on the local CE router, then the remote CE router's IP address can be configured on the PE router using the **ppp ipcp address proxy** *ip address* command on the xconnect PPP interface of PE router. The following example shows a sample configuration on the PPP PE router:

```
template type pseudowire mp
 encapsulation mpls
 protocol ldp
 interworking ip
!
int se2/0
 encap ppp
interface pseudowire 100
 source template type pseudowire mp
 neighbor 33.33.33.33 1
!
l2vpn xconnect context con1
 ppp ipcp address proxy 168.65.32.14
```

Static IP Addresses for L2VPN Interworking for PPP

If the PE router needs to perform address resolution with the local CE router for PPP, configure the remote CE router's IP address on the PE router. Use the **ppp ipcp address proxy** command with the remote CE router's IP address on the PE router's xconnect PPP interface. The following example shows a sample configuration:

```
pseudowire-class ip-interworking
 encapsulation mpls
 interworking ip
interface Serial2/0
 encapsulation ppp
 xconnect 10.0.0.2 200 pw-class ip-interworking
 ppp ipcp address proxy 10.65.32.14
```

You can also configure the remote CE router's IP address on the local CE router with the **peer default ip address** command if the local CE router performs address resolution.

Static IP Addresses for L2VPN Interworking for PPP using the commands associated with the L2VPN Protocol-Based CLIs feature

If the PE router needs to perform address resolution with the local CE router for PPP, configure the remote CE router's IP address on the PE router. Use the **ppp ipcp address proxy** command with the remote CE router's IP address on the PE router's xconnect PPP interface. The following example shows a sample configuration:

```
template type pseudowire ip-interworking
```

```
 encapsulation mpls
 interworking ip
interface Serial2/0
 encapsulation ppp
interface pseudowire 100
 source template type pseudowire ip-interworking
 neighbor 10.0.0.2 200
!
l2vpn xconnect context con1
 ppp ipcp address proxy 10.65.32.14
```

You can also configure the remote CE router's IP address on the local CE router with the **peer default ip address** command if the local CE router performs address resolution.

How to Configure L2VPN Interworking

Configuring L2VPN Interworking

L2VPN interworking allows you to connect disparate ACs. Configuring L2VPN interworking feature requires that you add the **interworking** command to the list of commands that make up the pseudowire. The steps for configuring the pseudowire for L2VPN interworking are included in this section. You use the **interworking**command as part of the overall AToM configuration. For specific instructions on configuring AToM, see the Any Transport over MPLS document.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class** *name*
4. **encapsulation** {**mpls** | **l2tpv3**}
5. **interworking** {**ethernet** | **ip**}
6. **end**

DETAILED STEPS

	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.

	Command or Action	Purpose
Step 3	**pseudowire-class** *name* **Example:** `Router(config)# pseudowire-class class1`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 4	**encapsulation** {**mpls** | **l2tpv3**} **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation, which is either **mpls** or **l2tpv3**.
Step 5	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 6	**end** **Example:** `Router(config-pw)# end`	Exits pseudowire class configuration mode and returns to privileged EXEC mode.

Verifying the L2VPN Configuration

You can verify L2VPN configuration using the following steps:

- You can issue the **show arp** command between the CE routers to ensure that data is being sent:

```
Router# show arp
Protocol   Address       Age (min)   Hardware Addr    Type    Interface
Internet   10.1.1.5          134    0005.0032.0854   ARPA    FastEthernet0/0/0
Internet   10.1.1.7            -    0005.0032.0000   ARPA    FastEthernet0/0/0
```

- You can issue the **ping** command between the CE routers to ensure that data is being sent:

```
Router# ping 10.1.1.5
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

- You can verify the AToM configuration by using the **show mpls l2transport vc detail** command.

Configuring L2VPN Interworking using the commands associated with the L2VPN Protocol-Based CLIs feature

L2VPN Interworking allows you to connect disparate attachment circuits. Configuring the L2VPN Interworking feature requires that you add the **interworking** command to the list of commands that make up the pseudowire. The steps for configuring the pseudowire for L2VPN Interworking are included in this section. You use the **interworking**command as part of the overall AToM or L2TPv3 configuration. For specific instructions on configuring AToM or L2TPv3, see the following documents:

- Layer 2 Tunnel Protocol Version 3
- Any Transport over MPLS

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **hw-module slot** *slot-number* **np mode feature**
4. **interface pseudowire** *number*
5. **encapsulation** {**mpls** | **l2tpv3**}
6. **interworking** {**ethernet** | **ip**}
7. **neighbor** *peer-address vcid-value*

DETAILED STEPS

	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	**hw-module slot** *slot-number* **np mode feature** **Example:** `Router(config)# hw-module slot 3 np mode feature`	(Optional) Enables L2VPN Interworking functionality on the Cisco 12000 series router. **Note** Enter this command only on a Cisco 12000 series Internet router if you use L2TPv3 for L2VPN Interworking on an ISE (Engine 3) or Engine 5 interface. In this case, you must first enable the L2VPN feature bundle on the line card by entering the **hw-module slot** *slot-number* **np mode feature** command.

	Command or Action	Purpose
Step 4	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 1`	Establishes an interface pseudowire with a value that you specify and enters pseudowire class configuration mode.
Step 5	**encapsulation** {**mpls** | **l2tpv3**} **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation, which is either **mpls** or **l2tpv3**.
Step 6	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it. **Note** On the Cisco 12000 series Internet router, Ethernet (bridged) interworking is not supported for L2TPv3. After you configure the L2TPv3 tunnel encapsulation for the pseudowire using the **encapsulation l2tpv3**command, you cannot enter the **interworking ethernet** command.
Step 7	**neighbor** *peer-address vcid-value* **Example:** `Router(config-pw)#  neighbor 10.0.0.1 123`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.

Verifying the L2VPN Configuration using the commands associated with the L2VPN Protocol-Based CLIs feature

You can verify L2VPN configuration using the following commands:

- You can issue the **show arp** command between the CE routers to ensure that data is being sent:

```
Device# show arp
Protocol   Address       Age (min)   Hardware Addr    Type    Interface
Internet   10.1.1.5           134    0005.0032.0854   ARPA    FastEthernet0/0/0
Internet   10.1.1.7             -    0005.0032.0000   ARPA    FastEthernet0/0/0
```

- You can issue the **ping** command between the CE routers to ensure that data is being sent:

```
Device# ping 10.1.1.5
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

- You can verify the AToM configuration by using the **show l2vpn atom vc detail** command.

Configuring Ethernet VLAN-to-ATM AAL5 Interworking

This section explains the following AToM configurations:

ATM AAL5-to-Ethernet Port

You can configure the ATM AAL5-to-Ethernet Port feature on a PE1 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **pseudowire-class** [*pw-class-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **interface atm** *slot* **/** *subslot* **/** *port* **.** *subinterface number*
10. **pvc** [*name*] *vpi* **/** *vci* **12transport**
11. **encapsulation aal5snap**
12. **xconnect** *ip-address vc-id* **pw-class** *pw-class-name*
13. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.

	Command or Action	Purpose
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configure an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**pseudowire-class** [*pw-class-name*] **Example:** `Router(config-if)# pseudowire-class atm-eth`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface atm** *slot* / *subslot* / *port* **.** *subinterface number* **Example:** `Router(config-pw)# interface atm 2/0/0.1`	Configures an ATM interface and enters interface configuration mode.
Step 10	**pvc** [*name*] *vpi* / *vci* **12transport** **Example:** `Router(config-subif)# pvc 0/200 l2transport`	Assigns a name to an ATM permanent virtual circuit (PVC) and enters ATM virtual circuit configuration mode.
Step 11	**encapsulation aal5snap** **Example:** `Router(config-if-atm-member)# encapsulation aal5snap`	Configures the ATM AAL and encapsulation type for an ATM VC.

	Command or Action	Purpose
Step 12	**xconnect** *ip-address vc-id* **pw-class** *pw-class-name* **Example:** `Router(config-if-atm-member)# xconnect 10.0.0.200 140 pw-class atm-eth`	Binds an AC to a pseudowire and configures an AToM static pseudowire.
Step 13	**end** **Example:** `Router(config-if-xconn)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

ATM AAL5-to-Ethernet Port using the commands associated with the L2VPN Protocol-Based CLIs feature

You can configure the ATM AAL5-to-Ethernet Port feature on a PE1 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **template type pseudowire** [*pw-class-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **interface atm** *slot* / *subslot* / *port* **.** *subinterface number*
10. **pvc** [*name*] *vpi* / *vci* **12transport**
11. **encapsulation aal5snap**
12. **end**
13. **interface pseudowire** *number*
14. **source template type pseudowire** *template-name*
15. **neighbor** *peer-address vcid-value*
16. **exit**
17. **exit**
18. **l2vpn xconnect context** *context-name*
19. **member pseudowire** *interface-number*
20. **member** *ip-address vc-id* **encapsulation mpls**
21. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configure an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**template type pseudowire** [*pw-class-name*] **Example:** `Router(config-if)# template type pseudowire atm-eth`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.

	Command or Action	Purpose
Step 9	**interface atm** *slot* **/** *subslot* **/** *port* **.** *subinterface number* **Example:** `Router(config-pw)# interface atm 2/0/0.1`	Configures an ATM interface and enters interface configuration mode.
Step 10	**pvc** [*name*] *vpi* **/** *vci* **12transport** **Example:** `Router(config-subif)# pvc 0/200 l2transport`	Assigns a name to an ATM permanent virtual circuit (PVC) and enters ATM virtual circuit configuration mode.
Step 11	**encapsulation aal5snap** **Example:** `Router(config-if-atm-member)# encapsulation aal5snap`	Configures the ATM AAL and encapsulation type for an ATM VC.
Step 12	**end** **Example:** `Router(config-if-atm-member)# end`	Exits to privileged EXEC mode.
Step 13	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 14	**source template type pseudowire** *template-name* **Example:** `Router(config-if)# source template type pseudowire atm-eth`	Configures the source template of type pseudowire named atm-eth.
Step 15	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)#  neighbor 10.0.0.200 140`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
Step 16	**exit** **Example:** `Router(config-if)# exit`	Exits to privileged EXEC mode.

	Command or Action	Purpose
Step 17	**exit** **Example:** `Router(config-if)# exit`	Exits to privileged EXEC mode.
Step 18	**l2vpn xconnect context** *context-name* **Example:** `Router(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 19	**member pseudowire** *interface-number* **Example:** `Router(config-xconnect)# member pseudowire 100`	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
Step 20	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.200 140 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.
Step 21	**end** **Example:** `Router(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

ATM AAL5-to-Ethernet Port on a PE2 Router

You can configure the ATM AAL5-to-Ethernet Port feature on a PE2 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **pseudowire-class** [*pw-class-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **interface** *type slot* / *subslot* / *port*
10. **xconnect** *ip-address vc-id* **pw-class** *pw-class-name*
11. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configure an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.

	Command or Action	Purpose
Step 6	**pseudowire-class** [*pw-class-name*] **Example:** `Router(config-if)# pseudowire-class atm-eth`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface** *type slot / subslot / port* **Example:** `Router(config-pw)# interface gigabitethernet 5/1/0`	Configure an interface and enters interface configuration mode.
Step 10	**xconnect** *ip-address vc-id* **pw-class** *pw-class-name* **Example:** `Router(config-if)# xconnect 10.0.0.100 140 pw-class atm-eth`	Binds an AC to a pseudowire and configures an AToM static pseudowire.
Step 11	**end** **Example:** `Router(config-if-xconn)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

What to Do Next

Note When configuring bridged interworking, the PE2 router configuration does not include the **interworking ethernet** command because it is treated as like-to-like, and also because the AC is already an Ethernet port. However, when configuring routed interworking, the **interworking ip** command is required.

ATM AAL5-to-Ethernet Port on a PE2 Router using the commands associated with the L2VPN Protocol-Based CLIs feature

You can configure the ATM AAL5-to-Ethernet Port feature on a PE2 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **template type pseudowire** [*pseudowire-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **interface** *type slot / subslot / port*
10. **end**
11. **interface pseudowire** *number*
12. **source template type pseudowire** *template-name*
13. **neighbor** *peer-address vcid-value*
14. **exit**
15. **l2vpn xconnect context** *context-name*
16. **member pseudowire** *interface-number*
17. **member** *ip-address vc-id* **encapsulation mpls**
18. **end**

DETAILED STEPS

	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.

	Command or Action	Purpose
Step 3	**mpls label protocol ldp** **Example:** `Router(config)# mpls label protocol ldp`	Establishes the label distribution protocol for the platform.
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configure an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**template type pseudowire** [*pseudowire-name*] **Example:** `Router(config)# template type pseudowire atm-eth`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface** *type slot / subslot / port* **Example:** `Router(config-pw)# interface gigabitethernet 5/1/0`	Configure an interface and enters interface configuration mode.
Step 10	**end** **Example:** `Router(config-pw)# end`	Exits to privileged EXEC mode.

	Command or Action	Purpose
Step 11	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 12	**source template type pseudowire** *template-name* **Example:** `Router(config-if)# source template type pseudowire atm-eth`	Configures the source template of type pseudowire named atm-eth
Step 13	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)#  neighbor 10.0.0.100 140`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
Step 14	**exit** **Example:** `Router(config-if)# exit`	Exits to privileged EXEC mode.
Step 15	**l2vpn xconnect context** *context-name* **Example:** `Router(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 16	**member pseudowire** *interface-number* **Example:** `Router(config-xconnect)# member pseudowire 100`	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
Step 17	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.100 140 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.
Step 18	**end** **Example:** `Router(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

What to Do Next

Note When configuring bridged interworking, the PE2 router configuration does not include the **interworking ethernet** command because it is treated as like-to-like, and also because the AC is already an Ethernet port. However, when configuring routed interworking, the **interworking ip** command is required.

ATM AAL5-to-Ethernet VLAN 802.1Q on a PE1 Router

You can configure the ATM AAL5-to-Ethernet VLAN 802.1Q feature on a PE1 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **pseudowire-class** [*pw-class-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **interface atm** *slot* / *subslot* / *port* **.** *subinterface number*
10. **pvc** [*name*] *vpi* / *vci* **12transport**
11. **encapsulation aal5snap**
12. **xconnect** *ip-address vc-id* **pw-class** *pw-class-name*
13. **end**

DETAILED STEPS

	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.

	Command or Action	Purpose
Step 3	**mpls label protocol ldp** **Example:** `Router(config)# mpls label protocol ldp`	Establishes the label distribution protocol for the platform.
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configure an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**pseudowire-class** [*pw-class-name*] **Example:** `Router(config-if)# pseudowire-class atm-eth`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface atm** *slot* / *subslot* / *port* **.** *subinterface number* **Example:** `Router(config-pw)# interface atm 2/0/0.1`	Configure an ATM interface and enters interface configuration mode.
Step 10	**pvc** [*name*] *vpi* / *vci* **12transport** **Example:** `Router(config-subif)# pvc 0/200 l2transport`	Assigns a name to an ATM permanent virtual circuit (PVC) and enters ATM virtual circuit configuration mode.

	Command or Action	Purpose
Step 11	**encapsulation aal5snap** **Example:** `Router(config-if-atm-member)# encapsulation aal5snap`	Configures the ATM AAL and encapsulation type for an ATM VC.
Step 12	**xconnect** *ip-address vc-id* **pw-class** *pw-class-name* **Example:** `Router(config-if-atm-member)# xconnect 10.0.0.200 140 pw-class atm-eth`	Binds an AC to a pseudowire and configures an AToM static pseudowire.
Step 13	**end** **Example:** `Router(config-if-xconn)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

ATM AAL5-to-Ethernet VLAN 802.1Q on a PE1 Router using the commands associated with the L2VPN Protocol-Based CLIs feature

You can configure the ATM AAL5-to-Ethernet VLAN 802.1Q feature on a PE1 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **template type pseudowire** [*pseudowire-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **interface atm** *slot* / *subslot* / *port* **.** *subinterface number*
10. **pvc** [*name*] *vpi* / *vci* **12transport**
11. **encapsulation aal5snap**
12. **end**
13. **interface pseudowire** *number*
14. **source template type pseudowire** *template-name*
15. **neighbor** *peer-address vcid-value*
16. **exit**
17. **l2vpn xconnect context** *context-name*
18. **member pseudowire** *interface-number*
19. **member** *ip-address vc-id* **encapsulation mpls**
20. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.

	Command or Action	Purpose
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configure an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**template type pseudowire** [*pseudowire-name*] **Example:** `Router(config)# template type pseudowire atm-eth`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface atm** *slot* / *subslot* / *port* **.** *subinterface number* **Example:** `Router(config-pw)# interface atm 2/0/0.1`	Configure an ATM interface and enters interface configuration mode.
Step 10	**pvc** [*name*] *vpi* / *vci* **12transport** **Example:** `Router(config-subif)# pvc 0/200 l2transport`	Assigns a name to an ATM permanent virtual circuit (PVC) and enters ATM virtual circuit configuration mode.
Step 11	**encapsulation aal5snap** **Example:** `Router(config-if-atm-member)# encapsulation aal5snap`	Configures the ATM AAL and encapsulation type for an ATM VC.

	Command or Action	Purpose
Step 12	**end** **Example:** `Router(config-if-atm-member)# end`	Exits to privileged EXEC mode.
Step 13	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 14	**source template type pseudowire** *template-name* **Example:** `Router(config-if)# source template type pseudowire atm-eth`	Configures the source template of type pseudowire named atm-eth
Step 15	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)#  neighbor 10.0.0.200 140`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
Step 16	**exit** **Example:** `Router(config-if)# exit`	Exits to privileged EXEC mode.
Step 17	**l2vpn xconnect context** *context-name* **Example:** `Router(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 18	**member pseudowire** *interface-number* **Example:** `Router(config-xconnect)# member pseudowire 100`	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
Step 19	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.200 140 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.

	Command or Action	Purpose
Step 20	**end** **Example:** `Router(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

ATM AAL5-to-Ethernet VLAN 802.1Q on a PE2 router

You can configure the ATM AAL5-to-Ethernet VLAN 802.1Q feature on a PE2 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **pseudowire-class** [*pw-class-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **interface** *type slot* / *subslot* / *port* **.** *subinterface-number*
10. **encapsulation dot1q** *vlan-id*
11. **xconnect** *ip-address vc-id* **pw-class** *pw-class-name*
12. **end**

DETAILED STEPS

	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.

	Command or Action	Purpose
Step 3	**mpls label protocol ldp** **Example:** `Router(config)# mpls label protocol ldp`	Establishes the label distribution protocol for the platform.
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configure an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**pseudowire-class** [*pw-class-name*] **Example:** `Router(config-if)# pseudowire-class atm-eth`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface** *type slot* / *subslot* / *port* **.** *subinterface-number* **Example:** `Router(config-pw)# interface gigabitethernet 5/1/0.3`	Configures an interface and enters interface configuration mode.
Step 10	**encapsulation dot1q** *vlan-id* **Example:** `Router(config-if)# encapsulation dot1q 1525`	Enables IEEE 802.1Q encapsulation of traffic on a specified sub interface in a VLAN.

	Command or Action	Purpose
Step 11	**xconnect** *ip-address vc-id* **pw-class** *pw-class-name* **Example:** `Router(config-if)# xconnect 10.0.0.100 140 pw-class atm-eth`	Binds an AC to a pseudowire and configures an AToM static pseudowire.
Step 12	**end** **Example:** `Router(config-if-xconn)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

What to Do Next

Note In the case of ATM AAl5-to-VLAN, the PE2 router configuration includes the **interworking**command for both bridged and routed interworking.

Note To verify the L2VPN interworking status and check the statistics, refer to the Verifying L2VPN Interworking, on page 114.

ATM AAL5-to-Ethernet VLAN 802.1Q on a PE2 router using the commands associated with the L2VPN Protocol-Based CLIs feature

You can configure the ATM AAL5-to-Ethernet VLAN 802.1Q feature on a PE2 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **template type pseudowire** [*pseudowire-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **interface** *type slot* / *subslot* / *port* . *subinterface-number*
10. **encapsulation dot1q** *vlan-id*
11. **end**
12. **interface pseudowire** *number*
13. **source template type pseudowire** *template-name*
14. **neighbor** *peer-address vcid-value*
15. **exit**
16. **l2vpn xconnect context** *context-name*
17. **member pseudowire** *interface-number*
18. **member** *ip-address vc-id* **encapsulation mpls**
19. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.

	Command or Action	Purpose
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configure an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**template type pseudowire** [*pseudowire-name*] **Example:** `Router(config)# template type pseudowire atm-eth`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface** *type slot / subslot / port . subinterface-number* **Example:** `Router(config-pw)# interface gigabitethernet 5/1/0.3`	Configures an interface and enters interface configuration mode.
Step 10	**encapsulation dot1q** *vlan-id* **Example:** `Router(config-if)# encapsulation dot1q 1525`	Enables IEEE 802.1Q encapsulation of traffic on a specified sub interface in a VLAN.
Step 11	**end** **Example:** `Router(config-if)# end`	Exits to privileged EXEC mode.

	Command or Action	Purpose
Step 12	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 13	**source template type pseudowire** *template-name* **Example:** `Router(config-if)# source template type pseudowire atm-eth`	Configures the source template of type pseudowire named atm-eth
Step 14	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)#  neighbor 10.0.0.100 140`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
Step 15	**exit** **Example:** `Router(config-if)# exit`	Exits to privileged EXEC mode.
Step 16	**l2vpn xconnect context** *context-name* **Example:** `Router(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 17	**member pseudowire** *interface-number* **Example:** `Router(config-xconnect)# member pseudowire 100`	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
Step 18	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.100 140 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.
Step 19	**end** **Example:** `Router(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

What to Do Next

Note In the case of ATM AAl5-to-VLAN, the PE2 router configuration includes the **interworking**command for both bridged and routed interworking.

Note To verify the L2VPN interworking status and check the statistics, refer to the Verifying L2VPN Interworking, on page 114.

Configuring Ethernet VLAN-to-Frame Relay Interworking

This section explains the following AToM configurations and provides examples. The Network Topology for FR-to-Ethernet AToM Bridged Interworking figure above illustrates different AToM configurations.

Frame Relay DLCI-to-Ethernet Port on a PE1 Router

You can configure the Frame Relay DLCI-to-Ethernet Port feature on a PE1 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **pseudowire-class** [*pw-class-name*]
7. **encapsulation mpls**
8. **interworking ethernet**
9. **interface** *type slot / subslot / port*
10. **encapsulation frame-relay**
11. **connect** *connection-name interface dlci* {*interface dlci* | **l2transport**}
12. **xconnect** *ip-address vc-id* **pw-class** *pw-class-name*
13. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Router> enable`	• 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`	Establishes the label distribution protocol for the platform.
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configures an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**pseudowire-class** [*pw-class-name*] **Example:** `Router(config-if)# pseudowire-class fr-eth`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking ethernet** **Example:** `Router(config-pw)# interworking ethernet`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface** *type slot / subslot / port* **Example:** `Router(config-pw)# interface serial 2/0/0`	Configures an interface and enters interface configuration mode.

	Command or Action	Purpose
Step 10	**encapsulation frame-relay** **Example:** `Router(config-if)# encapsulation frame-relay`	Enables Frame Relay encapsulation.
Step 11	**connect** *connection-name interface dlci* {*interface dlci* | **l2transport**} **Example:** `Router(config-if)# connect fr-vlan-1 POS2/3/1 151 l2transport`	Defines the connection between Frame Relay PVCs.
Step 12	**xconnect** *ip-address vc-id* **pw-class** *pw-class-name* **Example:** `Router(config-if)# xconnect 10.0.0.200 151 pw-class pw-class-bridge`	Binds an AC to a pseudowire and configures an AToM static pseudowire.
Step 13	**end** **Example:** `Router(config-if-xconn)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

Frame Relay DLCI-to-Ethernet Port on a PE1 Router using the commands associated with the L2VPN Protocol-Based CLIs feature

You can configure the Frame Relay DLCI-to-Ethernet Port feature on a PE1 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **template type pseudowire** [*pseudowire-name*]
7. **encapsulation mpls**
8. **interworking ethernet**
9. **interface** *type slot* / *subslot* / *port*
10. **encapsulation frame-relay**
11. **connect** *connection-name interface dlci* {*interface dlci* | **l2transport**}
12. **end**
13. **interface pseudowire** *number*
14. **source template type pseudowire** *template-name*
15. **neighbor** *peer-address vcid-value*
16. **exit**
17. **l2vpn xconnect context** *context-name*
18. **member pseudowire** *interface-number*
19. **member** *ip-address vc-id* **encapsulation mpls**
20. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.

	Command or Action	Purpose
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configures an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**template type pseudowire** [*pseudowire-name*] **Example:** `Router(config)# template type pseudowire fr-eth`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking ethernet** **Example:** `Router(config-pw)# interworking ethernet`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface** *type slot / subslot / port* **Example:** `Router(config-pw)# interface serial 2/0/0`	Configures an interface and enters interface configuration mode.
Step 10	**encapsulation frame-relay** **Example:** `Router(config-if)# encapsulation frame-relay`	Enables Frame Relay encapsulation.
Step 11	**connect** *connection-name interface dlci* {*interface dlci* | **l2transport**} **Example:** `Router(config-if)# connect fr-vlan-1 POS2/3/1 151 l2transport`	Defines the connection between Frame Relay PVCs.

	Command or Action	Purpose
Step 12	**end** **Example:** `Router(config-if)# end`	Exits to privileged EXEC mode.
Step 13	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 14	**source template type pseudowire** *template-name* **Example:** `Router(config-if)# source template type pseudowire pwclass-bridge`	Configures the source template of type pseudowire named pwclass-bridge.
Step 15	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)#  neighbor 10.0.0.200 151`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
Step 16	**exit** **Example:** `Router(config-if)# exit`	Exits to privileged EXEC mode.
Step 17	**l2vpn xconnect context** *context-name* **Example:** `Router(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 18	**member pseudowire** *interface-number* **Example:** `Router(config-xconnect)# member pseudowire 100`	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
Step 19	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.200 151 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.

	Command or Action	Purpose
Step 20	**end** **Example:** `Router(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

Frame Relay DLCI-to-Ethernet Port on a PE2 router

You can configure the Frame Relay DLCI-to-Ethernet Port feature on a PE2 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **pseudowire-class** [*pw-class-name*]
7. **encapsulation mpls**
8. **interworking ethernet**
9. **interface** *type slot / subslot / port*
10. **xconnect** *ip-address vc-id* **pw-class** *pw-class-name*
11. **end**

DETAILED STEPS

	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.

	Command or Action	Purpose
Step 3	**mpls label protocol ldp** **Example:** `Router(config)# mpls label protocol ldp`	Establishes the label distribution protocol for the platform.
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configures an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**pseudowire-class** [*pw-class-name*] **Example:** `Router(config-if)# pseudowire-class atm-eth`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking ethernet** **Example:** `Router(config-pw)# interworking ethernet`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface** *type slot / subslot / port* **Example:** `Router(config-pw)# interface gigabitethernet 2/0/0`	Configures an interface and enters interface configuration mode.
Step 10	**xconnect** *ip-address vc-id* **pw-class** *pw-class-name* **Example:** `Router(config-if)# xconnect 10.0.0.200 140 pw-class atm-eth`	Binds an AC to a pseudowire and configures an AToM static pseudowire.

	Command or Action	Purpose
Step 11	**end** **Example:** `Router(config-if-xconn)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

What to Do Next

Note When configuring bridged interworking, the PE2 router configuration does not include the **interworking ethernet**command because it is treated as like-to-like, and also because the AC is already an Ethernet port. However, when configuring routed interworking, the PE2 router configuration does include the **interworking ip** command.

Frame Relay DLCI-to-Ethernet Port on a PE2 router using the commands associated with the L2VPN Protocol-Based CLIs feature

You can configure the Frame Relay DLCI-to-Ethernet Port feature on a PE2 router using the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **template type pseudowire** [*pseudowire-name*]
7. **encapsulation mpls**
8. **interworking ethernet**
9. **interface** *type slot* / *subslot* / *port*
10. **end**
11. **interface pseudowire** *number*
12. **source template type pseudowire** *template-name*
13. **neighbor** *peer-address vcid-value*
14. **exit**
15. **l2vpn xconnect context** *context-name*
16. **member pseudowire** *interface-number*
17. **member** *ip-address vc-id* **encapsulation mpls**
18. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configures an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**template type pseudowire** [*pseudowire-name*] **Example:** `Router(config)# template type pseudowire atm-eth`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking ethernet** **Example:** `Router(config-pw)# interworking ethernet`	Specifies the type of pseudowire and the type of traffic that can flow across it.

	Command or Action	Purpose
Step 9	**interface** *type slot / subslot / port* **Example:** `Router(config-pw)# interface gigabitethernet 2/0/0`	Configures an interface and enters interface configuration mode.
Step 10	**end** **Example:** `Router(config-pw)# end`	Exits to privileged EXEC mode.
Step 11	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 12	**source template type pseudowire** *template-name* **Example:** `Router(config-if)# source template type pseudowire atm-eth`	Configures the source template of type pseudowire named atm-eth
Step 13	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)#  neighbor 10.0.0.200 140`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
Step 14	**exit** **Example:** `Router(config-if)# exit`	Exits to privileged EXEC mode.
Step 15	**l2vpn xconnect context** *context-name* **Example:** `Router(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 16	**member pseudowire** *interface-number* **Example:** `Router(config-xconnect)# member pseudowire 100`	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.

	Command or Action	Purpose
Step 17	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.200 140 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.
Step 18	**end** **Example:** `Router(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

What to Do Next

Note When configuring bridged interworking, the PE2 router configuration does not include the **interworking ethernet**command because it is treated as like-to-like, and also because the AC is already an Ethernet port. However, when configuring routed interworking, the PE2 router configuration does include the **interworking ip** command.

Frame Relay DLCI-to-Ethernet VLAN 802.1Q on a PE1 Router

To configure the Frame Relay DLCI-to-Ethernet VLAN 802.1Q feature on a PE1 router, use the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **pseudowire-class** [*pw-class-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **frame-relay switching**
10. **interface** *type slot / subslot / port*
11. **encapsulation frame-relay**
12. **frame-relay intf-type** [**dce**]
13. **connect** *connection-name interface dlci* {*interface dlci* | **l2transport**}
14. **xconnect** *ip-address vc-id* **pw-class** *pw-class-name*
15. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configures an interface type and enters interface configuration mode.

	Command or Action	Purpose
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**pseudowire-class** [*pw-class-name*] **Example:** `Router(config-if)# pseudowire-class atm-eth`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**frame-relay switching** **Example:** `Router(config-pw)# frame-relay switching`	Enables PVC switching on a Frame Relay DCE device.
Step 10	**interface** *type slot / subslot / port* **Example:** `Router(config-pw)# interface serial 2/0/0`	Configures an interface and enters interface configuration mode.
Step 11	**encapsulation frame-relay** **Example:** `Router(config-if)# encapsulation frame-relay`	Enables Frame Relay encapsulation.
Step 12	**frame-relay intf-type** [**dce**] **Example:** `Router(config-if)# frame-relay intf-type dce`	Configures a Frame Relay switch type.
Step 13	**connect** *connection-name interface dlci* {*interface dlci* | **l2transport**}	Defines the connection between Frame Relay PVCs.

	Command or Action	Purpose
	Example: `Router(config-if)# connect one serial0 16 serial1 100`	
Step 14	**xconnect** *ip-address vc-id* **pw-class** *pw-class-name* **Example:** `Router(config-if)# xconnect 10.0.0.200 140 pw-class atm-eth`	Binds an AC to a pseudowire and configures an AToM static pseudowire.
Step 15	**end** **Example:** `Router(config-if-xconn)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

Frame Relay DLCI-to-Ethernet VLAN 802.1Q on a PE1 Router using the commands associated with the L2VPN Protocol-Based CLIs feature

To configure the Frame Relay DLCI-to-Ethernet VLAN 802.1Q feature on a PE1 router, use the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **template type pseudowire** [*pseudowire-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **frame-relay switching**
10. **interface** *type slot* / *subslot* / *port*
11. **encapsulation frame-relay**
12. **frame-relay intf-type** [**dce**]
13. **connect** *connection-name interface dlci* {*interface dlci* | **l2transport**}
14. **end**
15. **interface pseudowire** *number*
16. **source template type pseudowire** *template-name*
17. **neighbor** *peer-address vcid-value*
18. **exit**
19. **l2vpn xconnect context** *context-name*
20. **member pseudowire** *interface-number*
21. **member** *ip-address vc-id* **encapsulation mpls**
22. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.

	Command or Action	Purpose
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configures an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**template type pseudowire** [*pseudowire-name*] **Example:** `Router(config)# template type pseudowire atm-eth`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**frame-relay switching** **Example:** `Router(config-pw)# frame-relay switching`	Enables PVC switching on a Frame Relay DCE device.
Step 10	**interface** *type slot / subslot / port* **Example:** `Router(config-pw)# interface serial 2/0/0`	Configures an interface and enters interface configuration mode.
Step 11	**encapsulation frame-relay** **Example:** `Router(config-if)# encapsulation frame-relay`	Enables Frame Relay encapsulation.

	Command or Action	Purpose
Step 12	**frame-relay intf-type** [**dce**] **Example:** `Router(config-if)# frame-relay intf-type dce`	Configures a Frame Relay switch type.
Step 13	**connect** *connection-name interface dlci* {*interface dlci* | **l2transport**} **Example:** `Router(config-if)# connect one serial0 16 serial1 100`	Defines the connection between Frame Relay PVCs.
Step 14	**end** **Example:** `Router(config-if)# end`	Exits to privileged EXEC mode.
Step 15	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 16	**source template type pseudowire** *template-name* **Example:** `Router(config-if)# source template type pseudowire atm-eth`	Configures the source template of type pseudowire named atm-eth
Step 17	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)#  neighbor 10.0.0.200 140`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
Step 18	**exit** **Example:** `Router(config-if)# exit`	Exits to privileged EXEC mode.
Step 19	**l2vpn xconnect context** *context-name* **Example:** `Router(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.

	Command or Action	Purpose
Step 20	**member pseudowire** *interface-number* **Example:** `Router(config-xconnect)# member pseudowire 100`	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
Step 21	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.200 140 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.
Step 22	**end** **Example:** `Router(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

Frame Relay DLCI-to-Ethernet VLAN 802.1Q on a PE2 Router

To configure the Frame Relay DLCI-to-Ethernet VLAN 802.1Q feature on a PE2 router, use the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **pseudowire-class** [*pw-class-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **interface** *type slot* **/** *subslot* **/** *port* **.** *subinterface-number*
10. **encapsulation dot1q** *vlan-id*
11. **xconnect** *ip-address vc-id* **pw-class** *pw-class-name*
12. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configures an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**pseudowire-class** [*pw-class-name*] **Example:** `Router(config-if)# pseudowire-class atm-eth`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.

	Command or Action	Purpose
Step 9	**interface** *type slot / subslot / port . subinterface-number* **Example:** `Router(config-pw)# interface gigabitethernet 5/1/0.3`	Configures an interface and enters interface configuration mode.
Step 10	**encapsulation dot1q** *vlan-id* **Example:** `Router(config-if)# encapsulation dot1q 1525`	Enables IEEE 802.1Q encapsulation of traffic on a specified subinterface in a VLAN.
Step 11	**xconnect** *ip-address vc-id* **pw-class** *pw-class-name* **Example:** `Router(config-if)# xconnect 10.0.0.100 140 pw-class atm-eth`	Binds an AC to a pseudowire and configures an AToM static pseudowire.
Step 12	**end** **Example:** `Router(config-if-xconn)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

What to Do Next

Note In the case of an Frame Relay DLCI-to-VLAN, the PE2 router configuration includes the **interworking**command for both bridged and routed interworking.

Note To verify the L2VPN interworking status and check the statistics, refer to the Verifying L2VPN Interworking, on page 114.

Frame Relay DLCI-to-Ethernet VLAN 802.1Q on a PE2 Router using the commands associated with the L2VPN Protocol-Based CLIs feature

To configure the Frame Relay DLCI-to-Ethernet VLAN 802.1Q feature on a PE2 router, use the following steps:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **pseudowire-class** [*pw-class-name*]
7. **encapsulation mpls**
8. **interworking** {**ethernet** | **ip**}
9. **interface** *type slot* / *subslot* / *port* **.** *subinterface-number*
10. **encapsulation dot1q** *vlan-id*
11. **end**
12. **interface pseudowire** *number*
13. **source template type pseudowire** *template-name*
14. **exit**
15. **l2vpn xconnect context** *context-name*
16. **member pseudowire** *interface-number*
17. **member** *ip-address vc-id* **encapsulation mpls**
18. **interworking ip**
19. **end**

DETAILED STEPS

	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`	Establishes the label distribution protocol for the platform.

	Command or Action	Purpose
Step 4	**interface** *type number* **Example:** `Router(config)# interface loopback 100`	Configures an interface type and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.0.0.100 255.255.255.255`	Sets the primary or secondary IP address for an interface.
Step 6	**pseudowire-class** [*pw-class-name*] **Example:** `Router(config-if)# pseudowire-class atm-eth`	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation.
Step 8	**interworking** {**ethernet** | **ip**} **Example:** `Router(config-pw)# interworking ip`	Specifies the type of pseudowire and the type of traffic that can flow across it.
Step 9	**interface** *type slot / subslot / port* **.** *subinterface-number* **Example:** `Router(config-pw)# interface gigabitethernet 5/1/0.3`	Configures an interface and enters interface configuration mode.
Step 10	**encapsulation dot1q** *vlan-id* **Example:** `Router(config-if)# encapsulation dot1q 1525`	Enables IEEE 802.1Q encapsulation of traffic on a specified subinterface in a VLAN.
Step 11	**end** **Example:** `Router(config-if)# end`	Exits to privileged EXEC mode.

	Command or Action	Purpose
Step 12	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 13	**source template type pseudowire** *template-name* **Example:** `Router(config-if)# source template type pseudowire ether-pw`	Configures the source template of type pseudowire named ether-pw.
Step 14	**exit** **Example:** `Router(config-if)# exit`	Exits to privileged EXEC mode.
Step 15	**l2vpn xconnect context** *context-name* **Example:** `Router(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 16	**member pseudowire** *interface-number* **Example:** `Router(config-xconnect)# member pseudowire 100`	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
Step 17	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.100 140 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.
Step 18	**interworking ip** **Example:** `Router(config-xconnect)# interworking ip`	Establishes an L2VPN cross connect context.
Step 19	**end** **Example:** `Router(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

What to Do Next

Note In the case of an Frame Relay DLCI-to-VLAN, the PE2 router configuration includes the **interworking**command for both bridged and routed interworking.

Note To verify the L2VPN interworking status and check the statistics, refer to the Verifying L2VPN Interworking, on page 114.

Configuring HDLC-to-Ethernet Interworking

HDLC-to-Ethernet Bridged Interworking on a HDLC PE Device

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class** [*pw-class-name*]
4. **encapsulation mpls**
5. **interworking ethernet**
6. **interface** *type slot/subslot /port* [**.** *subinterface*]
7. **no ip address** [*ip-address mask*] [**secondary**]
8. **xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*]
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**pseudowire-class** [*pw-class-name*] **Example:** `Device(config)# pseudowire-class pw-iw-ether`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Device(config-pw-class)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 5	**interworking ethernet** **Example:** `Device(config-pw-class)# interworking ethernet`	Specifies Ethernet as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.
Step 6	**interface** *type slot*/*subslot* /*port* [**.** *subinterface*] **Example:** `Device(config-pw-class)# interface serial 3/1/0`	Specifies a serial interface and enters interface configuration mode.
Step 7	**no ip address** [*ip-address mask*] [**secondary**] **Example:** `Device(config-if)# no ip address`	Disables IP processing.
Step 8	**xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*] **Example:** `Device(config-if)# xconnect 198.51.100.2 123 pseudowire-class pw-iw-ether`	Creates the virtual circuit (VC) to transport the Layer 2 packets.
Step 9	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Bridged Interworking on a HDLC PE Device Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **template type pseudowire** *name*
4. **encapsulation mpls**
5. **exit**
6. **interface pseudowire** *number*
7. **source template type pseudowire** *name*
8. **encapsulation mpls**
9. **neighbor** *peer-address vc id-value*
10. **signaling protocol ldp**
11. **no shutdown**
12. **exit**
13. **l2vpn xconnect context** *context-name*
14. **interworking ethernet**
15. **member** *interface-type-number*
16. **member pseudowire** *interface-number*
17. **no shutdown**
18. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**template type pseudowire** *name* **Example:** `Device# template type pseudowire temp5`	Creates a template pseudowire with a name that you specify and enters template configuration mode.

	Command or Action	Purpose
Step 4	**encapsulation mpls** **Example:** `Device(config-template)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 5	**exit** **Example:** `Device(config-template)# exit`	Exits template configuration mode and returns to global configuration mode.
Step 6	**interface pseudowire** *number* **Example:** `Device(config)# interface pseudowire 107`	Establishes an interface pseudowire with a value that you specify and enters interface configuration mode.
Step 7	**source template type pseudowire** *name* **Example:** `Device(config-if)# source template type pseudowire temp5`	Configures the source template of type pseudowire named temp5.
Step 8	**encapsulation mpls** **Example:** `Device(config-if)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 9	**neighbor** *peer-address vc id-value* **Example:** `Device(config-if)# neighbor 10.0.0.11 107`	Specifies the peer IP address and virtual circuit (VC) ID value of an L2VPN pseudowire.
Step 10	**signaling protocol ldp** **Example:** `Device(config-if)# signaling protocol ldp`	Specifies that the Label Distribution Protocol (LDP) is configured for the pseudowire class.
Step 11	**no shutdown** **Example:** `Device(config-if)# no shutdown`	Restarts the interface pseudowire.
Step 12	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 13	**l2vpn xconnect context** *context-name* **Example:** `Device(config)# l2vpn xconnect context con1`	Creates an L2VPN cross-connect context and enters xconnect configuration mode.
Step 14	**interworking ethernet** **Example:** `Device(config-xconnect)# interworking ethernet`	Specifies Ethernet as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.
Step 15	**member** *interface-type-number* **Example:** `Device(config-xconnect)# member serial 0/1/0:0`	Specifies the location of the member interface.
Step 16	**member pseudowire** *interface-number* **Example:** `Device(config-xconnect)# member pseudowire 107`	Specifies a member pseudowire to form an L2VPN cross connect.
Step 17	**no shutdown** **Example:** `Device(config-xconnect)# no shutdown`	Restarts the member interface.
Step 18	**end** **Example:** `Device(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Bridged Interworking (Port Mode) on an Ethernet PE Device

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class** [*pw-class-name*]
4. **encapsulation mpls**
5. **interworking ethernet**
6. **interface** *type slot*/*subslot* /*port* [**.** *subinterface*]
7. **encapsulation mpls**
8. **xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*]
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**pseudowire-class** [*pw-class-name*] **Example:** `Device(config)# pseudowire-class pw-iw-ether`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Device(config-pw-class)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 5	**interworking ethernet** **Example:** `Device(config-pw-class)# interworking ethernet`	Specifies Ethernet as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.
Step 6	**interface** *type slot*/*subslot* /*port* [**.** *subinterface*] **Example:** `Device(config-pw-class)# interface gigabitethernet 4/0/0.1`	Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode. • Ensure that the subinterface on the adjoining Ethernet CE device is on the same VLAN as this Ethernet PE device.
Step 7	**encapsulation mpls** **Example:** `Device(config-subif)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 8	**xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*] **Example:** `Device(config-subif)# xconnect 198.51.100.2 123 pseudowire-class pw-iw-ether`	Creates the virtual circuit (VC) to transport the Layer 2 packets.

	Command or Action	Purpose
Step 9	**end** **Example:** `Device(config-subif)# end`	Exits subinterface configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Bridged Interworking (Port Mode) on an Ethernet PE Device Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot/subslot /port* [**.** *subinterface*]
4. **encapsulation mpls**
5. **no ip address**
6. **no shutdown**
7. **exit**
8. **template type pseudowire** *name*
9. **encapsulation mpls**
10. **exit**
11. **interface pseudowire** *number*
12. **source template type pseudowire** *name*
13. **encapsulation mpls**
14. **neighbor** *peer-address vc id-value*
15. **signaling protocol ldp**
16. **no shutdown**
17. **exit**
18. **l2vpn xconnect context** *context-name*
19. **interworking ethernet**
20. **member** *interface-type-number*
21. **member pseudowire** *interface-number*
22. **no shutdown**
23. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type slot/subslot /port* [**.** *subinterface*] **Example:** `Device(config)# interface fastethernet 4/0/0.1`	Specifies the subinterface and enters subinterface configuration mode. • Ensure that the subinterface on the adjoining Ethernet CE device is on the same VLAN as this Ethernet PE device.
Step 4	**encapsulation mpls** **Example:** `Device(config-subif)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 5	**no ip address** **Example:** `Device(config-subif)# no ip address`	Disables IP processing.
Step 6	**no shutdown** **Example:** `Device(config-subif)# no shutdown`	Restarts the Fast Ethernet subinterface.
Step 7	**exit** **Example:** `Device(config-subif)# exit`	Exits subinterface configuration mode and returns to global configuration mode.
Step 8	**template type pseudowire** *name* **Example:** `Device(config)# template type pseudowire temp4`	Creates a template pseudowire with a name that you specify and enters template configuration mode.
Step 9	**encapsulation mpls** **Example:** `Device(config-template)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.

	Command or Action	Purpose
Step 10	**exit** **Example:** `Device(config-template)# exit`	Exits template configuration mode and returns to global configuration mode.
Step 11	**interface pseudowire** *number* **Example:** `Device(config)# interface pseudowire 109`	Establishes an interface pseudowire with a value that you specify and enters interface configuration mode.
Step 12	**source template type pseudowire** *name* **Example:** `Device(config-if)# source template type pseudowire temp4`	Configures the source template of type pseudowire named temp4.
Step 13	**encapsulation mpls** **Example:** `Device(config-if)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 14	**neighbor** *peer-address vc id-value* **Example:** `Device(config-if)# neighbor 10.0.0.15 109`	Specifies the peer IP address and virtual circuit (VC) ID value of an L2VPN pseudowire.
Step 15	**signaling protocol ldp** **Example:** `Device(config-if)# signaling protocol ldp`	Specifies that the Label Distribution Protocol (LDP) is configured for the pseudowire class.
Step 16	**no shutdown** **Example:** `Device(config-if)# no shutdown`	Restarts the interface pseudowire.
Step 17	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 18	**l2vpn xconnect context** *context-name* **Example:** `Device(config)# l2vpn xconnect context con2`	Creates an L2VPN cross-connect context and enters xconnect configuration mode.
Step 19	**interworking ethernet** **Example:** `Device(config-xconnect)# interworking ethernet`	Specifies Ethernet as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.

	Command or Action	Purpose
Step 20	**member** *interface-type-number* **Example:** `Device(config-xconnect)# member fastethernet 4/0/0.1`	Specifies the location of the member interface.
Step 21	**member pseudowire** *interface-number* **Example:** `Device(config-xconnect)# member pseudowire 109`	Specifies a member pseudowire to form an L2VPN cross connect.
Step 22	**no shutdown** **Example:** `Device(config-xconnect)# no shutdown`	Restarts the member interface.
Step 23	**end** **Example:** `Device(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Bridged Interworking (dot1q and QinQ Modes) on an Ethernet PE Device

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class** [*pw-class-name*]
4. **encapsulation mpls**
5. **interworking ethernet**
6. **interface** *type slot*/*subslot* /*port* [**.** *subinterface*]
7. **encapsulation dot1q** *vlan-id***second dot1q** *vlan-id*
8. **xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*]
9. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**pseudowire-class** [*pw-class-name*] **Example:** `Device(config)# pseudowire-class pw-iw-ether`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Device(config-pw-class)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 5	**interworking ethernet** **Example:** `Device(config-pw-class)# interworking ethernet`	Specifies Ethernet as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.
Step 6	**interface** *type slot*/*subslot* /*port* [**.** *subinterface*] **Example:** `Device(config-pw-class)# interface gigabitethernet 4/0/0.1`	Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode. • Ensure that the subinterface on the adjoining Ethernet CE device is on the same VLAN as this Ethernet PE device.
Step 7	**encapsulation dot1q** *vlan-id***second dot1q** *vlan-id* **Example:** `Device(config-subif)# encapsulation dot1q 100 second dot1q 200`	Defines the matching criteria to map QinQ ingress frames on an interface to the appropriate service instance.
Step 8	**xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*] **Example:** `Device(config-subif)# xconnect 198.51.100.2 123 pseudowire-class pw-iw-ether`	Creates the virtual circuit (VC) to transport the Layer 2 packets.
Step 9	**end** **Example:** `Device(config-subif)# end`	Exits subinterface configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Bridged Interworking (dot1q and QinQ Modes) on an Ethernet PE Device Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot/subslot /port* [**.** *subinterface*]
4. **encapsulation dot1q** *vlan-id* **second dot1q** *vlan-id*
5. **no ip address**
6. **no shutdown**
7. **exit**
8. **template type pseudowire** *name*
9. **encapsulation mpls**
10. **exit**
11. **interface pseudowire** *number*
12. **source template type pseudowire** *name*
13. **encapsulation mpls**
14. **neighbor** *peer-address vc id-value*
15. **signaling protocol ldp**
16. **no shutdown**
17. **exit**
18. **l2vpn xconnect context** *context-name*
19. **interworking ethernet**
20. **member** *interface-type-number*
21. **member pseudowire** *interface-number*
22. **no shutdown**
23. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**interface** *type slot/subslot /port* [**.** *subinterface*] **Example:** `Device(config)# interface fastethernet 4/0/0.1`	Specifies the subinterface and enters subinterface configuration mode. • Ensure that the subinterface on the adjoining Ethernet CE device is on the same VLAN as this Ethernet PE device.
Step 4	**encapsulation dot1q** *vlan-id* **second dot1q** *vlan-id* **Example:** `Device(config-subif)# encapsulation dot1q 100 second dot1q 200`	Defines the matching criteria to map QinQ ingress frames on an interface to the appropriate service instance.
Step 5	**no ip address** **Example:** `Device(config-subif)# no ip address`	Disables IP processing.
Step 6	**no shutdown** **Example:** `Device(config-subif)# no shutdown`	Restarts the Fast Ethernet subinterface.
Step 7	**exit** **Example:** `Device(config-subif)# exit`	Exits subinterface configuration mode and returns to global configuration mode.
Step 8	**template type pseudowire** *name* **Example:** `Device(config)# template type pseudowire temp4`	Creates a template pseudowire with a name that you specify and enters template configuration mode.
Step 9	**encapsulation mpls** **Example:** `Device(config-template)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 10	**exit** **Example:** `Device(config-template)# exit`	Exits template configuration mode and returns to global configuration mode.
Step 11	**interface pseudowire** *number* **Example:** `Device(config)# interface pseudowire 109`	Establishes an interface pseudowire with a value that you specify and enters interface configuration mode.

	Command or Action	Purpose
Step 12	**source template type pseudowire** *name* **Example:** `Device(config-if)# source template type pseudowire temp4`	Configures the source template of type pseudowire named temp4.
Step 13	**encapsulation mpls** **Example:** `Device(config-if)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 14	**neighbor** *peer-address vc id-value* **Example:** `Device(config-if)# neighbor 10.0.0.15 109`	Specifies the peer IP address and virtual circuit (VC) ID value of an L2VPN pseudowire.
Step 15	**signaling protocol ldp** **Example:** `Device(config-if)# signaling protocol ldp`	Specifies that the Label Distribution Protocol (LDP) is configured for the pseudowire class.
Step 16	**no shutdown** **Example:** `Device(config-if)# no shutdown`	Restarts the interface pseudowire.
Step 17	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 18	**l2vpn xconnect context** *context-name* **Example:** `Device(config)# l2vpn xconnect context con2`	Creates an L2VPN cross-connect context and enters xconnect configuration mode.
Step 19	**interworking ethernet** **Example:** `Device(config-xconnect)# interworking ethernet`	Specifies Ethernet as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.
Step 20	**member** *interface-type-number* **Example:** `Device(config-xconnect)# member fastethernet 4/0/0.1`	Specifies the location of the member interface.
Step 21	**member pseudowire** *interface-number* **Example:** `Device(config-xconnect)# member pseudowire 109`	Specifies a member pseudowire to form an L2VPN cross connect.

	Command or Action	Purpose
Step 22	**no shutdown** **Example:** `Device(config-xconnect)# no shutdown`	Restarts the member interface.
Step 23	**end** **Example:** `Device(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Routed Interworking on a HDLC PE Device

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class** [*pw-class-name*]
4. **encapsulation mpls**
5. **interworking ip**
6. **interface** *type slot/subslot /port* [**.** *subinterface*]
7. **no ip address** [*ip-address mask*] [**secondary**]
8. **xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*]
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**pseudowire-class** [*pw-class-name*] **Example:** `Device(config)# pseudowire-class pw-iw-ip`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Device(config-pw-class)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 5	**interworking ip** **Example:** `Device(config-pw-class)# interworking ip`	Specifies IP as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.
Step 6	**interface** *type slot*/*subslot* /*port* [**.** *subinterface*] **Example:** `Device(config-pw-class)# interface serial 3/1/0`	Specifies a serial interface and enters interface configuration mode.
Step 7	**no ip address** [*ip-address mask*] [**secondary**] **Example:** `Device(config-if)# no ip address`	Disables IP processing.
Step 8	**xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*] **Example:** `Device(config-if)# xconnect 198.51.100.2 123 pseudowire-class pw-iw-ip`	Creates the virtual circuit (VC) to transport the Layer 2 packets.
Step 9	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Routed Interworking on a HDLC PE Device Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **template type pseudowire** *name*
4. **encapsulation mpls**
5. **exit**
6. **interface pseudowire** *number*
7. **source template type pseudowire** *name*
8. **encapsulation mpls**
9. **neighbor** *peer-address vc id-value*
10. **signaling protocol ldp**
11. **no shutdown**
12. **exit**
13. **l2vpn xconnect context** *context-name*
14. **interworking ip**
15. **member** *interface-type-number*
16. **member pseudowire** *interface-number*
17. **no shutdown**
18. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**template type pseudowire** *name* **Example:** `Device# template type pseudowire temp5`	Creates a template pseudowire with a name that you specify and enters template configuration mode.

	Command or Action	Purpose
Step 4	**encapsulation mpls** **Example:** `Device(config-template)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 5	**exit** **Example:** `Device(config-template)# exit`	Exits template configuration mode and returns to global configuration mode.
Step 6	**interface pseudowire** *number* **Example:** `Device(config)# interface pseudowire 107`	Establishes an interface pseudowire with a value that you specify and enters interface configuration mode.
Step 7	**source template type pseudowire** *name* **Example:** `Device(config-if)# source template type pseudowire temp5`	Configures the source template of type pseudowire named temp5.
Step 8	**encapsulation mpls** **Example:** `Device(config-if)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 9	**neighbor** *peer-address vc id-value* **Example:** `Device(config-if)# neighbor 10.0.0.11 107`	Specifies the peer IP address and virtual circuit (VC) ID value of an L2VPN pseudowire.
Step 10	**signaling protocol ldp** **Example:** `Device(config-if)# signaling protocol ldp`	Specifies that the Label Distribution Protocol (LDP) is configured for the pseudowire class.
Step 11	**no shutdown** **Example:** `Device(config-if)# no shutdown`	Restarts the interface pseudowire.
Step 12	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 13	**l2vpn xconnect context** *context-name* **Example:** `Device(config)# l2vpn xconnect context con1`	Creates an L2VPN cross-connect context and enters xconnect configuration mode.
Step 14	**interworking ip** **Example:** `Device(config-xconnect)# interworking ip`	Specifies IP as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.
Step 15	**member** *interface-type-number* **Example:** `Device(config-xconnect)# member serial 0/1/0:0`	Specifies the location of the member interface.
Step 16	**member pseudowire** *interface-number* **Example:** `Device(config-xconnect)# member pseudowire 107`	Specifies a member pseudowire to form an L2VPN cross connect.
Step 17	**no shutdown** **Example:** `Device(config-xconnect)# no shutdown`	Restarts the member interface.
Step 18	**end** **Example:** `Device(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Routed Interworking (Port Mode) on an Ethernet PE Device

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class** [*pw-class-name*]
4. **encapsulation mpls**
5. **interworking ip**
6. **interface** *type slot*/*subslot* /*port* [**.** *subinterface*]
7. **encapsulation mpls**
8. **xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*]
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**pseudowire-class** [*pw-class-name*] **Example:** `Device(config)# pseudowire-class pw-iw-ip`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Device(config-pw-class)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 5	**interworking ip** **Example:** `Device(config-pw-class)# interworking ip`	Specifies IP as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.
Step 6	**interface** *type slot/subslot /port* [**.** *subinterface*] **Example:** `Device(config-pw-class)# interface gigabitethernet 4/0/0.1`	Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode. • Ensure that the subinterface on the adjoining Ethernet CE device is on the same VLAN as this Ethernet PE device.
Step 7	**encapsulation mpls** **Example:** `Device(config-subif)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 8	**xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*] **Example:** `Device(config-subif)# xconnect 198.51.100.2 123 pseudowire-class pw-iw-ip`	Creates the virtual circuit (VC) to transport the Layer 2 packets.

	Command or Action	Purpose
Step 9	**end** **Example:** `Device(config-subif)# end`	Exits subinterface configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Routed Interworking (Port Mode) on an Ethernet PE Device Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot/subslot /port* [**.** *subinterface*]
4. **encapsulation mpls**
5. **no ip address**
6. **no shutdown**
7. **exit**
8. **template type pseudowire** *name*
9. **encapsulation mpls**
10. **exit**
11. **interface pseudowire** *number*
12. **source template type pseudowire** *name*
13. **encapsulation mpls**
14. **neighbor** *peer-address vc id-value*
15. **signaling protocol ldp**
16. **no shutdown**
17. **exit**
18. **l2vpn xconnect context** *context-name*
19. **interworking ip**
20. **member** *interface-type-number*
21. **member pseudowire** *interface-number*
22. **no shutdown**
23. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type slot/subslot /port* [**.** *subinterface*] **Example:** `Device(config)# interface fastethernet 4/0/0.1`	Specifies the Fast Ethernet subinterface and enters subinterface configuration mode. • Ensure that the subinterface on the adjoining Ethernet CE device is on the same VLAN as this Ethernet PE device.
Step 4	**encapsulation mpls** **Example:** `Device(config-subif)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 5	**no ip address** **Example:** `Device(config-subif)# no ip address`	Disables IP processing.
Step 6	**no shutdown** **Example:** `Device(config-subif)# no shutdown`	Restarts the Fast Ethernet subinterface.
Step 7	**exit** **Example:** `Device(config-subif)# exit`	Exits subinterface configuration mode and returns to global configuration mode.
Step 8	**template type pseudowire** *name* **Example:** `Device(config)# template type pseudowire temp4`	Creates a template pseudowire with a name that you specify and enters template configuration mode.
Step 9	**encapsulation mpls** **Example:** `Device(config-template)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.

	Command or Action	Purpose
Step 10	**exit** **Example:** `Device(config-template)# exit`	Exits template configuration mode and returns to global configuration mode.
Step 11	**interface pseudowire** *number* **Example:** `Device(config)# interface pseudowire 109`	Establishes an interface pseudowire with a value that you specify and enters interface configuration mode.
Step 12	**source template type pseudowire** *name* **Example:** `Device(config-if)# source template type pseudowire temp4`	Configures the source template of type pseudowire named temp4.
Step 13	**encapsulation mpls** **Example:** `Device(config-if)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 14	**neighbor** *peer-address vc id-value* **Example:** `Device(config-if)# neighbor 10.0.0.15 109`	Specifies the peer IP address and virtual circuit (VC) ID value of an L2VPN pseudowire.
Step 15	**signaling protocol ldp** **Example:** `Device(config-if)# signaling protocol ldp`	Specifies that the Label Distribution Protocol (LDP) is configured for the pseudowire class.
Step 16	**no shutdown** **Example:** `Device(config-if)# no shutdown`	Restarts the interface pseudowire.
Step 17	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 18	**l2vpn xconnect context** *context-name* **Example:** `Device(config)# l2vpn xconnect context con2`	Creates an L2VPN cross-connect context and enters xconnect configuration mode.
Step 19	**interworking ip** **Example:** `Device(config-xconnect)# interworking ip`	Specifies IP as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.

	Command or Action	Purpose
Step 20	**member** *interface-type-number* **Example:** `Device(config-xconnect)# member fastethernet 4/0/0.1`	Specifies the location of the member interface.
Step 21	**member pseudowire** *interface-number* **Example:** `Device(config-xconnect)# member pseudowire 109`	Specifies a member pseudowire to form an L2VPN cross connect.
Step 22	**no shutdown** **Example:** `Device(config-xconnect)# no shutdown`	Restarts the member interface.
Step 23	**end** **Example:** `Device(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Routed Interworking (dot1q and QinQ Modes) on an Ethernet PE Device

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class** [*pw-class-name*]
4. **encapsulation mpls**
5. **interworking ip**
6. **interface** *type slot/subslot /port* [**.** *subinterface*]
7. **encapsulation dot1q** *vlan-id* **second dot1q** *vlan-id*
8. **xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*]
9. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**pseudowire-class** [*pw-class-name*] **Example:** `Device(config)# pseudowire-class pw-iw-ip`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Device(config-pw-class)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 5	**interworking ip** **Example:** `Device(config-pw-class)# interworking ip`	Specifies IP as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.
Step 6	**interface** *type slot/subslot /port* [**.** *subinterface*] **Example:** `Device(config-pw-class)# interface gigabitethernet 4/0/0.1`	Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode. • Ensure that the subinterface on the adjoining Ethernet CE device is on the same VLAN as this Ethernet PE device.
Step 7	**encapsulation dot1q** *vlan-id* **second dot1q** *vlan-id* **Example:** `Device(config-subif)# encapsulation dot1q 100 second dot1q 200`	Defines the matching criteria to map QinQ ingress frames on an interface to the appropriate service instance.
Step 8	**xconnect** *peer-router-id vc id* **pseudowire-class** [*pw-class-name*] **Example:** `Device(config-subif)# xconnect 198.51.100.2 123 pseudowire-class pw-iw-ip`	Creates the virtual circuit (VC) to transport the Layer 2 packets.
Step 9	**end** **Example:** `Device(config-subif)# end`	Exits subinterface configuration mode and returns to privileged EXEC mode.

HDLC-to-Ethernet Routed Interworking (dot1q and QinQ Modes) on an Ethernet PE Device Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot/subslot /port* [**.** *subinterface*]
4. **encapsulation dot1q** *vlan-id* **second dot1q** *vlan-id*
5. **no ip address**
6. **no shutdown**
7. **exit**
8. **template type pseudowire** *name*
9. **encapsulation mpls**
10. **exit**
11. **interface pseudowire** *number*
12. **source template type pseudowire** *name*
13. **encapsulation mpls**
14. **neighbor** *peer-address vc id-value*
15. **signaling protocol ldp**
16. **no shutdown**
17. **exit**
18. **l2vpn xconnect context** *context-name*
19. **interworking ip**
20. **member** *interface-type-number*
21. **member pseudowire** *interface-number*
22. **no shutdown**
23. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**interface** *type slot/subslot /port* [**.** *subinterface*] **Example:** `Device(config)# interface fastethernet 4/0/0.1`	Specifies the subinterface and enters subinterface configuration mode. • Ensure that the subinterface on the adjoining Ethernet CE device is on the same VLAN as this Ethernet PE device.
Step 4	**encapsulation dot1q** *vlan-id* **second dot1q** *vlan-id* **Example:** `Device(config-subif)# encapsulation dot1q 100 second dot1q 200`	Defines the matching criteria to map QinQ ingress frames on an interface to the appropriate service instance.
Step 5	**no ip address** **Example:** `Device(config-subif)# no ip address`	Disables IP processing.
Step 6	**no shutdown** **Example:** `Device(config-subif)# no shutdown`	Restarts the Fast Ethernet subinterface.
Step 7	**exit** **Example:** `Device(config-subif)# exit`	Exits subinterface configuration mode and returns to global configuration mode.
Step 8	**template type pseudowire** *name* **Example:** `Device(config)# template type pseudowire temp4`	Creates a template pseudowire with a name that you specify and enters template configuration mode.
Step 9	**encapsulation mpls** **Example:** `Device(config-template)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 10	**exit** **Example:** `Device(config-template)# exit`	Exits template configuration mode and returns to global configuration mode.
Step 11	**interface pseudowire** *number* **Example:** `Device(config)# interface pseudowire 109`	Establishes an interface pseudowire with a value that you specify and enters interface configuration mode.

	Command or Action	Purpose
Step 12	**source template type pseudowire** *name* **Example:** `Device(config-if)# source template type pseudowire temp4`	Configures the source template of type pseudowire named temp4.
Step 13	**encapsulation mpls** **Example:** `Device(config-if)# encapsulation mpls`	Specifies the tunneling encapsulation as MPLS.
Step 14	**neighbor** *peer-address vc id-value* **Example:** `Device(config-if)# neighbor 10.0.0.15 109`	Specifies the peer IP address and virtual circuit (VC) ID value of an L2VPN pseudowire.
Step 15	**signaling protocol ldp** **Example:** `Device(config-if)# signaling protocol ldp`	Specifies that the Label Distribution Protocol (LDP) is configured for the pseudowire class.
Step 16	**no shutdown** **Example:** `Device(config-if)# no shutdown`	Restarts the interface pseudowire.
Step 17	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 18	**l2vpn xconnect context** *context-name* **Example:** `Device(config)# l2vpn xconnect context con2`	Creates an L2VPN cross-connect context and enters xconnect configuration mode.
Step 19	**interworking ip** **Example:** `Device(config-xconnect)# interworking ip`	Specifies IP as the type of pseudowire as well as the type of traffic that can flow across the pseudowire.
Step 20	**member** *interface-type-number* **Example:** `Device(config-xconnect)# member fastethernet 4/0/0.1`	Specifies the location of the member interface.
Step 21	**member pseudowire** *interface-number* **Example:** `Device(config-xconnect)# member pseudowire 109`	Specifies a member pseudowire to form an L2VPN cross connect.

	Command or Action	Purpose
Step 22	**no shutdown** **Example:** `Device(config-xconnect)# no shutdown`	Restarts the member interface.
Step 23	**end** **Example:** `Device(config-xconnect)# end`	Exits xconnect configuration mode and returns to privileged EXEC mode.

Verifying HDLC-to-Ethernet Interworking (Port Mode) Configuration on a HDLC PE Device

You can use **show** commands to view information about a HDLC-to-Ethernet interworking (port mode) configuration on a HDLC provider edge (PE) device.

SUMMARY STEPS

1. **show mpls l2transport vc**
2. **show mpls l2transport vc detail**
3. **show l2vpn atom vc**
4. **show l2vpn atom vc detail**

DETAILED STEPS

Step 1 **show mpls l2transport vc**

The following is sample output from the **show mpls l2transport vc** command which displays basic information about HDLC-to-Ethernet interworking (port mode) configuration on a HDLC PE device:

Example:

```
Device# show mpls l2transport vc

Local intf  Local circuit  Dest address    VC ID      Status
----------- -------------- --------------- ---------- ----------
Se0/1/0:0   HDLC           10.0.0.1        101        UP
```

Step 2 **show mpls l2transport vc detail**

The following is sample output from the **show mpls l2transport vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (port mode) configuration on a HDLC PE device:

Example:

```
Device# show mpls l2transport vc detail

Local interface: Se0/1/0:0 up, line protocol up, HDLC up
Interworking type is Ethernet
Destination address: 10.0.0.1, VC ID: 101, VC status: up
```

```
Output interface: Fa0/0/1, imposed label stack {20 22}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.10
Create time: 00:00:19, last status change time: 00:00:15
Last label FSM state change time: 00:00:15
Signaling protocol: LDP, peer 10.0.0.1:0 up
Targeted Hello: 203.0.113.1(LDP Id) -> 10.0.0.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Last local dataplane status rcvd: No fault
Last BFD dataplane status rcvd: Not sent
Last BFD peer monitor status rcvd: No fault
Last local AC circuit status rcvd: No fault
Last local AC circuit status sent: No fault
Last local PW i/f circ status rcvd: No fault
Last local LDP TLV status sent: No fault
Last remote LDP TLV status rcvd: No fault
Last remote LDP ADJ status rcvd: No fault
MPLS VC labels: local 33, remote 22
Group ID: local 0, remote 0
MTU: local 1500, remote 1500
Remote interface description: Connect to CE2
Sequencing: receive disabled, send disabled
Control Word: On
SSO Descriptor: 10.0.0.1/101, local label: 33
Dataplane:
SSM segment/switch IDs: 4274/4273 (used), PWID: 26
VC statistics:
transit packet totals: receive 3, send 6
transit byte totals: receive 162, send 366
transit packet drops: receive 0, seq error 0, send 0
```

Step 3 **show l2vpn atom vc**

The following is sample output from the **show l2vpn atom vc** command which displays basic information about HDLC-to-Ethernet interworking (port mode) configuration on a HDLC PE device:

Example:

```
Device# show l2vpn atom vc

                            Service
Interface Peer ID    VC ID  Type   Name  Status
--------- ---------- ------ ------ ----- ----------
pw101     10.0.0.1   101    p2p    101   UP
```

Step 4 **show l2vpn atom vc detail**

The following is sample output from the **show l2vpn atom vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (port mode) configuration on a HDLC PE device:

Example:

```
Device# show l2vpn atom vc detail

pseudowire101 is up, VC status is up PW type: Ethernet
Create time: 00:00:18, last status change time: 00:00:14
Last label FSM state change time: 00:00:14
Destination address: 10.0.0.1 VC ID: 101
Output interface: Fa0/0/1, imposed label stack {16 17}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.10
Member of xconnect service hdlc101
Associated member Se0/1/0:0 is up, status is up
Interworking type is Ethernet
```

```
Service id: 0xde000002
Signaling protocol: LDP, peer 10.0.0.1:0 up
Targeted Hello: 203.0.113.1(LDP Id) -> 10.0.0.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
PWid FEC (128), VC ID: 101
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Local dataplane status received : No fault
BFD dataplane status received : Not sent
BFD peer monitor status received : No fault
Status received from access circuit : No fault
Status sent to access circuit : No fault
Status received from pseudowire i/f : No fault
Status sent to network peer : No fault
Status received from network peer : No fault
Adjacency status of remote peer : No fault
Sequencing: receive disabled, send disabled
Bindings
Parameter    Local                          Remote
------------ ------------------------------ ------------------------------
Label        18                             17
Group ID     0                              0
Interface    Connect to CE1                 Connect to CE2
MTU          1500                           1500
Control word on (configured: autosense)     on
PW type      Ethernet                       Ethernet
VCCV CV type 0x02                           0x02
             LSPV [2]                       LSPV [2]
VCCV CC type 0x07                           0x07
             CW [1], RA [2], TTL [3]        CW [1], RA [2], TTL [3]
Status TLV   enabled                        supported
SSO Descriptor: 10.0.0.1/101, local label: 18
Dataplane:
SSM segment/switch IDs: 4106/4105 (used), PWID: 2
Rx Counters
3 input transit packets, 162 bytes
0 drops, 0 seq err
Tx Counters
5 output transit packets, 305 bytes
0 drops
```

Verifying HDLC-to-Ethernet Interworking (Port Mode) Configuration on an Ethernet PE Device

You can use **show** commands to view information about a HDLC-to-Ethernet interworking (port mode) configuration on an Ethernet PE device.

SUMMARY STEPS

1. **show mpls l2transport vc**
2. **show l2vpn atom vc**
3. **show l2vpn atom vc detail**

DETAILED STEPS

Step 1 **show mpls l2transport vc**

The following is sample output from the **show mpls l2transport vc** command which displays basic information about HDLC-to-Ethernet interworking (port mode) configuration on an Ethernet PE device:

Example:

```
Device# show mpls l2transport vc

Local interface: Gi1/0/0 up, line protocol up, Ethernet up
Destination address: 203.0.113.1, VC ID: 101, VC status: up
Output interface: Fa0/0/1, imposed label stack {19 33}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.11
Create time: 00:00:22, last status change time: 00:00:19
Last label FSM state change time: 00:00:19
Signaling protocol: LDP, peer 203.0.113.1:0 up
Targeted Hello: 10.0.0.1(LDP Id) -> 203.0.113.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Last local dataplane status rcvd: No fault
Last BFD dataplane status rcvd: Not sent
Last BFD peer monitor status rcvd: No fault
Last local AC circuit status rcvd: No fault
Last local AC circuit status sent: No fault
Last local PW i/f circ status rcvd: No fault
Last local LDP TLV status sent: No fault
Last remote LDP TLV status rcvd: No fault
Last remote LDP ADJ status rcvd: No fault
MPLS VC labels: local 22, remote 33
Group ID: local 0, remote 0
MTU: local 1500, remote 1500
Remote interface description: Connect to CE1
Sequencing: receive disabled, send disabled
Control Word: On
SSO Descriptor: 203.0.113.1/101, local label: 22
Dataplane:
SSM segment/switch IDs: 4574/4573 (used), PWID: 80
VC statistics:
transit packet totals: receive 9, send 5
transit byte totals: receive 315, send 380
transit packet drops: receive 0, seq error 0, send 0
```

Step 2 **show l2vpn atom vc**

The following is sample output from the **show l2vpn atom vc** command which displays basic information about HDLC-to-Ethernet interworking (port mode) configuration on an Ethernet PE device:

Example:

```
Device# show l2vpn atom vc

                            Service
Interface Peer ID    VC ID  Type   Name  Status
--------- ---------- ------ ------ ----- ----------
pw101     10.0.0.1   101    p2p    101   UP
```

Step 3 **show l2vpn atom vc detail**

The following is sample output from the **show l2vpn atom vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (port mode) configuration on an Ethernet PE device:

Example:

```
Device# show l2vpn atom vc detail

pseudowire101 is up, VC status is up PW type: Ethernet
```

```
Create time: 00:00:18, last status change time: 00:00:14
Last label FSM state change time: 00:00:14
Destination address: 10.0.0.1 VC ID: 101
Output interface: Fa0/0/1, imposed label stack {16 17}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.10
Member of xconnect service eth101
Associated member Se0/1/0:0 is up, status is up
Interworking type is Ethernet
Service id: 0xde000002
Signaling protocol: LDP, peer 10.0.0.1:0 up
Targeted Hello: 203.0.113.1(LDP Id) -> 10.0.0.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
PWid FEC (128), VC ID: 101
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Local dataplane status received : No fault
BFD dataplane status received : Not sent
BFD peer monitor status received : No fault
Status received from access circuit : No fault
Status sent to access circuit : No fault
Status received from pseudowire i/f : No fault
Status sent to network peer : No fault
Status received from network peer : No fault
Adjacency status of remote peer : No fault
Sequencing: receive disabled, send disabled
Bindings
Parameter    Local                          Remote
------------ ------------------------------ ------------------------------
Label        18                             17
Group ID     0                              0
Interface    Connect to CE1                 Connect to CE2
MTU          1500                           1500
Control word on (configured: autosense)     on
PW type      Ethernet                       Ethernet
VCCV CV type 0x02                           0x02
             LSPV [2]                       LSPV [2]
VCCV CC type 0x07                           0x07
             CW [1], RA [2], TTL [3]        CW [1], RA [2], TTL [3]
Status TLV   enabled                        supported
SSO Descriptor: 10.0.0.1/101, local label: 18
Dataplane:
SSM segment/switch IDs: 4106/4105 (used), PWID: 2
Rx Counters
3 input transit packets, 162 bytes
0 drops, 0 seq err
Tx Counters
5 output transit packets, 305 bytes
0 drops
```

Verifying HDLC-to-Ethernet Interworking (dot1q Mode) Configuration on a HDLC PE Device

You can use **show** commands to view information about a HDLC-to-Ethernet interworking (dot1q mode) configuration on a HDLC PE device.

SUMMARY STEPS

1. **show mpls l2transport vc**
2. **show mpls l2transport vc detail**
3. **show l2vpn atom vc**
4. **show l2vpn atom vc detail**

DETAILED STEPS

Step 1 **show mpls l2transport vc**

The following is sample output from the **show mpls l2transport vc** command which displays basic information about HDLC-to-Ethernet interworking (dot1q mode) configuration on a HDLC PE device:

Example:

```
Device# show mpls l2transport vc

Local intf  Local circuit  Dest address    VC ID      Status
----------- -------------- --------------- ---------- ----------
Se0/1/0:0   HDLC           10.0.0.1        101        UP
```

Step 2 **show mpls l2transport vc detail**

The following is sample output from the **show mpls l2transport vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (dot1q mode) configuration on a HDLC PE device:

Example:

```
Device# show mpls l2transport vc detail

Local interface: Se0/1/0:0 up, line protocol up, HDLC up
Interworking type is Ethernet
Destination address: 10.0.0.1, VC ID: 101, VC status: up
Output interface: Fa0/0/1, imposed label stack {20 22}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.10
Create time: 00:00:19, last status change time: 00:00:15
Last label FSM state change time: 00:00:15
Signaling protocol: LDP, peer 10.0.0.1:0 up
Targeted Hello: 203.0.113.1(LDP Id) -> 10.0.0.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Last local dataplane status rcvd: No fault
Last BFD dataplane status rcvd: Not sent
Last BFD peer monitor status rcvd: No fault
Last local AC circuit status rcvd: No fault
Last local AC circuit status sent: No fault
Last local PW i/f circ status rcvd: No fault
Last local LDP TLV status sent: No fault
Last remote LDP TLV status rcvd: No fault
Last remote LDP ADJ status rcvd: No fault
MPLS VC labels: local 33, remote 22
Group ID: local 0, remote 0
MTU: local 1500, remote 1500
Remote interface description: Connect to CE2
Sequencing: receive disabled, send disabled
Control Word: On
SSO Descriptor: 10.0.0.1/101, local label: 33
Dataplane:
```

```
SSM segment/switch IDs: 4274/4273 (used), PWID: 26
VC statistics:
transit packet totals: receive 3, send 6
transit byte totals: receive 162, send 366
transit packet drops: receive 0, seq error 0, send 0
```

Step 3 **show l2vpn atom vc**

The following is sample output from the **show l2vpn atom vc** command which displays basic information about HDLC-to-Ethernet interworking (dot1q mode) configuration on a HDLC PE device:

Example:

```
Device# show l2vpn atom vc

                            Service
Interface Peer ID    VC ID  Type   Name  Status
--------- ---------- ------ ------ ----- ----------
pw101     10.0.0.1  101    p2p    101   UP
```

Step 4 **show l2vpn atom vc detail**

The following is sample output from the **show l2vpn atom vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (dot1q mode) configuration on a HDLC PE device:

Example:

```
Device# show l2vpn atom vc detail

pseudowire101 is up, VC status is up PW type: Ethernet
Create time: 00:00:18, last status change time: 00:00:14
Last label FSM state change time: 00:00:14
Destination address: 10.0.0.1 VC ID: 101
Output interface: Fa0/0/1, imposed label stack {16 17}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.10
Member of xconnect service hdlc101
Associated member Se0/1/0:0 is up, status is up
Interworking type is Ethernet
Service id: 0xde000002
Signaling protocol: LDP, peer 10.0.0.1:0 up
Targeted Hello: 203.0.113.1(LDP Id) -> 10.0.0.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
PWid FEC (128), VC ID: 101
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Local dataplane status received : No fault
BFD dataplane status received : Not sent
BFD peer monitor status received : No fault
Status received from access circuit : No fault
Status sent to access circuit : No fault
Status received from pseudowire i/f : No fault
Status sent to network peer : No fault
Status received from network peer : No fault
Adjacency status of remote peer : No fault
Sequencing: receive disabled, send disabled
Bindings
Parameter    Local                          Remote
------------ ------------------------------ ------------------------------
Label        18                             17
Group ID     0                              0
Interface    Connect to CE1                 Connect to CE2
MTU          1500                           1500
Control word on (configured: autosense)     on
PW type      Ethernet                       Ethernet
VCCV CV type 0x02                           0x02
             LSPV [2]                       LSPV [2]
```

```
VCCV CC type 0x07                           0x07
             CW [1], RA [2], TTL [3]        CW [1], RA [2], TTL [3]
Status TLV   enabled                        supported
SSO Descriptor: 10.0.0.1/101, local label: 18
Dataplane:
SSM segment/switch IDs: 4106/4105 (used), PWID: 2
Rx Counters
3 input transit packets, 162 bytes
0 drops, 0 seq err
Tx Counters
5 output transit packets, 305 bytes
0 drops
```

Verifying HDLC-to-Ethernet Interworking (dot1q Mode) Configuration on an Ethernet PE Device

You can use **show** commands to view information about a HDLC-to-Ethernet interworking (dot1q mode) configuration on an Ethernet PE device.

SUMMARY STEPS

1. **show mpls l2transport vc**
2. **show mpls l2transport vc detail**
3. **show l2vpn atom vc**
4. **show l2vpn atom vc detail**

DETAILED STEPS

Step 1 **show mpls l2transport vc**

The following is sample output from the **show mpls l2transport vc** command which displays basic information about HDLC-to-Ethernet interworking (dot1q mode) configuration on an Ethernet PE device:

Example:

```
Device# show mpls l2transport vc

Local intf  Local circuit  Dest address    VC ID      Status
----------- -------------- --------------- ---------- ----------
Gi1/0/0.10  Eth VLAN 10    203.0.113.1     138        UP
```

Step 2 **show mpls l2transport vc detail**

The following is sample output from the **show mpls l2transport vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (dot1q mode) configuration on an Ethernet PE device:

Example:

```
Device# show mpls l2transport vc detail

Local interface: Gi1/0/0.10 up, line protocol up, Eth VLAN 10 up
Interworking type is Ethernet
Destination address: 203.0.113.1, VC ID: 138, VC status: up
Output interface: Fa0/0/1, imposed label stack {19 35}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.11
Create time: 00:00:22, last status change time: 00:00:20
```

```
Last label FSM state change time: 00:00:20
Signaling protocol: LDP, peer 203.0.113.1:0 up
Targeted Hello: 10.0.0.1(LDP Id) -> 203.0.113.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Last local dataplane status rcvd: No fault
Last BFD dataplane status rcvd: Not sent
Last BFD peer monitor status rcvd: No fault
Last local AC circuit status rcvd: No fault
Last local AC circuit status sent: No fault
Last local PW i/f circ status rcvd: No fault
Last local LDP TLV status sent: No fault
Last remote LDP TLV status rcvd: No fault
Last remote LDP ADJ status rcvd: No fault
MPLS VC labels: local 53, remote 35
Group ID: local 0, remote 0
MTU: local 1500, remote 1500
Remote interface description: Connect to CE1
Sequencing: receive disabled, send disabled
Control Word: On
SSO Descriptor: 203.0.113.1/138, local label: 53
Dataplane:
SSM segment/switch IDs: 4784/4783 (used), PWID: 117
VC statistics:
transit packet totals: receive 6, send 6
transit byte totals: receive 234, send 1276
transit packet drops: receive 0, seq error 0, send 0
```

Step 3 **show l2vpn atom vc**

The following is sample output from the **show l2vpn atom vc** command which displays basic information about HDLC-to-Ethernet interworking (dot1q mode) configuration on an Ethernet PE device:

Example:

```
Device# show l2vpn atom vc

                            Service
Interface Peer ID    VC ID  Type   Name  Status
--------- ---------- ------ ------ ----- ----------
pw138     203.0.113.1 138    p2p    138   UP
```

Step 4 **show l2vpn atom vc detail**

The following is sample output from the **show l2vpn atom vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (dot1q mode) configuration on an Ethernet PE device:

Example:

```
Device# show l2vpn atom vc detail

pseudowire138 is up, VC status is up PW type: Ethernet
Create time: 00:00:23, last status change time: 00:00:20
Last label FSM state change time: 00:00:20
Destination address: 203.0.113.1 VC ID: 138
Output interface: Fa0/0/1, imposed label stack {18 20}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.11
Member of xconnect service eth138
Associated member Gi1/0/0.10 is up, status is up
Interworking type is Ethernet
Service id: 0x7b000029
Signaling protocol: LDP, peer 203.0.113.1:0 up
Targeted Hello: 10.0.0.1(LDP Id) -> 203.0.113.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
```

```
PWid FEC (128), VC ID: 138
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Local dataplane status received : No fault
BFD dataplane status received : Not sent
BFD peer monitor status received : No fault
Status received from access circuit : No fault
Status sent to access circuit : No fault
Status received from pseudowire i/f : No fault
Status sent to network peer : No fault
Status received from network peer : No fault
Adjacency status of remote peer : No fault
Sequencing: receive disabled, send disabled
Bindings
Parameter    Local                          Remote
------------ ------------------------------ ------------------------------
Label        30                             20
Group ID     0                              0
Interface    Connect to CE2                 Connect to CE1
MTU          1500                           1500
Control word on (configured: autosense)     on
PW type      Ethernet                       Ethernet
VCCV CV type 0x02                           0x02
             LSPV [2]                       LSPV [2]
VCCV CC type 0x07                           0x07
             CW [1], RA [2], TTL [3]        CW [1], RA [2], TTL [3]
Status TLV   enabled                        supported
SSO Descriptor: 203.0.113.1/138, local label: 30
Dataplane:
SSM segment/switch IDs: 4333/4332 (used), PWID: 41
Rx Counters
8 input transit packets, 312 bytes
0 drops, 0 seq err
Tx Counters
5 output transit packets, 380 bytes
0 drops
```

Verifying HDLC-to-Ethernet Interworking (QinQ Mode) Configuration on a HDLC PE Device

You can use **show** commands to view information about a HDLC-to-Ethernet interworking (QinQ mode) configuration on a HDLC PE device.

SUMMARY STEPS

1. **show mpls l2transport vc**
2. **show mpls l2transport vc detail**
3. **show l2vpn atom vc**
4. **show l2vpn atom vc detail**

DETAILED STEPS

Step 1 **show mpls l2transport vc**

The following is sample output from the **show mpls l2transport vc** command which displays basic information about HDLC-to-Ethernet interworking (QinQ mode) configuration on a HDLC PE device:

Example:

```
Device# show mpls l2transport vc

Local intf  Local circuit  Dest address    VC ID      Status
----------- -------------- --------------- ---------- ----------
Se0/1/0:0   HDLC           10.0.0.1        145        UP
```

Step 2 **show mpls l2transport vc detail**

The following is sample output from the **show mpls l2transport vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (QinQ mode) configuration on a HDLC PE device:

Example:

```
Device# show mpls l2transport vc detail

Local interface: Se0/1/0:0 up, line protocol up, HDLC up
Interworking type is Ethernet
Destination address: 10.0.0.1, VC ID: 101, VC status: up
Output interface: Fa0/0/1, imposed label stack {20 22}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.10
Create time: 00:00:19, last status change time: 00:00:15
Last label FSM state change time: 00:00:15
Signaling protocol: LDP, peer 10.0.0.1:0 up
Targeted Hello: 203.0.113.1(LDP Id) -> 10.0.0.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Last local dataplane status rcvd: No fault
Last BFD dataplane status rcvd: Not sent
Last BFD peer monitor status rcvd: No fault
Last local AC circuit status rcvd: No fault
Last local AC circuit status sent: No fault
Last local PW i/f circ status rcvd: No fault
Last local LDP TLV status sent: No fault
Last remote LDP TLV status rcvd: No fault
Last remote LDP ADJ status rcvd: No fault
MPLS VC labels: local 33, remote 22
Group ID: local 0, remote 0
MTU: local 1500, remote 1500
Remote interface description: Connect to CE2
Sequencing: receive disabled, send disabled
Control Word: On
SSO Descriptor: 10.0.0.1/101, local label: 33
Dataplane:
SSM segment/switch IDs: 4274/4273 (used), PWID: 26
VC statistics:
transit packet totals: receive 3, send 6
transit byte totals: receive 162, send 366
transit packet drops: receive 0, seq error 0, send 0
```

Step 3 **show l2vpn atom vc**

The following is sample output from the **show l2vpn atom vc** command which displays basic information about HDLC-to-Ethernet interworking (QinQ mode) configuration on a HDLC PE device:

Example:

```
Device# show l2vpn atom vc

                            Service
Interface Peer ID    VC ID  Type   Name  Status
```

```
--------- ---------- ------ ------ ----- ----------
pw145     10.0.0.1   145    p2p    145   UP
```

Step 4 **show l2vpn atom vc detail**

The following is sample output from the **show l2vpn atom vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (QinQ mode) configuration on a HDLC PE device:

Example:

```
Device# show l2vpn atom vc detail

pseudowire145 is up, VC status is up PW type: Ethernet
Create time: 00:00:18, last status change time: 00:00:13
Last label FSM state change time: 00:00:13
Destination address: 10.0.0.1 VC ID: 145
Output interface: Fa0/0/1, imposed label stack {16 33}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.10
Member of xconnect service hdlc145
Associated member Se0/1/0:0 is up, status is up
Interworking type is Ethernet
Service id: 0x2e
Signaling protocol: LDP, peer 10.0.0.1:0 up
Targeted Hello: 203.0.113.1(LDP Id) -> 10.0.0.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
PWid FEC (128), VC ID: 145
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Local dataplane status received : No fault
BFD dataplane status received : Not sent
BFD peer monitor status received : No fault
Status received from access circuit : No fault
Status sent to access circuit : No fault
Status received from pseudowire i/f : No fault
Status sent to network peer : No fault
Status received from network peer : No fault
Adjacency status of remote peer : No fault
Sequencing: receive disabled, send disabled
Bindings
Parameter    Local                          Remote
------------ ------------------------------ ------------------------------
Label        33                             33
Group ID     0                              0
Interface    Connect to CE1                 Connect to CE2
MTU          1500                           1500
Control word on (configured: autosense)     on
PW type      Ethernet                       Ethernet
VCCV CV type 0x02                           0x02
             LSPV [2]                       LSPV [2]
VCCV CC type 0x07                           0x07
             CW [1], RA [2], TTL [3]        CW [1], RA [2], TTL [3]
Status TLV   enabled                        supported
SSO Descriptor: 10.0.0.1/145, local label: 33
Dataplane:
SSM segment/switch IDs: 4345/4344 (used), PWID: 48
Rx Counters
2 input transit packets, 108 bytes
0 drops, 0 seq err
Tx Counters
3 output transit packets, 183 bytes
0 drops
```

Verifying HDLC-to-Ethernet Interworking (QinQ Mode) Configuration on an Ethernet PE Device

You can use **show** commands to view information about a HDLC-to-Ethernet interworking (QinQ mode) configuration on an Ethernet PE device.

SUMMARY STEPS

1. **show mpls l2transport vc**
2. **show mpls l2transport vc detail**
3. **show l2vpn atom vc**
4. **show l2vpn atom vc detail**

DETAILED STEPS

Step 1 **show mpls l2transport vc**

The following is sample output from the **show mpls l2transport vc** command which displays basic information about HDLC-to-Ethernet interworking (QinQ mode) configuration on an Ethernet PE device:

Example:

```
Device# show mpls l2transport vc

Local intf  Local circuit  Dest address    VC ID      Status
----------- -------------- --------------- ---------- ----------
Gi1/0/0.10  Eth VLAN 10/20  203.0.113.1    145        UP
```

Step 2 **show mpls l2transport vc detail**

The following is sample output from the **show mpls l2transport vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (QinQ mode) configuration on an Ethernet PE device:

Example:

```
Device# show mpls l2transport vc detail

Local interface: Gi1/0/0.10 up, line protocol up, Eth VLAN 10/20 up
Interworking type is Ethernet
Destination address: 203.0.113.1, VC ID: 145, VC status: up
Output interface: Fa0/0/1, imposed label stack {19 27}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.11
Create time: 00:00:23, last status change time: 00:00:21
Last label FSM state change time: 00:00:21
Signaling protocol: LDP, peer 203.0.113.1:0 up
Targeted Hello: 10.0.0.1(LDP Id) -> 203.0.113.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Last local dataplane status rcvd: No fault
Last BFD dataplane status rcvd: Not sent
Last BFD peer monitor status rcvd: No fault
Last local AC circuit status rcvd: No fault
Last local AC circuit status sent: No fault
Last local PW i/f circ status rcvd: No fault
Last local LDP TLV status sent: No fault
Last remote LDP TLV status rcvd: No fault
Last remote LDP ADJ status rcvd: No fault
```

```
MPLS VC labels: local 25, remote 27
Group ID: local 0, remote 0
MTU: local 1500, remote 1500
Remote interface description: Connect to CE1
Sequencing: receive disabled, send disabled
Control Word: On
SSO Descriptor: 203.0.113.1/145, local label: 25
Dataplane:
SSM segment/switch IDs: 4815/4814 (used), PWID: 124
VC statistics:
transit packet totals: receive 10, send 6
transit byte totals: receive 430, send 456
transit packet drops: receive 0, seq error 0, send 0
```

Step 3 **show l2vpn atom vc**

The following is sample output from the **show l2vpn atom vc** command which displays basic information about HDLC-to-Ethernet interworking (QinQ mode) configuration on an Ethernet PE device:

Example:

```
Device# show l2vpn atom vc

                            Service
Interface Peer ID    VC ID  Type   Name  Status
--------- ---------- ------ ------ ----- ----------
pw145     203.0.113.1  145    p2p    145   UP
```

Step 4 **show l2vpn atom vc detail**

The following is sample output from the **show l2vpn atom vc detail** command which displays detailed information about HDLC-to-Ethernet interworking (QinQ mode) configuration on an Ethernet PE device:

Example:

```
Device# show l2vpn atom vc detail

pseudowire145 is up, VC status is up PW type: Ethernet
Create time: 00:00:23, last status change time: 00:00:19
Last label FSM state change time: 00:00:19
Destination address: 203.0.113.1 VC ID: 145
Output interface: Fa0/0/1, imposed label stack {18 33}
Preferred path: not configured
Default path: active
Next hop: 10.0.0.11
Member of xconnect service eth145
Associated member Gi1/0/0.10 is up, status is up
Interworking type is Ethernet
Service id: 0xed000030
Signaling protocol: LDP, peer 203.0.113.1:0 up
Targeted Hello: 10.0.0.1(LDP Id) -> 203.0.113.1, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
PWid FEC (128), VC ID: 145
Status TLV support (local/remote) : enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Local dataplane status received : No fault
BFD dataplane status received : Not sent
BFD peer monitor status received : No fault
Status received from access circuit : No fault
Status sent to access circuit : No fault
Status received from pseudowire i/f : No fault
Status sent to network peer : No fault
Status received from network peer : No fault
Adjacency status of remote peer : No fault
Sequencing: receive disabled, send disabled
Bindings
Parameter    Local                          Remote
------------ ------------------------------ ------------------------------
```

```
Label        33                              33
Group ID     0                               0
Interface    Connect to CE2                  Connect to CE1
MTU          1500                            1500
Control word on (configured: autosense)      on
PW type      Ethernet                        Ethernet
VCCV CV type 0x02                            0x02
             LSPV [2]                        LSPV [2]
VCCV CC type 0x07                            0x07
             CW [1], RA [2], TTL [3]         CW [1], RA [2], TTL [3]
Status TLV   enabled                         supported
SSO Descriptor: 203.0.113.1/145, local label: 33
Dataplane:
SSM segment/switch IDs: 4361/4360 (used), PWID: 48
Rx Counters
8 input transit packets, 344 bytes
0 drops, 0 seq err
Tx Counters
5 output transit packets, 380 bytes
0 drops
```

Verifying L2VPN Interworking

To verify the L2VPN status (in the AToM configuration), use the following commands:

- **show connection** [**all** | **name** | **id** | **elements** | **port**]
- **show xconnect** [**all** | **interface** | **peer**]
- **show mpls l2transport** [**binding** | **checkpoint** | **hw-capability** | **summary** | **vc**]
- **show mpls infrastructure lfd pseudowire vcid**

Verifying L2VPN Interworking using the commands associated with the L2VPN Protocol-Based CLIs feature

To verify the L2VPN status (in the AToM configuration), use the following commands:

- **show connection** [**all** | **name** | **id** | **elements** | **port**]
- **show l2vpn service**[**all** | **interface** | **peer**]
- **show l2vpn atom** [**binding** | **checkpoint** | **hw-capability** | **summary** | **vc**]
- **show mpls infrastructure lfd pseudowire vcid**

Configuration Examples for L2VPN Interworking

Frame Relay DLCI-to-Ethernet VLAN 802.1Q Using Bridged Internetworking Example

The following example shows how to configure the Frame Relay DLCI-to-Ethernet VLAN 802.1Q feature using bridged interworking:

PE1 router	PE2 router
config t mpls label protocol ldp interface Loopback100 ip address 10.0.0.100 255.255.255.255 pseudowire-class fr-vlan encapsulation mpls interworking ethernet frame-relay switching interface serial 2/0/0:1 encapsulation frame-relay frame-relay intf-type dce connect mpls serial 2/0/0:1 567 l2transport xconnect 10.0.0.200 150 pw-class fr-vlan	config t mpls label protocol ldp interface Loopback200 ip address 10.0.0.200 255.255.255.255 pseudowire-class fr-vlan encapsulation mpls interworking ethernet interface gigabitethernet 5/1/0.3 encapsulation dot1q 1525 xconnect 10.0.0.100 150 pw-class fr-vlan

Frame Relay DLCI-to-Ethernet VLAN 802.1Q Using Bridged Internetworking Example using the commands associated with the L2VPN Protocol-Based CLIs feature

The following example shows how to configure the Frame Relay DLCI-to-Ethernet VLAN 802.1Q feature using bridged interworking:

PE1 router	PE2 router
config t mpls label protocol ldp interface Loopback100 ip address 10.0.0.100 255.255.255.255 template type pseudowire fr-vlan encapsulation mpls interworking ethernet frame-relay switching interface serial 2/0/0:1 encapsulation frame-relay frame-relay intf-type dce connect mpls serial 2/0/0:1 567 l2transport interface pseudowire 100 source template type pseudowire fr-vlan neighbor 10.0.0.200 150 ! l2vpn xconnect context con1 member pseudowire 100 member 10.0.0.200 150 encapsulation mpls	config t mpls label protocol ldp interface Loopback200 ip address 10.0.0.200 255.255.255.255 template type pseudowire fr-vlan encapsulation mpls interworking ethernet interface gigabitethernet 5/1/0.3 encapsulation dot1q 1525 interface pseudowire 100 source template type pseudowire fr-vlan neighbor 10.0.0.100 150 ! l2vpn xconnect context con1 member pseudowire 100 member 10.0.0.100 150 encapsulation mpls

ATM AAL5-to-Ethernet VLAN 802.1Q Using Bridged Internetworking Example

The following example shows how to configure the ATM AAL5-to-Ethernet VLAN 802.1Q feature using bridged interworking:

PE1 router	PE2 router
config t mpls label protocol ldp interface Loopback100 ip address 10.0.0.100 255.255.255.255 pseudowire-class atm-vlan encapsulation mpls interworking ethernet interface atm 2/0/0 pvc 0/200 l2transport encapsulation aal5snap xconnect 10.0.0.200 140 pw-class atm-vlan	config t mpls label protocol ldp interface Loopback200 ip address 10.0.0.200 255.255.255.255 pseudowire-class atm-vlan encapsulation mpls interworking ethernet interface gigabitethernet 5/1/0.3 encapsulation dot1q 1525 xconnect 10.0.0.100 140 pw-class atm-vlan

ATM AAL5-to-Ethernet VLAN 802.1Q Using Bridged Internetworking Example using the commands associated with the L2VPN Protocol-Based CLIs feature

The following example shows how to configure the ATM AAL5-to-Ethernet VLAN 802.1Q feature using bridged interworking:

PE1 router	PE2 router
config t mpls label protocol ldp interface Loopback100 ip address 10.0.0.100 255.255.255.255 template type pseudowire atm-vlan encapsulation mpls interworking ethernet interface atm 2/0/0 pvc 0/200 l2transport encapsulation aal5snap interface pseudowire 100 source template type pseudowire atm-vlan neighbor 10.0.0.200 140 ! l2vpn xconnect context con1 member pseudowire 100 member 10.0.0.200 140 encapsulation mpls	config t mpls label protocol ldp interface Loopback200 ip address 10.0.0.200 255.255.255.255 template type pseudowire atm-vlan encapsulation mpls interworking ethernet interface gigabitethernet 5/1/0.3 encapsulation dot1q 1525 interface pseudowire 100 source template type pseudowire atm-vlan neighbor 10.0.0.100 140 ! l2vpn xconnect context con1 member pseudowire 100 member 10.0.0.200 140 encapsulation mpls

ATM AAL5-to-Ethernet Port Using Routed Interworking Example

The following example shows how to configure the ATM AAL5-to-Ethernet Port feature using routed interworking:

PE1 router	PE2 router
config t mpls label protocol ldp interface Loopback100 ip address 10.0.0.100 255.255.255.255 pseudowire-class atm-eth encapsulation mpls interworking ip interface atm 2/0.1 pvc 0/200 l2transport encapsulation aal5 xconnect 10.0.0.200 140 pw-class atm-eth	config t mpls label protocol ldp interface Loopback200 ip address 10.0.0.200 255.255.255.255 pseudowire-class atm-eth encapsulation mpls interworking ip interface gigabitethernet 5/1/0 xconnect 10.0.0.100 140 pw-class atm-eth

Frame Relay DLCI-to-Ethernet Port Using Routed Interworking Example

The following example shows how to configure the Frame Relay DLCI-to-Ethernet Port feature using routed interworking:

PE1 router	PE2 router
config t mpls label protocol ldp interface Loopback100 ip address 10.0.0.100 255.255.255.255 pseudowire-class fr-eth encapsulation mpls interworking ip frame-relay switching interface serial 2/0/0:1 encapsulation frame-relay frame-relay intf-type dce frame-relay interface-dlci 567 switched connect fr-vlan-1 POS2/3/1 151 l2transport xconnect 10.0.0.200 151 pw-class pw-class-bridge	config t mpls label protocol ldp interface Loopback200 ip address 10.0.0.200 255.255.255.255 pseudowire-class fr-eth encapsulation mpls interworking ip interface gigabitethernet 5/1/0 xconnect 10.0.0.100 150 pw-class fr-eth

Frame Relay DLCI-to-Ethernet Port Using Routed Interworking Example using the commands associated with the L2VPN Protocol-Based CLIs feature

The following example shows how to configure the Frame Relay DLCI-to-Ethernet Port feature using routed interworking:

PE1 router	PE2 router
config t mpls label protocol ldp interface Loopback100 ip address 10.0.0.100 255.255.255.255 template type pseudowire fr-eth encapsulation mpls interworking ip frame-relay switching interface serial 2/0/0:1 encapsulation frame-relay frame-relay intf-type dce frame-relay interface-dlci 567 switched connect fr-vlan-1 POS2/3/1 151 l2transport interface pseudowire 100 source template type pseudowire fr-eth neighbor 10.0.0.200 140 ! l2vpn xconnect context con1 member pseudowire 100 member 10.0.0.200 140 encapsulation mpls	config t mpls label protocol ldp interface Loopback200 ip address 10.0.0.200 255.255.255.255 template type pseudowire fr-eth encapsulation mpls interworking ip interface gigabitethernet 5/1/0 interface pseudowire 100 source template type pseudowire fr-eth neighbor 10.0.0.200 140 ! l2vpn xconnect context con1 member pseudowire 100 member 10.0.0.200 140 encapsulation mpls

Ethernet-to-VLAN over AToM--Bridged Example

The following example shows how to configure Ethernet-to-VLAN over AToM in a PE router:

PE1 router	PE2 router
ip cef ! mpls label protocol ldp mpls ldp router-id Loopback0 force ! pseudowire-class atom encapsulation mpls ! interface Loopback0 ip address 10.9.9.9 255.255.255.255 ! interface FastEthernet0/0 no ip address ! interface FastEthernet1/0 xconnect 10.8.8.8 123 pw-class atom	ip cef ! mpls label protocol ldp mpls ldp router-id Loopback0 force ! pseudowire-class atom-eth-iw encapsulation mpls interworking ethernet ! interface Loopback0 ip address 10.8.8.8 255.255.255.255 ! interface FastEthernet1/0.1 encapsulation dot1q 100 xconnect 10.9.9.9 123 pw-class atom-eth-iw

Ethernet to VLAN over AToM (Bridged) Example using the commands associated with the L2VPN Protocol-Based CLIs feature

The following example shows the configuration of Ethernet to VLAN over AToM:

PE1	PE2
ip cef ! mpls label protocol ldp mpls ldp router-id Loopback0 force ! template type pseudowire atom-eth-iw encapsulation mpls interworking ethernet ! interface Loopback0 ip address 10.8.8.8 255.255.255.255 ! interface FastEthernet1/0.1 encapsulation dot1q 100 interface pseudowire 100 source template type pseudowire atom-eth-iw neighbor 10.8.8.8 123 ! l2vpn xconnect context con1 member pseudowire 100 member 10.8.8.8 123 encapsulation mpls	ip cef ! mpls label protocol ldp mpls ldp router-id Loopback0 force ! template type pseudowire atom encapsulation mpls ! interface Loopback0 ip address 10.9.9.9 255.255.255.255 ! interface FastEthernet0/0 no ip address ! interface FastEthernet1/0 interface pseudowire 100 source template type pseudowire ether-pw neighbor 10.9.9.9 123 ! l2vpn xconnect context con1 member pseudowire 100 member 10.9.9.9 123 encapsulation mpls

VLAN-to-ATM AAL5 over AToM (Bridged) Example

The following example shows the configuration of VLAN-to-ATM AAL5 over AToM:

PE1 router	PE2 router
ip cef ! mpls ip mpls label protocol ldp mpls ldp router-id Loopback0 ! pseudowire-class inter-ether encapsulation mpls interworking ethernet ! interface Loopback0 ip address 10.8.8.8 255.255.255.255 ! interface ATM1/0.1 point-to-point pvc 0/100 l2transport encapsulation aal5snap xconnect 10.9.9.9 123 pw-class inter-ether ! interface FastEthernet1/0 xconnect 10.9.9.9 1 pw-class inter-ether ! router ospf 10 log-adjacency-changes network 10.8.8.8 0.0.0.0 area 0 network 10.1.1.1 0.0.0.0 area 0	ip cef ! mpls ip mpls label protocol ldp mpls ldp router-id Loopback0 ! pseudowire-class inter-ether encapsulation mpls interworking ethernet ! interface Loopback0 ip address 10.9.9.9 255.255.255.255 ! interface FastEthernet0/0 no ip address ! interface FastEthernet0/0.1 encapsulation dot1Q 10 xconnect 10.8.8.8 123 pw-class inter-ether ! router ospf 10 log-adjacency-changes network 10.9.9.9 0.0.0.0 area 0 network 10.1.1.2 0.0.0.0 area 0

VLAN-to-ATM AAL5 over AToM (Bridged) Example using the commands associated with the L2VPN Protocol-Based CLIs feature

The following example shows the configuration of VLAN-to-ATM AAL5 over AToM:

PE1 router	PE2 router
	ip cef ! mpls ip mpls label protocol ldp mpls ldp router-id Loopback0 ! template type pseudowire inter-ether encapsulation mpls interworking ethernet ! interface Loopback0 ip address 10.9.9.9 255.255.255.255 ! interface FastEthernet0/0 no ip address ! interface FastEthernet0/0.1 encapsulation dot1Q 10 interface pseudowire 100 source template type pseudowire inter-ether neighbor 10.8.8.8 123 ! l2vpn xconnect context con1 member pseudowire 100 member 10.8.8.8 123 encapsulation mpls ! router ospf 10 log-adjacency-changes network 10.9.9.9 0.0.0.0 area 0 network 10.1.1.2 0.0.0.0 area 0

PE1 router	PE2 router
ip cef ! mpls ip mpls label protocol ldp mpls ldp router-id Loopback0 ! template type pseudowire inter-ether encapsulation mpls interworking ethernet ! interface Loopback0 ip address 10.8.8.8 255.255.255.255 ! interface ATM1/0.1 point-to-point pvc 0/100 l2transport encapsulation aal5snap interface pseudowire 100 source template type pseudowire inter-ether neighbor 10.9.9.9 123 ! l2vpn xconnect context con1 ! interface FastEthernet1/0 interface pseudowire 100 source template type pseudowire inter-ether neighbor 10.9.9.9 1 ! l2vpn xconnect context con1 member pseudowire 100 member 10.9.9.9.9 1 encapsulation mpls ! router ospf 10 log-adjacency-changes network 10.8.8.8 0.0.0.0 area 0 network 10.1.1.1 0.0.0.0 area 0	

Ethernet VLAN-to-PPP over AToM (Routed) Example

The following example shows the configuration of Ethernet VLAN-to-PPP over AToM

PE1 router	PE2 router
configure terminal mpls label protocol ldp mpls ldp router-id Loopback0 mpls ip ! pseudowire-class ppp-ether encapsulation mpls interworking ip ! interface Loopback0 ip address 10.8.8.8 255.255.255.255 no shutdown ! interface POS2/0/1 no ip address encapsulation ppp no peer default ip address ppp ipcp address proxy 10.10.10.1 xconnect 10.9.9.9 300 pw-class ppp-ether no shutdown	configure terminal mpls label protocol ldp mpls ldp router-id Loopback0 mpls ip ! pseudowire-class ppp-ether encapsulation mpls interworking ip ! interface Loopback0 ip address 10.9.9.9 255.255.255.255 no shutdown ! interface GigabitEthernet6/2 xconnect 10.8.8.8 300 pw-class ppp-ether no shutdown

Ethernet VLAN to PPP over AToM (Routed) Example using the commands associated with the L2VPN Protocol-Based CLIs feature

The following example shows the configuration of Ethernet VLAN to PPP over AToM:

PE1	PE2
configure terminal mpls label protocol ldp mpls ldp router-id Loopback0 mpls ip ! template type pseudowire ppp-ether encapsulation mpls interworking ip ! interface Loopback0 ip address 10.8.8.8 255.255.255.255 no shutdown ! interface POS2/0/1 no ip address encapsulation ppp no peer default ip address ppp ipcp address proxy 10.10.10.1 interface pseudowire 100 source template type pseudowire ppp-ether neighbor 10.9.9.9 300 ! l2vpn xconnect context con1 member pseudowire 100 member 10.9.9.9 300 encapsulation mpls no shutdown	

PE1	PE2
	configure terminal mpls label protocol ldp mpls ldp router-id Loopback0 mpls ip ! template type pseudowire ppp-ether encapsulation mpls interworking ip ! interface Loopback0 ip address 10.9.9.9 255.255.255.255 no shutdown ! interface vlan300 mtu 4470 no ip address interface pseudowire 100 source template type pseudowire ppp-ether neighbor 10.8.8.8 300 ! l2vpn xconnect context con1 member pseudowire 100 member 10.8.8.8 300 encapsulation mpls no shutdown ! interface GigabitEthernet6/2 switchport switchport trunk encapsulation dot1q switchport trunk allowed vlan 300 switchport mode trunk no shutdown

ATM VC-to-VC Local Switching (Different Port) Example

The following example shows the configuration of ATM VC-to-VC local switching:

CE1 router	CE2 router	PE router
interface ATM1/0 no ip address atm clock INTERNAL no atm ilmi-keepalive no atm enable-ilmi-trap interface ATM1/0 ip address 10.1.1.1 255.255.255.0 no atm enable-ilmi-trap pvc 0/100 encapsulation aal5snap	interface ATM3/0 no ip address atm clock INTERNAL no atm ilmi-keepalive no atm enable-ilmi-trap ! interface ATM3/0.1 multipoint ip address 10.1.1.2 255.255.255.0 no atm enable-ilmi-trap pvc 0/50 protocol ip 10.1.1.1 encapsulation aal5snap	interface ATM0/1/0 no ip address atm clock INTERNAL no atm enable-ilmi-trap ! interface ATM0/1/0.50 point-to-point no atm enable-ilmi-trap pvc 0/50 l2transport encapsulation aal5 ! ! interface ATM0/1/1 no ip address atm clock INTERNAL no atm enable-ilmi-trap ! interface ATM0/1/1.100 point-to-point no atm enable-ilmi-trap pvc 0/100 l2transport encapsulation aal5 connect con_atm ATM0/1/1 0/100 ATM0/1/0 0/50

ATM VP-to-VP Local Switching (Different Port) Example

The following example shows the configuration of ATM VP-to-VP local switching:

CE1 router	CE2 router	PE router

interface ATM1/0
 no ip address
 atm clock INTERNAL
 no atm enable-ilmi-trap
!
interface ATM1/0.1 point-to-point
 ip address 10.1.1.1 255.255.255.0
 no atm enable-ilmi-trap
 pvc 100/100
  encapsulation aal5snap
	interface ATM3/0
	 no ip address
	 atm clock INTERNAL
	 no atm ilmi-keepalive
	 no atm enable-ilmi-trap
	!
	interface ATM3/0.1 point-to-point
	 ip address 10.1.1.2 255.255.255.0
	 no atm enable-ilmi-trap
	 pvc 100/100
	  encapsulation aal5snap
		interface ATM0/1/0
		 no ip address
		 atm clock INTERNAL
		 no atm ilmi-keepalive
		 no atm enable-ilmi-trap
		!
		interface ATM0/1/0.50 multipoint
		 atm pvp 100 l2transport
		 no atm enable-ilmi-trap
		!
		interface ATM0/1/1
		 no ip address
		 atm clock INTERNAL
		 no atm ilmi-keepalive
		 no atm enable-ilmi-trap
		!
		interface ATM0/1/1.100 multipoint
		 atm pvp 100 l2transport
		 no atm enable-ilmi-trap
		
		connect atm_con ATM0/1/1 100 ATM0/1/0 100

Example: Configuring HDLC-to-Ethernet Interworking: Controller Slot on HDLC Devices

The following example shows how to configure the serial controller and interface on HDLC devices:

HDLC CE device	HDLC PE device
enable configure terminal controller E1 2/0 channel-group 0 timeslots 1 no shutdown ! interface serial 2/0:0 no shutdown end	enable configure terminal controller E1 0/1/0 channel-group 0 timeslots 1 no shutdown ! interface serial 0/1/0:0 no shutdown end

Example: Configuring HDLC-to-Ethernet Bridged Interworking on HDLC Devices

The following example shows how to configure HDLC-to-Ethernet bridged interworking on HDLC devices:

HDLC CE device	HDLC PE device
enable configure terminal bridge irb bridge 1 protocol ieee bridge 1 route ip ! interface BVI1 ip address 192.0.2.1 255.255.255.0 no shutdown ! interface serial 2/0:0 encapsulation hdlc bridge-group 1 no shutdown end	enable configure terminal pseudowire-class pw-iw-eth encapsulation mpls interworking Ethernet ! interface serial 0/1/0:0 encapsulation hdlc no ip address xconnect 203.0.113.10 100 pw-class pw-iw-eth no shutdown end

Example: Configuring HDLC-to-Ethernet Bridged Interworking on HDLC Devices Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

The following example shows how to configure HDLC-to-Ethernet bridged interworking on HDLC devices using the commands associated with the L2VPN protocol-based CLIs feature:

HDLC CE device	HDLC PE device

enable
 configure terminal
  bridge irb
  bridge 1 protocol ieee
  bridge 1 route ip
!
interface BVI1
 ip address 192.0.2.1 255.255.255.0
 no shutdown
!
interface serial 2/0:0
 encapsulation hdlc
 bridge-group 1
 no shutdown
end
	enable
	 configure terminal
	  interface serial 0/1/0:0
	  encapsulation hdlc
	  no ip address
	  no shutdown
	!
	interface pseudowire 101
	 encapsulation mpls
	 neighbor 203.0.113.10 100
	 signaling protocol ldp
	 no shutdown
	!
	l2vpn xconnect context hdlc
	 interworking ethernet
	 member Serial 0/1/0:0
	 member pseudowire 101
	 no shutdown
	end

Example: Configuring HDLC-to-Ethernet Bridged Interworking on Ethernet Devices

The following example shows how to configure HDLC-to-Ethernet bridged interworking on Ethernet devices:

Ethernet CE device	Ethernet PE device

enable
 configure terminal
  interface GigabitEthernet0/1
  ip address 198.51.100.19 255.255.255.0
  ip irdp
  ip irdp maxadvertinterval 4
  no shutdown
end
	enable
	 configure terminal
	 pseudowire-class pw-iw-eth
	  encapsulation mpls
	  interworking Ethernet
	!
	interface GigabitEthernet 1/0/0
	 no ip address
	 xconnect 203.0.113.20 100 pseudowire-class
	 pw-iw-eth
	  no shutdown
	end

Example: Configuring HDLC-to-Ethernet Bridged Interworking on Ethernet Devices Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

The following example shows how to configure HDLC-to-Ethernet bridged interworking on Ethernet devices using the commands associated with the L2VPN protocol-based CLIs feature:

Ethernet CE device	Ethernet PE device
enable configure terminal interface GigabitEthernet 0/1 ip address 198.51.100.19 255.255.255.0 ip irdp ip irdp maxadvertinterval 4 no shutdown end	enable configure terminal interface GigabitEthernet 1/0/0 no ip address no shutdown ! interface pseudowire 101 encapsulation mpls neighbor 203.0.113.20 100 signaling protocol ldp no shutdown ! l2vpn xconnect context eth interworking ethernet member GigabitEthernet 1/0/0 member pseudowire101 no shutdown end

Example: Configuring HDLC-to-VLAN Bridged Interworking (Port Mode) on Ethernet Devices

The following example shows how to configure HDLC-to-VLAN bridged interworking (port mode) on Ethernet devices:

Ethernet CE device	Ethernet PE device

enable
 configure terminal
  interface GigabitEthernet 0/1
  no ip address
  no shutdown
!
interface GigabitEthernet 0/1.10
 encapsulation dot1q 10
 ip address 198.51.100.19 255.255.255.0
 ip irdp
 ip irdp maxadvertinterval 4
 no shutdown
end
	enable
	 configure terminal
	  pseudowire-class pw-iw-eth
	  encapsulation mpls
	  interworking Ethernet
	!
	interface GigabitEthernet 1/0/0
	 no ip address
	 no shutdown
	!
	interface GigabitEthernet 1/0/0.10
	 encapsulation dot1Q 10
	 no ip address
	!
	 xconnect 203.0.113.20 100 pseudowire-class
	 pw-iw-eth
	  no shutdown
	end

Example: Configuring HDLC-to-VLAN Bridged Interworking on Ethernet Devices Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

The following example shows how to configure HDLC-to-VLAN bridged interworking on Ethernet devices using the commands associated with the L2VPN protocol-based CLIs feature:

Ethernet CE device	Ethernet PE device

enable
 configure terminal
  interface GigabitEthernet 0/1
  no ip address
  no shutdown
!
interface GigabitEthernet 0/1.10
 encapsulation dot1q 10
 ip address 198.51.100.19 255.255.255.0
 ip irdp
 ip irdp maxadvertinterval 4
 no shutdown
end
	enable
	 configure terminal
	  interface GigabitEthernet 1/0/0
	  no ip address
	  no shutdown
	!
	interface GigabitEthernet 1/0/0.10
	 encapsulation dot1q 10
	 no ip addres
	 no shutdown
	!
	interface pseudowire 101
	 encapsulation mpls
	 neighbor 203.0.113.20 100
	 signaling protocol ldp
	 no shutdown
	!
	l2vpn xconnect context vlan
	 interworking ethernet
	 member GigabitEthernet 1/0/0.10
	 member pseudowire 101
	 no shutdown
	end

Example: Configuring HDLC-to-VLAN Bridged Interworking (dot1q Mode) Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

The following example shows how to configure HDLC-to-VLAN bridged interworking (dot1q mode) using the commands associated with the L2VPN protocol-based CLIs feature:

HDLC PE device	Ethernet PE device

enable
 configure terminal
  template type pseudowire hdlc-vlan1
  encapsulation mpls
!
interface pseudowire 107
 source template type pseudowire hdlc-vlan1
  encapsulation mpls
  neighbor 203.0.113.10 107
  signaling protocol ldp
  no shutdown
!
l2vpn xconnect context hdlc-vlan1-con
 interworking ethernet
 member Serial 0/2/0:3
 member pseudowire 107
 no shutdown
end
	enable
	 configure terminal
	  interface FastEthernet 0/0/0.16
	  encapsulation dot1q 16
	  no ip addres
	  no shutdown
	!
	template type pseudowire hdlc-vlan1
	 encapsulation mpls
	!
	interface pseudowire 107
	 source template type pseudowire hdlc-vlan1
	  encapsulation mpls
	  neighbor 203.0.113.20 107
	  signaling protocol ldp
	  no shutdown
	!
	l2vpn xconnect context hdlc-vlan1-con
	 interworking ethernet
	 member FastEthernet 0/0/0.16
	 member pseudowire 107
	 no shutdown
	end

Example: Configuring HDLC-to-VLAN Bridged Interworking (QinQ Mode) on Ethernet Devices

The following example shows how to configure HDLC-to-VLAN bridged interworking (QinQ mode) on Ethernet devices:

Ethernet CE device	Ethernet PE device
enable configure terminal interface GigabitEthernet 0/1 no ip address no shutdown ! interface GigabitEthernet 0/1.10 encapsulation dot1q 10 second-dot1q 20 ip address 198.51.100.19 255.255.255.0 ip irdp ip irdp maxadvertinterval 4 no shutdown end	enable configure terminal pseudowire-class pw-iw-eth encapsulation mpls interworking Ethernet ! interface GigabitEthernet 1/0/0 no ip address no shutdown ! interface GigabitEthernet 1/0/0.10 encapsulation dot1Q 10 second-dot1q 20 no ip address xconnect 203.0.113.20 100 pseudowire-class pw-iw-eth no shutdown end

Example: Configuring HDLC-to-VLAN Bridged Interworking (QinQ Mode) on Ethernet Devices Using the Commands Associated with the L2VPN Protocol-Based CLIs Feature

The following example shows how to configure HDLC-to-VLAN bridged interworking (QinQ mode) on Ethernet devices using the commands associated with the L2VPN protocol-based CLIs feature:

Ethernet CE device	Ethernet PE device

`enable`
` configure terminal`
`  interface GigabitEthernet 0/1`
`  no ip address`
`  no shutdown`
`!`
`interface GigabitEthernet 0/1.10`
` encapsulation dot1q 10 second-dot1q 20`
` ip address 198.51.100.19 255.255.255.0`
` ip irdp`
` ip irdp maxadvertinterval 4`
` no shutdown`
`end`
	`enable`
	` configure terminal`
	`  interface GigabitEthernet 1/0/0`
	`  no ip address`
	`  no shutdown`
	`!`
	`interface GigabitEthernet 1/0/0.10`
	` encapsulation dot1q 10 second-dot1q 20`
	` no ip address`
	` no shutdown`
	`!`
	`interface pseudowire 101`
	` encapsulation mpls`
	` neighbor 203.0.113.20 100`
	` signaling protocol ldp`
	` no shutdown`
	`!`
	`l2vpn xconnect context qinq`
	` interworking ethernet`
	` member GigabitEthernet 1/0/0.10`
	` member pseudowire 101`
	` no shutdown`
	`end`

Additional References for L2VPN Interworking

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
MPLS commands	Multiprotocol Label Switching Command Reference
Any Transport over MPLS	Any Transport over MPLS

Standards and RFCs

Standard/RFC	Title
draft-ietf-l2tpext-l2tp-base-03.txt	*Layer Two Tunneling Protocol (Version 3) 'L2TPv3'*

Standard/RFC	Title
draft-martini-l2circuit-trans-mpls-09.txt	*Transport of Layer 2 Frames Over MPLS*
draft-ietf-pwe3-frame-relay-03.txt.	*Encapsulation Methods for Transport of Frame Relay over MPLS Networks*
draft-martini-l2circuit-encap-mpls-04.txt.	*Encapsulation Methods for Transport of Layer 2 Frames Over IP and MPLS Networks*
draft-ietf-pwe3-ethernet-encap-08.txt.	*Encapsulation Methods for Transport of Ethernet over MPLS Networks*
draft-ietf-pwe3-hdlc-ppp-encap-mpls-03.txt.	*Encapsulation Methods for Transport of PPP/HDLC over MPLS Networks*
draft-ietf-ppvpn-l2vpn-00.txt.	*An Architecture for L2VPNs*
RFC 4618	Encapsulation Methods for Transport of PPP/High-Level Data Link Control (HDLC) over MPLS Networks

MIBs

MIB	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register on Cisco.com.	http://www.cisco.com/techsupport

Feature Information for L2VPN Interworking

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 3: Feature Information for L2VPN Interworking

Feature Name	Releases	Feature Information
L2VPN Interworking	Cisco IOS XE Release 2.4 Cisco IOS XE Release 3.3S	This feature allows disparate ACs to be connected. An interworking function facilitates the translation between the different Layer 2 encapsulations. The following commands were introduced or modified: **debug frame-relay pseudowire**, **debug ssm**, **interworking**, **mtu**, **pseudowire-class**, **show l2tun session**, **show l2tun tunnel** , **show mpls l2transport vc**, **show platform**.
L2VPN Interworking: Ethernet to VLAN Interworking	Cisco IOS XE Release 2.4 Cisco IOS XE Release 3.8S	This feature allows interworking by stripping the VLAN tags and sending them as untagged frames on the remote end. In Cisco IOS XE Release 3.8S, support was added for the Cisco ISR 4400 Series Routers.
L2VPN Interworking: Ethernet VLAN to Frame Relay	Cisco IOS XE Release 3.3S	This feature allows interworking of Ethernet VLANs with Frame Relay DLCIs. The following command was modified: **interworking**
L2VPN Interworking: Ethernet VLAN to PPP	Cisco IOS XE Release 3.3S	The L2VPN interworking - Ethernet VLAN-to-PPP feature allows disparate ACs to be connected. An interworking function facilitates the translation between the following Layer 2 encapsulations.

Feature Name	Releases	Feature Information
L2VPN Interworking: Frame Relay to ATM (Bridged Mode)	Cisco IOS XE Release 3.6S Cisco IOS XE Release 3.8S	This feature allows Frame Relay to ATM Interworking using bridged and routed mode encapsulation. In Cisco IOS XE Release 3.8S, support was added for the Cisco ISR 4400 Series Routers.
L2VPN Interworking: HDLC to Ethernet Interworking	Cisco IOS XE Release 3.13S	High-Level Data Link Control (HDLC) and Ethernet are two independent data link layer transport protocols that utilize the Any Transport over MPLS (AToM) framework to communicate with each other. The interworking function enables translation between two heterogeneous Layer 2 encapsulations over a Multiprotocol Label Switching (MPLS) backbone. In Cisco IOS XE Release 3.13S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. This feature introduced no new or modified commands.