Any Transport over MPLS

This module describes how to configure Any Transport over MPLS (AToM) transports data link layer (Layer 2) packets over a Multiprotocol Label Switching (MPLS) backbone. AToM enables service providers to connect customer sites with existing Layer 2 networks by using a single, integrated, packet-based network infrastructure--a Cisco MPLS network. Instead of using separate networks with network management environments, service providers can deliver Layer 2 connections over an MPLS backbone. AToM provides a common framework to encapsulate and transport supported Layer 2 traffic types over an MPLS network core.

AToM supports the following like-to-like transport types:

- ATM Adaptation Layer Type-5 (AAL5) over MPLS
- ATM Cell Relay over MPLS
- Ethernet over MPLS (port modes)

Prerequisites for Any Transport over MPLS

- IP routing must be configured in the core so that the provider edge (PE) routers can reach each other via IP.
- MPLS must be configured in the core so that a label-switched path (LSP) exists between the PE routers.
- A loopback interface must be configured for originating and terminating Layer 2 traffic. Ensure that the PE routers can access the other router’s loopback interface. Note that the loopback interface is not needed in all cases. For example, tunnel selection does not need a loopback interface when AToM is directly mapped to a traffic engineering (TE) tunnel.

Restrictions for Any Transport over MPLS

General Restrictions

The following general restrictions pertain to all transport types under AToM:

- Address format: Configure the Label Distribution Protocol (LDP) router ID on all PE routers to be a loopback address with a /32 mask. Otherwise, some configurations might not function properly.

Ethernet over MPLS (EoMPLS) Restrictions

The following restrictions pertain to the Ethernet over MPLS feature:

- Ethernet over MPLS supports VLAN packets that conform to the IEEE 802.1Q standard. The 802.1Q specification establishes a standard method for inserting VLAN membership information into Ethernet frames. The Inter-Switch Link (ISL) protocol is not supported between the PE and CE routers.
- The AToM control word is supported. However, if the peer PE does not support a control word, the control word is disabled. This negotiation is done by LDP label binding.
- Ethernet packets with hardware-level cyclic redundancy check (CRC) errors, framing errors, and runt packets are discarded on input.

General Restrictions

- In a member configuration, the **l2vpn xconnect context** command does not prompt any error or warning, if you specify without a service instance.
- The **show mpls l2transport vc** *<vcid>* **detail** command output displays few LDP-related information, even in case of static pseudowire.
- Address format--Configure the Label Distribution Protocol (LDP) router ID on all PE routers to be a loopback address with a /32 mask. Otherwise, some configurations might not function properly.
- For PTPoIP configuration with explicit Null MPLS encapsulation, when a Transparent Clock (TC) is placed between a PTP primary and a PTP subordinate, the TC does not update the correction field.
- If an AToM tunnel spans different service providers that exchange MPLS labels using IPv4 Border Gateway Protocol (BGP) (RFC 3107), you add a label to the stack. The maximum MPLS label stack is .
- Hot standby pseudowire (HSPW) convergence without pseudowire grouping increments linearly. For example, for a thousand virtual circuits, it requires about 54 seconds of convergence time. This is applicable only for the Cisco RSP3 Module.

  Clear interface is not the recommended way to measure the convergence numbers.
- With two ECMP paths, load sharing on L2VPN traffic occurs based on odd or even MPLS VC labels. If L2VPN circuits have either odd **or** even MPLS VC labels, load sharing is not performed. But if L2VPN circuits have a combination of both odd **and** even MPLS VC labels, then the odd MPLS VC labels circuits select one link whereas the even MPLS VC labels circuits select another link.

ATM AAL5 over MPLS Restrictions

- AAL5 over MPLS is supported only in SDU mode.

ATM Cell Relay over MPLS Restrictions

- If you have TE tunnels running between the PE routers, you must enable LDP on the tunnel interfaces.
- The F4 end-to-end OAM cells are transparently transported along with the ATM cells. When a permanent virtual path (PVP) or permanent virtual circuit (PVC) is down on one PE router, the label associated with that PVP or PVC is withdrawn. Subsequently, the peer PE router detects the label withdrawal and sends an F4 AIS/RDI signal to its corresponding CE router. The PVP or PVC on the peer PE router remains in the up state.
- VC class configuration mode is not supported in port mode.
- The AToM control word is supported. However, if a peer PE does not support the control word, it is disabled.

For configuring ATM cell relay over MPLS in VP mode, the following restrictions apply:

- If a VPI is configured for VP cell relay, you cannot configure a PVC using the same VPI.
- VP trunking (mapping multiple VPs to one emulated VC label) is not supported. Each VP is mapped to one emulated VC.
- VP mode and VC mode drop idle cells.

Ethernet over MPLS (EoMPLS) Restrictions

- The subinterfaces between the CE and PE routers that are running Ethernet over MPLS must be in the same subnet.
- The subinterface on the adjoining CE router must be on the same VLAN as the PE router.
- Ethernet over MPLS supports VLAN packets that conform to the IEEE 802.1Q standard. The 802.1Q specification establishes a standard method for inserting VLAN membership information into Ethernet frames. The Inter-Switch Link (ISL) protocol is not supported between the PE and CE routers.
- The AToM control word is supported. However, if the peer PE does not support a control word, the control word is disabled.
- Ethernet packets with hardware-level cyclic redundancy check (CRC) errors, framing errors, and runt packets are discarded on input.

Per-Subinterface MTU for Ethernet over MPLS Restrictions

- The following features do not support MTU values in xconnect subinterface configuration mode:
    - Layer 2 Tunnel Protocol Version 3 (L2TPv3)
    - Virtual Private LAN services (VPLS)
    - L2VPN Pseudowire Switching

- The MTU value can be configured in xconnect subinterface configuration mode only on the following interfaces and subinterfaces:
  - Fast Ethernet
  - Gigabit Ethernet
- The router uses an MTU validation process for remote VCs established through LDP, which compares the MTU value configured in xconnect subinterface configuration mode to the MTU value of the remote customer interface. If an MTU value has not been configured in xconnect subinterface configuration mode, then the validation process compares the MTU value of the local customer interface to the MTU value of the remote xconnect, either explicitly configured or inherited from the underlying interface or subinterface.
- When you configure the MTU value in xconnect subinterface configuration mode, the specified MTU value is not enforced by the dataplane. The dataplane enforces the MTU values of the interface (port mode) or subinterface (VLAN mode).
- Ensure that the interface MTU is larger than the MTU value configured in xconnect subinterface configuration mode. If the MTU value of the customer-facing subinterface is larger than the MTU value of the core-facing interface, traffic may not be able to travel across the pseudowire.

Frame Relay over MPLS Restrictions

Frame Relay traffic shaping is not supported with AToM switched VCs.

HDLC over MPLS Restrictions

- Asynchronous interfaces are not supported.
- You must configure HDLC over MPLS on router interfaces only. You cannot configure HDLC over MPLS on subinterfaces.

PPP over MPLS Restrictions

- Zero hops on one router is not supported. However, you can have back-to-back PE routers.
- Asynchronous interfaces are not supported. The connections between the CE and PE routers on both ends of the backbone must have similar link layer characteristics. The connections between the CE and PE routers must both be synchronous.
- Multilink PPP (MLP) is not supported.
- You must configure PPP on router interfaces only. You cannot configure PPP on subinterfaces.

Tunnel Selection Restrictions

- The selected path should be an LSP destined to the peer PE router.
- The selected tunnel must be an MPLS TE tunnel.

- If you specify an IP address, that address must be the IP address of the loopback interface on the remote PE router. The address must have a /32 mask. There must be an LSP destined to that selected address. The LSP need not be a TE tunnel.

Experimental Bits with AToM Restrictions

- You must statically set the experimental (EXP) bits in both the VC label and the LSP tunnel label, because the LSP tunnel label might be removed at the penultimate router.
- For EXP bits and ATM AAL5 over MPLS and for EXP bits and Frame Relay over MPLS, if you do not assign values to the experimental bits, the priority bits in the header's "tag control information" field are set to zero.
- For EXP bits and ATM Cell Relay over MPLS in VC mode, if you do not assign values to the experimental bits, the priority bits in the header's "tag control information" field are set to zero.
- For EXP bits and HDLC over MPLS and PPP over MPLS, if you do not assign values to the experimental bits, zeros are written into the experimental bit fields.

Remote Ethernet Port Shutdown Restrictions

This feature is not symmetrical if the remote PE router is running an older version image or is on another platform that does not support the EoMPLS remote Ethernet port shutdown feature and the local PE is running an image which supports this feature.

Remote Ethernet Port Shutdown is supported only on EFP with encapsulation default.

Information About Any Transport over MPLS

To configure AToM, you must understand the following concepts:

How AToM Transports Layer 2 Packets

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

The successful transmission of the Layer 2 frames between PE routers is due to the configuration of the PE routers. You set up the connection, called a pseudowire, between the routers. You specify the following information on each PE router:

- The type of Layer 2 data that will be transported across the pseudowire, such as Ethernet, Frame Relay, or ATM
- The IP address of the loopback interface of the peer PE router, which enables the PE routers to communicate
- A unique combination of peer PE IP address and VC ID that identifies the pseudowire

The following example shows the basic configuration steps on a PE router that enable the transport of Layer 2 packets. Each transport type has slightly different steps.

Step 1 defines the interface or subinterface on the PE router:

```
Router# interface
 interface-type interface-number
```

Step specifies the encapsulation type for the interface, such as dot1q:

```
Router(config-if-srv)# encapsulation
encapsulation-type
```

Step 4 does the following:

- Makes a connection to the peer PE router by specifying the LDP router ID of the peer PE router.
- Specifies a 32-bit unique identifier, called the VC ID, which is shared between the two PE routers.

The combination of the peer router ID and the VC ID must be unique on the router. Two circuits cannot use the same combination of peer router ID and VC ID.

- Specifies the tunneling method used to encapsulate data in the pseudowire. AToM uses MPLS as the tunneling method.

```
Router(config-if-srv)# xconnect
peer-router-id vcid
encapsulation mpls
```

As an alternative, you can set up a pseudowire class to specify the tunneling method and other characteristics. For more information, see the Configuring the Pseudowire Class, on page 19.

How AToM Transports Layer 2 Packets Using Commands Associated with L2VPN Protocol-Based Feature

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- A unique combination of peer PE IP address and VC ID that identifies the pseudowire

The following example shows the basic configuration steps on a PE router that enable the transport of Layer 2 packets. Each transport type has slightly different steps.

Step 1 defines the interface or subinterface on the PE router:

```
Router# interface
interface-type interface-number
```

Step 3 specifies the encapsulation type for the interface, such as dot1q:

```
Router(config-if)# encapsulation
encapsulation-type
```

Step 3 does the following:

- Makes a connection to the peer PE router by specifying the LDP router ID of the peer PE router.
- Specifies a 32-bit unique identifier, called the VC ID, which is shared between the two PE routers.

The combination of the peer router ID and the VC ID must be unique on the router. Two circuits cannot use the same combination of peer router ID and VC ID.

- Specifies the tunneling method used to encapsulate data in the pseudowire. AToM uses MPLS as the tunneling method.

```
Router(config)# interface pseudowire 100
Router(config-if)# encapsulation mpls
Router(config-if)# neighbor 10.0.0.1 123
Router(config-if)# exit
!
Router(config)# l2vpn xconnect context A
Router(config-xconnect)# member pseudowire 100


Router(config-xconnect)# exit
```

As an alternative, you can set up a pseudowire class to specify the tunneling method and other characteristics. For more information, see the Configuring the Pseudowire Class, on page 19.

Benefits of AToM

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

- The AToM product set accommodates many types of Layer 2 packets, including Ethernet and Frame Relay, across multiple Cisco router platforms. This enables the service provider to transport all types of traffic over the backbone and accommodate all types of customers.
- AToM adheres to the standards developed for transporting Layer 2 packets over MPLS. This benefits the service provider that wants to incorporate industry-standard methodologies in the network. Other Layer 2 solutions are proprietary, which can limit the service provider's ability to expand the network and can force the service provider to use only one vendor's equipment.
- Upgrading to AToM is transparent to the customer. Because the service provider network is separate from the customer network, the service provider can upgrade to AToM without disruption of service to the customer. The customers assume that they are using a traditional Layer 2 backbone.

MPLS Traffic Engineering Fast Reroute

AToM can use MPLS traffic engineering (TE) tunnels with fast reroute (FRR) support. AToM VCs can be rerouted around a failed link or node at the same time as MPLS and IP prefixes.

Enabling fast reroute on AToM does not require any special commands; you can use standard fast reroute commands. At the ingress PE, an AToM tunnel is protected by fast reroute when it is routed to an FRR-protected TE tunnel. Both link and node protection are supported for AToM VCs at the ingress PE.

Maximum Transmission Unit Guidelines for Estimating Packet Size

The following calculation helps you determine the size of the packets traveling through the core network. You set the maximum transmission unit (MTU) on the core-facing interfaces of the P and PE routers to accommodate packets of this size. The MTU should be greater than or equal to the total bytes of the items in the following equation:

```
Core MTU >= (Edge MTU + Transport header + AToM header + (MPLS label stack * MPLS label
size))
```

The following sections describe the variables used in the equation.

Edge MTU

The edge MTU is the MTU for the customer-facing interfaces.

Transport Header

The Transport header depends on the transport type. The table below lists the specific sizes of the headers.

Table 1: Header Size of Packets

Transport Type	Packet Size
AAL5	0-32 bytes
Ethernet VLAN	18 bytes
Ethernet Port	14 bytes
Frame Relay DLCI	2 bytes for Cisco encapsulation, 8 bytes for Internet Engineering Task Force (IETF) encapsulation
HDLC	4 bytes
PPP	4 bytes

AToM Header

The AToM header is 4 bytes (control word). The control word is optional for Ethernet, PPP, HDLC, and cell relay transport types. The control word is required for Frame Relay and ATM AAL5 transport types.

MPLS Label Stack

The MPLS label stack size depends on the configuration of the core MPLS network:

- AToM uses one MPLS label to identify the AToM VCs (VC label). Therefore, the minimum MPLS label stack is one for directly connected AToM PEs, which are PE routers that do not have a P router between them.
- If LDP is used in the MPLS network, the label stack size is two (the LDP label and the VC label).
- If a TE tunnel instead of LDP is used between PE routers in the MPLS network, the label stack size is two (the TE label and the VC label).
- If a TE tunnel and LDP are used in the MPLS network (for example, a TE tunnel between P routers or between P and PE routers, with LDP on the tunnel), the label stack is three (TE label, LDP label, VC label).
- If you use MPLS fast reroute in the MPLS network, you add a label to the stack. The maximum MPLS label stack in this case is four (FRR label, TE label, LDP label, VC label).
- If AToM is used by the customer carrier in an MPLS VPN Carrier Supporting Carrier environment, you add a label to the stack. The maximum MPLS label stack in the provider carrier network is .
- If an AToM tunnel spans different service providers that exchange MPLS labels using IPv4 Border Gateway Protocol (BGP) (RFC 3107), you add a label to the stack. The maximum MPLS label stack is
- TE-FRR with BGP labels for layer 2 and layer 3 VPNs must terminate on the BGP gateway because of the four-label limitation.

Other circumstances can increase the MPLS label stack size. Therefore, analyze the complete data path between the AToM tunnel endpoints and determine the maximum MPLS label stack size for your network. Then multiply the label stack size by the size of the MPLS label.

Estimating Packet Size Example

The estimated packet size in the following example is 1526 bytes, based on the following assumptions:

- The edge MTU is 1500 bytes.
- The transport type is Ethernet VLAN, which designates 18 bytes for the transport header.
- The AToM header is 0, because the control word is not used.
- The MPLS label stack is 2, because LDP is used. The MPLS label is 4 bytes.

```
Edge MTU + Transport header + AToM header + (MPLS label stack * MPLS label) = Core MTU
1500     + 18                    + 0      + (2                * 4         ) = 1526
```

You must configure the P and PE routers in the core to accept packets of 1526 bytes.

Per-Subinterface MTU for Ethernet over MPLS

MTU values can be specified in xconnect subinterface configuration mode. When you use xconnect subinterface configuration mode to set the MTU value, you establish a pseudowire connection for situations where the interfaces have different MTU values that cannot be changed.

If you specify an MTU value in xconnect subinterface configuration mode that is outside the range of supported MTU values (64 bytes to the maximum number of bytes supported by the interface), the command might be rejected. If you specify an MTU value that is out of range in xconnect subinterface configuration mode, the router enters the command in subinterface configuration mode.

For example, if you specify an MTU of 1501 in xconnect subinterface configuration mode, and that value is out of range, the router enters the command in subinterface configuration mode, where it is accepted:

```
Router# configure terminal
Router(config)# interface gigabitethernet0/0/2.1
Router(config-subif)# xconnect 10.10.10.1 100 encapsulation mpls
Router(config-subif-xconn)# mtu ?
<64 - 1500> MTU size in bytes
Router(config-subif-xconn)# mtu 1501 <<================
Router(config-subif)# mtu ?
<64 - 17940> MTU size in bytes
```

If the MTU value is not accepted in either xconnect subinterface configuration mode or subinterface configuration mode, then the command is rejected.

Per-Subinterface MTU for Ethernet over MPLS using the commands associated with the L2VPN Protocol-Based CLIs feature

MTU values can be specified in xconnect configuration mode. When you use xconnect configuration mode to set the MTU value, you establish a pseudowire connection for situations where the interfaces have different MTU values that cannot be changed.

If you specify an MTU value in xconnect configuration mode that is outside the range of supported MTU values (64 bytes to the maximum number of bytes supported by the interface), the command might be rejected. If you specify an MTU value that is out of range in xconnect configuration mode, the router enters the command in subinterface configuration mode.

For example, if you specify an MTU of 1501 in xconnect configuration mode, and that value is out of range, the router enters the command in subinterface configuration mode, where it is accepted:

```
Router# configure terminal
Router(config)# interface gigabitethernet0/0/2.1
Router(config)# interface pseudowire 100
Router(config-if)# encapsulation mpls
Router(config-if)# neighbor 10.10.10.1 100
Router(config-if)# mtu ?
<64 - 1500> MTU size in bytes
Router(config-if)# mtu 1501 <<================
Router(config-if)# mtu ?
<64 - 17940> MTU size in bytes
Router(config-if)# exit
!
Router(config)# l2vpn xconnect context A
Router(config-xconnect)# member pseudowire 100 Router
Router(config-xconnect)# member gigabitethernet0/0/2.1
Router(config-xconnect)# exit
```

If the MTU value is not accepted in either xconnect configuration mode or subinterface configuration mode, then the command is rejected.

Frame Relay over MPLS and DTE DCE and NNI Connections

You can configure an interface as a DTE device or a DCE switch, or as a switch connected to a switch with network-to-network interface (NNI) connections. Use the following command in interface configuration mode:

frame-relay intf-type [**dce** | **dte** | **nni**]

The keywords are explained in the table below.

Table 2: frame-relay intf-type Command Keywords

Keyword	Description
dce	Enables the router or access server to function as a switch connected to a router.
dte	Enables the router or access server to function as a DTE device. DTE is the default.
nni	Enables the router or access server to function as a switch connected to a switch.

Local Management Interface and Frame Relay over MPLS

Local Management Interface (LMI) is a protocol that communicates status information about PVCs. When a PVC is added, deleted, or changed, the LMI notifies the endpoint of the status change. LMI also provides a polling mechanism that verifies that a link is up.

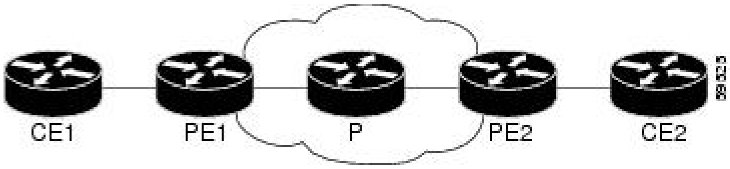
How LMI Works

To determine the PVC status, LMI checks that a PVC is available from the reporting device to the Frame Relay end-user device. If a PVC is available, LMI reports that the status is “Active,” which means that all interfaces, line protocols, and core segments are operational between the reporting device and the Frame Relay end-user device. If any of those components is not available, the LMI reports a status of “Inactive.”

Note Only the DCE and NNI interface types can report the LMI status.

The figure below is a sample topology that helps illustrate how LMI works.

Figure 1: Sample Topology



In the figure above, note the following:

- CE1 and PE1 and PE2 and CE2 are Frame Relay LMI peers.
- CE1 and CE2 can be Frame Relay switches or end-user devices.
- Each Frame Relay PVC comprises multiple segments.
- The DLCI value is local to each segment and is changed as traffic is switched from segment to segment. Two Frame Relay PVC segments exist in the figure; one is between PE1 and CE1 and the other is between PE2 and CE2.

The LMI protocol behavior depends on whether you have DLCI-to-DLCI or port-to-port connections.

DLCI-to-DLCI Connections

If you have DLCI-to-DLCI connections, LMI runs locally on the Frame Relay ports between the PE and CE devices:

- CE1 sends an active status to PE1 if the PVC for CE1 is available. If CE1 is a switch, LMI checks that the PVC is available from CE1 to the user device attached to CE1.
- PE1 sends an active status to CE1 if the following conditions are met:
  - A PVC for PE1 is available.
  - PE1 received an MPLS label from the remote PE router.
  - An MPLS tunnel label exists between PE1 and the remote PE.

For DTE or DCE configurations, the following LMI behavior exists: The Frame Relay device accessing the network (DTE) does not report the PVC status. Only the network device (DCE) or NNI can report the status. Therefore, if a problem exists on the DTE side, the DCE is not aware of the problem.

Port-to-Port Connections

If you have port-to-port connections, the PE routers do not participate in the LMI status-checking procedures. LMI operates only between the CE routers. The CE routers must be configured as DCE-DTE or NNI-NNI.

For information about LMI, including configuration instructions, see the “Configuring the LMI” section of the Configuring Frame Relay document.

QoS Features Supported with AToM

The tables below list the QoS features supported by AToM.

Table 3: QoS Features Supported with Ethernet over MPLS

QoS Feature	Ethernet over MPLS
Service policy	Can be applied to: • Interface (input and output)
Classification	Supports the following commands: • **match cos** (on interfaces) • **match mpls experimental** (on interfaces) • **match qos-group** (on interfaces) (output policy)
Marking	Supports the following commands: • **set cos** (output policy) • **set discard-class** (input policy) • **set mpls experimental** (input policy) (on interfaces) • **set qos-group** (input policy)

QoS Feature	Ethernet over MPLS
Policing	Supports the following: • Color-aware policing • Multiple-action policing • Single-rate policing • Two-rate policing
Queueing and shaping	Supports the following: • Byte-based WRED • Low Latency Queueing (LLQ) • Weighted Random Early Detection (WRED)

Table 4: QoS Features Supported with Frame Relay over MPLS

QoS Feature	Frame Relay over MPLS
Service policy	Can be applied to: • Interface (input and output) • PVC (input and output)
Classification	Supports the following commands: • **match fr-de** (on interfaces and VCs) • **match fr-dlci** (on interfaces) • **match qos-group**
Marking	Supports the following commands: • **frame-relay congestion management** (output) • **set discard-class** • **set fr-de** (output policy) • **set fr-fecn-becn** (output) • **set mpls experimental** • **set qos-group** • **threshold ecn** (output)

QoS Feature	Frame Relay over MPLS
Policing	Supports the following: • Color-aware policing • Multiple-action policing • Single-rate policing • Two-rate policing
Queueing and shaping	Supports the following: • Byte-based WRED • Class-based weighted fair queueing (CBWFQ) • LLQ • **random-detect discard-class-based** command • Traffic shaping • WRED

Table 5: QoS Features Supported with ATM Cell Relay and AAL5 over MPLS

QoS Feature	ATM Cell Relay and AAL5 over MPLS
Service policy	Can be applied to: • Interface (input and output) • PVC (input and output) • Subinterface (input and output)
Classification	Supports the following commands: • **match mpls experimental** (on VCs) • **match qos-group** (output)
Marking	Supports the following commands: • **random-detect discard-class-based** (input) • **set clp** (output) (on interfaces, subinterfaces, and VCs) • **set discard-class** (input) • **set mpls experimental** (input) (on interfaces, subinterfaces, and VCs) • **set qos-group** (input)

QoS Feature	ATM Cell Relay and AAL5 over MPLS
Policing	Supports the following: • Color-aware policing • Multiple-action policing • Single-rate policing • Two-rate policing
Queueing and shaping	Supports the following: • Byte-based WRED • CBWFQ • Class-based shaping support on ATM PVCs • LLQ • **random-detect discard-class-based** command • WRED

OAM Cell Emulation for ATM AAL5 over MPLS

If a PE router does not support the transport of Operation, Administration, and Maintenance (OAM) cells across a label switched path (LSP), you can use OAM cell emulation to locally terminate or loop back the OAM cells. You configure OAM cell emulation on both PE routers, which emulates a VC by forming two unidirectional LSPs. You use Cisco software commands on both PE routers to enable OAM cell emulation.

After you enable OAM cell emulation on a router, you can configure and manage the ATM VC in the same manner as you would a terminated VC. A VC that has been configured with OAM cell emulation can send loopback cells at configured intervals toward the local CE router. The endpoint can be either of the following:

- End-to-end loopback, which sends OAM cells to the local CE router.
- Segment loopback, which responds to OAM cells to a device along the path between the PE and CE routers.

The OAM cells include the following cells:

- Alarm indication signal (AIS)
- Remote defect indication (RDI)

These cells identify and report defects along a VC. When a physical link or interface failure occurs, intermediate nodes insert OAM AIS cells into all the downstream devices affected by the failure. When a router receives an AIS cell, it marks the ATM VC down and sends an RDI cell to let the remote end know about the failure.

OAM Cell Emulation for ATM AAL5 over MPLS in VC Class Configuration Mode

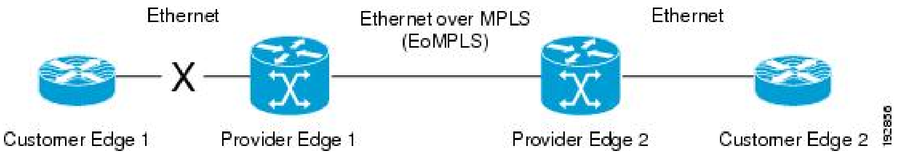
You can configure OAM cell emulation as part of a VC class and then apply the VC class to an interface, a subinterface, or a VC. When you configure OAM cell emulation in VC class configuration mode and then apply the VC class to an interface, the settings in the VC class apply to all the VCs on the interface, unless you specify a different OAM cell emulation value at a lower level, such as the subinterface or VC level. For example, you can create a VC class that specifies OAM cell emulation and sets the rate of AIS cells to every 30 seconds. You can apply the VC class to an interface. Then, for one PVC, you can enable OAM cell emulation and set the rate of AIS cells to every 15 seconds. All the PVCs on the interface use the cell rate of 30 seconds, except for the one PVC that was set to 15 seconds.

Any Transport over MPLS (AToM) Remote Ethernet Port Shutdown

This Cisco IOS XE feature allows a service provider edge (PE) router on the local end of an Ethernet over MPLS (EoMPLS) pseudowire to detect a remote link failure and cause the shutdown of the Ethernet port on the local customer edge (CE) router. Because the Ethernet port on the local CE router is shut down, the router does not lose data by continuously sending traffic to the failed remote link. This is beneficial if the link is configured as a static IP route.

The figure below illustrates a condition in an EoMPLS WAN, with a down Layer 2 tunnel link between a CE router (Customer Edge 1) and the PE router (Provider Edge 1). A CE router on the far side of the Layer 2 tunnel (Customer Edge 2), continues to forward traffic to Customer Edge 1 through the L2 tunnel.

Figure 2: Remote Link Outage in EoMPLS WAN



Previous to this feature, the Provider Edge 2 router could not detect a failed remote link. Traffic forwarded from Customer Edge 2 to Customer Edge 1 would be lost until routing or spanning tree protocols detected the down remote link. If the link was configured with static routing, the remote link outage would be even more difficult to detect.

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

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

1. The remote link between Customer Edge 1 and Provider Edge 1 fails.
2. Provider Edge 2 detects the remote link failure and disables the transmit laser on the line card interface connected to Customer Edge 2.
3. An RX_LOS error alarm is received by Customer Edge 2 causing Customer Edge 2 to bring down the interface.
4. Provider Edge 2 maintains its interface with Customer Edge 2 in an up state.
5. When the remote link and EoMPLS connection is restored, the Provider Edge 2 router enables the transmit laser.
6. The Customer Edge 2 router brings up its downed interface.

This feature is enabled by default for Ethernet over MPLS (EoMPLS). You can also enable this feature by using the **remote link failure notification** command in xconnect configuration mode as shown in the following example:

```
pseudowire-class eompls
 encapsulation mpls
!
interface GigabitEthernet1/0/0
 xconnect 10.13.13.13 1 pw-class eompls
  remote link failure notification
!
```

This feature can be disabled using the **no remote link failure notification** command in xconnect configuration mode. Use the **show ip interface brief** privileged EXEC command to display the status of all remote L2 tunnel links. Use the **show interface** privileged EXEC command to show the status of the L2 tunnel on a specific interface.

Note The **no remote link failure notification** command will not give notification to clients for remote attachment circuit status down.

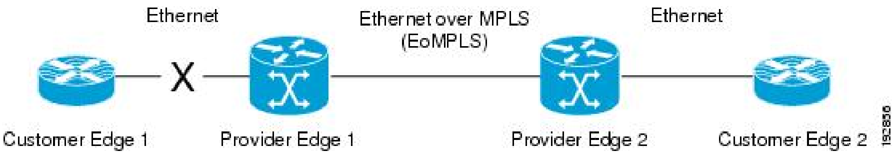
Note Remote Ethernet Port Shutdown is supported only on EFP with encapsulation default.

Any Transport over MPLS (AToM) Remote Ethernet Port Shutdown Using Commands Associated with L2VPN Protocol-Based Feature

This Cisco IOS XE feature allows a service provider edge (PE) router on the local end of an Ethernet over MPLS (EoMPLS) pseudowire to detect a remote link failure and cause the shutdown of the Ethernet port on the local customer edge (CE) router. Because the Ethernet port on the local CE router is shut down, the router does not lose data by continuously sending traffic to the failed remote link. This is beneficial if the link is configured as a static IP route.

The figure below illustrates a condition in an EoMPLS WAN, with a down Layer 2 tunnel link between a CE router (Customer Edge 1) and the PE router (Provider Edge 1). A CE router on the far side of the Layer 2 tunnel (Customer Edge 2), continues to forward traffic to Customer Edge 1 through the L2 tunnel.

Figure 3: Remote Link Outage in EoMPLS WAN



Previous to this feature, the Provider Edge 2 router could not detect a failed remote link. Traffic forwarded from Customer Edge 2 to Customer Edge 1 would be lost until routing or spanning tree protocols detected the down remote link. If the link was configured with static routing, the remote link outage would be even more difficult to detect.

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

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

1. The remote link between Customer Edge 1 and Provider Edge 1 fails.
2. Provider Edge 2 detects the remote link failure and disables the transmit laser on the line card interface connected to Customer Edge 2.
3. An RX_LOS error alarm is received by Customer Edge 2 causing Customer Edge 2 to bring down the interface.
4. Provider Edge 2 maintains its interface with Customer Edge 2 in an up state.
5. When the remote link and EoMPLS connection is restored, the Provider Edge 2 router enables the transmit laser.
6. The Customer Edge 2 router brings up its downed interface.

This feature is enabled by default for Ethernet over MPLS (EoMPLS). You can also enable this feature by using the **remote link failure notification** command in xconnect configuration mode as shown in the following example:

This feature can be disabled using the **no remote link failure notification** command in xconnect configuration mode. Use the **show ip interface brief** privileged EXEC command to display the status of all remote L2 tunnel links. Use the **show interface** privileged EXEC command to show the status of the L2 tunnel on a specific interface.

Note The **no remote link failure notification** command will not give notification to clients for remote attachment circuit status down.

AToM Load Balancing with Single PW

The AToM Load Balancing with Single PW feature enables load balancing for packets within the same pseudowire by further classifying packets within the same pseudowire into different flows based on certain fields in the packet received on an attachment circuit. For example, for Ethernet this load balancing is based on the source MAC address in the incoming packets.

Flow-Aware Transport (FAT) Load Balancing

The Flow-Aware Transport of MPLS Pseudowires feature enables load balancing of packets within the same pseudowire by further classifying the packets into different flows by adding a flow label at the bottom of the MPLS label stack.

Information About EoMPLS over IPv6 GRE Tunnel

Ethernet over MPLS (EoMPLS) is a tunneling mechanism that allows you to tunnel Layer 2 traffic through a Layer 3 MPLS network. EoMPLS is also known as Layer 2 tunneling.

The EoMPLS over IPv6 GRE Tunnel feature supports tunneling of EoMPLS traffic via an IPv6 network by using GRE tunnels. Effective from Cisco IOS XE Release 3.15s, EoMPLS is supported over IPv6 GRE tunnel.

Additional Information on EoMPLS over IPv6 GRE Tunnel

For more information on EoMPLS over IPv6 GRE Tunnel feature, see GRE IPv6 Tunnels chapter of the *Interface and Hardware Component Configuration Guide, Cisco IOS XE Release 3S (ASR 1000)*.

How to Configure Any Transport over MPLS

This section explains how to perform a basic AToM configuration and includes the following procedures:

Configuring the Pseudowire Class

Note In simple configurations, this task is optional. You need not specify a pseudowire class if you specify the tunneling method as part of the **xconnect** command.

- You must specify the **encapsulation mpls** command as part of the pseudowire class or as part of the **xconnect** command for the AToM VCs to work properly. If you omit the **encapsulation mpls** command as part of the **xconnect** command, you receive the following error:

```
% Incomplete command.
```

Step 1 **enable**

Example:

```
Router> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Router# configure terminal
```

Enters global configuration mode.

Step 3 **pseudowire-class** *name*

Example:

```
Router(config)# pseudowire-class atom
```

Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.

Step 4 **encapsulation mpls**

Example:

```
Router(config-pw)# encapsulation mpls
```

Specifies the tunneling encapsulation.

Configuring the Pseudowire Class Using Commands Associated with L2VPN Protocol-Based Feature

Note In simple configurations, this task is optional. You need not specify a pseudowire class if you specify the tunneling method as part of the **l2vpn xconnect context** command.

- You must specify the **encapsulation mpls** command as part of the pseudowire class or as part of the **l2vpn xconnect context** command for the AToM VCs to work properly. If you omit the **encapsulation mpls** command as part of the **l2vpn xconnect context**command, you receive the following error:

```
% Incomplete command.
```

Step 1 **enable**

Example:

```
Router> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Router# configure terminal
```

Enters global configuration mode.

Step 3 **interface pseudowire** *name*

Example:

```
Router(config)# interface pseudowire atom
```

Establishes an interface pseudowire with a name that you specify and enters pseudowire class configuration mode.

Step 4 **encapsulation mpls**

Example:

```
Router(config-pw-class)# encapsulation mpls
```

Specifies the tunneling encapsulation.

Step 5 **neighbor** *peer-address vcid-value*

Example:

```
Router(config-pw-class)#  neighbor 33.33.33.33 1
```

Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.

Changing the Encapsulation Type and Removing a Pseudowire

Once you specify the **encapsulation mpls** command, you cannot remove it using the **no encapsulation mpls** command.

Those methods result in the following error message:

```
Encapsulation changes are not allowed on an existing pw-class.
```

To remove the **encapsulation mpls** command, you must delete the pseudowire with the **no pseudowire-class** command.

To change the type of encapsulation, remove the pseudowire using the **no pseudowire-class** command and reconfigure the pseudowire to specify the new encapsulation type.

Changing the Encapsulation Type and Removing a Pseudowire Using Commands Associated with the L2VPN Protocol-Based Feature

Once you specify the **encapsulation mpls** command, you cannot remove it using the **no encapsulation mpls** command.

Those methods result in the following error message:

To remove the **encapsulation mpls** command, you must delete the pseudowire with the **no interface pseudowire** command.

To change the type of encapsulation, remove the pseudowire using the **no template type pseudowire** command and reconfigure the pseudowire to specify the new encapsulation type.

Configuring ATM AAL5 over MPLS

Configuring ATM AAL5 over MPLS on PVCs

Step 1 **enable**

Example:

```
Router> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Router# configure terminal
```

Enters global configuration mode.

Step 3 **interface** *type slot* / *subslot* / *port* [**.** *subinterface*]

Example:

```
Router(config)# interface atm1/0/0
```

Specifies the interface type and enters interface configuration mode.

Step 4 **pvc** [*name*] *vpi* **/** *vci* **l2transport**

Example:

```
Router(config-if)# pvc 1/200 l2transport
```

Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.

- The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.

Step 5 **encapsulation aal5**

Example:

```
Router(config-if-atm-l2trans-pvc)# encapsulation aal5
```

Specifies ATM AAL5 encapsulation for the PVC. Make sure you specify the same encapsulation type on the PE and customer edge (CE) routers.

Step 6 **xconnect** *peer-router-id vcid* **encapsulation mpls**

Example:

```
Router(config-if-atm-l2trans-pvc)# xconnect 10.13.13.13 100 encapsulation mpls
```

Binds the attachment circuit to a pseudowire VC.

Step 7 **end**

Example:

```
Router(config-if-atm-l2trans-pvc)# end
```

Exits to privileged EXEC mode.

Step 8 **show mpls l2transport vc**

Example:

```
Router# show mpls l2transport vc
```

Displays output that shows ATM AAL5 over MPLS is configured on a PVC.

Examples

The following is sample output from the **show mpls l2transport vc** command that shows that ATM AAL5 over MPLS is configured on a PVC:

```
Router# show mpls l2transport vc
Local intf   Local circuit          Dest address      VC ID      Status
---------    -------------          ------------      -----      ------
ATM1/0       ATM AAL5 1/100         10.4.4.4           100        UP
```

Configuring ATM AAL5 over MPLS on PVCs using the commands associated with the L2VPN Protocol-Based CLIs feature

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 atm1/0/0
```

Specifies the interface type and enters interface configuration mode.

Step 4 **pvc** [*name*] *vpi* **/** *vci* **l2transport**

Example:

```
Device(config-if)# pvc 1/200 l2transport
```

Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.

- The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.

Step 5 **encapsulation aal5**

Example:

```
Device(config-if-atm-l2trans-pvc)# encapsulation aal5
```

Specifies ATM AAL5 encapsulation for the PVC. Make sure you specify the same encapsulation type on the PE and customer edge (CE) routers.

Step 6 **end**

Example:

```
Device(config-if-atm-l2trans-pvc)# end
```

Exits to privileged EXEC mode.

Step 7 **interface pseudowire** *number*

Example:

```
Device(config)# interface pseudowire 100
```

Specifies the pseudowire interface and enters interface configuration mode.

Step 8 **encapsulation mpls**

Example:

```
Device(config-if)# encapsulation mpls
```

Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.

Step 9 **neighbor** *peer-address vcid-value*

Example:

```
Device(config-if)# neighbor 10.13.13.13 100
```

Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.

Step 10 **exit**

Example:

```
Device(config-if)# exit
```

Exits interface configuration mode.

Step 11 **l2vpn xconnect context** *context-name*

Example:

```
Device(config)# l2vpn xconnect context con1
```

Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.

Step 12 **member pseudowire** *interface-number*

Example:

```
Device(config-xconnect)# member pseudowire 100
```

Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.

Step 13 **member atm** *interface-number* **pvc** *vpi* / *vci*

Example:

```
Device(config-xconnect)# member atm 100 pvc 1/200
```

Specifies the location of the ATM member interface.

Step 14 **end**

Example:

```
Device(config-xconnect)# end
```

Exits to privileged EXEC mode.

Step 15 **show l2vpn atom vc**

Example:

```
Device# show l2vpn atom vc
```

Displays output that shows ATM AAL5 over MPLS is configured on a PVC.

Examples

The following is sample output from the **show l2vpn atom vc** command that shows that ATM AAL5 over MPLS is configured on a PVC:

```
Device# show l2vpn atom vc
Local intf   Local circuit          Dest address      VC ID      Status
---------    -------------          ------------      -----      ------
ATM1/0       ATM AAL5 1/100         10.4.4.4           100        UP
```

Configuring ATM AAL5 over MPLS in VC Class Configuration Mode

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 **vc-class atm** *vc-class-name*

Example:

```
Router(config)# vc-class atm aal5class
```

Creates a VC class and enters VC class configuration mode.

Step 4 **encapsulation** *layer-type*

Example:

```
Router(config-vc-class)# encapsulation aal5
```

Configures the AAL and encapsulation type.

Step 5 **exit**

Example:

```
Router(config-vc-class)# exit
```

Exits VC class configuration mode.

Step 6 **interface** *type* *slot* **/** *subslot* **/** *port* [**.** *subinterface*]

Example:

```
Router(config)# interface atm1/0/0
```

Specifies the interface type enters interface configuration mode.

Step 7 **class-int** *vc-class-name*

Example:

```
Router(config-if)# class-int aal5class
```

Applies a VC class to the ATM main interface or subinterface.

Note You can also apply a VC class to a PVC.

Step 8 **pvc** [*name*] *vpi* **/** *vci* **l2transport**

Example:

```
Router(config-if)# pvc 1/200 l2transport
```

Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.

- The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.

Step 9 **xconnect** *peer-router-id vcid* **encapsulation mpls**

Example:

```
Router(config-if-atm-l2trans-pvc)# xconnect 10.13.13.13 100 encapsulation mpls
```

Binds the attachment circuit to a pseudowire VC.

Step 10 **end**

Example:

```
Router(config-if-atm-l2trans-pvc)# end
```

Exits to privileged EXEC mode.

Step 11 **show atm class-links**

Example:

```
Router# show atm class-links
```

Displays the type of encapsulation and that the VC class was applied to an interface.

Examples

In the following example, the command output from the **show atm class-links** command verifies that ATM AAL5 over MPLS is configured as part of a VC class. The command output shows the type of encapsulation and that the VC class was applied to an interface.

```
Router# show atm class-links 1/100
Displaying vc-class inheritance for ATM1/0/0.0, vc 1/100:
no broadcast - Not configured - using default
encapsulation aal5 - VC-class configured on main interface
```

Configuring ATM AAL5 over MPLS in VC Class Configuration Mode using the commands associated with the L2VPN Protocol-Based CLIs feature

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 **vc-class atm** *vc-class-name*

Example:

```
Router(config)# vc-class atm aal5class
```

Creates a VC class and enters VC class configuration mode.

Step 4 **encapsulation** *layer-type*

Example:

```
Router(config-vc-class)# encapsulation aal5
```

Configures the AAL and encapsulation type.

Step 5 **exit**

Example:

```
Router(config-vc-class)# exit
```

Exits VC class configuration mode.

Step 6 **interface** *type slot* / *subslot* / *port* [**.** *subinterface*]

Example:

```
Router(config)# interface atm1/0/0
```

Specifies the interface type enters interface configuration mode.

Step 7 **class-int** *vc-class-name*

Example:

```
Router(config-if)# class-int aal5class
```

Applies a VC class to the ATM main interface or subinterface.

Note You can also apply a VC class to a PVC.

Step 8 **pvc** [*name*] *vpi* / *vci* **l2transport**

Example:

```
Router(config-if)# pvc 1/200 l2transport
```

Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.

- The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.

Step 9 **exit**

Example:

```
Router(config-if)# exit
```

Exits interface configuration mode.

Step 10 **interface pseudowire** *number*

Example:

```
Router(config)# interface pseudowire 100
```

Specifies the pseudowire interface and enters interface configuration mode.

Step 11 **encapsulation mpls**

Example:

```
Router(config-if)# encapsulation mpls
```

Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.

Step 12 **neighbor** *peer-address vcid-value*

Example:

```
Router(config-if)# neighbor 10.0.0.1 123
```

Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.

Step 13 **exit**

Example:

```
Router(config-if)# exit
```

Exits interface configuration mode.

Step 14 **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 15 **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 16 **member atm** *interface-number*

Example:

```
Device(config-xconnect)# member atm 100
```

Specifies the location of the ATM member interface.

Step 17 **end**

Example:

```
Router(config-if-atm-l2trans-pvc)# end
```

Exits to privileged EXEC mode.

Step 18 **show atm class-links**

Example:

```
Router# show atm class-links
```

Displays the type of encapsulation and that the VC class was applied to an interface.

Examples

In the following example, the command output from the **show atm class-links** command verifies that ATM AAL5 over MPLS is configured as part of a VC class. The command output shows the type of encapsulation and that the VC class was applied to an interface.

```
Router# show atm class-links 1/100
Displaying vc-class inheritance for ATM1/0/0.0, vc 1/100:
no broadcast - Not configured - using default
encapsulation aal5 - VC-class configured on main interface
```

Configuring OAM Cell Emulation for ATM AAL5 over MPLS

Configuring OAM Cell Emulation for ATM AAL5 over MPLS on PVCs

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot* / *subslot* / *port* [**.** *subinterface*]
4. **pvc** [*name*] *vpi* / *vci* **l2transport**
5. **encapsulation aal5**
6. **xconnect** *peer-router-id vcid* **encapsulation mpls**
7. **oam-ac emulation-enable** [*ais-rate*]
8. *oam-pvc manage* [*frequency*]
9. **end**
10. **show atm pvc**

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	**interface** *type slot* / *subslot* / *port* [**.** *subinterface*] **Example:**	Specifies the interface type enters interface configuration mode.

	Command or Action	Purpose
	`Router(config)# interface atm1/0/0`	
Step 4	**pvc** [*name*] *vpi* / *vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode. • The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.
Step 5	**encapsulation aal5** **Example:** `Router(config-if-atm-l2trans-pvc)# encapsulation aal5`	Specifies ATM AAL5 encapsulation for the PVC. • Specify the same encapsulation type on the PE and CE routers.
Step 6	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(config-if-atm-l2trans-pvc)# xconnect 10.13.13.13 100 encapsulation mpls`	Binds the attachment circuit to a pseudowire VC.
Step 7	**oam-ac emulation-enable** [*ais-rate*] **Example:** `Router(config-if-atm-l2trans-pvc)# oam-ac emulation-enable 30`	Enables OAM cell emulation for AAL5 over MPLS. The *ais-rate* argument lets you specify the rate at which AIS cells are sent. The default is one cell every second. The range is 0 to 60 seconds.
Step 8	*oam-pvc manage* [*frequency*] **Example:** `Router(config-if-atm-l2trans-pvc)# oam-pvc manage`	Enables the PVC to generate end-to-end OAM loopback cells that verify connectivity on the virtual circuit. The optional *frequency* argument is the interval between transmission of loopback cells and ranges from 0 to 600 seconds. The default value is 10 seconds.

Step 9	**end**
	Example:
	`Router(config-if-atm-l2trans-pvc)# end`
		Exits to privileged EXEC mode.

Step 10	**show atm pvc** **Example:** `Router# show atm pvc`	Displays output that shows OAM cell emulation is enabled on the ATM PVC.

Examples

The following output from the **show atm pvc** command shows that OAM cell emulation is enabled on the ATM PVC:

```
Router# show atm pvc 5/500
ATM4/1/0.200: VCD: 6, VPI: 5, VCI: 500
UBR, PeakRate: 1
AAL5-LLC/SNAP, etype:0x0, Flags: 0x34000C20, VCmode: 0x0
OAM Cell Emulation: enabled, F5 End2end AIS Xmit frequency: 1 second(s)
OAM frequency: 0 second(s), OAM retry frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Disabled
OAM VC state: Not ManagedVerified
ILMI VC state: Not Managed
InPkts: 564, OutPkts: 560, InBytes: 19792, OutBytes: 19680
InPRoc: 0, OutPRoc: 0
InFast: 4, OutFast: 0, InAS: 560, OutAS: 560
InPktDrops: 0, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0
Out CLP=1 Pkts: 0
OAM cells received: 26
F5 InEndloop: 0, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 26
OAM cells sent: 77
F5 OutEndloop: 0, F5 OutSegloop: 0, F5 OutAIS: 77, F5 OutRDI: 0
OAM cell drops: 0
Status: UP
```

Configuring OAM Cell Emulation for ATM AAL5 over MPLS on PVCs 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. **pvc** [*name*] *vpi* / *vci* **l2transport**
5. **encapsulation aal5**
6. **exit**
7. **interface pseudowire** *number*
8. **encapsulation mpls**
9. **neighbor** *peer-address vcid-value*
10. **exit**
11. **l2vpn xconnect context** *context-name*
12. **member pseudowire** *interface-number*
13. **member atm** *interface-number* **pvc** *vpi* / *vci*
14. **exit**
15. **pvc** [*name*] *vpi* / *vci* **l2transport**
16. **oam-ac emulation-enable** [*ais-rate*]
17. *oam-pvc manage* [*frequency*]
18. **end**
19. **show atm pvc**

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	**interface** *type slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface atm1/0/0`	Specifies the interface type enters interface configuration mode.
Step 4	**pvc** [*name*] *vpi* / *vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode. - The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.
Step 5	**encapsulation aal5** **Example:** `Router(config-if-atm-l2trans-pvc)# encapsulation aal5`	Specifies ATM AAL5 encapsulation for the PVC. - Specify the same encapsulation type on the PE and CE routers.
Step 6	**exit** **Example:** `Router(config-if-atm-l2trans-pvc)# exit`	Exits L2transport PVC configuration mode.
Step 7	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 8	**encapsulation mpls** **Example:** `Router(config-if)# encapsulation mpls`	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 9	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)# neighbor 10.0.0.1 123`	Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.

	Command or Action	Purpose
Step 10	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 11	**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 12	**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 13	**member atm** *interface-number* **pvc** *vpi* / *vci* **Example:** `Device(config-xconnect)# member atm 100 pvc 1/200`	Specifies the location of the ATM member interface.
Step 14	**exit** **Example:** `Router(config-xconnect)# exit`	Exits xconnect configuration mode.
Step 15	**pvc** [*name*] *vpi* / *vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.
Step 16	**oam-ac emulation-enable** [*ais-rate*] **Example:** `Router(config-if-atm-l2trans-pvc)# oam-ac emulation-enable 30`	Enables OAM cell emulation for AAL5 over MPLS. The *ais-rate* argument lets you specify the rate at which AIS cells are sent. The default is one cell every second. The range is 0 to 60 seconds.
Step 17	*oam-pvc manage* [*frequency*] **Example:** `Router(config-if-atm-l2trans-pvc)# oam-pvc manage`	Enables the PVC to generate end-to-end OAM loopback cells that verify connectivity on the virtual circuit. The optional *frequency* argument is the interval between transmission of loopback cells and ranges from 0 to 600 seconds. The default value is 10 seconds.

Step 18	**end**
	Example:
	`Router(config-if-atm-l2trans-pvc)# end`
		Exits to privileged EXEC mode.

	Command or Action	Purpose
Step 19	**show atm pvc** **Example:** `Router# show atm pvc`	Displays output that shows OAM cell emulation is enabled on the ATM PVC.

Examples

The following output from the **show atm pvc** command shows that OAM cell emulation is enabled on the ATM PVC:

```
Router# show atm pvc 5/500
ATM4/1/0.200: VCD: 6, VPI: 5, VCI: 500
UBR, PeakRate: 1
AAL5-LLC/SNAP, etype:0x0, Flags: 0x34000C20, VCmode: 0x0
OAM Cell Emulation: enabled, F5 End2end AIS Xmit frequency: 1 second(s)
OAM frequency: 0 second(s), OAM retry frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Disabled
OAM VC state: Not ManagedVerified
ILMI VC state: Not Managed
InPkts: 564, OutPkts: 560, InBytes: 19792, OutBytes: 19680
InPRoc: 0, OutPRoc: 0
InFast: 4, OutFast: 0, InAS: 560, OutAS: 560
InPktDrops: 0, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0
Out CLP=1 Pkts: 0
OAM cells received: 26
F5 InEndloop: 0, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 26
OAM cells sent: 77
F5 OutEndloop: 0, F5 OutSegloop: 0, F5 OutAIS: 77, F5 OutRDI: 0
OAM cell drops: 0
Status: UP
```

Configuring OAM Cell Emulation for ATM AAL5 over MPLS in VC Class Configuration Mode

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vc-class atm** *name*
4. **encapsulation** *layer-type*
5. **oam-ac emulation-enable** [*ais-rate*]
6. **oam-pvc manage** [*frequency*]
7. **exit**
8. **interface** *type slot* / *subslot* / *port* [**.** *subinterface*]
9. **class-int** *vc-class-name*
10. **pvc** [*name*] *vpi* / *vci* **l2transport**
11. **xconnect** *peer-router-id vcid* **encapsulation mpls**

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	**vc-class atm** *name* **Example:** `Router(config)# vc-class atm oamclass`	Creates a VC class and enters VC class configuration mode.
Step 4	**encapsulation** *layer-type* **Example:** `Router(config-vc-class)# encapsulation aal5`	Configures the AAL and encapsulation type.
Step 5	**oam-ac emulation-enable** [*ais-rate*] **Example:** `Router(config-vc-class)# oam-ac emulation-enable 30`	Enables OAM cell emulation for AAL5 over MPLS and specifies the rate at which AIS cells are sent.
Step 6	**oam-pvc manage** [*frequency*] **Example:** `Router(config-vc-class)# oam-pvc manage`	Enables the PVC to generate end-to-end OAM loopback cells that verify connectivity on the virtual circuit.
Step 7	**exit** **Example:** `Router(config-vc-class)# exit`	Exits VC class configuration mode.
Step 8	**interface** *type slot* **/** *subslot* **/** *port* [**.** *subinterface*] **Example:** `Router(config)# interface atm1/0/0`	Specifies the interface type and enters interface configuration mode.

Step 9	**class-int** *vc-class-name*
	Example:
	`Router(config-if)# class-int oamclass`
		Applies a VC class to the ATM main interface or subinterface.
		Note You can also apply a VC class to a PVC.

	Command or Action	Purpose
Step 10	**pvc** [*name*] *vpi* / *vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode. • The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.
Step 11	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(config-if-atm-l2trans-pvc)# xconnect 10.13.13.13 100 encapsulation mpls`	Binds the attachment circuit to a pseudowire VC.

Configuring OAM Cell Emulation for ATM AAL5 over MPLS in VC Class Configuration Mode using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vc-class atm** *name*
4. **encapsulation** *layer-type*
5. **oam-ac emulation-enable** [*ais-rate*]
6. **oam-pvc manage** [*frequency*]
7. **exit**
8. **interface** *type slot* / *subslot* / *port* [**.** *subinterface*]
9. **class-int** *vc-class-name*
10. **pvc** [*name*] *vpi* / *vci* **l2transport**
11. **end**
12. **interface pseudowire** *number*
13. **encapsulation mpls**
14. **neighbor** *peer-address vcid-value*
15. **exit**
16. **l2vpn xconnect context** *context-name*
17. **member pseudowire** *interface-number*
18. **member atm** *interface-number*
19. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**vc-class atm** *name* **Example:** `Router(config)# vc-class atm oamclass`	Creates a VC class and enters VC class configuration mode.
Step 4	**encapsulation** *layer-type* **Example:** `Router(config-vc-class)# encapsulation aal5`	Configures the AAL and encapsulation type.
Step 5	**oam-ac emulation-enable** [*ais-rate*] **Example:** `Router(config-vc-class)# oam-ac emulation-enable 30`	Enables OAM cell emulation for AAL5 over MPLS and specifies the rate at which AIS cells are sent.
Step 6	**oam-pvc manage** [*frequency*] **Example:** `Router(config-vc-class)# oam-pvc manage`	Enables the PVC to generate end-to-end OAM loopback cells that verify connectivity on the virtual circuit.
Step 7	**exit** **Example:** `Router(config-vc-class)# exit`	Exits VC class configuration mode.
Step 8	**interface** *type slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface atm1/0/0`	Specifies the interface type and enters interface configuration mode.

Step 9	**class-int** *vc-class-name*
	Example:
	`Router(config-if)# class-int oamclass`
		Applies a VC class to the ATM main interface or subinterface.
		Note You can also apply a VC class to a PVC.

Step 10	**pvc** [*name*] *vpi* / *vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode. • The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.

	Command or Action	Purpose

Step 11	**end**
	Example:
	`Router(config-if-atm-l2trans-pvc)# end`
		Exits to privileged EXEC mode.

Step 12	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 13	**encapsulation mpls** **Example:** `Router(config-if)# encapsulation mpls`	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 14	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)# neighbor 10.0.0.1 123`	Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.
Step 15	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration 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 atm** *interface-number* **Example:** `Device(config-xconnect)# member atm 100`	Specifies the location of the ATM member interface.

Step 19	**end**
	Example:
	`Router(config-xconnect)# end`
		Exits to privileged EXEC mode.

Configuring ATM Cell Relay over MPLS

Configuring ATM Cell Relay over MPLS in VC Mode

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *slot* **/** *subslot* **/** *port* [**.** *subinterface*]
4. **pvc** *vpi* **/** *vci* **l2transport**
5. **encapsulation aal0**
6. **xconnect** *peer-router-id vcid* **encapsulation mpls**
7. **end**
8. **show atm vc**

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	**interface atm** *slot* **/** *subslot* **/** *port* [**.** *subinterface*] **Example:** `Router(config)# interface atm1/0/0`	Specifies an ATM interface and enters interface configuration mode.
Step 4	**pvc** *vpi* **/** *vci* **l2transport** **Example:** `Router(config-if)# pvc 0/100 l2transport`	Assigns a virtual path identifier (VPI) and virtual circuit identifier (VCI) and enters L2transport VC configuration mode.
Step 5	**encapsulation aal0** **Example:** `Router(config-if-atm-l2trans-pvc)# encapsulation aal0`	For ATM cell relay, specifies raw cell encapsulation for the interface. • Make sure you specify the same encapsulation type on the PE and CE routers.
Step 6	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:**	Binds the attachment circuit to a pseudowire VC.

	Command or Action	Purpose
	`Router(config-if-atm-l2trans-pvc)# xconnect 10.13.13.13 100 encapsulation mpls`	

Step 7	**end**
	Example:
	`Router(config-if-atm-l2trans-pvc)# end`
		Exits to privileged EXEC mode.

Step 8	**show atm vc** **Example:** `Router# show atm vc`	Verifies that OAM cell emulation is enabled on the ATM VC.

Example

The following sample output from the **show atm vc** command shows that the interface is configured for VC mode cell relay:

```
Router# show atm vc 7
ATM3/0: VCD: 7, VPI: 23, VCI: 100
UBR, PeakRate: 149760
AAL0-Cell Relay, etype:0x10, Flags: 0x10000C2D, VCmode: 0x0
OAM Cell Emulation: not configured
InBytes: 0, OutBytes: 0
Status: UP
```

Configuring ATM Cell Relay over MPLS in VC Mode using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *slot* **/** *subslot* **/** *port* [**.** *subinterface*]
4. **pvc** *vpi* **/** *vci* **l2transport**
5. **encapsulation aal0**
6. **end**
7. **interface pseudowire** *number*
8. **encapsulation mpls**
9. **neighbor** *peer-address vcid-value*
10. **exit**
11. **l2vpn xconnect context** *context-name*
12. **member pseudowire** *interface-number*
13. **member atm** *interface-number*
14. **end**
15. **show atm vc**

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	**interface atm** *slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface atm1/0/0`	Specifies an ATM interface and enters interface configuration mode.
Step 4	**pvc** *vpi* / *vci* **l2transport** **Example:** `Router(config-if)# pvc 0/100 l2transport`	Assigns a virtual path identifier (VPI) and virtual circuit identifier (VCI) and enters L2transport VC configuration mode.
Step 5	**encapsulation aal0** **Example:** `Router(config-if-atm-l2trans-pvc)# encapsulation aal0`	For ATM cell relay, specifies raw cell encapsulation for the interface. • Make sure you specify the same encapsulation type on the PE and CE routers.

Step 6	**end**
	Example:
	`Router(config-if-atm-l2trans-pvc)# end`
		Exits to privileged EXEC mode.

Step 7	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 8	**encapsulation mpls** **Example:** `Router(config-if)# encapsulation mpls`	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 9	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)# neighbor 10.0.0.1 123`	Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.

	Command or Action	Purpose
Step 10	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 11	**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 12	**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 13	**member atm** *interface-number* **Example:** `Device(config-xconnect)# member atm 100`	Specifies the location of the ATM member interface.

Step 14	**end**
	Example:
	`Router(config-xconnect)# end`
		Exits to privileged EXEC mode.

Step 15	**show atm vc** **Example:** `Router# show atm vc`	Verifies that OAM cell emulation is enabled on the ATM VC.

Example

The following sample output from the **show atm vc** command shows that the interface is configured for VC mode cell relay:

```
Router# show atm vc 7
ATM3/0: VCD: 7, VPI: 23, VCI: 100
UBR, PeakRate: 149760
AAL0-Cell Relay, etype:0x10, Flags: 0x10000C2D, VCmode: 0x0
OAM Cell Emulation: not configured
InBytes: 0, OutBytes: 0
Status: UP
```

Configuring ATM Cell Relay over MPLS in VC Mode Using VC Class Configuration Mode

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vc-class atm** *name*
4. **encapsulation** *layer-type*
5. **exit**
6. **interface** *type slot* / *subslot* / *port* [**.** *subinterface*]
7. **class-int** *vc-class-name*
8. **pvc** [*name*] *vpi* / *vci* **l2transport**
9. **xconnect** *peer-router-id vcid* **encapsulation mpls**

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	**vc-class atm** *name* **Example:** `Router(config)# vc-class atm cellrelay`	Creates a VC class and enters VC class configuration mode.
Step 4	**encapsulation** *layer-type* **Example:** `Router(config-vc-class)# encapsulation aal0`	Configures the AAL and encapsulation type.
Step 5	**exit** **Example:** `Router(config-vc-class)# exit`	Exits VC class configuration mode.
Step 6	**interface** *type slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface atm1/0/0`	Specifies the interface type and enters interface configuration mode.

	Command or Action	Purpose

Step 7	**class-int** *vc-class-name*
	Example:
	`Router(config-if)# class-int cellrelay`
		Applies a VC class to the ATM main interface or subinterface.
		Note You can also apply a VC class to a PVC.

Step 8	**pvc** [*name*] *vpi* / *vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.
Step 9	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(config-if-atm-l2trans-pvc)# xconnect 10.13.13.13 100 encapsulation mpls`	Binds the attachment circuit to a pseudowire VC.

Configuring ATM Cell Relay over MPLS in VC Mode Using VC Class Configuration Mode using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vc-class atm** *name*
4. **encapsulation** *layer-type*
5. **exit**
6. **interface** *type slot* / *subslot* / *port* [**.** *subinterface*]
7. **class-int** *vc-class-name*
8. **pvc** [*name*] *vpi* / *vci* **l2transport**
9. **end**
10. **interface pseudowire** *number*
11. **encapsulation mpls**
12. **neighbor** *peer-address vcid-value*
13. **exit**
14. **l2vpn xconnect context** *context-name*
15. **member pseudowire** *interface-number*
16. **member atm** *interface-number*
17. **end**

DETAILED STEPS

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

	Command or Action	Purpose
	`Router> enable`	
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**vc-class atm** *name* **Example:** `Router(config)# vc-class atm cellrelay`	Creates a VC class and enters VC class configuration mode.
Step 4	**encapsulation** *layer-type* **Example:** `Router(config-vc-class)# encapsulation aal0`	Configures the AAL and encapsulation type.
Step 5	**exit** **Example:** `Router(config-vc-class)# exit`	Exits VC class configuration mode.
Step 6	**interface** *type* *slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface atm1/0/0`	Specifies the interface type and enters interface configuration mode.

Step 7	**class-int** *vc-class-name*
	Example:
	`Router(config-if)# class-int cellrelay`
		Applies a VC class to the ATM main interface or subinterface.
		Note You can also apply a VC class to a PVC.

Step 8	**pvc** [*name*] *vpi* / *vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.

Step 9	**end**
	Example:
	`Router(config-if-atm-l2trans-pvc)# end`
		Exits to privileged EXEC mode.

Step 10	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.

	Command or Action	Purpose
Step 11	**encapsulation mpls** **Example:** `Router(config-if)# encapsulation mpls`	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 12	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)# neighbor 10.0.0.1 123`	Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.
Step 13	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 14	**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 15	**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 16	**member atm** *interface-number* **Example:** `Device(config-xconnect)# member atm 100`	Specifies the location of the ATM member interface.

Step 17	**end**
	Example:
	`Router(config-xconnect)# end`
		Exits to privileged EXEC mode.

Configuring ATM Cell Relay over MPLS in PVP Mode

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *slot* / *subslot* / *port* [**.** *subinterface*]
4. **atm pvp** *vpi* **l2transport**
5. **xconnect** *peer-router-id vcid* **encapsulation mpls**
6. **end**
7. **show atm vp**

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	**interface atm** *slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface atm1/0/0`	Defines the interface and enters interface configuration mode.
Step 4	**atm pvp** *vpi* **l2transport** **Example:** `Router(config-if)# atm pvp 1 l2transport`	Specifies that the PVP is dedicated to transporting ATM cells and enters L2transport PVP configuration mode. • The **l2transport** keyword indicates that the PVP is for cell relay. This mode is for Layer 2 transport only; it is not for regular PVPs.
Step 5	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(config-if-atm-l2trans-pvp)# xconnect 10.0.0.1 123 encapsulation mpls`	Binds the attachment circuit to a pseudowire VC. The syntax for this command is the same as for all other Layer 2 transports.

Step 6	**end**
	Example:
	`Router(config-if-atm-l2trans-pvp)# end`
		Exits to privileged EXEC mode.

Step 7	**show atm vp** **Example:** `Router# show atm vp`	Displays output that shows OAM cell emulation is enabled on the ATM VP.

Examples

The following output from the **show atm vp** command shows that the interface is configured for VP mode cell relay:

```
Router# show atm vp 1
ATM5/0  VPI: 1, Cell Relay, PeakRate: 149760, CesRate: 0, DataVCs: 1, CesVCs: 0, Status:
ACTIVE
```

```
  VCD    VCI   Type   InPkts   OutPkts   AAL/Encap     Status
  6      3     PVC    0        0         F4 OAM        ACTIVE
  7      4     PVC    0        0         F4 OAM        ACTIVE
TotalInPkts: 0, TotalOutPkts: 0, TotalInFast: 0, TotalOutFast: 0,
TotalBroadcasts: 0 TotalInPktDrops: 0, TotalOutPktDrops: 0
```

Configuring ATM Cell Relay over MPLS in PVP Mode using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *slot* / *subslot* / *port* [**.** *subinterface*]
4. **atm pvp** *vpi* **l2transport**
5. **end**
6. **interface pseudowire** *number*
7. **encapsulation mpls**
8. **neighbor** *peer-address vcid-value*
9. **exit**
10. **l2vpn xconnect context** *context-name*
11. **member pseudowire** *interface-number*
12. **member atm** *interface-number* **pvp** *vpi*
13. **end**
14. **show atm vp**

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	**interface atm** *slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface atm1/0/0`	Defines the interface and enters interface configuration mode.
Step 4	**atm pvp** *vpi* **l2transport** **Example:**	Specifies that the PVP is dedicated to transporting ATM cells and enters L2transport PVP configuration mode.

	Command or Action	Purpose
	`Router(config-if)# atm pvp 1 l2transport`	- The **l2transport** keyword indicates that the PVP is for cell relay. This mode is for Layer 2 transport only; it is not for regular PVPs.

Step 5	**end**
	Example:
	`Router(config-if-atm-l2trans-pvc)# end`
		Exits to privileged EXEC mode.

Step 6	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-if)# encapsulation mpls`	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 8	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)# neighbor 10.0.0.1 123`	Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.
Step 9	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 10	**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 11	**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 12	**member atm** *interface-number* **pvp** *vpi* **Example:** `Device(config-xconnect)# member atm 100 pvp 1`	Specifies the location of the ATM member interface.
Step 13	**end** **Example:**	Exits to privileged EXEC mode.

	Command or Action	Purpose
	`Router(config-xconnect)# end`	
Step 14	**show atm vp** **Example:** `Router# show atm vp`	Displays output that shows OAM cell emulation is enabled on the ATM VP.

Examples

The following output from the **show atm vp** command shows that the interface is configured for VP mode cell relay:

```
Router# show atm vp 1
ATM5/0  VPI: 1, Cell Relay, PeakRate: 149760, CesRate: 0, DataVCs: 1, CesVCs: 0, Status:
ACTIVE
  VCD    VCI   Type   InPkts   OutPkts   AAL/Encap     Status
  6      3     PVC    0        0         F4 OAM        ACTIVE
  7      4     PVC    0        0         F4 OAM        ACTIVE
TotalInPkts: 0, TotalOutPkts: 0, TotalInFast: 0, TotalOutFast: 0,
TotalBroadcasts: 0 TotalInPktDrops: 0, TotalOutPktDrops: 0
```

Configuring Ethernet over MPLS

Configuring Ethernet over MPLS in VLAN Mode to Connect Two VLAN Networks That Are in Different Locations.

Step 1 **enable**

Example:

```
Router> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Router# configure terminal
```

Enters global configuration mode.

Step 3 **interface gigabitethernet** *slot* / *subslot* / *port* [**.** *subinterface*]

Example:

```
Router(config)# interface gigabitethernet4/0/0.1
```

Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode.

- Make sure the subinterface on the adjoining CE router is on the same VLAN as this PE router.

Step 4 **encapsulation dot1q** *vlan-id*

Example:

```
Router(config-subif)# encapsulation dot1q 100
```

Enables the subinterface to accept 802.1Q VLAN packets.

Step 5 **xconnect** *peer-router-id vcid* **encapsulation mpls**

Example:

```
Router(config-subif)# xconnect 10.0.0.1 123 encapsulation mpls
```

Binds the attachment circuit to a pseudowire VC.

Configuring Ethernet over MPLS in VLAN Mode to Connect Two VLAN Networks That Are in Different Locations using the commands associated with the L2VPN Protocol-Based CLIs feature

Step 1 **enable**

Example:

```
Router> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Router# configure terminal
```

Enters global configuration mode.

Step 3 **interface gigabitethernet** *slot* / *subslot* / *port* [**.** *subinterface*]

Example:

```
Router(config)# interface gigabitethernet4/0/0.1
```

Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode.

- Make sure the subinterface on the adjoining CE router is on the same VLAN as this PE router.

Step 4 **encapsulation dot1q** *vlan-id*

Example:

```
Router(config-subif)# encapsulation dot1q 100
```

Enables the subinterface to accept 802.1Q VLAN packets.

Step 5 **end**

Example:

```
Router(config-subif)# end
```

Exits to privileged EXEC mode.

Step 6 **interface pseudowire** *number*

Example:

```
Router(config)# interface pseudowire 100
```

Specifies the pseudowire interface and enters interface configuration mode.

Step 7 **encapsulation mpls**

Example:

```
Router(config-if)# encapsulation mpls
```

Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.

Step 8 **neighbor** *peer-address vcid-value*

Example:

```
Router(config-if)# neighbor 10.0.0.1 123
```

Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.

Step 9 **exit**

Example:

```
Router(config-if)# exit
```

Exits interface configuration mode.

Step 10 **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 11 **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 12 **member gigabitethernet** *interface-number*

Example:

```
Router(config-xconnect)# member GigabitEthernet0/0/0.1
```

Specifies the location of the Gigabit Ethernet member interface.

Step 13 **end**

Example:

```
Router(config-xconnect)# end
```

Exits to privileged EXEC mode.

Configuring Ethernet over MPLS in Port Mode

Step 1 **enable**

Example:

```
Router> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Router# configure terminal
```

Enters global configuration mode.

Step 3 **interface gigabitethernet** *slot* / *subslot* / *port*

Example:

Specifies the Gigabit Ethernet interface and enters interface configuration mode.

Step 4 **xconnect** *peer-router-id vcid* **encapsulation mpls**

Example:

```
Router(config-if)# xconnect 10.0.0.1 123 encapsulation mpls
```

Binds the attachment circuit to a pseudowire VC.

Step 5 **end**

Example:

```
Router(config-if)# end
```

Exits to privileged EXEC mode.

Step 6 **show mpls l2transport vc**

Example:

```
Router# show mpls l2transport vc
```

Displays information about Ethernet over MPLS port mode.

Configuring Ethernet over MPLS in Port Mode Using Commands Associated with the L2VPN Protocol-Based Feature

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 gigabitethernet** *slot* **/** *subslot* **/** *port*[**.** *subinterface*]

Example:

```
Device(config)# interface gigabitethernet4/0/0
```

Specifies the Gigabit Ethernet interface and enters interface configuration mode.

- Make sure the interface on the adjoining CE router is on the same VLAN as this PE router.

Step 4 **end**

Example:

```
Device(config-if)# end
```

Exits to privileged EXEC mode.

Step 5 **interface pseudowire** *number*

Example:

```
Device(config)# interface pseudowire 100
```

Specifies the pseudowire interface and enters interface configuration mode.

Step 6 **encapsulation mpls**

Example:

```
Device(config-if)# encapsulation mpls
```

Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.

Step 7 **neighbor** *peer-address vcid-value*

Example:

```
Device(config-if)# neighbor 10.0.0.1 123
```

Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.

Step 8 **exit**

Example:

```
Device(config-if)# exit
```

Exits interface configuration mode.

Step 9 **l2vpn xconnect context** *context-name*

Example:

```
Device(config)# l2vpn xconnect context con1
```

Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.

Step 10 **member pseudowire** *interface-number*

Example:

```
Device(config-xconnect)# member pseudowire 100
```

Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.

Step 11 **member gigabitethernet** *interface-number*

Example:

```
Device(config-xconnect)# member GigabitEthernet0/0/0.1
```

Specifies the location of the Gigabit Ethernet member interface.

Step 12 **end**

Example:

```
Device(config-xconnect)# end
```

Exits to privileged EXEC mode.

Step 13 **end**

Example:

```
Device(config-if)# end
```

Exits to privileged EXEC mode.

Step 14 **show l2vpn atom vc**

Example:

```
Device# show l2vpn atom vc
```

Displays information about Ethernet over MPLS port mode.

Configuring Ethernet over MPLS with VLAN ID Rewrite

Step 1 **enable**

Example:

```
Router> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Router# configure terminal
```

Enters global configuration mode.

Step 3 **interface gigabitethernet** *slot* / *subslot* / *port*

Example:

Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode.

Step 4 **encapsulation dot1q** *vlan-id*

Example:

```
Router(config-subif)# encapsulation dot1q 100
```

Enables the subinterface to accept 802.1Q VLAN packets.

Step 5 **xconnect** *peer-router-id vcid* **encapsulation mpls**

Example:

```
Router(config-subif)# xconnect 10.0.0.1 123 encapsulation mpls
```

Binds the attachment circuit to a pseudowire VC and enters xconnect configuration mode.

Step 6 **remote circuit id** *remote-vlan-id*

Example:

```
Router(config-subif-xconn)# remote circuit id 101
```

(Optional) Enables you to use VLAN interfaces with different VLAN IDs at both ends of the tunnel.

Step 7 **end**

Example:

```
Router(config-subif-xconn)# end
```

Exits to privileged EXEC mode.

Configuring Ethernet over MPLS with VLAN ID Rewrite Using Commands Associated with the L2VPN Protocol-Based Feature

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 **encapsulation dot1q** *vlan-id*

Example:

```
Router(config-subif)# encapsulation dot1q 100
```

Enables the subinterface to accept 802.1Q VLAN packets.

Step 4 **end**

Example:

```
Router(config-subif)# end
```

Exits to privileged EXEC mode.

Step 5 **interface pseudowire** *number*

Example:

```
Router(config)# interface pseudowire 100
```

Specifies the pseudowire interface and enters interface configuration mode.

Step 6 **encapsulation mpls**

Example:

```
Router(config-if)# encapsulation mpls
```

Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.

Step 7 **neighbor** *peer-address vcid-value*

Example:

```
Router(config-if)# neighbor 10.0.0.1 123
```

Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.

Step 8 **exit**

Example:

```
Router(config-if)# exit
```

Exits interface configuration mode.

Step 9 **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 10 **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 11 **member gigabitethernet** *interface-number*

Example:

Specifies the location of the Gigabit Ethernet member interface.

Step 12 **remote circuit id** *remote-vlan-id*

Example:

```
Router(config-xconnect)# remote circuit id 101
```

(Optional) Enables you to use VLAN interfaces with different VLAN IDs at both ends of the tunnel.

Step 13 **end**

Example:

```
Router(config-xconnect)# end
```

Exits to privileged EXEC mode.

Step 14 **show controllers eompls forwarding-table**

Example:

```
Router# show controllers eompls forwarding-table
```

Displays information about VLAN ID rewrite.

Configuring per-Subinterface MTU for Ethernet over MPLS

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface gigabitethernet** *slot* / *subslot* / *port* [**.** *subinterface*]
4. **mtu** *mtu-value*
5. **interface gigabitethernet** *slot* / *subslot* / *port* [**.** *subinterface*]
6. **encapsulation dot1q** *vlan-id*
7. **xconnect** *peer-router-id vcid* **encapsulation mpls**
8. **mtu** *mtu-value*
9. **end**
10. **show mpls l2transport binding**

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	**interface gigabitethernet** *slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface gigabitethernet4/0/0`	Specifies the Gigabit Ethernet interface and enters interface configuration mode.
Step 4	**mtu** *mtu-value* **Example:** `Router(config-if)# mtu 2000`	Specifies the MTU value for the interface. The MTU value specified at the interface level can be inherited by a subinterface.

	Command or Action	Purpose
Step 5	**interface gigabitethernet** *slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config-if)# interface gigabitethernet4/0/0.1`	Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode. Make sure the subinterface on the adjoining CE router is on the same VLAN as this PE router.
Step 6	**encapsulation dot1q** *vlan-id* **Example:** `Router(config-subif)# encapsulation dot1q 100`	Enables the subinterface to accept 802.1Q VLAN packets. The subinterfaces between the CE and PE routers that are running Ethernet over MPLS must be in the same subnet. All other subinterfaces and backbone routers need not be.
Step 7	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(config-subif)# xconnect 10.0.0.1 123 encapsulation mpls`	Binds the attachment circuit to a pseudowire VC. The syntax for this command is the same as for all other Layer 2 transports. Enters xconnect subinterface configuration mode.
Step 8	**mtu** *mtu-value* **Example:** `Router(config-if-xconn)# mtu 1400`	Specifies the MTU for the VC.

Step 9	**end**
	Example:
	`Router(config-if-xconn)# end`
		Exits to privileged EXEC mode.

Step 10	**show mpls l2transport binding** **Example:** `Router# show mpls l2transport binding`	Displays the MTU values assigned to the local and remote interfaces.

Configuring per-Subinterface MTU for Ethernet over MPLS using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface gigabitethernet** *slot* / *subslot* / *port*[**.** *subinterface*]
4. **mtu** *mtu-value*
5. **interface gigabitethernet** *slot* / *subslot* / *port*[**.** *subinterface*]
6. **encapsulation dot1q** *vlan-id*
7. **end**
8. **interface pseudowire** *number*

9. **encapsulation mpls**
10. **neighbor** *peer-address vcid-value*
11. **mtu** *mtu-value*
12. **exit**
13. **l2vpn xconnect context** *context-name*
14. **member pseudowire** *interface-number*
15. **member gigabitethernet** *interface-number*
16. **end**
17. **show l2vpn atom binding**

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 gigabitethernet** *slot* / *subslot* / *port*[**.** *subinterface*] **Example:** `Device(config)# interface gigabitethernet4/0/0`	Specifies the Gigabit Ethernet interface and enters interface configuration mode.
Step 4	**mtu** *mtu-value* **Example:** `Device(config-if)# mtu 2000`	Specifies the MTU value for the interface. The MTU value specified at the interface level can be inherited by a subinterface.
Step 5	**interface gigabitethernet** *slot* / *subslot* / *port*[**.** *subinterface*] **Example:** `Device(config-if)# interface gigabitethernet4/0/0.1`	Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode. Make sure the subinterface on the adjoining CE router is on the same VLAN as this PE router.
Step 6	**encapsulation dot1q** *vlan-id* **Example:** `Device(config-subif)# encapsulation dot1q 100`	Enables the subinterface to accept 802.1Q VLAN packets. The subinterfaces between the CE and PE routers that are running Ethernet over MPLS must be in the same subnet. All other subinterfaces and backbone routers need not be.
Step 7	**end** **Example:**	Exits to privileged EXEC mode.

	Command or Action	Purpose
	`Device(config-subif)# end`	
Step 8	**interface pseudowire** *number* **Example:** `Device(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 9	**encapsulation mpls** **Example:** `Device(config-if)# encapsulation mpls`	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 10	**neighbor** *peer-address vcid-value* **Example:** `Device(config-if)# neighbor 10.0.0.1 123`	Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.
Step 11	**mtu** *mtu-value* **Example:** `Device(config-if)# mtu 1400`	Specifies the MTU for the VC.
Step 12	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode.
Step 13	**l2vpn xconnect context** *context-name* **Example:** `Device(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 14	**member pseudowire** *interface-number* **Example:** `Device(config-xconnect)# member pseudowire 100`	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
Step 15	**member gigabitethernet** *interface-number* **Example:** `Device(config-xconnect)# member GigabitEthernet0/0/0.1`	Specifies the location of the Gigabit Ethernet member interface.

Step 16	**end**
	Example:
	`Device(config-xconnect)# end`
		Exits to privileged EXEC mode.

	Command or Action	Purpose
Step 17	**show l2vpn atom binding** **Example:** `Device# show l2vpn atom binding`	Displays Layer 2 VPN (L2VPN) Any Transport over MPLS (AToM) label binding information.

Configuring Frame Relay over MPLS

Configuring Frame Relay over MPLS with DLCI-to-DLCI Connections

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **frame-relay switching**
4. **interface serial** *slot* **/** *subslot* **/** *port* [**.** *subinterface*]
5. **encapsulation frame-relay** [**cisco** | **ietf**]
6. **frame-relay intf-type dce**
7. **exit**
8. **connect** *connection-name interface dlci* **l2transport**
9. **xconnect** *peer-router-id vcid* **encapsulation mpls**

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	**frame-relay switching** **Example:** `Router(config)# frame-relay switching`	Enables PVC switching on a Frame Relay device.
Step 4	**interface serial** *slot* **/** *subslot* **/** *port* [**.** *subinterface*] **Example:** `Router(config)# interface serial3/1/0`	Specifies a serial interface and enters interface configuration mode.

	Command or Action	Purpose
Step 5	**encapsulation frame-relay** [**cisco** | **ietf**] **Example:** `Router(config-if)# encapsulation frame-relay ietf`	Specifies Frame Relay encapsulation for the interface. You can specify different types of encapsulations. You can set one interface to Cisco encapsulation and the other interface to IETF encapsulation.
Step 6	**frame-relay intf-type dce** **Example:** `Router(config-if)# frame-relay intf-type dce`	Specifies that the interface is a DCE switch. You can also specify the interface to support Network-to-Network Interface (NNI) and DTE connections.
Step 7	**exit** **Example:** `Router(config-if)# exit`	Exits from interface configuration mode.
Step 8	**connect** *connection-name interface dlci* **l2transport** **Example:** `Router(config)# connect fr1 serial5/0 1000 l2transport`	Defines connections between Frame Relay PVCs and enters connect configuration mode. Using the **l2transport** keyword specifies that the PVC will not be a locally switched PVC, but will be tunneled over the backbone network. The *connection-name* argument is a text string that you provide. The *interface* argument is the interface on which a PVC connection will be defined. The *dlci* argument is the DLCI number of the PVC that will be connected.
Step 9	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(config-fr-pw-switching)# xconnect 10.0.0.1 123 encapsulation mpls`	Creates the VC to transport the Layer 2 packets. In a DLCI-to DLCI connection type, Frame Relay over MPLS uses the **xconnect** command in connect configuration mode.

Configuring Frame Relay over MPLS with DLCI-to-DLCI Connections using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **frame-relay switching**
4. **interface serial** *slot* **/** *subslot* **/** *port* [**.** *subinterface*]
5. **encapsulation frame-relay** [**cisco** | **ietf**]
6. **frame-relay intf-type dce**
7. **exit**

8. **connect** *connection-name interface dlci* **l2transport**
9. **end**
10. **interface pseudowire** *number*
11. **encapsulation mpls**
12. **neighbor** *peer-address vcid-value*
13. **exit**
14. **l2vpn xconnect context** *context-name*
15. **member pseudowire** *interface-number*
16. **member** *ip-address vc-id* **encapsulation mpls**
17. **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	**frame-relay switching** **Example:** `Router(config)# frame-relay switching`	Enables PVC switching on a Frame Relay device.
Step 4	**interface serial** *slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface serial3/1/0`	Specifies a serial interface and enters interface configuration mode.
Step 5	**encapsulation frame-relay** [**cisco** | **ietf**] **Example:** `Router(config-if)# encapsulation frame-relay ietf`	Specifies Frame Relay encapsulation for the interface. You can specify different types of encapsulations. You can set one interface to Cisco encapsulation and the other interface to IETF encapsulation.
Step 6	**frame-relay intf-type dce** **Example:** `Router(config-if)# frame-relay intf-type dce`	Specifies that the interface is a DCE switch. You can also specify the interface to support Network-to-Network Interface (NNI) and DTE connections.
Step 7	**exit** **Example:**	Exits from interface configuration mode.

	Command or Action	Purpose
	`Router(config-if)# exit`	
Step 8	**connect** *connection-name interface dlci* **l2transport** **Example:** `Router(config)# connect fr1 serial5/0 1000 l2transport`	Defines connections between Frame Relay PVCs and enters connect configuration mode. Using the **l2transport**keyword specifies that the PVC will not be a locally switched PVC, but will be tunneled over the backbone network. The *connection-name*argument is a text string that you provide. The *interface*argument is the interface on which a PVC connection will be defined. The *dlci*argument is the DLCI number of the PVC that will be connected.

Step 9	**end**
	Example:
	`Router(config-xconnect-conn-config)# end`
		Exits to privileged EXEC mode.

Step 10	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 11	**encapsulation mpls** **Example:** `Router(config-if)# encapsulation mpls`	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 12	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)# neighbor 10.0.0.1 123`	Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.
Step 13	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 14	**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 15	**member pseudowire** *interface-number* **Example:**	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.

	Command or Action	Purpose
	`Router(config-xconnect)# member pseudowire 100`	
Step 16	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.1 123 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.

Step 17	**end**
	Example:
	`Router(config-xconnect)# end`
		Exits to privileged EXEC mode.

Configuring Frame Relay over MPLS with Port-to-Port Connections

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface serial** *slot* / *subslot* / *port* [**.** *subinterface*]
4. **encapsulation hdlc**
5. **xconnect** *peer-router-id vcid* **encapsulation mpls**

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	**interface serial** *slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface serial5/0/0`	Specifies a serial interface and enters interface configuration mode.
Step 4	**encapsulation hdlc** **Example:** `Router(config-if)# encapsulation hdlc`	Specifies that Frame Relay PDUs will be encapsulated in HDLC packets.

	Command or Action	Purpose
Step 5	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(config-if)# xconnect 10.0.0.1 123 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.

Configuring Frame Relay over MPLS with Port-to-Port Connections using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface serial** *slot* / *subslot* / *port* [**.** *subinterface*]
4. **encapsulation hdlc**
5. **end**
6. **interface pseudowire** *number*
7. **encapsulation mpls**
8. **neighbor** *peer-address vcid-value*
9. **exit**
10. **l2vpn xconnect context** *context-name*
11. **member pseudowire** *interface-number*
12. **member** *ip-address vc-id* **encapsulation mpls**
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	**interface serial** *slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface serial5/0/0`	Specifies a serial interface and enters interface configuration mode.
Step 4	**encapsulation hdlc** **Example:**	Specifies that Frame Relay PDUs will be encapsulated in HDLC packets.

	Command or Action	Purpose
	`Router(config-if)# encapsulation hdlc`	

Step 5	**end**
	Example:
	`Router(config-if)# end`
		Exits to privileged EXEC mode.

Step 6	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-if)# encapsulation mpls`	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 8	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)# neighbor 10.0.0.1 123`	Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.
Step 9	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 10	**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 11	**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 12	**member** *ip-address vc-id* **encapsulation mpls**
	Example:
	`Router(config-xconnect)# member 10.0.0.1 123`
	`encapsulation mpls`
		Creates the VC to transport the Layer 2 packets.

Step 13	**end**
	Example:
	`Router(config-xconnect)# end`
		Exits to privileged EXEC mode.

Configuring HDLC or PPP over MPLS

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface serial** *slot* **/** *subslot* **/** *port* [**.** *subinterface*]
4. Do one of the following:
   - **encapsulation ppp**
   - **encapsulation hdlc**
5. **xconnect** *peer-router-id vcid* **encapsulation mpls**

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	**interface serial** *slot* **/** *subslot* **/** *port* [**.** *subinterface*] **Example:** `Router(config)# interface serial5/0/0`	Specifies a serial interface and enters interface configuration mode.

Step 4	Do one of the following:
	• **encapsulation ppp**
	• **encapsulation hdlc**
	Example:
	`Router(config-if)# encapsulation ppp`
	Example:
	`or`
	Example:
	Example:
		Specifies HDLC or PPP encapsulation and enters connect configuration mode.

	Command or Action	Purpose
	`Router(config-if)# encapsulation hdlc`	
Step 5	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(config-fr-pw-switching)# xconnect 10.0.0.1 123 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.

Configuring HDLC or PPP over MPLS using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface serial** *slot* **/** *subslot* **/** *port* [**.** *subinterface*]
4. Do one of the following:
   - **encapsulation ppp**
   - **encapsulation hdlc**
5. **end**
6. **interface pseudowire** *number*
7. **encapsulation mpls**
8. **neighbor** *peer-address vcid-value*
9. **exit**
10. **l2vpn xconnect context** *context-name*
11. **member pseudowire** *interface-number*
12. **member** *ip-address vc-id* **encapsulation mpls**
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	**interface serial** *slot* / *subslot* / *port* [**.** *subinterface*] **Example:** `Router(config)# interface serial5/0/0`	Specifies a serial interface and enters interface configuration mode.

Step 4	Do one of the following:
	• **encapsulation ppp**
	• **encapsulation hdlc**
	Example:
	`Router(config-if)# encapsulation ppp`
	Example:
	`Router(config-if)# encapsulation hdlc`
		Specifies HDLC or PPP encapsulation and enters connect configuration mode.

Step 5	**end**
	Example:
	`Router(config-xconnect-conn-config)# end`
		Exits to privileged EXEC mode.

Step 6	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 7	**encapsulation mpls** **Example:** `Router(config-if)# encapsulation mpls`	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 8	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)# neighbor 10.0.0.1 123`	Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.
Step 9	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 10	**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 11	**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 12	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.1 123 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.

Step 13	**end**
	Example:
	`Router(config-xconnect)# end`
		Exits to privileged EXEC mode.

Configuring Tunnel Selection

Step 1 **enable**

Example:

```
Router> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Router# configure terminal
```

Enters global configuration mode.

Step 3 **pseudowire-class** *name*

Example:

```
Router(config)# pseudowire-class ts1
```

Establishes a pseudowire class with a name that you specify and enters pseudowire configuration mode.

Step 4 **encapsulation mpls**

Example:

```
Router(config-pw)# encapsulation mpls
```

Specifies the tunneling encapsulation. For AToM, the encapsulation type is mpls.

Step 5 **preferred-path** {**interface tunnel** *tunnel-number* | **peer**{*ip-address* | *host-name*}} [**disable-fallback**]

Example:

```
Router(config-pw)# preferred path peer 10.18.18.18
```

Specifies the MPLS traffic engineering tunnel or IP address or hostname to be used as the preferred path.

Step 6 **exit**

Example:

```
Router(config-pw)# exit
```

Exits from pseudowire configuration mode and enables the Tunnel Selection feature.

Step 7 **interface** *type* *slot* / *subslot* / *port*

Example:

```
Router(config)# interface atm1/1/0
```

Specifies an interface type and enters interface configuration mode.

Step 8 **encapsulation** *encapsulation-type*

Example:

```
Router(config-if)# encapsulation aal5
```

Specifies the encapsulation for the interface.

Step 9 **xconnect** *peer-router-id vcid* **pw-class** *name*

Example:

```
Router(config-if)# xconnect 10.0.0.1 123 pw-class ts1
```

Binds the attachment circuit to a pseudowire VC.

Examples

In the following sample output from the **show mpls l2transport vc** command includes the following information about the VCs:

- VC 101 has been assigned a preferred path called Tunnel1. The default path is disabled, because the preferred path specified that the default path should not be used if the preferred path fails.
- VC 150 has been assigned an IP address of a loopback address on PE2. The default path can be used if the preferred path fails.

Command output that is in boldface font shows the preferred path information.

```
Router# show mpls l2transport vc detail
Local interface: Gi0/0/0.1 up, line protocol up, Eth VLAN 222 up
  Destination address: 10.16.16.16, VC ID: 101, VC status: up
    Preferred path: Tunnel1,  active
```

```
      Default path: disabled
      Tunnel label: 3, next hop point2point
      Output interface: Tu1, imposed label stack {17 16}
    Create time: 00:27:31, last status change time: 00:27:31
    Signaling protocol: LDP, peer 10.16.16.16:0 up
      MPLS VC labels: local 25, remote 16
      Group ID: local 0, remote 6
      MTU: local 1500, remote 1500
      Remote interface description:
    Sequencing: receive disabled, send disabled
    VC statistics:
      packet totals: receive 10, send 10
      byte totals:   receive 1260, send 1300
      packet drops:  receive 0, send 0
  Local interface: ATM1/0/0 up, line protocol up, ATM AAL5 0/50 up
    Destination address: 10.16.16.16, VC ID: 150, VC status: up
      Preferred path: 10.18.18.18, active
      Default path: ready
      Tunnel label: 3, next hop point2point
      Output interface: Tu2, imposed label stack {18 24}
    Create time: 00:15:08, last status change time: 00:07:37
    Signaling protocol: LDP, peer 10.16.16.16:0 up
      MPLS VC labels: local 26, remote 24
      Group ID: local 2, remote 0
      MTU: local 4470, remote 4470
      Remote interface description:
    Sequencing: receive disabled, send disabled
    VC statistics:
      packet totals: receive 0, send 0
      byte totals:   receive 0, send 0
      packet drops:  receive 0, send 0
```

Troubleshooting Tips

To debug ATM cell packing, issue the **debug atm cell-packing** command.

Configuring Tunnel Selection Using Commands Associated with L2VPN Protocol-Based Feature

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 **template type pseudowire** *name*

Example:

```
Router(config)# template type pseudowire ts1
```

Creates a template pseudowire with a name that you specify and enters pseudowire configuration mode.

Step 4 **encapsulation mpls**

Example:

```
Router(config-pw)# encapsulation mpls
```

Specifies the tunneling encapsulation. For AToM, the encapsulation type is mpls.

Step 5 **preferred-path** {**interface tunnel** *tunnel-number* | **peer** {*ip-address* | *hostname*}} [**disable-fallback**]

Example:

```
Router(config-pw)# preferred path peer 10.18.18.18
```

Specifies the MPLS traffic engineering tunnel or IP address or hostname to be used as the preferred path.

Step 6 **exit**

Example:

```
Router(config-pw)# exit
```

Exits from pseudowire configuration mode and enables the Tunnel Selection feature.

Step 7 **interface** *type slot* / *subslot* / *port*[**.** *subinterface*]

Example:

```
Router(config)# interface atm1/1/0
```

Specifies an interface type and enters interface configuration mode.

Step 8 **encapsulation** *encapsulation-type*

Example:

```
Router(config-if)# encapsulation aal5
```

Specifies the encapsulation for the interface.

Step 9 **end**

Example:

```
Router(config-if)# end
```

Exits to privileged EXEC mode.

Step 10 **interface pseudowire** *number*

Example:

```
Router(config)# interface pseudowire 100
```

Specifies the pseudowire interface and enters interface configuration mode.

Step 11 **source template type pseudowire** *name*

Example:

```
Router(config-if)# source template type pseudowire ts1
```

Configures the source template of type pseudowire named ts1.

Step 12 **neighbor** *peer-address* *vcid-value*

Example:

```
Router(config-if)#  neighbor 10.0.0.1 123
```

Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.

Step 13 **end**

Example:

```
Router(config-if)# end
```

Exits to privileged EXEC mode.

Step 14 **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 15 **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 16 **member** *ip-address vc-id* **encapsulation mpls**

Example:

```
Router(config-xconnect)# member 10.0.0.1 123 encapsulation mpls
```

Creates the VC to transport the Layer 2 packets.

Step 17 **end**

Example:

```
Router(config-xconnect)# end
```

Exits to privileged EXEC mode.

Troubleshooting Tips using the commands associated with the L2VPN Protocol-Based CLIs feature

You can use the **debug l2vpn atom vc event** command to troubleshoot tunnel selection. For example, if the tunnel interface that is used for the preferred path is shut down, the default path is enabled. The **debug l2vpn atom vc event** command provides the following output:

```
AToM SMGR [10.2.2.2, 101]: Processing imposition update, vc_handle 62091860, update_action
 3, remote_vc_label 16
AToM SMGR [10.2.2.2, 101]: selected route no parent rewrite: tunnel not up
AToM SMGR [10.2.2.2, 101]: Imposition Programmed, Output Interface: Et3/2
```

Setting Experimental Bits with AToM

Note Only EoMPLS and CEM is supported .

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 **class-map** *class-name*

Example:

```
Router(config)# class-map class1
```

Specifies the user-defined name of the traffic class and enters class map configuration mode.

Step 4 **match any**

Example:

```
Router(config-cmap)# match any
```

Specifies that all packets will be matched. Use only the **any** keyword. Other keywords might cause unexpected results.

Step 5 **policy-map** *policy-name*

Example:

```
Router(config-cmap)# policy-map policy1
```

Specifies the name of the traffic policy to configure and enters policy-map configuration mode.

Step 6 **class** *class-name*

Example:

```
Router(config-pmap)# class class1
```

Specifies the name of a predefined traffic class, which was configured with the **class-map** command, used to classify traffic to the traffic policy and enters policy-map class configuration mode.

Step 7 **set mpls experimental** *value*

Example:

```
Router(config-pmap-c)# set mpls experimental 7
```

Designates the value to which the MPLS bits are set if the packets match the specified policy map.

Step 8 **exit**

Example:

```
Router(config-pmap-c)# exit
```

Exits policy-map class configuration mode.

Step 9 **exit**

Example:

```
Router(config-pmap)# exit
```

Exits policy-map configuration mode.

Step 10 **interface** *type* *slot* **/** *subslot* **/** *port*

Example:

```
Router(config)# interface atm1/0/0
```

Specifies the interface type and enters interface configuration mode.

Step 11 **service-policy input** *policy-name*

Example:

```
Router(config-if)# service-policy input policy1
```

Attaches a traffic policy to an interface.

Step 12 **end**

Example:

```
Router(config-if)# end
```

Exits to privileged EXEC mode.

Step 13 **show policy-map interface** *interface-name* [*vc* [*vpi* /] *vci*] [**dlci** *dlci*] [**input** | **output**]

Example:

```
Router# show policy-map interface serial3/0/0
```

Displays the traffic policy attached to an interface.

Enabling the Control Word

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class cw_enable**
4. **encapsulation mpls**
5. **control-word**
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.
Step 3	**pseudowire-class cw_enable** **Example:** `Router(config)# pseudowire-class cw_enable`	Enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Router(config-pw-class)# encapsulation mpls`	Specifies the tunneling encapsulation. • For AToM, the encapsulation type is MPLS.
Step 5	**control-word** **Example:** `Router(config-pw-class)# control-word`	Enables the control word.

	Command or Action	Purpose

Step 6	**end**
	Example:
	`Router(config-pw-class)# end`
		Exits to privileged EXEC mode.

Enabling the Control Word using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface pseudowire** *number*
4. **encapsulation mpls**
5. **control-word include**
6. **neighbor** *peer-address vcid-value*
7. **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	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 1`	Creates an interface pseudowire with a value that you specify and enters pseudowire configuration mode.
Step 4	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies the tunneling encapsulation. • For AToM, the encapsulation type is mpls.
Step 5	**control-word include** **Example:**	Enables the control word.

	Command or Action	Purpose
	`Router(config-pw)# control-word include`	
Step 6	**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.

Step 7	**end**
	Example:
	`Router(config-pw)# end`
		Exits to privileged EXEC mode.

Configuring MPLS AToM Remote Ethernet Port Shutdown

Note The Any Transport over MPLS (AToM): Remote Ethernet Port Shutdown feature is automatically enabled by default when an image with the feature supported is loaded on the router.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class** [*pw-class-name*]
4. **encapsulation mpls**
5. **exit**
6. **xconnect** *peer-ip-address* *vc-id* *pw-class* *pw-class-name*
7. **no remote link failure notification**
8. **remote link failure notification**
9. **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** [*pw-class-name*] **Example:** `Router(config)# pseudowire-class eompls`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Router(config-pw)# encapsulation mpls`	Specifies that MPLS is used as the data encapsulation method for tunneling Layer 2 traffic over the pseudowire.
Step 5	**exit** **Example:** `Router(config-pw)# exit`	Exits to global configuration mode.
Step 6	**xconnect** *peer-ip-address vc-id* *pw-class pw-class-name* **Example:** `Router(config-if)# xconnect 10.1.1.1 1 pw-class eompls`	Binds an attachment circuit to a pseudowire, and configures an Any Transport over MPLS (AToM) static pseudowire.
Step 7	**no remote link failure notification** **Example:** `Router(config-if-xconn)# remote link failure notification`	Disables MPLS AToM remote link failure notification and shutdown.
Step 8	**remote link failure notification** **Example:** `Router(config-if-xconn)# remote link failure notification`	Enables MPLS AToM remote link failure notification and shutdown.

Step 9	**end**
	Example:
	`Router(config-if-xconn)# end`
		Exits to privileged EXEC mode.

Configuring MPLS AToM Remote Ethernet Port Shutdown using the commands associated with the L2VPN Protocol-Based CLIs feature

Note The Any Transport over MPLS (AToM): Remote Ethernet Port Shutdown feature is automatically enabled by default when an image with the feature supported is loaded on the router.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **template type pseudowire** [*pseudowire-name*]
4. **encapsulation mpls**
5. **exit**
6. **interface** *type slot* / *subslot* / *port*
7. **interface pseudowire** *number*
8. **source template type pseudowire**
9. **neighbor** *peer-address vcid-value*
10. **end**
11. **l2vpn xconnect context** *context-name*
12. **no remote link failure notification**
13. **remote link failure notification**
14. **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** [*pseudowire-name*] **Example:** `Device(config)# template type pseudowire eompls`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Device(config-pw)# encapsulation mpls`	Specifies that MPLS is used as the data encapsulation method for tunneling Layer 2 traffic over the pseudowire.
Step 5	**exit** **Example:** `Device(config-pw)# exit`	Exits to global configuration mode.
Step 6	**interface** *type slot* / *subslot* / *port* **Example:**	Configures an interface type and enters interface configuration mode.

	Command or Action	Purpose
	`Device(config)# interface GigabitEthernet1/0/0`	
Step 7	**interface pseudowire** *number* **Example:** `Device(config-if)# interface pseudowire 100`	Specifies the pseudowire interface.
Step 8	**source template type pseudowire** **Example:** `Device(config-if)# source template type pseudowire eompls`	Configures the source template of type pseudowire named eompls.
Step 9	**neighbor** *peer-address vcid-value* **Example:** `Device(config-if)#  neighbor 10.1.1.1 1`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.

Step 10	**end**
	Example:
	`Device(config-if)# end`
		Exits to privileged EXEC mode.

Step 11	**l2vpn xconnect context** *context-name* **Example:** `Device(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 12	**no remote link failure notification** **Example:** `Device(config-xconnect)# no remote link failure notification`	Disables MPLS AToM remote link failure notification and shutdown.
Step 13	**remote link failure notification** **Example:** `Device(config-xconnect)# remote link failure notification`	Enables MPLS AToM remote link failure notification and shutdown.

Step 14	**end**
	Example:
	`Device(config-xconnect)# end`
		Exits to privileged EXEC mode.

Configuring AToM Load Balancing with Single PW

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class** *pw-class-name*
4. **encapsulation mpls**
5. **load-balance flow**
6. **xconnect** *url* **pw-class** *pw-class-name*

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	**pseudowire-class** *pw-class-name* **Example:** `Router(config)# pseudowire-class ecmp-class`	Establishes a pseudowire class with a name that you specify, and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Router(config-pw-class)# encapsulation mpls`	Specifies the tunneling encapsulation. • For AToM, the encapsulation type is mpls.
Step 5	**load-balance flow** **Example:** `Router(config-pw-class)# load-balance flow`	Enables the AToM Load Balancing with Single PW feature so that load balancing is done on a per-flow basis.
Step 6	**xconnect** *url* **pw-class** *pw-class-name* **Example:** `Router(config-pw-class)# xconnect 10.0.0.1 pw-class ecmp-class`	Binds the attachment circuit to a pseudowire virtual circuit, and enters xconnect configuration mode. • The syntax for this command is the same as for all other Layer 2 transports.

Configuring AToM Load Balancing with Single PW using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **template type pseudowire** [*pseudowire-name*]
4. **encapsulation mpls**
5. **load-balance flow**
6. **end**
7. **interface pseudowire** *number*
8. **source template type pseudowire**
9. **neighbor** *peer-address vcid-value*
10. **end**
11. **l2vpn xconnect context** *context-name*
12. **member pseudowire** *interface-number*
13. **member** *ip-address vc-id* **encapsulation mpls**
14. **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	**template type pseudowire** [*pseudowire-name*] **Example:** `Router(config)# template type pseudowire eompls`	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Router(config-pw-class)# encapsulation mpls`	Specifies the tunneling encapsulation. • For AToM, the encapsulation type is mpls.
Step 5	**load-balance flow** **Example:**	Enables the AToM Load Balancing with Single PW feature so that load balancing is done on a per-flow basis.

	Command or Action	Purpose
	`Router(config-pw-class)# load-balance flow`	

Step 6	**end**
	Example:
	`Router(config-pw-class)# end`
		Exits to privileged EXEC mode.

Step 7	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 8	**source template type pseudowire** **Example:** `Router(config-if)# source template type pseudowire ether-pw`	Configures the source template of type pseudowire named ether-pw.
Step 9	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)#  neighbor 10.1.1.1 1`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.

Step 10	**end**
	Example:
	`Router(config-if)# end`
		Exits to privileged EXEC mode.

Step 11	**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 12	**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 13	**member** *ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-xconnect)# member 10.0.0.1 123 encapsulation mpls`	Creates the VC to transport the Layer 2 packets.
Step 14	**end** **Example:**	Exits to privileged EXEC mode.

	Command or Action	Purpose
	`Router(config-xconnect)# end`	

Configuring Flow-Aware Transport (FAT) Load Balancing

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface pseudowire** *name*
4. **encapsulation mpls**
5. **neighbor** *peer-address vcid-value*
6. **signaling protocol ldp**
7. **load-balance flow-label both**
8. **end**
9. **show l2vpn atom vc detail**
10. **show ssm id**

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 pseudowire** *name* **Example:** `Device(config)# interface pseudowire 1001`	Establishes a pseudowire with a name that you specify, and enters pseudowire class configuration mode.
Step 4	**encapsulation mpls** **Example:** `Device(config-pw-class)# encapsulation mpls`	Specifies the tunneling encapsulation. • For AToM, the encapsulation type is mpls.
Step 5	**neighbor** *peer-address vcid-value* **Example:** `Device(config-pw-class)# neighbor 10.1.1.200 200`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.

	Command or Action	Purpose
Step 6	**signaling protocol ldp** **Example:** `Device(config-pw-class)# signaling protocol ldp`	Specifies that the Label Distribution Protocol (LDP) is configured for the pseudowire class.
Step 7	**load-balance flow-label both** **Example:** `Device(config-pw-class)# load-balance flow-label both`	Enables the Flow-Aware Transport of MPLS Pseudowire feature and specifies how flow labels are used. It is recommended that you use both as the option for flow-label. However, if you choose not to use both, you can either use **load-balance flow-label transmit** or **load-balance flow-label receive** if necessary.

Step 8	**end**
	Example:
	`Device(config-pw-class)# end`
		Exits to privileged EXEC mode.

Step 9	**show l2vpn atom vc detail** **Example:** `Device# show l2vpn atom vc detail`	Displays detailed output that shows information about the flow labels configured for the pseudowire.
Step 10	**show ssm id** **Example:** `Device# show ssm id`	Displays information for all Segment Switching Manager (SSM) IDs.

Examples

The following is sample output from the **show mpls l2transport vc 1 detail** command that shows information about the VC details:

```
Device# show mpls l2transport vc 1 detail

Local interface: Te0/5/2 up, line protocol up, Eth VLAN 1 up
  Interworking type is Ethernet
  Destination address: 4.4.4.4, VC ID: 1, VC status: up
    Output interface: BD12, imposed label stack {23 16}
    Preferred path: not configured
    Default path: active
    Next hop: 12.0.0.2
  Create time: 23:12:54, last status change time: 23:09:05
    Last label FSM state change time: 23:09:02
  Signaling protocol: LDP, peer 4.4.4.4:0 up
    Targeted Hello: 1.1.1.1(LDP Id) -> 4.4.4.4, 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 27, remote 16
    Group ID: local 8, remote 8
    MTU: local 9216, remote 9216
    Remote interface description:
  Sequencing: receive disabled, send disabled
  Control Word: On
  SSO Descriptor: 4.4.4.4/1, local label: 27
  Dataplane:
    SSM segment/switch IDs: 32854/4116 (used), PWID: 1
  VC statistics:
    transit packet totals: receive 0, send 0
    transit byte totals:   receive 0, send 0
    transit packet drops:  receive 0, seq error 0, send 0
```

The following is sample output from the **show ssm id** command that shows information for all Segment Switching Manager (SSM) IDs:

```
Device# show ssm id

SSM Status: 1 switch
  Switch-ID 4096 State: Open
    Segment-ID: 8194 Type: Eth[2]
      Switch-ID:                    4096
      Physical intf:                Local
      Allocated By:                 This CPU
      Locked By:                    SIP     [1]
      Circuit status:               UP      [1]
    Class:                        SSS
      State:                        Active
      AC Switching Context:         Et0/0
      SSS Info : Switch Handle 2583691265 Ckt 0xC36A59E0
      Interworking 0 Encap Len 0 Boardencap Len 0 MTU 1500
      Flow Classification src-dst-mac
      AC Encap [0 bytes]
    Class:                        ADJ
      State:                        Active
      AC Adjacency context:
      adjacency = 0xC36B6100 [complete] RAW Ethernet0/0:0
      AC Encap [0 bytes]
      1stMem: 8194 2ndMem: 0 ActMem: 8194

    Segment-ID: 4097 Type: AToM[17]
      Switch-ID:                    4096
      Allocated By:                 This CPU
      Locked By:                    SIP     [1]
    Class:                        SSS
      State:                        Active
    Class:                        ADJ
      State:                        Active
```

Configuring Flow-Aware Transport (FAT) Load Balancing using a template

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **template type pseudowire** [*pseudowire-name*]
4. **encapsulation mpls**
5. **load-balance flow**
6. **load-balance flow-label**
7. **end**
8. **interface pseudowire** *number*
9. **source template type pseudowire**
10. **encapsulation mpls**
11. **neighbor** *peer-address vcid-value*
12. **signaling protocol ldp**
13. **end**
14. **show l2vpn atom vc detail**
15. **show ssm id**
16. **show mpls forwarding-table exact-route**

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** [*pseudowire-name*] **Example:** `Device(config)# template type pseudowire fatpw`	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. • For AToM, the encapsulation type is MPLS.
Step 5	**load-balance flow** **Example:**	Enables the AToM Load Balancing with Single PW feature so that load balancing is done on a per-flow basis.

	Command or Action	Purpose
	`Device(config-pw-class)# load-balance flow`	
Step 6	**load-balance flow-label** **Example:** `Device(config-pw-class)# load-balance flow-label both`	Enables the Flow-Aware Transport of MPLS Pseudowires feature and specifies how flow labels are to be used.

Step 7	**end**
	Example:
	`Device(config-pw-class)# end`
		Exits to privileged EXEC mode.

Step 8	**interface pseudowire** *number* **Example:** `Device(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 9	**source template type pseudowire** **Example:** `Device(config-if)# source template type pseudowire fatpw`	Configures the source template of type pseudowire named fatpw.
Step 10	**encapsulation mpls** **Example:** `Device(config-if)# encapsulation mpls`	Specifies the tunneling encapsulation. - For AToM, the encapsulation type is MPLS.
Step 11	**neighbor** *peer-address vcid-value* **Example:** `Device(config-if)# neighbor 10.1.1.1 1`	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
Step 12	**signaling protocol ldp** **Example:** `Device(config-if)# signaling protocol ldp`	Specifies that the Label Distribution Protocol (LDP) is configured for the pseudowire class.

Step 13	**end**
	Example:
	`Device(config-if)# end`
		Exits to privileged EXEC mode.

Step 14	**show l2vpn atom vc detail** **Example:**	Displays detailed output that shows information about the flow labels configured for the pseudowire.

	Command or Action	Purpose
	`Device# show l2vpn atom vc detail`	
Step 15	**show ssm id** **Example:** `Device# show ssm id`	Displays information for all Segment Switching Manager (SSM) IDs.
Step 16	**show mpls forwarding-table exact-route** **Example:** `Device# show mpls forwarding-table exact-route label 32 ethernet source 001d.e558.5c1a dest 000e.8379.1c1b detail`	Displays the exact path for the source and destination address pair.

Examples

The following is sample output from the **show l2vpn atom vc detail** command that shows information about the flow labels configured for the pseudowire:

```
Device# show l2vpn atom vc detail

pseudowire100001 is up, VC status is up PW type: Ethernet
  Create time: 00:01:47, last status change time: 00:01:29
    Last label FSM state change time: 00:01:29
  Destination address: 10.1.1.151 VC ID: 100
    Output interface: Se3/0, imposed label stack {1001 100}
    Preferred path: not configured
    Default path: active
    Next hop: point2point
    Load Balance: Flow
    flow classification: ethernet src-dst-mac
  Member of xconnect service Et0/0-2, group right
    Associated member Et0/0 is up, status is up
    Interworking type is Like2Like
    Service id: 0xcf000001
  Signaling protocol: LDP, peer 10.1.1.151:0 up
    Targeted Hello: 10.1.1.152(LDP Id) -> 10.1.1.151, LDP is UP
    Graceful restart: not configured and not enabled
    Non stop routing: not configured and not enabled
    PWid FEC (128), VC ID: 100
    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        200                            100
    Group ID     0                              0
    Interface
    MTU          1500                           1500
    Control word on (configured: autosense)     on
    PW type      Ethernet                       Ethernet
    VCCV CV type 0x12                           0x12
                   LSPV [2], BFD/Raw [5]          LSPV [2], BFD/Raw [5]
    VCCV CC type 0x07                           0x07
                   CW [1], RA [2], TTL [3]       CW [1], RA [2], TTL [3]
    Status TLV   enabled                        supported
    Flow label   enabled, T=1, R=0              enabled, T=1, R=1
  Dataplane:
    SSM segment/switch IDs: 4097/4096 (used), PWID: 1
  Rx Counters
    28 input transit packets, 2602 bytes
    0 drops, 0 seq err
  Tx Counters
    31 output transit packets, 3694 bytes
    0 drops
```

The following is sample output from the **show ssm id** command that shows information for all Segment Switching Manager (SSM) IDs:

```
Device# show ssm id

SSM Status: 1 switch
  Switch-ID 4096 State: Open
    Segment-ID: 8194 Type: Eth[2]
      Switch-ID:                  4096
      Physical intf:              Local
      Allocated By:               This CPU
      Locked By:                  SIP     [1]
      Circuit status:             UP      [1]
    Class:                      SSS
      State:                      Active
      AC Switching Context:       Et0/0
      SSS Info : Switch Handle 2583691265 Ckt 0xC36A59E0
      Interworking 0 Encap Len 0 Boardencap Len 0 MTU 1500
      Flow Classification src-dst-mac
      AC Encap [0 bytes]
    Class:                      ADJ
      State:                      Active
      AC Adjacency context:
      adjacency = 0xC36B6100 [complete] RAW Ethernet0/0:0
      AC Encap [0 bytes]
      1stMem: 8194 2ndMem: 0 ActMem: 8194

    Segment-ID: 4097 Type: AToM[17]
      Switch-ID:                  4096
      Allocated By:               This CPU
      Locked By:                  SIP     [1]
    Class:                      SSS
      State:                      Active
    Class:                      ADJ
      State:                      Active
```

The following is sample output from the **show mpls forwarding-table exact-route** command that shows the exact path for the source and destination address pair:

```
Device# show mpls forwarding-table exact-route label 32 ethernet source 001d.e558.5c1a dest
 000e.8379.1c1b detail
```

```
Local      Outgoing   Prefix           Bytes Label   Outgoing   Next Hop
Label      Label      or Tunnel Id     Switched      interface
32         No Label   l2ckt(66)        1163          Gi1/0/4    point2point
        MAC/Encaps=0/0, MRU=0, Label Stack{}
        No output feature configured
        Flow label: 227190
```

Configuration Examples for Any Transport over MPLS

Example: ATM over MPLS

The table below shows the configuration of ATM over MPLS on two PE routers.

Table 6: ATM over MPLS Configuration Example

PE1	PE2
mpls label protocol ldp	mpls label protocol ldp
mpls ldp router-id Loopback0 force	mpls ldp router-id Loopback0 force
!	!
interface Loopback0	interface Loopback0
ip address 10.16.12.12 255.255.255.255	ip address 10.13.13.13 255.255.255.255
!	
interface ATM4/0/0	interface ATM4/0/0
pvc 0/100 l2transport	pvc 0/100 l2transport
encapsulation aal0	encapsulation aal0
xconnect 10.13.13.13 100 encapsulation mpls	xconnect 10.16.12.12 100 encapsulation mpls
!	!
interface ATM4/0/0.300 point-to-point	interface ATM4/0/0.300 point-to-point
no ip directed-broadcast	no ip directed-broadcast
no atm enable-ilmi-trap	no atm enable-ilmi-trap
pvc 0/300 l2transport	pvc 0/300 l2transport
encapsulation aal0	encapsulation aal0
xconnect 10.13.13.13 300 encapsulation mpls	xconnect 10.16.12.12 300 encapsulation mpls

Example: ATM over MPLS Using Commands Associated with L2VPN Protocol-Based Feature

The table below shows the configuration of ATM over MPLS on two PE routers.

Table 7: ATM over MPLS Configuration Example

PE1	PE2

PE1	PE2
mpls label protocol ldp	mpls label protocol ldp
mpls ldp router-id Loopback0 force	mpls ldp router-id Loopback0 force
!	!
interface Loopback0	interface Loopback0
ip address 10.16.12.12 255.255.255.255	ip address 10.13.13.13 255.255.255.255
!	
interface ATM4/0/0	interface ATM4/0/0
pvc 0/100 l2transport	pvc 0/100 l2transport
encapsulation aal0	encapsulation aal0
interface pseudowire 100	interface pseudowire 100
encapsulation mpls	encapsulation mpls
neighbor 10.0.0.1 123	neighbor 10.0.0.1 123
!	!
l2vpn xconnect context A	l2vpn xconnect context A
member pseudowire 100	member pseudowire 100
member atm 100	member atm 100
!	!
interface ATM4/0/0.300 point-to-point	interface ATM4/0/0.300 point-to-point
no atm enable-ilmi-trap	no ip directed-broadcast
pvc 0/300 l2transport	no atm enable-ilmi-trap
encapsulation aal0	pvc 0/300 l2transport
interface pseudowire 300	encapsulation aal0
encapsulation mpls	interface pseudowire 300
neighbor 10.0.0.1 123	encapsulation mpls

PE1	PE2
! l2vpn xconnect context A member pseudowire 300 member atm 300	neighbor 10.0.0.1 123 ! l2vpn xconnect context A member pseudowire 300 member atm 300

Example: Configuring ATM AAL5 over MPLS in VC Class Configuration Mode

The following example configures ATM AAL5 over MPLS in VC class configuration mode. The VC class is then applied to an interface.

```
enable
configure terminal
vc-class atm aal5class
encapsulation aal5
interface atm1/0/0
class-int aal5class
pvc 1/200 l2transport
xconnect 10.13.13.13 100 encapsulation mpls
```

The following example configures ATM AAL5 over MPLS in VC class configuration mode. The VC class is then applied to a PVC.

```
enable
configure terminal
vc-class atm aal5class
encapsulation aal5
interface atm1/0/0
pvc 1/200 l2transport
class-vc aal5class
xconnect 10.13.13.13 100 encapsulation mpls
```

Example: Configuring ATM AAL5 over MPLS in VC Class Configuration Mode Using Commands Associated with L2VPN Protocol-Based Feature

The following example configures ATM AAL5 over MPLS in VC class configuration mode. The VC class is then applied to an interface.

```
enable
configure terminal
vc-class atm aal5class
encapsulation aal5
interface atm1/0/0
class-int aal5class
pvc 1/200 l2transport
interface pseudowire 100
encapsulation mpls
```

```
neighbor 10.0.0.1 123
exit
l2vpn xconnect context A
member pseudowire 100
member atm 100
exit
```

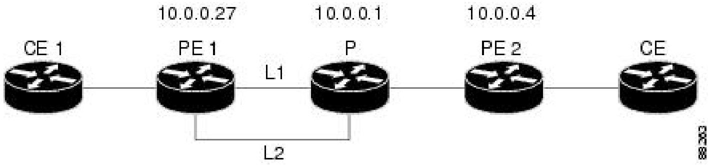
Example: Ethernet over MPLS with MPLS Traffic Engineering Fast Reroute

The following configuration example and the figure show the configuration of Ethernet over MPLS with fast reroute on AToM PE routers.

Routers PE1 and PE2 have the following characteristics:

- A TE tunnel called Tunnel41 is configured between PE1and PE2, using an explicit path through a link called L1. AToM VCs are configured to travel through the FRR-protected tunnel Tunnel41.
- The link L1 is protected by FRR, the backup tunnel is Tunnel1.
- PE2 is configured to forward the AToM traffic back to PE1 through the L2 link.

Figure 4: Fast Reroute Configuration



PE1 Configuration

```
mpls label protocol ldp
mpls traffic-eng tunnels
mpls ldp router-id Loopback1 force
!
pseudowire-class T41
 encapsulation mpls
 preferred-path interface Tunnel41 disable-fallback
!
pseudowire-class IP1
 encapsulation mpls
 preferred-path peer 10.4.0.1 disable-fallback
!
interface Loopback1
 ip address 10.0.0.27 255.255.255.255
!
interface Tunnel1
 ip unnumbered Loopback1
 tunnel destination 10.0.0.1
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng priority 1 1
 tunnel mpls traffic-eng bandwidth 10000
 tunnel mpls traffic-eng path-option 1 explicit name FRR
!
interface Tunnel41
 ip unnumbered Loopback1
 tunnel destination 10.0.0.4
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng priority 1 1
 tunnel mpls traffic-eng bandwidth 1000
 tunnel mpls traffic-eng path-option 1 explicit name name-1
 tunnel mpls traffic-eng fast-reroute
!
interface POS0/0/0
 description pe1name POS8/0/0
 ip address 10.1.0.2 255.255.255.252
 mpls traffic-eng tunnels
 mpls traffic-eng backup-path Tunnel1
 crc 16
 clock source internal
 pos ais-shut
 pos report lrdi
 ip rsvp bandwidth 155000 155000
!
interface POS0/3/0
 description pe1name POS10/1/0
 ip address 10.1.0.14 255.255.255.252
 mpls traffic-eng tunnels
 crc 16
 clock source internal
 ip rsvp bandwidth 155000 155000
!
interface gigabitethernet3/0/0.1
 encapsulation dot1Q 203
 xconnect 10.0.0.4 2 pw-class IP1
!
interface gigabitethernet3/0/0.2
 encapsulation dot1Q 204
 xconnect 10.0.0.4 4 pw-class T41
!
router ospf 1
 network 10.0.0.0 0.255.255.255 area 0
 mpls traffic-eng router-id Loopback1
 mpls traffic-eng area 0
!
ip classless
ip route 10.4.0.1 255.255.255.255 Tunnel41
!
ip explicit-path name xxxx-1 enable
 next-address 10.4.1.2
 next-address 10.1.0.10
```

P Configuration

```
ip cef
mpls traffic-eng tunnels
!
interface Loopback1
 ip address 10.0.0.1 255.255.255.255
!
interface FastEthernet1/0/0
 ip address 10.4.1.2 255.255.255.0
 mpls traffic-eng tunnels
 ip rsvp bandwidth 10000 10000
!
interface POS8/0/0
 description xxxx POS0/0
 ip address 10.1.0.1 255.255.255.252
 mpls traffic-eng tunnels
 pos ais-shut
 pos report lrdi
 ip rsvp bandwidth 155000 155000
!
```

```
interface POS10/1/0
 description xxxx POS0/3
 ip address 10.1.0.13 255.255.255.252
 mpls traffic-eng tunnels
 ip rsvp bandwidth 155000 155000
!
router ospf 1
 network 10.0.0.0 0.255.255.255 area 0
 mpls traffic-eng router-id Loopback1
 mpls traffic-eng area 0
```

PE2 Configuration

```
ip cef
mpls label protocol ldp
mpls traffic-eng tunnels
mpls ldp router-id Loopback1 force
!
interface Loopback1
 ip address 10.0.0.4 255.255.255.255
!
interface loopback 2
ip address 10.4.0.1 255.255.255.255
!
interface Tunnel27
 ip unnumbered Loopback1
 tunnel destination 10.0.0.27
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng priority 1 1
 tunnel mpls traffic-eng bandwidth 1000
 tunnel mpls traffic-eng path-option 1 explicit name xxxx-1
!
interface FastEthernet0/0/0.2
 encapsulation dot1Q 203
 xconnect 10.0.0.27 2 encapsulation mpls
!
interface FastEthernet0/0/0.3
 encapsulation dot1Q 204
 xconnect 10.0.0.27 4 encapsulation mpls
!
interface FastEthernet1/1/0
 ip address 10.4.1.1 255.255.255.0
 mpls traffic-eng tunnels
 ip rsvp bandwidth 10000 10000
!
router ospf 1
 network 10.0.0.0 0.255.255.255 area 0
 mpls traffic-eng router-id Loopback1
 mpls traffic-eng area 0
!
ip explicit-path name xxxx-1 enable
 next-address 10.4.1.2
 next-address 10.1.0.10
```

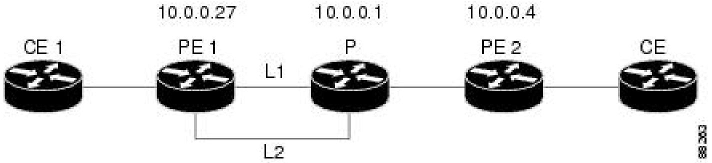
Example: Ethernet over MPLS with MPLS Traffic Engineering Fast Reroute Using Commands Associated with L2VPN Protocol-Based Feature

The following configuration example and the figure show the configuration of Ethernet over MPLS with fast reroute on AToM PE routers.

Routers PE1 and PE2 have the following characteristics:

- A TE tunnel called Tunnel41 is configured between PE1and PE2, using an explicit path through a link called L1. AToM VCs are configured to travel through the FRR-protected tunnel Tunnel41.
- The link L1 is protected by FRR, the backup tunnel is Tunnel1.
- PE2 is configured to forward the AToM traffic back to PE1 through the L2 link.

Figure 5: Fast Reroute Configuration



PE1 Configuration

```
mpls label protocol ldp
mpls traffic-eng tunnels
mpls ldp router-id Loopback1 force
!
template type pseudowire T41
 encapsulation mpls
 preferred-path interface Tunnel41 disable-fallback
!
template type pseudowire IP1
 encapsulation mpls
 preferred-path peer 10.4.0.1 disable-fallback
!
interface Loopback1
 ip address 10.0.0.27 255.255.255.255
!
interface Tunnel1
 ip unnumbered Loopback1
 tunnel destination 10.0.0.1
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng priority 1 1
 tunnel mpls traffic-eng bandwidth 10000
 tunnel mpls traffic-eng path-option 1 explicit name FRR
!
interface Tunnel41
 ip unnumbered Loopback1
 tunnel destination 10.0.0.4
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng priority 1 1
 tunnel mpls traffic-eng bandwidth 1000
 tunnel mpls traffic-eng path-option 1 explicit name name-1
 tunnel mpls traffic-eng fast-reroute
!
interface POS0/0/0
 description pe1name POS8/0/0
 ip address 10.1.0.2 255.255.255.252
 mpls traffic-eng tunnels
 mpls traffic-eng backup-path Tunnel1
 crc 16
 clock source internal
 pos ais-shut
 pos report lrdi
 ip rsvp bandwidth 155000 155000
```

```
!
interface POS0/3/0
 description pe1name POS10/1/0
 ip address 10.1.0.14 255.255.255.252
 mpls traffic-eng tunnels
 crc 16
 clock source internal
 ip rsvp bandwidth 155000 155000
!
interface gigabitethernet3/0/0.1
 encapsulation dot1Q 203
 interface pseudowire 100
 source template type pseudowire T41
 neighbor 10.0.0.4 2
!
l2vpn xconnect context con1
!
interface gigabitethernet3/0/0.2
 encapsulation dot1Q 204
 interface pseudowire 100
 source template type pseudowire IP1
 neighbor 10.0.0.4 4
!
l2vpn xconnect context con2
!
router ospf 1
 network 10.0.0.0 0.255.255.255 area 0
 mpls traffic-eng router-id Loopback1
 mpls traffic-eng area 0
!
ip classless
ip route 10.4.0.1 255.255.255.255 Tunnel41
!
ip explicit-path name xxxx-1 enable
 next-address 10.4.1.2
 next-address 10.1.0.10
```

P Configuration

```
ip cef
mpls traffic-eng tunnels
!
interface Loopback1
 ip address 10.0.0.1 255.255.255.255
!
interface FastEthernet1/0/0
 ip address 10.4.1.2 255.255.255.0
 mpls traffic-eng tunnels
 ip rsvp bandwidth 10000 10000
!
interface POS8/0/0
 description xxxx POS0/0
 ip address 10.1.0.1 255.255.255.252
 mpls traffic-eng tunnels
 pos ais-shut
 pos report lrdi
 ip rsvp bandwidth 155000 155000
!
interface POS10/1/0
 description xxxx POS0/3
 ip address 10.1.0.13 255.255.255.252
 mpls traffic-eng tunnels
 ip rsvp bandwidth 155000 155000
```

```
!
router ospf 1
 network 10.0.0.0 0.255.255.255 area 0
 mpls traffic-eng router-id Loopback1
 mpls traffic-eng area 0
```

PE2 Configuration

```
ip cef
mpls label protocol ldp
mpls traffic-eng tunnels
mpls ldp router-id Loopback1 force
!
interface Loopback1
 ip address 10.0.0.4 255.255.255.255
!
interface loopback 2
ip address 10.4.0.1 255.255.255.255
!
interface Tunnel27
 ip unnumbered Loopback1
 tunnel destination 10.0.0.27
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng priority 1 1
 tunnel mpls traffic-eng bandwidth 1000
 tunnel mpls traffic-eng path-option 1 explicit name xxxx-1
!
interface FastEthernet0/0/0.2
 encapsulation dot1Q 203
 interface pseudowire 100
 encapsulation mpls
 neighbor 10.0.0.1 123
!
l2vpn xconnect context A
 member pseudowire 100
 member gigabitethernet 0/0/0.1
!
interface FastEthernet0/0/0.3
 encapsulation dot1Q 204
 interface pseudowire 100
 encapsulation mpls
 neighbor 10.0.0.1 123
!
l2vpn xconnect context A
 member pseudowire 100
 member gigabitethernet 0/0/0.1
!
interface FastEthernet1/1/0
 ip address 10.4.1.1 255.255.255.0
 mpls traffic-eng tunnels
 ip rsvp bandwidth 10000 10000
!
router ospf 1
 network 10.0.0.0 0.255.255.255 area 0
 mpls traffic-eng router-id Loopback1
 mpls traffic-eng area 0
!
ip explicit-path name xxxx-1 enable
 next-address 10.4.1.2
 next-address 10.1.0.10
```

Example: Configuring OAM Cell Emulation

The following example shows how to enable OAM cell emulation on an ATM PVC:

```
interface ATM 1/0/0
pvc 1/200 l2transport
encapsulation aal5
xconnect 10.13.13.13 100 encapsulation mpls
oam-ac emulation-enable
oam-pvc manage
```

The following example shows how to set the rate at which an AIS cell is sent every 30 seconds:

```
interface ATM 1/0/0
pvc 1/200 l2transport
encapsulation aal5
xconnect 10.13.13.13 100 encapsulation mpls
oam-ac emulation-enable 30
oam-pvc manage
```

The following example shows how to configure OAM cell emulation for ATM AAL5 over MPLS in VC class configuration mode. The VC class is then applied to an interface.

```
enable
configure terminal
vc-class atm oamclass
encapsulation aal5
oam-ac emulation-enable 30
oam-pvc manage
interface atm1/0/0
class-int oamclass
pvc 1/200 l2transport
xconnect 10.13.13.13 100 encapsulation mpls
```

The following example shows how to configure OAM cell emulation for ATM AAL5 over MPLS in VC class configuration mode. The VC class is then applied to a PVC.

```
enable
configure terminal
vc-class atm oamclass
encapsulation aal5
oam-ac emulation-enable 30
oam-pvc manage
interface atm1/0/0
pvc 1/200 l2transport
class-vc oamclass
xconnect 10.13.13.13 100 encapsulation mpls
```

The following example shows how to configure OAM cell emulation for ATM AAL5 over MPLS in VC class configuration mode. The VC class is then applied to an interface. One PVC is configured with OAM cell emulation at an AIS rate of 10. That PVC uses the AIS rate of 10 instead of 30.

```
enable
configure terminal
vc-class atm oamclass
encapsulation aal5
oam-ac emulation-enable 30
oam-pvc manage
```

```
interface atm1/0/0
class-int oamclass
pvc 1/200 l2transport
oam-ac emulation-enable 10
xconnect 10.13.13.13 100 encapsulation mpls
```

Example: Configuring OAM Cell Emulation using the commands associated with the L2VPN Protocol-Based CLIs feature

The following example shows how to enable OAM cell emulation on an ATM PVC:

```
interface ATM 1/0/0
pvc 1/200 l2transport
encapsulation aal5
interface pseudowire 100
encapsulation mpls
neighbor 10.0.0.1 123
!
l2vpn xconnect context A
member pseudowire 100
member gigabitethernet 0/0/0.1
!
oam-ac emulation-enable
oam-pvc manage
```

The following example shows how to set the rate at which an AIS cell is sent every 30 seconds:

```
interface ATM 1/0/0
pvc 1/200 l2transport
encapsulation aal5
interface pseudowire 100
encapsulation mpls
neighbor 10.0.0.1 123
!
l2vpn xconnect context A
member pseudowire 100
member gigabitethernet 0/0/0.1
!
oam-ac emulation-enable 30
oam-pvc manage
```

The following example shows how to configure OAM cell emulation for ATM AAL5 over MPLS in VC class configuration mode. The VC class is then applied to an interface.

```
enable
configure terminal
vc-class atm oamclass
encapsulation aal5
oam-ac emulation-enable 30
oam-pvc manage
interface atm1/0/0
class-int oamclass
pvc 1/200 l2transport
interface pseudowire 100
encapsulation mpls
neighbor 10.0.0.1 123
!
l2vpn xconnect context A
```

```
member pseudowire 100
member gigabitethernet 0/0/0.1

The following example shows how to configure OAM cell emulation for ATM AAL5 over MPLS in
VC class configuration mode. The VC class is then applied to a PVC.
```

```
enable
configure terminal
vc-class atm oamclass
encapsulation aal5
oam-ac emulation-enable 30
oam-pvc manage
interface atm1/0/0
pvc 1/200 l2transport
class-vc oamclass
interface pseudowire 100
encapsulation mpls
neighbor 10.0.0.1 123
!
l2vpn xconnect context A
member pseudowire 100
member gigabitethernet 0/0/0.1
```

The following example shows how to configure OAM cell emulation for ATM AAL5 over MPLS in VC class configuration mode. The VC class is then applied to an interface. One PVC is configured with OAM cell emulation at an AIS rate of 10. That PVC uses the AIS rate of 10 instead of 30.

```
enable
configure terminal
vc-class atm oamclass
encapsulation aal5
oam-ac emulation-enable 30
oam-pvc manage
interface atm1/0/0
class-int oamclass
pvc 1/200 l2transport
oam-ac emulation-enable 10
interface pseudowire 100
encapsulation mpls
neighbor 10.0.0.1 123
!
l2vpn xconnect context A
member pseudowire 100
member gigabitethernet 0/0/0.1
```

Example: Configuring ATM Cell Relay over MPLS

The following example shows how to configure ATM cell relay over MPLS in VC class configuration mode. The VC class is then applied to an interface.

```
enable
configure terminal
vc-class atm cellrelay
encapsulation aal0
interface atm1/0/0
class-int cellrelay
pvc 1/200 l2transport
xconnect 10.13.13.13 100 encapsulation mpls
```

The following example shows how to configure ATM cell relay over MPLS in VC class configuration mode. The VC class is then applied to a PVC.

```
enable
configure terminal
vc-class atm cellrelay
encapsulation aal0
interface atm1/0/0
pvc 1/200 l2transport
class-vc cellrelay
xconnect 10.13.13.13 100 encapsulation mpls
```

The following example shows how to configure a pseudowire class to transport single ATM cells over a virtual path:

```
pseudowire-class vp-cell-relay
encapsulation mpls
interface atm 5/0
atm pvp 1 l2transport
xconnect 10.0.0.1 123 pw-class vp-cell-relay
```

Example: Configuring ATM Cell Relay over MPLS using the commands associated with the L2VPN Protocol-Based CLIs feature

The following example shows how to configure ATM cell relay over MPLS in VC class configuration mode. The VC class is then applied to an interface.

```
enable
configure terminal
vc-class atm cellrelay
encapsulation aal0
interface atm1/0/0
class-int cellrelay
pvc 1/200 l2transport
interface pseudowire 100
encapsulation mpls
neighbor 10.13.13.13 100
!
l2vpn xconnect context A
member pseudowire 100
member gigabitethernet 0/0/0.1
```

The following example shows how to configure ATM cell relay over MPLS in VC class configuration mode. The VC class is then applied to a PVC.

```
enable
configure terminal
vc-class atm cellrelay
encapsulation aal0
interface atm1/0/0
pvc 1/200 l2transport
class-vc cellrelay
interface pseudowire 100
encapsulation mpls
neighbor 10.13.13.13 100
!
l2vpn xconnect context A
```

```
member pseudowire 100
member gigabitethernet 0/0/0.1
```

The following example shows how to configure a pseudowire class to transport single ATM cells over a virtual path:

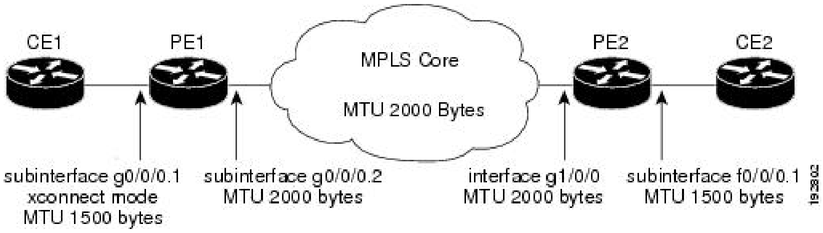
```
template type pseudowire vp-cell-relay
encapsulation mpls
interface atm 5/0
atm pvp 1 l2transport
interface pseudowire 100
 source template type pseudowire ether-pw
 neighbor 10.0.0.1 123
!
l2vpn xconnect context con1
```

Example: Configuring per-Subinterface MTU for Ethernet over MPLS

The figure below shows a configuration that enables matching MTU values between VC endpoints.

As shown in the figure, PE1 is configured in xconnect subinterface configuration mode with an MTU value of 1500 bytes in order to establish an end-to-end VC with PE2, which also has an MTU value of 1500 bytes. If PE1 was not set with an MTU value of 1500 bytes, in xconnect subinterface configuration mode, the subinterface would inherit the MTU value of 2000 bytes set on the interface. This would cause a mismatch in MTU values between the VC endpoints, and the VC would not come up.

Figure 6: Configuring MTU Values in xconnect Subinterface Configuration Mode



The following examples show the router configurations in the figure above:

CE1 Configuration

```
interface gigabitethernet0/0/0
 mtu 1500
 no ip address
!
interface gigabitethernet0/0/0.1
 encapsulation dot1Q 100
 ip address 10.181.182.1 255.255.255.0
```

PE1 Configuration

```
interface gigabitethernet0/0/0
 mtu 2000
 no ip address
!
interface gigabitethernet0/0/0.1
 encapsulation dot1Q 100
 xconnect 10.1.1.152 100 encapsulation mpls
  mtu 1500
!
interface gigabitethernet0/0/0.2
 encapsulation dot1Q 200
 ip address 10.151.100.1 255.255.255.0
 mpls ip
```

PE2 Configuration

```
interface gigabitethernet1/0/0
 mtu 2000
 no ip address
!
interface gigabitethernet1/0/0.2
 encapsulation dot1Q 200
 ip address 10.100.152.2 255.255.255.0
 mpls ip
!
interface fastethernet0/0/0
 no ip address
!
interface fastethernet0/0/0.1
 description default MTU of 1500 for FastEthernet
 encapsulation dot1Q 100
 xconnect 10.1.1.151 100 encapsulation mpls
```

CE2 Configuration

```
interface fastethernet0/0/0
 no ip address
interface fastethernet0/0/0.1
 encapsulation dot1Q 100
 ip address 10.181.182.2 255.255.255.0
```

The **show mpls l2transport binding** command, issued from router PE1, shows a matching MTU value of 1500 bytes on both the local and remote routers:

```
Router# show mpls l2transport binding
Destination Address: 10.1.1.152,  VC ID: 100
    Local Label: 100
        Cbit: 1,    VC Type: FastEthernet,    GroupID: 0
        MTU: 1500,   Interface Desc: n/a
        VCCV: CC Type: CW [1], RA [2]
              CV Type: LSPV [2]
    Remote Label: 202
        Cbit: 1,    VC Type: FastEthernet,    GroupID: 0
        MTU: 1500,   Interface Desc: n/a
        VCCV: CC Type: RA [2]
              CV Type: LSPV [2]
```

```
Router# show mpls l2transport vc detail
Local interface: Gi0/0/0.1 up, line protocol up, Eth VLAN 100 up
  Destination address: 10.1.1.152, VC ID: 100, VC status: up
    Output interface: Gi0/0/0.2, imposed label stack {202}
    Preferred path: not configured
    Default path: active
    Next hop: 10.151.152.2
  Create time: 1d11h, last status change time: 1d11h
  Signaling protocol: LDP, peer 10.1.1.152:0 up
```

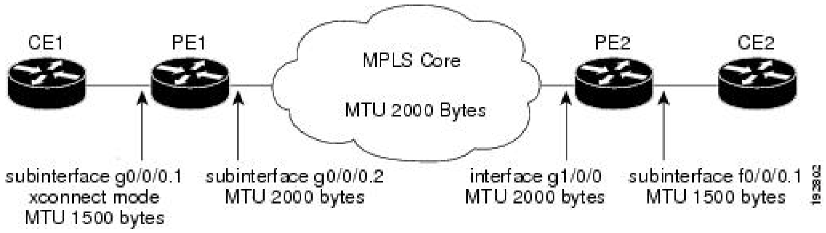
```
    Targeted Hello: 10.1.1.151(LDP Id) -> 10.1.1.152
    MPLS VC labels: local 100, remote 202
    Group ID: local 0, remote 0
    MTU: local 1500, remote 1500
    Remote interface description:
  Sequencing: receive disabled, send disabled
  VC statistics:
    packet totals: receive 41, send 39
    byte totals:   receive 4460, send 5346
    packet drops:  receive 0, send 0
```

Example: Configuring per-Subinterface MTU for Ethernet over MPLS using the commands associated with the L2VPN Protocol-Based CLIs feature

The figure below shows a configuration that enables matching MTU values between VC endpoints.

As shown in the figure, PE1 is configured in xconnect subinterface configuration mode with an MTU value of 1500 bytes in order to establish an end-to-end VC with PE2, which also has an MTU value of 1500 bytes. If PE1 was not set with an MTU value of 1500 bytes, in xconnect subinterface configuration mode, the subinterface would inherit the MTU value of 2000 bytes set on the interface. This would cause a mismatch in MTU values between the VC endpoints, and the VC would not come up.

Figure 7: Configuring MTU Values in xconnect Subinterface Configuration Mode



The following examples show the router configurations in the figure above:

CE1 Configuration

```
interface gigabitethernet0/0/0
 mtu 1500
 no ip address
!
interface gigabitethernet0/0/0.1
 encapsulation dot1Q 100
 ip address 10.181.182.1 255.255.255.0
```

PE1 Configuration

```
interface gigabitethernet0/0/0
 mtu 2000
 no ip address
!
interface gigabitethernet0/0/0.1
 encapsulation dot1Q 100
 interface pseudowire 100
encapsulation mpls
neighbor 10.0.0.1 123
mtu 1500
```

```
!
l2vpn xconnect context A
member pseudowire 100
member gigabitethernet 0/0/0.1
!
interface gigabitethernet0/0/0.2
 encapsulation dot1Q 200
 ip address 10.151.100.1 255.255.255.0
 mpls ip
```

PE2 Configuration

```
interface gigabitethernet1/0/0
 mtu 2000
 no ip address
!
interface gigabitethernet1/0/0.2
 encapsulation dot1Q 200
 ip address 10.100.152.2 255.255.255.0
 mpls ip
!
interface fastethernet0/0/0
 no ip address
!
interface fastethernet0/0/0.1
 description default MTU of 1500 for FastEthernet
 encapsulation dot1Q 100
 interface pseudowire 100
 encapsulation mpls
 neighbor 10.0.0.1 123
mtu 1500
!
l2vpn xconnect context A
 member pseudowire 100
 member gigabitethernet 0/0/0.1
```

CE2 Configuration

```
interface fastethernet0/0/0
 no ip address
interface fastethernet0/0/0.1
 encapsulation dot1Q 100
 ip address 10.181.182.2 255.255.255.0
```

The **show l2vpn atom binding** command, issued from router PE1, shows a matching MTU value of 1500 bytes on both the local and remote routers:

```
Device# show l2vpn atom binding
Destination Address: 10.1.1.152,  VC ID: 100
    Local Label: 100
        Cbit: 1,    VC Type: FastEthernet,    GroupID: 0
        MTU: 1500,   Interface Desc: n/a
        VCCV: CC Type: CW [1], RA [2]
              CV Type: LSPV [2]
    Remote Label: 202
        Cbit: 1,    VC Type: FastEthernet,    GroupID: 0
        MTU: 1500,   Interface Desc: n/a
        VCCV: CC Type: RA [2]
              CV Type: LSPV [2]
```

Example: Configuring Tunnel Selection

The following example shows how to set up two preferred paths for PE1. One preferred path specifies an MPLS traffic engineering tunnel. The other preferred path specifies an IP address of a loopback address on PE2. There is a static route configured on PE1 that uses a TE tunnel to reach the IP address on PE2.

PE1 Configuration

```
mpls label protocol ldp
mpls traffic-eng tunnels
tag-switching tdp router-id Loopback0
pseudowire-class pw1
 encapsulation mpls
 preferred-path interface Tunnel1 disable-fallback
!
pseudowire-class pw2
 encapsulation mpls
 preferred-path peer 10.18.18.18
!
interface Loopback0
 ip address 10.2.2.2 255.255.255.255
 no ip directed-broadcast
 no ip mroute-cache
!
interface Tunnel1
 ip unnumbered Loopback0
 no ip directed-broadcast
 tunnel destination 10.16.16.16
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng priority 7 7
 tunnel mpls traffic-eng bandwidth 1500
 tunnel mpls traffic-eng path-option 1 explicit name path-tu1
!
interface Tunnel2
 ip unnumbered Loopback0
 no ip directed-broadcast
 tunnel destination 10.16.16.16
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng priority 7 7
 tunnel mpls traffic-eng bandwidth 1500
 tunnel mpls traffic-eng path-option 1 dynamic
!
interface gigabitethernet0/0/0
 no ip address
 no ip directed-broadcast
 no negotiation auto
!
interface gigabitethernet0/0/0.1
 encapsulation dot1Q 222
 no ip directed-broadcast
 xconnect 10.16.16.16 101 pw-class pw1
!
interface ATM1/0/0
 no ip address
 no ip directed-broadcast
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
 pvc 0/50 l2transport
  encapsulation aal5
  xconnect 10.16.16.16 150 pw-class pw2
!
```

```
interface FastEthernet2/0/1
 ip address 10.0.0.1 255.255.255.0
 no ip directed-broadcast
 tag-switching ip
 mpls traffic-eng tunnels
 ip rsvp bandwidth 15000 15000
!
router ospf 1
 log-adjacency-changes
 network 10.0.0.0 0.0.0.255 area 0
 network 10.2.2.2 0.0.0.0 area 0
 mpls traffic-eng router-id Loopback0
 mpls traffic-eng area 0
!
ip route 10.18.18.18 255.255.255.255 Tunnel2
!
ip explicit-path name path-tu1 enable
 next-address 10.0.0.1
 index 3 next-address 10.0.0.1
```

PE2 Configuration

```
mpls label protocol ldp
mpls traffic-eng tunnels
mpls ldp router-id Loopback0
interface Loopback0
 ip address 10.16.16.16 255.255.255.255
 no ip directed-broadcast
 no ip mroute-cache
!
interface Loopback2
 ip address 10.18.18.18 255.255.255.255
 no ip directed-broadcast
!
interface FastEthernet1/1/0
 ip address 10.0.0.2 255.255.255.0
 no ip directed-broadcast
 mpls traffic-eng tunnels
 mpls ip
 no cdp enable
 ip rsvp bandwidth 15000 15000
!
interface FastEthernet1/1/1
 no ip address
 no ip directed-broadcast
 no cdp enable
!
interface FastEthernet1/1/1.1
 encapsulation dot1Q 222
 no ip directed-broadcast
 no cdp enable
 mpls l2transport route 10.2.2.2 101
!
interface ATM5/0/0
 no ip address
 no ip directed-broadcast
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
 pvc 0/50 l2transport
  encapsulation aal5
  xconnect 10.2.2.2 150 encapsulation mpls
!
router ospf 1
```

```
 log-adjacency-changes
 network 10.0.0.0 0.0.0.255 area 0
 network 10.16.16.16 0.0.0.0 area 0
 mpls traffic-eng router-id Loopback0
 mpls traffic-eng area 0
```

Example: Configuring Tunnel Selection Using Commands Associated with L2VPN Protocol-Based Feature

The following example shows how to set up two preferred paths for PE1. One preferred path specifies an MPLS traffic engineering tunnel. The other preferred path specifies an IP address of a loopback address on PE2. There is a static route configured on PE1 that uses a TE tunnel to reach the IP address on PE2.

PE1 Configuration

```
mpls label protocol ldp
mpls traffic-eng tunnels
tag-switching tdp router-id Loopback0
template type pseudowire pw1
 encapsulation mpls
 preferred-path interface Tunnel1 disable-fallback
!
template type pseudowire pw2
 encapsulation mpls
 preferred-path peer 10.18.18.18
!
interface Loopback0
 ip address 10.2.2.2 255.255.255.255
 no ip directed-broadcast
 no ip mroute-cache
!
interface Tunnel1
 ip unnumbered Loopback0
 no ip directed-broadcast
 tunnel destination 10.16.16.16
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng priority 7 7
 tunnel mpls traffic-eng bandwidth 1500
 tunnel mpls traffic-eng path-option 1 explicit name path-tu1
!
interface Tunnel2
 ip unnumbered Loopback0
 no ip directed-broadcast
 tunnel destination 10.16.16.16
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng priority 7 7
 tunnel mpls traffic-eng bandwidth 1500
 tunnel mpls traffic-eng path-option 1 dynamic
!
interface gigabitethernet0/0/0
 no ip address
 no ip directed-broadcast
 no negotiation auto
!
interface gigabitethernet0/0/0.1
 encapsulation dot1Q 222
 no ip directed-broadcast
 interface pseudowire 100
 source template type pseudowire pw1
```

```
  neighbor 10.16.16.16 101
!
l2vpn xconnect context con1
!
interface ATM1/0/0
 no ip address
 no ip directed-broadcast
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
 pvc 0/50 l2transport
  encapsulation aal5
 interface pseudowire 100
 source template type pseudowire pw2
 neighbor 10.16.16.16 150
!
l2vpn xconnect context con1
!
interface FastEthernet2/0/1
 ip address 10.0.0.1 255.255.255.0
 no ip directed-broadcast
 tag-switching ip
 mpls traffic-eng tunnels
 ip rsvp bandwidth 15000 15000
!
router ospf 1
 log-adjacency-changes
 network 10.0.0.0 0.0.0.255 area 0
 network 10.2.2.2 0.0.0.0 area 0
 mpls traffic-eng router-id Loopback0
 mpls traffic-eng area 0
!
ip route 10.18.18.18 255.255.255.255 Tunnel2
!
ip explicit-path name path-tu1 enable
 next-address 10.0.0.1
 index 3 next-address 10.0.0.1
```

PE2 Configuration

```
mpls label protocol ldp
mpls traffic-eng tunnels
mpls ldp router-id Loopback0
interface Loopback0
 ip address 10.16.16.16 255.255.255.255
 no ip directed-broadcast
 no ip mroute-cache
!
interface Loopback2
 ip address 10.18.18.18 255.255.255.255
 no ip directed-broadcast
!
interface FastEthernet1/1/0
 ip address 10.0.0.2 255.255.255.0
 no ip directed-broadcast
 mpls traffic-eng tunnels
 mpls ip
 no cdp enable
 ip rsvp bandwidth 15000 15000
!
interface FastEthernet1/1/1
 no ip address
 no ip directed-broadcast
 no cdp enable
```

```
!
interface FastEthernet1/1/1.1
 encapsulation dot1Q 222
 no ip directed-broadcast
 no cdp enable
 mpls l2transport route 10.2.2.2 101
!
interface ATM5/0/0
 no ip address
 no ip directed-broadcast
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
 pvc 0/50 l2transport
  encapsulation aal5
  interface pseudowire 100
   encapsulation mpls
   neighbor 10.2.2.2 150
!
l2vpn xconnect context A
  member pseudowire 100
  member GigabitEthernet0/0/0.1
!
router ospf 1
 log-adjacency-changes
 network 10.0.0.0 0.0.0.255 area 0
 network 10.16.16.16 0.0.0.0 area 0
 mpls traffic-eng router-id Loopback0
 mpls traffic-eng area 0
```

Example: Configuring MTU Values in xconnect Configuration Mode for L2VPN Interworking

The following example shows an L2VPN Interworking example. The PE1 router has a serial interface configured with an MTU value of 1492 bytes. The PE2 router uses xconnect configuration mode to set a matching MTU of 1492 bytes, which allows the two routers to form an interworking VC. If the PE2 router did not set the MTU value in xconnect configuration mode, the interface would be set to 1500 bytes by default and the VC would not come up.

Note L2VPN interworking is not supported on Cisco ASR 900 RSP3 Module.

PE1 Configuration

```
pseudowire-class atom-ipiw
 encapsulation mpls
 interworking ip
!
interface Loopback0
 ip address 10.1.1.151 255.255.255.255
!
interface Serial2/0/0
 mtu 1492
 no ip address
 encapsulation ppp
 no fair-queue
 serial restart-delay 0
 xconnect 10.1.1.152 123 pw-class atom-ipiw
!
interface Serial4/0/0
 ip address 10.151.100.1 255.255.255.252
 encapsulation ppp
 mpls ip
 serial restart-delay 0
!
router ospf 1
 log-adjacency-changes
 network 10.1.1.151 0.0.0.0 area 0
 network 10.151.100.0 0.0.0.3 area 0
!
mpls ldp router-id Loopback0
```

PE2 Configuration

```
pseudowire-class atom-ipiw
 encapsulation mpls
 interworking ip
!
interface Loopback0
 ip address 10.1.1.152 255.255.255.255
!
interface FastEthernet0/0/0
 no ip address
 xconnect 10.1.1.151 123 pw-class atom-ipiw
  mtu 1492
!
interface Serial4/0/0
 ip address 10.100.152.2 255.255.255.252
 encapsulation ppp
 mpls ip
 serial restart-delay 0
!
router ospf 1
 log-adjacency-changes
 network 10.1.1.152 0.0.0.0 area 0
 network 10.100.152.0 0.0.0.3 area 0
!
mpls ldp router-id Loopback0
```

The **show mpls l2transport binding** command shows that the MTU value for the local and remote routers is 1492 bytes.

PE1

```
Router# show mpls l2transport binding
Destination Address: 10.1.1.152,  VC ID: 123
    Local Label: 105
        Cbit: 1,    VC Type: PPP,    GroupID: 0
        MTU: 1492,   Interface Desc: n/a
        VCCV: CC Type: CW [1], RA [2]
              CV Type: LSPV [2]
    Remote Label: 205
        Cbit: 1,    VC Type: FastEthernet,    GroupID: 0
        MTU: 1492,   Interface Desc: n/a
        VCCV: CC Type: RA [2]
              CV Type: LSPV [2]
Router# show mpls l2transport vc detail
Local interface: Serial2/0/0 up, line protocol up, PPP up
```

```
  MPLS VC type is PPP, interworking type is IP
  Destination address: 10.1.1.152, VC ID: 123, VC status: up
    Output interface: Serial4/0/0, imposed label stack {1003 205}
    Preferred path: not configured
    Default path: active
    Next hop: point2point
  Create time: 00:25:29, last status change time: 00:24:54
  Signaling protocol: LDP, peer 10.1.1.152:0 up
    Targeted Hello: 10.1.1.151(LDP Id) -> 10.1.1.152
    Status TLV support (local/remote)   : enabled/supported
      Label/status state machine        : established, LruRru
      Last local dataplane   status rcvd: no fault
      Last local SSS circuit status rcvd: no fault
      Last local SSS circuit status sent: no fault
      Last local  LDP TLV    status sent: no fault
      Last remote LDP TLV    status rcvd: no fault
    MPLS VC labels: local 105, remote 205
    Group ID: local n/a, remote 0
    MTU: local 1492, remote 1492
    Remote interface description:
  Sequencing: receive disabled, send disabled
  VC statistics:
    packet totals: receive 30, send 29
    byte totals:   receive 2946, send 3364
    packet drops:  receive 0, send 0
```

PE2

```
Router# show mpls l2transport binding
Destination Address: 10.1.1.151,  VC ID: 123
    Local Label: 205
        Cbit: 1,    VC Type: FastEthernet,    GroupID: 0
        MTU: 1492,   Interface Desc: n/a
        VCCV: CC Type: RA [2]
              CV Type: LSPV [2]
    Remote Label: 105
        Cbit: 1,    VC Type: FastEthernet,    GroupID: 0
        MTU: 1492,   Interface Desc: n/a
        VCCV: CC Type: CW [1], RA [2]
              CV Type: LSPV [2]
Router# show mpls l2transport vc detail
Local interface: Fe0/0/0 up, line protocol up, FastEthernet up
  MPLS VC type is FastEthernet, interworking type is IP
  Destination address: 10.1.1.151, VC ID: 123, VC status: up
    Output interface: Se4/0/0, imposed label stack {1002 105}
    Preferred path: not configured
    Default path: active
    Next hop: point2point
  Create time: 00:25:19, last status change time: 00:25:19
  Signaling protocol: LDP, peer 10.1.1.151:0 up
    Targeted Hello: 10.1.1.152(LDP Id) -> 10.1.1.151
    Status TLV support (local/remote)   : enabled/supported
      Label/status state machine        : established, LruRru
      Last local dataplane   status rcvd: no fault
      Last local SSS circuit status rcvd: no fault
      Last local SSS circuit status sent: no fault
      Last local  LDP TLV    status sent: no fault
      Last remote LDP TLV    status rcvd: no fault
    MPLS VC labels: local 205, remote 105
    Group ID: local n/a, remote 0
    MTU: local 1492, remote 1492
    Remote interface description:
  Sequencing: receive disabled, send disabled
  VC statistics:
    packet totals: receive 29, send 30
    byte totals:   receive 2900, send 3426
    packet drops:  receive 0, send 0
```

Example: Configuring MTU Values in xconnect Configuration Mode for L2VPN Interworking Using Commands Associated with L2VPN Protocol-Based Feature

The following example shows an L2VPN Interworking example. The PE1 router has a serial interface configured with an MTU value of 1492 bytes. The PE2 router uses xconnect configuration mode to set a matching MTU of 1492 bytes, which allows the two routers to form an interworking VC. If the PE2 router did not set the MTU value in xconnect configuration mode, the interface would be set to 1500 bytes by default and the VC would not come up.

PE1 Configuration

```
template type pseudowire atom-ipiw
 encapsulation mpls
 interworking ip
!
interface Loopback0
 ip address 10.1.1.151 255.255.255.255
!
interface Serial2/0/0
 mtu 1492
 no ip address
 encapsulation ppp
 no fair-queue
 serial restart-delay 0
interface pseudowire 100
 source template type pseudowire atom-ipiw
 neighbor 10.1.1.152 123
!
l2vpn xconnect context con1
 member <ac_int>
 member pseudowire 100
!
interface Serial4/0/0
 ip address 10.151.100.1 255.255.255.252
 encapsulation ppp
 mpls ip
 serial restart-delay 0
!
router ospf 1
 log-adjacency-changes
 network 10.1.1.151 0.0.0.0 area 0
 network 10.151.100.0 0.0.0.3 area 0
!
mpls ldp router-id Loopback0
```

PE2 Configuration

```
template type pseudowire atom-ipiw
 encapsulation mpls
 interworking ip
!
interface Loopback0
 ip address 10.1.1.152 255.255.255.255
```

```
!
interface FastEthernet0/0/0
 no ip address
 interface pseudowire 100
 source template type pseudowire atom-ipiw
 neighbor 10.1.1.151 123
!
l2vpn xconnect context con1
 member <ac_int>
 member pseudowire1
!
interface Serial4/0/0
 ip address 10.100.152.2 255.255.255.252
 encapsulation ppp
 mpls ip
 serial restart-delay 0
!
router ospf 1
 log-adjacency-changes
 network 10.1.1.152 0.0.0.0 area 0
 network 10.100.152.0 0.0.0.3 area 0
!
mpls ldp router-id Loopback0
```

The **show l2vpn atom binding** command shows that the MTU value for the local and remote routers is 1492 bytes.

PE1

```
Device# show l2vpn atom binding
Destination Address: 10.1.1.152,  VC ID: 123
    Local Label: 105
        Cbit: 1,    VC Type: PPP,    GroupID: 0
        MTU: 1492,   Interface Desc: n/a
        VCCV: CC Type: CW [1], RA [2]
              CV Type: LSPV [2]
    Remote Label: 205
        Cbit: 1,    VC Type: FastEthernet,    GroupID: 0
        MTU: 1492,   Interface Desc: n/a
        VCCV: CC Type: RA [2]
              CV Type: LSPV [2]
Device# show l2vpn atom vc detail
Local interface: Serial2/0/0 up, line protocol up, PPP up
  MPLS VC type is PPP, interworking type is IP
  Destination address: 10.1.1.152, VC ID: 123, VC status: up
    Output interface: Serial4/0/0, imposed label stack {1003 205}
    Preferred path: not configured
    Default path: active
    Next hop: point2point
  Create time: 00:25:29, last status change time: 00:24:54
  Signaling protocol: LDP, peer 10.1.1.152:0 up
    Targeted Hello: 10.1.1.151(LDP Id) -> 10.1.1.152
    Status TLV support (local/remote)   : enabled/supported
      Label/status state machine        : established, LruRru
      Last local dataplane   status rcvd: no fault
      Last local SSS circuit status rcvd: no fault
      Last local SSS circuit status sent: no fault
      Last local  LDP TLV    status sent: no fault
      Last remote LDP TLV    status rcvd: no fault
    MPLS VC labels: local 105, remote 205
    Group ID: local n/a, remote 0
    MTU: local 1492, remote 1492
    Remote interface description:
```

```
  Sequencing: receive disabled, send disabled
  VC statistics:
    packet totals: receive 30, send 29
    byte totals:   receive 2946, send 3364
    packet drops:  receive 0, send 0
```

PE2

```
Device# show l2vpn atom binding
Destination Address: 10.1.1.151,  VC ID: 123
    Local Label: 205
        Cbit: 1,    VC Type: FastEthernet,    GroupID: 0
        MTU: 1492,   Interface Desc: n/a
        VCCV: CC Type: RA [2]
              CV Type: LSPV [2]
    Remote Label: 105
        Cbit: 1,    VC Type: FastEthernet,    GroupID: 0
        MTU: 1492,   Interface Desc: n/a
        VCCV: CC Type: CW [1], RA [2]
              CV Type: LSPV [2]
Device# show l2vpn atom vc detail
Local interface: Fe0/0/0 up, line protocol up, FastEthernet up
  MPLS VC type is FastEthernet, interworking type is IP
  Destination address: 10.1.1.151, VC ID: 123, VC status: up
    Output interface: Se4/0/0, imposed label stack {1002 105}
    Preferred path: not configured
    Default path: active
    Next hop: point2point
  Create time: 00:25:19, last status change time: 00:25:19
  Signaling protocol: LDP, peer 10.1.1.151:0 up
    Targeted Hello: 10.1.1.152(LDP Id) -> 10.1.1.151
    Status TLV support (local/remote)   : enabled/supported
      Label/status state machine        : established, LruRru
      Last local dataplane   status rcvd: no fault
      Last local SSS circuit status rcvd: no fault
      Last local SSS circuit status sent: no fault
      Last local  LDP TLV    status sent: no fault
      Last remote LDP TLV    status rcvd: no fault
    MPLS VC labels: local 205, remote 105
    Group ID: local n/a, remote 0
    MTU: local 1492, remote 1492
    Remote interface description:
  Sequencing: receive disabled, send disabled
  VC statistics:
    packet totals: receive 29, send 30
    byte totals:   receive 2900, send 3426
    packet drops:  receive 0, send 0
```

Examples: Configuring Any Transport over MPLS (AToM) Remote Ethernet Port Shutdown

The following example shows how to enable remote Ethernet port shutdown:

```
configure terminal
!
pseudowire-class eompls
 encapsulation mpls
!
interface GigabitEthernet1/0/0
```

```
 xconnect 10.1.1.1 1 pw-class eompls
  remote link failure notification
```

The following example shows how to disable remote Ethernet port shutdown:

```
configure terminal
!
pseudowire-class eompls
 encapsulation mpls
!
interface GigabitEthernet1/0/0
 xconnect 10.1.1.1 1 pw-class eompls
  no remote link failure notification
```

The related **show** command output reports operational status for all remote L2 Tunnels by interface.

```
Router# show interface G1/0/0
GigabitEthernet1/0/0 is L2 Tunnel remote down, line protocol is up
Hardware is GigMac 4 Port GigabitEthernet, address is 0003.ff4e.12a8 (bia 0003.ff4e.12a8)
  Internet address is 10.9.9.2/16
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec, rely 255/255, load 1/255
Router# show ip interface brief
Interface              IP-Address      OK? Method Status Protocol
GigabitEthernet2/0/0 unassigned      YES NVRAM  L2 Tunnel remote down up
GigabitEthernet2/1/0 unassigned      YES NVRAM  administratively down down
```

Note Remote Ethernet port shutdown is enabled by default when EVC "default encapsulation" is configured.

Examples: Configuring Any Transport over MPLS (AToM) Remote Ethernet Port Shutdown Using Commands Associated with L2VPN Protocol-Based Feature

The following example shows how to enable remote Ethernet port shutdown:

```
configure terminal
!
template type pseudowire eompls
 encapsulation mpls
!
interface GigabitEthernet1/0/0
interface pseudowire 100
 source template type pseudowire eompls
 neighbor 10.1.1.1 1
!
l2vpn xconnect context con1
 remote link failure notification
```

The following example shows how to disable remote Ethernet port shutdown:

```
configure terminal
!
template type pseudowire eompls
 encapsulation mpls
!
interface GigabitEthernet1/0/0
 interface pseudowire 100
 source template type pseudowire eompls
 neighbor 10.1.1.1 1
!
l2vpn xconnect context con1
 no remote link failure notification
```

The related **show** command output reports operational status for all remote L2 Tunnels by interface.

```
Router# show interface G1/0/0
GigabitEthernet1/0/0 is L2 Tunnel remote down, line protocol is up
Hardware is GigMac 4 Port GigabitEthernet, address is 0003.ff4e.12a8 (bia 0003.ff4e.12a8)
  Internet address is 10.9.9.2/16
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec, rely 255/255, load 1/255
Router# show ip interface brief
Interface              IP-Address      OK? Method Status Protocol
GigabitEthernet2/0/0 unassigned      YES NVRAM  L2 Tunnel remote down up
GigabitEthernet2/1/0 unassigned      YES NVRAM  administratively down down
```

Additional References for Any Transport over MPLS

Related Documents

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

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Any Transport over MPLS

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Table 8: Feature Information for Any Transport over MPLS

Feature Name	Releases	Feature Information
Any Transport over MPLS (AToM): ATM AAL5 over MPLS (AAL5oMPLS)	Cisco IOS XE Release 3.2S Cisco IOS XE Release 3.6S	In Cisco IOS XE Release 3.2S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. In Cisco IOS XE Release 3.6S, support was added for the Cisco ASR 903 Router. This feature introduced no new or modified commands.
Any Transport over MPLS (AToM): ATM Cell Relay over MPLS: Packed Cell Relay	Cisco IOS XE Release 3.5S	In Cisco IOS XE Release 3.5S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. In Cisco IOS XE Release 3.5S, support was added for the Cisco ASR 903 Router.
Any Transport over MPLS (AToM): ATM OAM Emulation	Cisco IOS XE Release 3.2S	In Cisco IOS XE Release 3.2S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. This feature introduced no new or modified commands.
	Cisco IOS XE Release 2.5	This feature provides capability to support sequencing of AToM) data plane packets.
Any Transport over MPLS (AToM): Ethernet over MPLS (EoMPLS)	Cisco IOS XE Release 2.4 Cisco IOS XE Release 3.5S	This feature allows you to transport Layer 2 Ethernet VLAN packets from various sources over an MPLS backbone. Ethernet over MPLS extends the usability of the MPLS backbone by enabling it to offer Layer 2 services in addition to already existing Layer 3 services. You can enable the MPLS backbone network to accept Layer 2 VLAN packets by configuring the PE routers at the both ends of the MPLS backbone. In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Routers. In Cisco IOS XE Release 3.5S, support was added for the Cisco ASR 903 Router.
Any Transport over MPLS (AToM): Ethernet over MPLS: Port Mode (EoMPLS)	Cisco IOS XE Release 2.4	Ethernet over MPLS (EoMPLS) is the transport of Ethernet frames across an MPLS core. It transports all frames received on a particular Ethernet or virtual LAN (VLAN) segment, regardless of the destination Media Access Control (MAC) information. It does not perform MAC learning or MAC look up for forwarding packets from the Ethernet interface. Port mode allows a frame coming into an interface to be packed into an MPLS packet and transported over the MPLS backbone to an egress interface. In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Routers.

Feature Name	Releases	Feature Information
Any Transport over MPLS-Ethernet over MPLS Enhancements: Fast Reroute	Cisco IOS XE Release 2.4	AToM can use MPLS traffic engineering (TE) tunnels with fast reroute (FRR) support. This features enhances FRR functionality for Ethernet over MPLS (EoMPLS). In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Routers.
Any Transport over MPLS (AToM): Frame Relay over MPLS (FRoMPLS)	Cisco IOS XE Release 3.2.1S	In Cisco IOS XE Release 3.2.1S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. This feature introduced no new or modified commands.
Any Transport over MPLS (AToM): HDLC over MPLS (HDLCoMPLS)	Cisco IOS XE Release 3.2S	In Cisco IOS XE Release 3.2S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. This feature introduced no new or modified commands.
Any Transport over MPLS (AToM): Layer 2 Quality of Service (QoS)	Cisco IOS XE Release 2.3	This feature provides support for quality of service (QoS) features such as traffic policing, traffic shaping, packet marking, and mapping of the packets. In Cisco IOS XE Release 2.3, this feature was introduced on the Cisco ASR 1000 Series Routers.
Any Transport over MPLS (AToM): PPP over MPLS (PPPoMPLS)	Cisco IOS XE Release 3.2S	In Cisco IOS XE Release 3.2S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. This feature introduced no new or modified commands.
Any Transport over MPLS (AToM): Remote Ethernet Port Shutdown	Cisco IOS XE Release 2.4	This feature allows a service provider edge (PE) router on the local end of an Ethernet over MPLS (EoMPLS) pseudowire to detect a remote link failure and cause the shutdown of the Ethernet port on the local customer edge (CE) router. Because the Ethernet port on the local CE router is shut down, the router does not lose data by continuously sending traffic to the failed remote link. This is beneficial if the link is configured as a static IP route. In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Routers.
ATM Port Mode Packed Cell Relay over MPLS	Cisco IOS XE Release 3.5S	In Cisco IOS XE Release 3.5S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.
ATM VC Class Support	Cisco IOS XE Release 2.3	The ATM VC Class Support feature allows you to specify AAL5 and AAL0 encapsulations as part of a VC class. In Cisco IOS XE Release 2.3, this feature was introduced on the Cisco ASR 1000 Series Routers.

Feature Name	Releases	Feature Information
AToM Tunnel Selection	Cisco IOS XE Release 2.3	The AToM Tunnel Selection feature allows you to specify the path that traffic uses. You can specify either an MPLS TE tunnel or destination IP address or domain name server (DNS) name. You also have the option of specifying whether the VCs should use the default path (the path LDP uses for signaling) if the preferred path is unreachable. This option is enabled by default; you must explicitly disable it. In Cisco IOS XE Release 2.3, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.
AToM: ATM Cell Relay over MPLS: VP Mode	Cisco IOS XE Release 2.3	The AToM: ATM Cell Relay over MPLS: VP Mode feature allows you to insert one ATM cell in each MPLS packet in VP mode. In Cisco IOS XE Release 2.3, this feature was introduced on the Cisco ASR 1000 Series Routers.
AToM: Single Cell Relay-VC Mode	Cisco IOS XE Release 2.3	The AToM Single Cell Relay-VC Mode feature allows you to insert one ATM cell in each MPLS packet in VC mode. In Cisco IOS XE Release 2.3, this feature was introduced on the Cisco ASR 1000 Series Routers.
MPLS MTU Command for GRE Tunnels	Cisco IOS XE Release 2.6	This feature allows you to set the MPLS MTU size in GRE tunnels to the maximum size besides the current default size. The following command was modified for this release: **mpls mtu**.
MPLS L2VPN Clear Xconnect Command	Cisco IOS XE Release 3.1S	These features enable you to: • Reset a VC associated with an interface, a peer address, or on all the configured xconnect circuit attachments • Set the control word on dynamic pseudowires (L2VPN pseudowire control word configuration • Enable ATM cell packing for static pseudowires. The following commands were introduced or modified by these features: **cell-packing**, **clear xconnect**, **control-word**, **encapsulation**(Any Transport over MPLS), **oam-ac emulation-enable**.

Feature Name	Releases	Feature Information
Per-Subinterface MTU for Ethernet over MPLS (EoMPLS)	Cisco IOS XE Release 2.4	This feature provides you with the ability to specify maximum transmission unit (MTU) values in xconnect subinterface configuration mode. When you use xconnect subinterface configuration mode to set the MTU value, you establish a pseudowire connection for situations where the interfaces have different MTU values that cannot be changed. In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. No commands were new or modified for this release.
VLAN ID Rewrite	Cisco IOS XE Release 2.4	The VLAN ID rewrite feature enables you to use VLAN interfaces with different VLAN IDs at both ends of the tunnel. In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Routers.
AToM Load Balancing with Single PW	Cisco IOS XE Release 3.4S	The AToM Load Balancing with Single PW feature enables load balancing for packets within the same pseudowire by further classifying packets within the same pseudowire into different flows based on some field in the packet received on attachment circuit. In Cisco IOS XE Release 3.4S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.
Flow-Aware Transport of MPLS Pseudowires	Cisco IOS XE Release 3.11S	The Flow-Aware Transport of MPLS Pseudowires feature enables load balancing of packets within the same pseudowire by further classifying the packets into different flows by adding a flow label at the bottom of the MPLS label stack.
EoMPLS over IPv6 GRE Tunnel	Cisco IOS XE Release 3.15S	The EoMPLS over IPv6 GRE Tunnel feature supports tunneling of EoMPLS traffic via an IPv6 network by using GRE tunnels.