



## Any Transport over MPLS

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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 (VLAN and port modes)
- Circuit Emulation (CEM)



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**Note**

For information on ATM Cell relay and Circuit Emulation(CEM), see [Configuring Pseudowire](#).

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- [Finding Feature Information, page 2](#)
- [Prerequisites for Any Transport over MPLS, page 2](#)
- [Restrictions for Any Transport over MPLS, page 2](#)
- [Information About Any Transport over MPLS, page 4](#)
- [How to Configure Any Transport over MPLS, page 14](#)
- [Configuration Examples for Any Transport over MPLS, page 60](#)
- [Additional References for Any Transport over MPLS, page 79](#)
- [Feature Information for Any Transport over MPLS, page 79](#)

## Finding Feature Information

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

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

## 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

- 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.

## ATM AAL5 over MPLS Restrictions

- AAL5 over MPLS is supported only in SDU mode.

## 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.

## 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 select a tunnel, the tunnel tailend must be on the remote PE router.
- 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.

## 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 2 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-if) # 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 14.

## How AToM Transports Layer 2 Packets using the commands associated with the L2VPN Protocol-Based CLIs feature

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- 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)# member gigabitethernet0/0/0.1
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 14.

## 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.

In the following example, the primary link is disabled, which causes the backup tunnel (Tunnel 1) to become the primary path. The output in boldface font shows the status of the tunnel:

```
Router# execute-on slot 3 debug mpls l2transport fast-reroute
===== Line Card (Slot 3) =====
AToM fast reroute debugging is on
SLOT 3:Sep 16 17:58:56.346: AToM SMGR: Processing TFIB FRR event for 10.4.0.1
SLOT 3:Sep 16 17:58:56.346: AToM SMGR: Finished processing TFIB FRR event for 10.4.0.1
SLOT 3:Sep 16 17:58:56.346: AToM SMGR: Processing TFIB FRR event for Tunnel41
SLOT 3:Sep 16 17:58:56.346: AToM SMGR: Finished processing TFIB FRR event for Tunnel41
Sep 16 17:58:58.342: %LINK-3-UPDOWN: Interface POS0/0/0, changed state to down
Sep 16 17:58:58.342: %OSPF-5-ADJCHG: Process 1, Nbr 10.0.0.1 on POS0/0 from FULL to DOWN,
Neighbor Down: Interface down or detached
Sep 16 17:58:59.342: %LINEPROTO-5-UPDOWN: Line protocol on Interface POS0/0/0, changed state
to down
```

## 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 five (FRR label, TE label, LDP label, VPN label, VC label).
- 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 five (FRR label, TE label, Border Gateway Protocol (BGP) label, LDP label, VC label).

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.

$$\begin{array}{r} \text{Edge MTU} + \text{Transport header} + \text{AToM header} + (\text{MPLS label stack} * \text{MPLS label}) = \text{Core MTU} \\ 1500 \quad + 18 \quad \quad \quad + 0 \quad \quad \quad + (2 \quad \quad \quad * 4 \quad \quad \quad) = 1526 \end{array}$$

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

## QoS Features Supported with AToM

The tables below list the QoS features supported by AToM.

**Table 2: QoS Features Supported with Ethernet over MPLS**

QoS Feature	Ethernet over MPLS
Service policy	Can be applied to: <ul style="list-style-type: none"> <li>• Interface (input and output)</li> <li>• Subinterface (input and output)</li> </ul>



QoS Feature	Ethernet over MPLS
Classification	Supports the following commands: <ul style="list-style-type: none"> <li>• <b>match cos</b> (on interfaces and subinterfaces)</li> <li>• <b>match mpls experimental</b> (on interfaces and subinterfaces)</li> <li>• <b>match qos-group</b> (on interfaces) (output policy)</li> </ul>
Marking	Supports the following commands: <ul style="list-style-type: none"> <li>• <b>set cos</b> (output policy)</li> <li>• <b>set discard-class</b> (input policy)</li> <li>• <b>set mpls experimental</b> (input policy) (on interfaces and subinterfaces)</li> <li>• <b>set qos-group</b> (input policy)</li> </ul>
Policing	Supports the following: <ul style="list-style-type: none"> <li>• Color-aware policing</li> <li>• Multiple-action policing</li> <li>• Single-rate policing</li> <li>• Two-rate policing</li> </ul>
Queueing and shaping	Supports the following: <ul style="list-style-type: none"> <li>• Byte-based WRED</li> <li>• Low Latency Queueing (LLQ)</li> <li>• Weighted Random Early Detection (WRED)</li> </ul>

**Table 3: QoS Features Supported with Frame Relay over MPLS**

QoS Feature	Frame Relay over MPLS
Service policy	Can be applied to: <ul style="list-style-type: none"> <li>• Interface (input and output)</li> <li>• PVC (input and output)</li> </ul>

QoS Feature	Frame Relay over MPLS
Classification	Supports the following commands: <ul style="list-style-type: none"> <li>• <b>match fr-de</b> (on interfaces and VCs)</li> <li>• <b>match fr-dlci</b> (on interfaces)</li> <li>• <b>match qos-group</b></li> </ul>
Marking	Supports the following commands: <ul style="list-style-type: none"> <li>• <b>frame-relay congestion management</b> (output)</li> <li>• <b>set discard-class</b></li> <li>• <b>set fr-de</b> (output policy)</li> <li>• <b>set fr-fecn-becn</b> (output)</li> <li>• <b>set mpls experimental</b></li> <li>• <b>set qos-group</b></li> <li>• <b>threshold ecn</b> (output)</li> </ul>
Policing	Supports the following: <ul style="list-style-type: none"> <li>• Color-aware policing</li> <li>• Multiple-action policing</li> <li>• Single-rate policing</li> <li>• Two-rate policing</li> </ul>
Queueing and shaping	Supports the following: <ul style="list-style-type: none"> <li>• Byte-based WRED</li> <li>• Class-based weighted fair queueing (CBWFQ)</li> <li>• LLQ</li> <li>• <b>random-detect discard-class-based</b> command</li> <li>• Traffic shaping</li> <li>• WRED</li> </ul>

**Table 4: QoS Features Supported with ATM Cell Relay and AAL5 over MPLS**

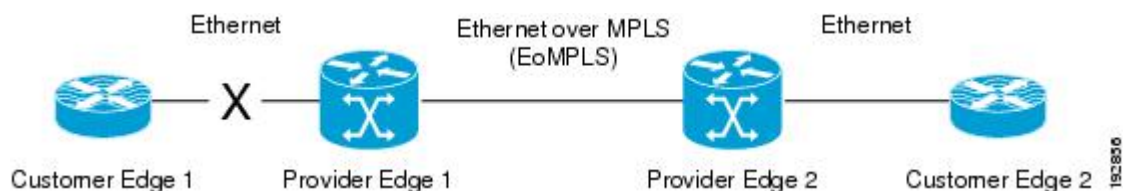
QoS Feature	ATM Cell Relay and AAL5 over MPLS
Service policy	Can be applied to: <ul style="list-style-type: none"> <li>• Interface (input and output)</li> <li>• PVC (input and output)</li> <li>• Subinterface (input and output)</li> </ul>
Classification	Supports the following commands: <ul style="list-style-type: none"> <li>• <b>match mpls experimental</b> (on VCs)</li> <li>• <b>match qos-group</b> (output)</li> </ul>
Marking	Supports the following commands: <ul style="list-style-type: none"> <li>• <b>random-detect discard-class-based</b> (input)</li> <li>• <b>set clp</b> (output) (on interfaces, subinterfaces, and VCs)</li> <li>• <b>set discard-class</b> (input)</li> <li>• <b>set mpls experimental</b> (input) (on interfaces, subinterfaces, and VCs)</li> <li>• <b>set qos-group</b> (input)</li> </ul>
Policing	Supports the following: <ul style="list-style-type: none"> <li>• Color-aware policing</li> <li>• Multiple-action policing</li> <li>• Single-rate policing</li> <li>• Two-rate policing</li> </ul>
Queueing and shaping	Supports the following: <ul style="list-style-type: none"> <li>• Byte-based WRED</li> <li>• CBWFQ</li> <li>• Class-based shaping support on ATM PVCs</li> <li>• LLQ</li> <li>• <b>random-detect discard-class-based</b> command</li> <li>• WRED</li> </ul>

## 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 1: 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.



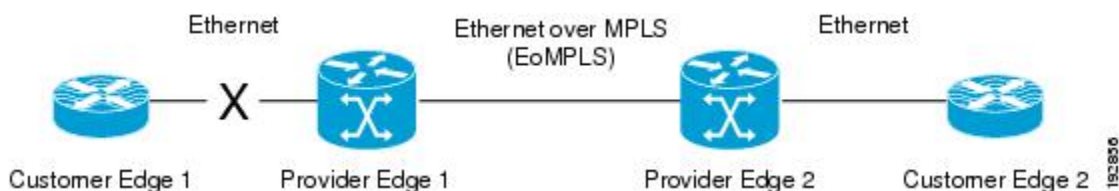
**Note** The **no remote link failure notification** command will not give notification to clients for remote attachment circuit status down.

## Any Transport over MPLS (AToM) Remote Ethernet Port Shutdown using the commands associated with the L2VPN Protocol-Based CLIs 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 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.

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- 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:

```
template type pseudowire eompls
 encapsulation mpls
 !
 interface Pseudowire 100
  source template type pseudowire test
  neighbor 10.13.13.13 1
 interface GigabitEthernet1/0/0
  service instance 300 ethernet
  remote link failure notification
 l2vpn xconnect context con1
 member GigabitEthernet1/0/0 service-instance 300
 member Pseudowire 100
 !
```

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.




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## 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.

## 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




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**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.

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- 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.
```

## SUMMARY STEPS

- enable
- configure terminal
- pseudowire-class *name*
- encapsulation mpls

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>pseudowire-class <i>name</i></b>  <b>Example:</b> Router(config)# pseudowire-class atom	Establishes a pseudowire class with a name that you specify and enters pseudowire class configuration mode.
<b>Step 4</b>	<b>encapsulation mpls</b>  <b>Example:</b> Router(config-pw)# encapsulation mpls	Specifies the tunneling encapsulation.

## Configuring the Pseudowire Class using the commands associated with the L2VPN Protocol-Based CLIs 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.
```

### SUMMARY STEPS

- enable**
- configure terminal**
- interface pseudowire** *name*
- encapsulation mpls**
- neighbor** *peer-address* *vcid-value*

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  • Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface pseudowire</b> <i>name</i>  <b>Example:</b> Router(config)# interface pseudowire atom	Establishes an interface pseudowire with a name that you specify and enters pseudowire class configuration mode.



	Command or Action	Purpose
<b>Step 4</b>	<b>encapsulation mpls</b>  <b>Example:</b> <pre>Router(config-pw-class)# encapsulation mpls</pre>	Specifies the tunneling encapsulation.
<b>Step 5</b>	<b>neighbor peer-address vcid-value</b>  <b>Example:</b> <pre>Router(config-pw-class)# neighbor 33.33.33.33 1</pre>	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 the commands associated with the L2VPN Protocol-Based CLIs 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:

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

To remove the **encapsulation mpls** command, you must delete the pseudowire with the **no template type 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

### 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. **end**
8. **show mpls l2transport vc**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface</b> <i>type slot / subslot / port</i> [ <i>.subinterface</i> ]  <b>Example:</b> Router(config)# interface atm1/0/0	Specifies the interface type and enters interface configuration mode.
<b>Step 4</b>	<b>pvc</b> [ <i>name</i> ] <i>vpi / vci l2transport</i>  <b>Example:</b> Router(config-if)# pvc 1/200 l2transport	Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.  <ul style="list-style-type: none"> <li>• The <b>l2transport</b> keyword indicates that the PVC is a switched PVC instead of a terminated PVC.</li> </ul>

	Command or Action	Purpose
<b>Step 5</b>	<b>encapsulation aal5</b>  <b>Example:</b> <pre>Router(config-if-atm-l2trans-pvc)# encapsulation aal5</pre>	Specifies ATM AAL5 encapsulation for the PVC. Make sure you specify the same encapsulation type on the PE and customer edge (CE) routers.
<b>Step 6</b>	<b>xconnect peer-router-id vcid encapsulation mpls</b>  <b>Example:</b> <pre>Router(config-if-atm-l2trans-pvc)# xconnect 10.13.13.13 100 encapsulation mpls</pre>	Binds the attachment circuit to a pseudowire VC.
<b>Step 7</b>	<b>end</b>  <b>Example:</b> <pre>Router(config-if-atm-l2trans-pvc)# end</pre>	Exits to privileged EXEC mode.
<b>Step 8</b>	<b>show mpls l2transport vc</b>  <b>Example:</b> <pre>Router# show mpls l2transport vc</pre>	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

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot / subslot / port[, subinterface]*
4. **pvc** [*name*] *vpi / vci l2transport*
5. **encapsulation aal5**
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 pvc vpi / vci*
14. **end**
15. **show l2vpn atom vc**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface</b> <i>type slot / subslot / port[, subinterface]</i>  <b>Example:</b> Device(config)# interface atm1/0/0	Specifies the interface type and enters interface configuration mode.

	Command or Action	Purpose
<b>Step 4</b>	<p><b>pvc</b> [<i>name</i>] <i>vpi</i> / <i>vci</i> <b>l2transport</b></p> <p><b>Example:</b></p> <pre>Device(config-if)# pvc 1/200 l2transport</pre>	<p>Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.</p> <ul style="list-style-type: none"> <li>The <b>l2transport</b> keyword indicates that the PVC is a switched PVC instead of a terminated PVC.</li> </ul>
<b>Step 5</b>	<p><b>encapsulation aal5</b></p> <p><b>Example:</b></p> <pre>Device(config-if-atm-l2trans-pvc)# encapsulation aal5</pre>	<p>Specifies ATM AAL5 encapsulation for the PVC. Make sure you specify the same encapsulation type on the PE and customer edge (CE) routers.</p>
<b>Step 6</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Device(config-if-atm-l2trans-pvc)# end</pre>	<p>Exits to privileged EXEC mode.</p>
<b>Step 7</b>	<p><b>interface pseudowire</b> <i>number</i></p> <p><b>Example:</b></p> <pre>Device(config)# interface pseudowire 100</pre>	<p>Specifies the pseudowire interface and enters interface configuration mode.</p>
<b>Step 8</b>	<p><b>encapsulation mpls</b></p> <p><b>Example:</b></p> <pre>Device(config-if)# encapsulation mpls</pre>	<p>Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.</p>
<b>Step 9</b>	<p><b>neighbor</b> <i>peer-address</i> <i>vcid-value</i></p> <p><b>Example:</b></p> <pre>Device(config-if)# neighbor 10.13.13.13 100</pre>	<p>Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.</p>
<b>Step 10</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Device(config-if)# exit</pre>	<p>Exits interface configuration mode.</p>
<b>Step 11</b>	<p><b>l2vpn xconnect context</b> <i>context-name</i></p> <p><b>Example:</b></p> <pre>Device(config)# l2vpn xconnect context con1</pre>	<p>Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.</p>

	Command or Action	Purpose
<b>Step 12</b>	<b>member pseudowire</b> <i>interface-number</i>  <b>Example:</b> Device(config-xconnect)# member pseudowire 100	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
<b>Step 13</b>	<b>member atm</b> <i>interface-number</i> <b>pvc</b> <i>vpi / vci</i>  <b>Example:</b> Device(config-xconnect)# member atm 100 pvc 1/200	Specifies the location of the ATM member interface.
<b>Step 14</b>	<b>end</b>  <b>Example:</b> Device(config-xconnect)# end	Exits to privileged EXEC mode.
<b>Step 15</b>	<b>show l2vpn atm vc</b>  <b>Example:</b> Device# show l2vpn atm vc	Displays output that shows ATM AAL5 over MPLS is configured on a PVC.

### Examples

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

```

Device# show l2vpn atm 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

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vc-class atm** *vc-class-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*
10. **end**
11. **show atm class-links**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>vc-class atm</b> <i>vc-class-name</i>  <b>Example:</b> Router(config)# vc-class atm aal5class	Creates a VC class and enters VC class configuration mode.
Step 4	<b>encapsulation</b> <i>layer-type</i>  <b>Example:</b> Router(config-vc-class)# encapsulation aal5	Configures the AAL and encapsulation type.
Step 5	<b>exit</b>  <b>Example:</b> Router(config-vc-class)# exit	Exits VC class configuration mode.

	Command or Action	Purpose
<b>Step 6</b>	<b>interface</b> <i>type slot / subslot / port</i> [ <i>.subinterface</i> ]  <b>Example:</b> Router(config)# interface atm1/0/0	Specifies the interface type enters interface configuration mode.
<b>Step 7</b>	<b>class-int</b> <i>vc-class-name</i>  <b>Example:</b> Router(config-if)# class-int aal5class	Applies a VC class to the ATM main interface or subinterface.  <b>Note</b> You can also apply a VC class to a PVC.
<b>Step 8</b>	<b>pvc</b> [ <i>name</i> ] <i>vpi / vci l2transport</i>  <b>Example:</b> Router(config-if)# pvc 1/200 l2transport	Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.  <ul style="list-style-type: none"> <li>The <b>l2transport</b> keyword indicates that the PVC is a switched PVC instead of a terminated PVC.</li> </ul>
<b>Step 9</b>	<b>xconnect</b> <i>peer-router-id vcid encapsulation mpls</i>  <b>Example:</b> Router(config-if-atm-l2trans-pvc)# xconnect 10.13.13.13 100 encapsulation mpls	Binds the attachment circuit to a pseudowire VC.
<b>Step 10</b>	<b>end</b>  <b>Example:</b> Router(config-if-atm-l2trans-pvc)# end	Exits to privileged EXEC mode.
<b>Step 11</b>	<b>show atm class-links</b>  <b>Example:</b> 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

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vc-class atm** *vc-class-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. **exit**
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**
18. **show atm class-links**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>vc-class atm</b> <i>vc-class-name</i>  <b>Example:</b> Router(config)# vc-class atm aal5class	Creates a VC class and enters VC class configuration mode.

	Command or Action	Purpose
<b>Step 4</b>	<b>encapsulation</b> <i>layer-type</i>  <b>Example:</b> Router(config-vc-class)# encapsulation aal5	Configures the AAL and encapsulation type.
<b>Step 5</b>	<b>exit</b>  <b>Example:</b> Router(config-vc-class)# exit	Exits VC class configuration mode.
<b>Step 6</b>	<b>interface</b> <i>type slot / subslot / port [subinterface]</i>  <b>Example:</b> Router(config)# interface atm1/0/0	Specifies the interface type enters interface configuration mode.
<b>Step 7</b>	<b>class-int</b> <i>vc-class-name</i>  <b>Example:</b> Router(config-if)# class-int aal5class	Applies a VC class to the ATM main interface or subinterface.  <b>Note</b> You can also apply a VC class to a PVC.
<b>Step 8</b>	<b>pvc</b> [ <i>name</i> ] <i>vpi / vci l2transport</i>  <b>Example:</b> Router(config-if)# pvc 1/200 l2transport	Creates or assigns a name to an ATM PVC and enters L2transport PVC configuration mode.  <ul style="list-style-type: none"> <li>• The <b>l2transport</b> keyword indicates that the PVC is a switched PVC instead of a terminated PVC.</li> </ul>
<b>Step 9</b>	<b>exit</b>  <b>Example:</b> Router(config-if)# exit	Exits interface configuration mode.
<b>Step 10</b>	<b>interface pseudowire</b> <i>number</i>  <b>Example:</b> Router(config)# interface pseudowire 100	Specifies the pseudowire interface and enters interface configuration mode.
<b>Step 11</b>	<b>encapsulation mpls</b>  <b>Example:</b> Router(config-if)# encapsulation mpls	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.

	Command or Action	Purpose
<b>Step 12</b>	<b>neighbor</b> <i>peer-address vcid-value</i>  <b>Example:</b> 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.
<b>Step 13</b>	<b>exit</b>  <b>Example:</b> Router(config-if)# exit	Exits interface configuration mode.
<b>Step 14</b>	<b>l2vpn xconnect context</b> <i>context-name</i>  <b>Example:</b> Router(config)# l2vpn xconnect context con1	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
<b>Step 15</b>	<b>member pseudowire</b> <i>interface-number</i>  <b>Example:</b> Router(config-xconnect)# member pseudowire 100	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
<b>Step 16</b>	<b>member atm</b> <i>interface-number</i>  <b>Example:</b> Device(config-xconnect)# member atm 100	Specifies the location of the ATM member interface.
<b>Step 17</b>	<b>end</b>  <b>Example:</b> Router(config-if-atm-l2trans-pvc)# end	Exits to privileged EXEC mode.
<b>Step 18</b>	<b>show atm class-links</b>  <b>Example:</b> 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 Ethernet over MPLS

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

#### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `interface gigabitethernet slot / subslot / port [.subinterface]`
4. `encapsulation dot1q vlan-id`
5. `xconnect peer-router-id vcid encapsulation mpls`

#### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<code>enable</code>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  • Enter your password if prompted.
<b>Step 2</b>	<code>configure terminal</code>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<code>interface gigabitethernet slot / subslot / port [.subinterface]</code>  <b>Example:</b> 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.
<b>Step 4</b>	<code>encapsulation dot1q vlan-id</code>  <b>Example:</b> Router(config-subif)# encapsulation dot1q 100	Enables the subinterface to accept 802.1Q VLAN packets.

	Command or Action	Purpose
Step 5	<p><code>xconnect peer-router-id vcid encapsulation mpls</code></p> <p><b>Example:</b></p> <pre>Router(config-subif)# xconnect 10.0.0.1 123 encapsulation mpls</pre>	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

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `interface gigabitethernet slot / subslot / port [, subinterface]`
4. `encapsulation dot1q vlan-id`
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 gigabitethernet interface-number`
13. `end`

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<p><code>enable</code></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface gigabitethernet slot / subslot / port [subinterface]</b>  <b>Example:</b> Router(config)# interface gigabitethernet4/0/0.1	Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode. <ul style="list-style-type: none"> <li>• Make sure the subinterface on the adjoining CE router is on the same VLAN as this PE router.</li> </ul>
<b>Step 4</b>	<b>encapsulation dot1q vlan-id</b>  <b>Example:</b> Router(config-subif)# encapsulation dot1q 100	Enables the subinterface to accept 802.1Q VLAN packets.
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Router(config-subif)# end	Exits to privileged EXEC mode.
<b>Step 6</b>	<b>interface pseudowire number</b>  <b>Example:</b> Router(config)# interface pseudowire 100	Specifies the pseudowire interface and enters interface configuration mode.
<b>Step 7</b>	<b>encapsulation mpls</b>  <b>Example:</b> Router(config-if)# encapsulation mpls	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
<b>Step 8</b>	<b>neighbor peer-address vcid-value</b>  <b>Example:</b> 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.
<b>Step 9</b>	<b>exit</b>  <b>Example:</b> Router(config-if)# exit	Exits interface configuration mode.

	Command or Action	Purpose
<b>Step 10</b>	<b>l2vpn xconnect context</b> <i>context-name</i>  <b>Example:</b> <pre>Router(config)# l2vpn xconnect context con1</pre>	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
<b>Step 11</b>	<b>member pseudowire</b> <i>interface-number</i>  <b>Example:</b> <pre>Router(config-xconnect)# member pseudowire 100</pre>	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
<b>Step 12</b>	<b>member gigabitethernet</b> <i>interface-number</i>  <b>Example:</b> <pre>Router(config-xconnect)# member GigabitEthernet0/0/0.1</pre>	Specifies the location of the Gigabit Ethernet member interface.
<b>Step 13</b>	<b>end</b>  <b>Example:</b> <pre>Router(config-xconnect)# end</pre>	Exits to privileged EXEC mode.

## Configuring Ethernet over MPLS in Port Mode

### SUMMARY STEPS

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

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> <pre>Router&gt; enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface gigabitethernet slot / subslot / port [subinterface]</b>  <b>Example:</b> Router(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.
<b>Step 4</b>	<b>xconnect peer-router-id vcid encapsulation mpls</b>  <b>Example:</b> Router(config-if)# xconnect 10.0.0.1 123 encapsulation mpls	Binds the attachment circuit to a pseudowire VC.
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Router(config-if)# end	Exits to privileged EXEC mode.
<b>Step 6</b>	<b>show mpls l2transport vc</b>  <b>Example:</b> Router# show mpls l2transport vc	Displays information about Ethernet over MPLS port mode.

### Examples

The sample output in the following example shows two VCs for Ethernet over MPLS:

- VC 2 is in Ethernet VLAN mode.
- VC 8 is in Ethernet port mode.

```
Router# show mpls l2transport vc
Local intf      Local circuit      Dest address      VC ID      Status
-----
Gi4/0/0.1      Eth VLAN 2         10.1.1.1          2          UP
Gi8/0/1        Ethernet           10.1.1.1          8          UP
```

The sample output from the **show mpls l2transport vc detail** command displays the same information in a different format:

```
Router# show mpls l2transport vc detail
Local interface: Gi4/0/0.1 up, line protocol up, Eth VLAN 2 up
Destination address: 10.1.1.1, VC ID: 2, VC status: up
```



```

.
.
.
Local interface: Gi8/0/1 up, line protocol up, Ethernet up
Destination address: 10.1.1.1, VC ID: 8, VC status: up

```

## Configuring Ethernet over MPLS in Port Mode 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. **end**
5. **interface pseudowire number**
6. **encapsulation mpls**
7. **neighbor peer-address vcid-value**
8. **exit**
9. **l2vpn xconnect context context-name**
10. **member pseudowire interface-number**
11. **member gigabitethernet interface-number**
12. **end**
13. **end**
14. **show l2vpn atom vc**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface gigabitethernet slot / subslot / port[. subinterface]</b>  <b>Example:</b> Device(config)# interface gigabitethernet4/0/0	Specifies the Gigabit Ethernet interface and enters interface configuration mode. <ul style="list-style-type: none"> <li>• Make sure the interface on the adjoining CE router is on the same VLAN as this PE router.</li> </ul>

	Command or Action	Purpose
<b>Step 4</b>	<b>end</b>  <b>Example:</b> Device(config-if)# end	Exits to privileged EXEC mode.
<b>Step 5</b>	<b>interface pseudowire <i>number</i></b>  <b>Example:</b> Device(config)# interface pseudowire 100	Specifies the pseudowire interface and enters interface configuration mode.
<b>Step 6</b>	<b>encapsulation mpls</b>  <b>Example:</b> Device(config-if)# encapsulation mpls	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
<b>Step 7</b>	<b>neighbor <i>peer-address vcid-value</i></b>  <b>Example:</b> 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.
<b>Step 8</b>	<b>exit</b>  <b>Example:</b> Device(config-if)# exit	Exits interface configuration mode.
<b>Step 9</b>	<b>l2vpn xconnect context <i>context-name</i></b>  <b>Example:</b> Device(config)# l2vpn xconnect context con1	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
<b>Step 10</b>	<b>member pseudowire <i>interface-number</i></b>  <b>Example:</b> Device(config-xconnect)# member pseudowire 100	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
<b>Step 11</b>	<b>member gigabitethernet <i>interface-number</i></b>  <b>Example:</b> Device(config-xconnect)# member GigabitEthernet0/0/0.1	Specifies the location of the Gigabit Ethernet member interface.

	Command or Action	Purpose
Step 12	<b>end</b>  <b>Example:</b> Device(config-xconnect)# end	Exits to privileged EXEC mode.
Step 13	<b>end</b>  <b>Example:</b> Device(config-if)# end	Exits to privileged EXEC mode.
Step 14	<b>show l2vpn atom vc</b>  <b>Example:</b> Device# show l2vpn atom vc	Displays information about Ethernet over MPLS port mode.

### Examples

The sample output in the following example shows two VCs for Ethernet over MPLS:

- VC 2 is in Ethernet VLAN mode.
- VC 8 is in Ethernet port mode.

```

Device# show l2vpn atom vc
Service Interface  Dest Address  VC ID  Type  Name  Status
-----
pw100              10.1.1.1     2      p2p   FOO   UP
pw200              10.1.1.1     8      p2p   FOO   UP

```

## Configuring Ethernet over MPLS with VLAN ID Rewrite

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface gigabitethernet slot / subslot / port [.subinterface]**
4. **encapsulation dot1q vlan-id**
5. **xconnect peer-router-id vcid encapsulation mpls**
6. **remote circuit id remote-vlan-id**
7. **end**
8. **show controllers eompls forwarding-table**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  • Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface gigabitethernet slot / subslot / port [.</b> <i>subinterface]</i>  <b>Example:</b> Router(config)# interface gigabitethernet4/0/0.1	Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode.
<b>Step 4</b>	<b>encapsulation dot1q vlan-id</b>  <b>Example:</b> Router(config-subif)# encapsulation dot1q 100	Enables the subinterface to accept 802.1Q VLAN packets.
<b>Step 5</b>	<b>xconnect peer-router-id vcid encapsulation mpls</b>  <b>Example:</b> Router(config-subif)# xconnect 10.0.0.1 123 encapsulation mpls	Binds the attachment circuit to a pseudowire VC and enters xconnect configuration mode.
<b>Step 6</b>	<b>remote circuit id remote-vlan-id</b>  <b>Example:</b> 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.
<b>Step 7</b>	<b>end</b>  <b>Example:</b> Router(config-subif-xconn)# end	Exits to privileged EXEC mode.
<b>Step 8</b>	<b>show controllers eompls forwarding-table</b>  <b>Example:</b> Router# show controllers eompls forwarding-table	Displays information about VLAN ID rewrite.

## Examples

The following sample output from the **show controllers eompls forwarding-table** command shows VLAN ID rewrite configured on a router with an engine 2 3-port Gigabit Ethernet line card. In this example, the output in boldface font shows the VLAN ID rewrite information.

### On PE1

```
Router# execute slot 0 show controllers eompls forwarding-table 0 2
Port # 0, VLAN-ID # 2, Table-index 2
EoMPLS configured: 1
tag_rew_ptr           = D001BB58
Leaf entry?          = 1
FCR index             = 20
    **tagrew_psa_addr   = 0006ED60
    **tagrew_vir_addr   = 7006ED60
    **tagrew_phy_addr   = F006ED60
    [0-7] loq 8800 mtu 4458 oq 4000 ai 3 oi 04019110 (encaps size 4)
    cw-size 4 vlanid-rew 3
    gather A30 (bufhdr size 32 EoMPLS (Control Word) Imposition profile 81)
    2 tag: 18 18
    counters 1182, 10 reported 1182, 10.
Local OutputQ (Unicast): Slot:2 Port:0 RED queue:0 COS queue:0
Output Q (Unicast):      Port:0      RED queue:0 COS queue:0
```

### On PE2

```
Router# execute slot 0 show controllers eompls forwarding-table 0 3
Port # 0, VLAN-ID # 3, Table-index 3
EoMPLS configured: 1
tag_rew_ptr           = D0027B90
Leaf entry?          = 1
FCR index             = 20
    **tagrew_psa_addr   = 0009EE40
    **tagrew_vir_addr   = 7009EE40
    **tagrew_phy_addr   = F009EE40
    [0-7] loq 9400 mtu 4458 oq 4000 ai 8 oi 84000002 (encaps size 4)
    cw-size 4 vlanid-rew 2
    gather A30 (bufhdr size 32 EoMPLS (Control Word) Imposition profile 81)
    2 tag: 17 18
    counters 1182, 10 reported 1182, 10.
Local OutputQ (Unicast): Slot:5 Port:0 RED queue:0 COS queue:0
Output Q (Unicast):      Port:0      RED queue:0 COS queue:0
```

## Configuring Ethernet over MPLS with VLAN ID Rewrite 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. `encapsulation dot1q vlan-id`
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 gigabitethernet interface-number`
13. `remote circuit id remote-vlan-id`
14. `end`
15. `show controllers eompls forwarding-table`

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<p><code>enable</code></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><code>configure terminal</code></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
<b>Step 3</b>	<p><code>interface gigabitethernet slot / subslot / port [, subinterface]</code></p> <p><b>Example:</b></p> <pre>Router(config)# interface gigabitethernet4/0/0.1</pre>	<p>Specifies the Gigabit Ethernet subinterface and enters subinterface configuration mode.</p>

	Command or Action	Purpose
Step 4	<b>encapsulation dot1q</b> <i>vlan-id</i>  <b>Example:</b> Router(config-subif)# encapsulation dot1q 100	Enables the subinterface to accept 802.1Q VLAN packets.
Step 5	<b>end</b>  <b>Example:</b> Router(config-subif)# end	Exits to privileged EXEC mode.
Step 6	<b>interface pseudowire</b> <i>number</i>  <b>Example:</b> Router(config)# interface pseudowire 100	Specifies the pseudowire interface and enters interface configuration mode.
Step 7	<b>encapsulation mpls</b>  <b>Example:</b> Router(config-if)# encapsulation mpls	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 8	<b>neighbor</b> <i>peer-address vcid-value</i>  <b>Example:</b> 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	<b>exit</b>  <b>Example:</b> Router(config-if)# exit	Exits interface configuration mode.
Step 10	<b>l2vpn xconnect context</b> <i>context-name</i>  <b>Example:</b> Router(config)# l2vpn xconnect context con1	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 11	<b>member pseudowire</b> <i>interface-number</i>  <b>Example:</b> Router(config-xconnect)# member pseudowire 100	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.

	Command or Action	Purpose
<b>Step 12</b>	<b>member gigabitethernet</b> <i>interface-number</i>  <b>Example:</b>  Router(config-xconnect)# member GigabitEthernet0/0/0.1	Specifies the location of the Gigabit Ethernet member interface.
<b>Step 13</b>	<b>remote circuit id</b> <i>remote-vlan-id</i>  <b>Example:</b>  Router(config-xconnect)# remote circuit id 101	(Optional) Enables you to use VLAN interfaces with different VLAN IDs at both ends of the tunnel.
<b>Step 14</b>	<b>end</b>  <b>Example:</b>  Router(config-xconnect)# end	Exits to privileged EXEC mode.
<b>Step 15</b>	<b>show controllers eompls forwarding-table</b>  <b>Example:</b>  Router# show controllers eompls forwarding-table	Displays information about VLAN ID rewrite.

### Examples

The following sample output from the **show controllers eompls forwarding-table** command shows VLAN ID rewrite configured on a router with an engine 2 3-port Gigabit Ethernet line card. In this example, the output in boldface font shows the VLAN ID rewrite information.

#### On PE1

```

Router# execute slot 0 show controllers eompls forwarding-table 0 2
Port # 0, VLAN-ID # 2, Table-index 2
EoMPLS configured: 1
tag_rew_ptr          = D001BB58
Leaf entry?         = 1
FCR index           = 20
    **tagrew_psa_addr   = 0006ED60
    **tagrew_vir_addr  = 7006ED60
    **tagrew_phy_addr  = F006ED60
    [0-7] loq 8800 mtu 4458 oq 4000 ai 3 oi 04019110 (encaps size 4)
    cw-size 4 vlanid-rew 3
    gather A30 (bufhdr size 32 EoMPLS (Control Word) Imposition profile 81)
    2 tag: 18 18
    counters 1182, 10 reported 1182, 10.
Local OutputQ (Unicast):   Slot:2 Port:0 RED queue:0 COS queue:0
Output Q (Unicast):       Port:0 RED queue:0 COS queue:0

```



**On PE2**

```

Router# execute slot 0 show controllers eompls forwarding-table 0 3
Port # 0, VLAN-ID # 3, Table-index 3
EoMPLS configured: 1
tag_rew_ptr           = D0027B90
Leaf entry?          = 1
FCR index             = 20
    **tagrew_psa_addr   = 0009EE40
    **tagrew_vir_addr   = 7009EE40
    **tagrew_phy_addr   = F009EE40
[0-7] loq 9400 mtu 4458 oq 4000 ai 8 oi 84000002 (encaps size 4)
cw-size 4 vlanid-rew 2
gather A30 (bufhdr size 32 EoMPLS (Control Word) Imposition profile 81)
2 tag: 17 18
counters 1182, 10 reported 1182, 10.
Local OutputQ (Unicast): Slot:5 Port:0 RED queue:0 COS queue:0
Output Q (Unicast):      Port:0      RED queue:0 COS queue:0

```

## Configuring Tunnel Selection

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **pseudowire-class** *name*
4. **encapsulation mpls**
5. **preferred-path** {**interface tunnel** *tunnel-number* | **peer** {*ip-address* | *host-name*}} [**disable-fallback**]
6. **exit**
7. **interface** *type slot / subslot / port* [. *subinterface*]
8. **encapsulation** *encapsulation-type*
9. **xconnect** *peer-router-id vcid pw-class name*

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 3</b>	<p><b>pseudowire-class</b> <i>name</i></p> <p><b>Example:</b></p> <pre>Router(config)# pseudowire-class ts1</pre>	Establishes a pseudowire class with a name that you specify and enters pseudowire configuration mode.
<b>Step 4</b>	<p><b>encapsulation mpls</b></p> <p><b>Example:</b></p> <pre>Router(config-pw)# encapsulation mpls</pre>	Specifies the tunneling encapsulation. For AToM, the encapsulation type is mpls.
<b>Step 5</b>	<p><b>preferred-path</b> {<b>interface tunnel</b> <i>tunnel-number</i>   <b>peer</b> {<i>ip-address</i>   <i>host-name</i>}} [<b>disable-fallback</b>]</p> <p><b>Example:</b></p> <pre>Router(config-pw)# preferred path peer 10.18.18.18</pre>	Specifies the MPLS traffic engineering tunnel or IP address or hostname to be used as the preferred path.
<b>Step 6</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config-pw)# exit</pre>	Exits from pseudowire configuration mode and enables the Tunnel Selection feature.
<b>Step 7</b>	<p><b>interface</b> <i>type slot / subslot / port</i> [, <i>subinterface</i>]</p> <p><b>Example:</b></p> <pre>Router(config)# interface atm1/1/0</pre>	Specifies an interface type and enters interface configuration mode.
<b>Step 8</b>	<p><b>encapsulation</b> <i>encapsulation-type</i></p> <p><b>Example:</b></p> <pre>Router(config-if)# encapsulation aal5</pre>	Specifies the encapsulation for the interface.
<b>Step 9</b>	<p><b>xconnect</b> <i>peer-router-id vcid</i> <b>pw-class</b> <i>name</i></p> <p><b>Example:</b></p> <pre>Router(config-if)# xconnect 10.0.0.1 123 pw-class ts1</pre>	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 the commands associated with the L2VPN Protocol-Based CLIs feature

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **template type pseudowire** *name*
4. **encapsulation mpls**
5. **preferred-path** {**interface tunnel** *tunnel-number* | **peer** {*ip-address* | *hostname*}} [**disable-fallback**]
6. **exit**
7. **interface type** *slot* / *subslot* / *port*[, *subinterface*]
8. **encapsulation** *encapsulation-type*
9. **end**
10. **interface pseudowire** *number*
11. **source template type pseudowire** *name*
12. **neighbor** *peer-address* *vcid-value*
13. **end**
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
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>template type pseudowire</b> <i>name</i>  <b>Example:</b> Router(config)# template type pseudowire ts1	Creates a template pseudowire with a name that you specify and enters pseudowire configuration mode.

	Command or Action	Purpose
<b>Step 4</b>	<b>encapsulation mpls</b>  <b>Example:</b> <pre>Router(config-pw)# encapsulation mpls</pre>	Specifies the tunneling encapsulation. For AToM, the encapsulation type is mpls.
<b>Step 5</b>	<b>preferred-path {interface tunnel <i>tunnel-number</i>   peer {ip-address   hostname}} [disable-fallback]</b>  <b>Example:</b> <pre>Router(config-pw)# preferred path peer 10.18.18.18</pre>	Specifies the MPLS traffic engineering tunnel or IP address or hostname to be used as the preferred path.
<b>Step 6</b>	<b>exit</b>  <b>Example:</b> <pre>Router(config-pw)# exit</pre>	Exits from pseudowire configuration mode and enables the Tunnel Selection feature.
<b>Step 7</b>	<b>interface type slot / subslot / port[.subinterface]</b>  <b>Example:</b> <pre>Router(config)# interface atm1/1/0</pre>	Specifies an interface type and enters interface configuration mode.
<b>Step 8</b>	<b>encapsulation encapsulation-type</b>  <b>Example:</b> <pre>Router(config-if)# encapsulation aal5</pre>	Specifies the encapsulation for the interface.
<b>Step 9</b>	<b>end</b>  <b>Example:</b> <pre>Router(config-if)# end</pre>	Exits to privileged EXEC mode.
<b>Step 10</b>	<b>interface pseudowire number</b>  <b>Example:</b> <pre>Router(config)# interface pseudowire 100</pre>	Specifies the pseudowire interface and enters interface configuration mode.
<b>Step 11</b>	<b>source template type pseudowire name</b>  <b>Example:</b> <pre>Router(config-if)# source template type pseudowire ts1</pre>	Configures the source template of type pseudowire named ts1.

	Command or Action	Purpose
Step 12	<b>neighbor</b> <i>peer-address</i> <i>vcid-value</i>  <b>Example:</b> 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	<b>end</b>  <b>Example:</b> Router(config-if)# end	Exits to privileged EXEC mode.
Step 14	<b>l2vpn xconnect context</b> <i>context-name</i>  <b>Example:</b> Router(config)# l2vpn xconnect context con1	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 15	<b>member pseudowire</b> <i>interface-number</i>  <b>Example:</b> Router(config-xconnect)# member pseudowire 100	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
Step 16	<b>member</b> <i>ip-address</i> <i>vc-id</i> <b>encapsulation mpls</b>  <b>Example:</b> Router(config-xconnect)# member 10.0.0.1 123 encapsulation mpls	Creates the VC to transport the Layer 2 packets.
Step 17	<b>end</b>  <b>Example:</b> 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

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map** *class-name*
4. **match any**
5. **policy-map** *policy-name*
6. **class** *class-name*
7. **set mpls experimental** *value*
8. **exit**
9. **exit**
10. **interface** *type slot / subslot / port* [*.subinterface*]
11. **service-policy input** *policy-name*
12. **end**
13. **show policy-map interface** *interface-name* [*vc [vpi /] vci*] [*dlci dlci*] [**input** | **output**]

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>class-map</b> <i>class-name</i>  <b>Example:</b> Router(config)# class-map class1	Specifies the user-defined name of the traffic class and enters class map configuration mode.
Step 4	<b>match any</b>  <b>Example:</b> Router(config-cmap)# match any	Specifies that all packets will be matched. Use only the <b>any</b> keyword. Other keywords might cause unexpected results.

	Command or Action	Purpose
<b>Step 5</b>	<p><b>policy-map</b> <i>policy-name</i></p> <p><b>Example:</b></p> <pre>Router(config-cmap)# policy-map policy1</pre>	Specifies the name of the traffic policy to configure and enters policy-map configuration mode.
<b>Step 6</b>	<p><b>class</b> <i>class-name</i></p> <p><b>Example:</b></p> <pre>Router(config-pmap)# class class1</pre>	Specifies the name of a predefined traffic class, which was configured with the <b>class-map</b> command, used to classify traffic to the traffic policy and enters policy-map class configuration mode.
<b>Step 7</b>	<p><b>set mpls experimental</b> <i>value</i></p> <p><b>Example:</b></p> <pre>Router(config-pmap-c)# set mpls experimental 7</pre>	Designates the value to which the MPLS bits are set if the packets match the specified policy map.
<b>Step 8</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config-pmap-c)# exit</pre>	Exits policy-map class configuration mode.
<b>Step 9</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config-pmap)# exit</pre>	Exits policy-map configuration mode.
<b>Step 10</b>	<p><b>interface</b> <i>type slot / subslot / port [subinterface]</i></p> <p><b>Example:</b></p> <pre>Router(config)# interface atm1/0/0</pre>	Specifies the interface type and enters interface configuration mode.
<b>Step 11</b>	<p><b>service-policy input</b> <i>policy-name</i></p> <p><b>Example:</b></p> <pre>Router(config-if)# service-policy input policy1</pre>	Attaches a traffic policy to an interface.
<b>Step 12</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# end</pre>	Exits to privileged EXEC mode.



	Command or Action	Purpose
<b>Step 13</b>	<p><b>show policy-map interface</b> <i>interface-name</i> [<i>vc</i> [<i>vpi</i> /] <i>vci</i>] [<i>dldci</i> <i>dldci</i>] [<i>input</i>   <i>output</i>]</p> <p><b>Example:</b></p> <pre>Router# show policy-map interface serial3/0/0</pre>	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
<b>Step 1</b>	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<p><b>pseudowire-class cw_enable</b></p> <p><b>Example:</b></p> <pre>Router(config)# pseudowire-class cw_enable</pre>	Enters pseudowire class configuration mode.
<b>Step 4</b>	<p><b>encapsulation mpls</b></p>	Specifies the tunneling encapsulation.

	Command or Action	Purpose
	<b>Example:</b> <pre>Router(config-pw-class)# encapsulation mpls</pre>	<ul style="list-style-type: none"> <li>For AToM, the encapsulation type is MPLS.</li> </ul>
<b>Step 5</b>	<b>control-word</b>  <b>Example:</b> <pre>Router(config-pw-class)# control-word</pre>	Enables the control word.
<b>Step 6</b>	<b>end</b>  <b>Example:</b> <pre>Router(config-pw-class)# end</pre>	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
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> <pre>Router&gt; enable</pre>	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface pseudowire <i>number</i></b>  <b>Example:</b> Router(config)# interface pseudowire 1	Creates an interface pseudowire with a value that you specify and enters pseudowire configuration mode.
<b>Step 4</b>	<b>encapsulation mpls</b>  <b>Example:</b> Router(config-pw)# encapsulation mpls	Specifies the tunneling encapsulation.  • For AToM, the encapsulation type is mpls.
<b>Step 5</b>	<b>control-word include</b>  <b>Example:</b> Router(config-pw)# control-word include	Enables the control word.
<b>Step 6</b>	<b>neighbor <i>peer-address vcid-value</i></b>  <b>Example:</b> 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.
<b>Step 7</b>	<b>end</b>  <b>Example:</b> 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. **interface** *type slot / subslot / port* [*.subinterface*]
7. **xconnect** *peer-ip-address vc-id pw-class pw-class-name*
8. **no remote link failure notification**
9. **remote link failure notification**
10. **end**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  • Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>pseudowire-class</b> [ <i>pw-class-name</i> ]  <b>Example:</b> Router(config)# pseudowire-class eompls	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
<b>Step 4</b>	<b>encapsulation mpls</b>  <b>Example:</b> Router(config-pw)# encapsulation mpls	Specifies that MPLS is used as the data encapsulation method for tunneling Layer 2 traffic over the pseudowire.
<b>Step 5</b>	<b>exit</b>  <b>Example:</b> Router(config-pw)# exit	Exits to global configuration mode.

	Command or Action	Purpose
<b>Step 6</b>	<b>interface</b> <i>type slot / subslot / port [.subinterface]</i>  <b>Example:</b> <pre>Router (config)# interface GigabitEthernet1/0/0</pre>	Configures an interface type and enters interface configuration mode.
<b>Step 7</b>	<b>xconnect</b> <i>peer-ip-address vc-id pw-class pw-class-name</i>  <b>Example:</b> <pre>Router(config-if)# xconnect 10.1.1.1 1 pw-class eompls</pre>	Binds an attachment circuit to a pseudowire, and configures an Any Transport over MPLS (AToM) static pseudowire.
<b>Step 8</b>	<b>no remote link failure notification</b>  <b>Example:</b> <pre>Router(config-if-xconn)# remote link failure notification</pre>	Disables MPLS AToM remote link failure notification and shutdown.
<b>Step 9</b>	<b>remote link failure notification</b>  <b>Example:</b> <pre>Router(config-if-xconn)# remote link failure notification</pre>	Enables MPLS AToM remote link failure notification and shutdown.
<b>Step 10</b>	<b>end</b>  <b>Example:</b> <pre>Router(config-if-xconn)# end</pre>	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* [, *subinterface*]
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**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>template type pseudowire</b> [ <i>pseudowire-name</i> ]  <b>Example:</b> Device(config)# template type pseudowire eompls	Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.
<b>Step 4</b>	<b>encapsulation mpls</b>  <b>Example:</b> Device(config-pw)# encapsulation mpls	Specifies that MPLS is used as the data encapsulation method for tunneling Layer 2 traffic over the pseudowire.

	Command or Action	Purpose
<b>Step 5</b>	<b>exit</b>  <b>Example:</b> Device(config-pw)# exit	Exits to global configuration mode.
<b>Step 6</b>	<b>interface</b> <i>type slot / subslot / port[. subinterface]</i>  <b>Example:</b> Device(config)# interface GigabitEthernet1/0/0	Configures an interface type and enters interface configuration mode.
<b>Step 7</b>	<b>interface pseudowire</b> <i>number</i>  <b>Example:</b> Device(config-if)# interface pseudowire 100	Specifies the pseudowire interface.
<b>Step 8</b>	<b>source template type pseudowire</b>  <b>Example:</b> Device(config-if)# source template type pseudowire eompls	Configures the source template of type pseudowire named eompls.
<b>Step 9</b>	<b>neighbor</b> <i>peer-address vcid-value</i>  <b>Example:</b> 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.
<b>Step 10</b>	<b>end</b>  <b>Example:</b> Device(config-if)# end	Exits to privileged EXEC mode.
<b>Step 11</b>	<b>l2vpn xconnect context</b> <i>context-name</i>  <b>Example:</b> Device(config)# l2vpn xconnect context con1	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
<b>Step 12</b>	<b>no remote link failure notification</b>  <b>Example:</b> Device(config-xconnect)# no remote link failure notification	Disables MPLS AToM remote link failure notification and shutdown.

	Command or Action	Purpose
<b>Step 13</b>	<b>remote link failure notification</b>  <b>Example:</b> Device(config-xconnect)# remote link failure notification	Enables MPLS AToM remote link failure notification and shutdown.
<b>Step 14</b>	<b>end</b>  <b>Example:</b> 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
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.



	Command or Action	Purpose
<b>Step 3</b>	<p><b>pseudowire-class</b> <i>pw-class-name</i></p> <p><b>Example:</b></p> <pre>Router(config)# pseudowire-class ecmp-class</pre>	Establishes a pseudowire class with a name that you specify, and enters pseudowire class configuration mode.
<b>Step 4</b>	<p><b>encapsulation mpls</b></p> <p><b>Example:</b></p> <pre>Router(config-pw-class)# encapsulation mpls</pre>	<p>Specifies the tunneling encapsulation.</p> <ul style="list-style-type: none"> <li>• For AToM, the encapsulation type is mpls.</li> </ul>
<b>Step 5</b>	<p><b>load-balance flow</b></p> <p><b>Example:</b></p> <pre>Router(config-pw-class)# load-balance flow</pre>	Enables the AToM Load Balancing with Single PW feature so that load balancing is done on a per-flow basis.
<b>Step 6</b>	<p><b>xconnect url pw-class</b> <i>pw-class-name</i></p> <p><b>Example:</b></p> <pre>Router(config-pw-class)# xconnect 10.0.0.1 pw-class ecmp-class</pre>	<p>Binds the attachment circuit to a pseudowire virtual circuit, and enters xconnect configuration mode.</p> <ul style="list-style-type: none"> <li>• The syntax for this command is the same as for all other Layer 2 transports.</li> </ul>

## 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
<b>Step 1</b>	<p><code>enable</code></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><code>configure terminal</code></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
<b>Step 3</b>	<p><code>template type pseudowire [pseudowire-name]</code></p> <p><b>Example:</b></p> <pre>Router(config)# template type pseudowire eompls</pre>	<p>Specifies the name of a Layer 2 pseudowire class and enters pseudowire class configuration mode.</p>

	Command or Action	Purpose
Step 4	<b>encapsulation mpls</b>  <b>Example:</b> <pre>Router(config-pw-class)# encapsulation mpls</pre>	Specifies the tunneling encapsulation. <ul style="list-style-type: none"> <li>• For AToM, the encapsulation type is mpls.</li> </ul>
Step 5	<b>load-balance flow</b>  <b>Example:</b> <pre>Router(config-pw-class)# load-balance flow</pre>	Enables the AToM Load Balancing with Single PW feature so that load balancing is done on a per-flow basis.
Step 6	<b>end</b>  <b>Example:</b> <pre>Router(config-pw-class)# end</pre>	Exits to privileged EXEC mode.
Step 7	<b>interface pseudowire <i>number</i></b>  <b>Example:</b> <pre>Router(config)# interface pseudowire 100</pre>	Specifies the pseudowire interface and enters interface configuration mode.
Step 8	<b>source template type pseudowire</b>  <b>Example:</b> <pre>Router(config-if)# source template type pseudowire ether-pw</pre>	Configures the source template of type pseudowire named ether-pw.
Step 9	<b>neighbor <i>peer-address vcid-value</i></b>  <b>Example:</b> <pre>Router(config-if)# neighbor 10.1.1.1 1</pre>	Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire.
Step 10	<b>end</b>  <b>Example:</b> <pre>Router(config-if)# end</pre>	Exits to privileged EXEC mode.
Step 11	<b>l2vpn xconnect context <i>context-name</i></b>  <b>Example:</b> <pre>Router(config)# l2vpn xconnect context con1</pre>	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.

	Command or Action	Purpose
<b>Step 12</b>	<b>member pseudowire</b> <i>interface-number</i>  <b>Example:</b> Router(config-xconnect)# member pseudowire 100	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
<b>Step 13</b>	<b>member</b> <i>ip-address vc-id</i> <b>encapsulation mpls</b>  <b>Example:</b> Router(config-xconnect)# member 10.0.0.1 123 encapsulation mpls	Creates the VC to transport the Layer 2 packets.
<b>Step 14</b>	<b>end</b>  <b>Example:</b> Router(config-xconnect)# end	Exits to privileged EXEC mode.

## 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 5: ATM over MPLS Configuration Example**

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

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

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

**Table 6: ATM over MPLS Configuration Example**

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

## 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 the commands associated with the L2VPN Protocol-Based CLIs 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

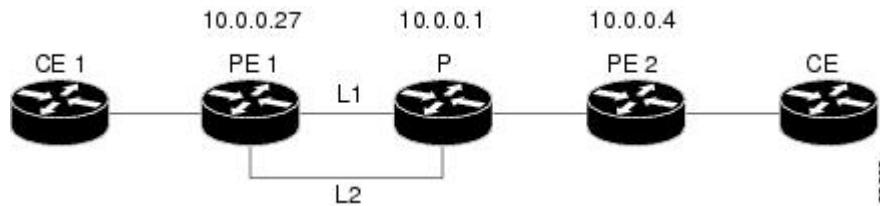
The following configuration example and the figure show the configuration of Ethernet over MPLS with fast reroute on AToM PE routers.

Routers PE1 and PE2 have the following characteristics:

- A TE tunnel called Tunnel41 is configured between PE1 and 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 3: 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 pelname 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 lrldi
  ip rsvp bandwidth 155000 155000
!
interface POS0/3/0
  description pelname 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 lrld
 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

```

**Example: Ethernet over MPLS with MPLS Traffic Engineering Fast Reroute using the commands associated with the L2VPN Protocol-Based CLIs feature**

```

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

```

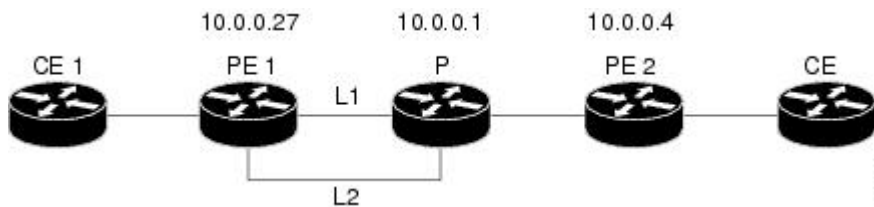
## Example: Ethernet over MPLS with MPLS Traffic Engineering Fast Reroute using the commands associated with the L2VPN Protocol-Based CLIs feature

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 PE1 and 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
!
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 pelname 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 lrldi
ip rsvp bandwidth 155000 155000
!
interface POS0/3/0
description pelname 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 lrld
 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 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

```

## Example: Configuring Tunnel Selection

```

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-tul 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 the commands associated with the L2VPN Protocol-Based CLIs 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-tul
!
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.

### 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 the commands associated with the L2VPN Protocol-Based CLIs 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

```

**Example: Configuring MTU Values in xconnect Configuration Mode for L2VPN Interworking using the commands associated with the L2VPN Protocol-Based CLIs feature**

```

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
```

## Examples: Configuring Any Transport over MPLS (AToM) Remote Ethernet Port Shutdown using the commands associated with the L2VPN Protocol-Based CLIs 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	<a href="#">Cisco IOS Master Command List, All Releases</a>
MPLS commands	<a href="#">Cisco IOS Multiprotocol Label Switching Command Reference</a>

### 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.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Any Transport over MPLS

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

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

**Table 7: 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 3.6S	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, support was added for the Cisco ASR 903 Router.
Any Transport over MPLS (AToM): Ethernet over MPLS (EoMPLS)	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 3.5S, support was added for the Cisco ASR 903 Router.