



# L2VPN Pseudowire Switching

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This feature module explains how to configure L2VPN Pseudowire Switching, which extends Layer 2 Virtual Private Network (L2VPN) pseudowires across an interautonomous system (inter-AS) boundary or across two separate Multiprotocol Label Switching (MPLS) networks. The feature supports ATM and time-division multiplexing (TDM) attachment circuits (ACs) and Ethernet ACs.

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see 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 for L2VPN Pseudowire Switching”](#) section on page 15.

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## Contents

- [Prerequisites for L2VPN Pseudowire Switching, page 2](#)
- [Restrictions for L2VPN Pseudowire Switching, page 2](#)
- [Information About L2VPN Pseudowire Switching, page 2](#)
- [How to Configure L2VPN Pseudowire Switching, page 4](#)
- [Configuration Examples for L2VPN Pseudowire Switching, page 7](#)
- [Additional References, page 13](#)
- [Feature Information for L2VPN Pseudowire Switching, page 15](#)



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## Prerequisites for L2VPN Pseudowire Switching

For the Cisco 12000 series routers, the L2VPN Pseudowire Switching feature for Any Transport over MPLS (AToM) is supported on the following engines:

- E2
- E3
- E4+
- E5
- E6

For engines that do not support this feature, the packets are sent to the software and forwarded through the slow path.

**Note**

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Engines E1 and E4 do not support L2VPN Pseudowire Switching, even in the slow path.

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## Restrictions for L2VPN Pseudowire Switching

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

## Information About L2VPN Pseudowire Switching

To configure the L2VPN Pseudowire Switching feature, you should understand the following concepts:

- [How L2VPN Pseudowire Switching Works, page 3](#)
- [How Packets Are Manipulated at the L2VPN Pseudowire Switching Aggregation Point, page 3](#)

## How L2VPN Pseudowire Switching Works

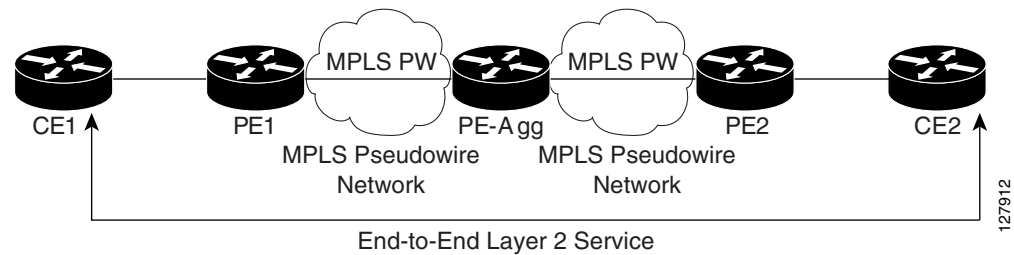
L2VPN Pseudowire Switching allows the user to extend L2VPN pseudowires across two separate MPLS networks or across an inter-AS boundary, as shown in [Figure 1](#) and [Figure 2](#).

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

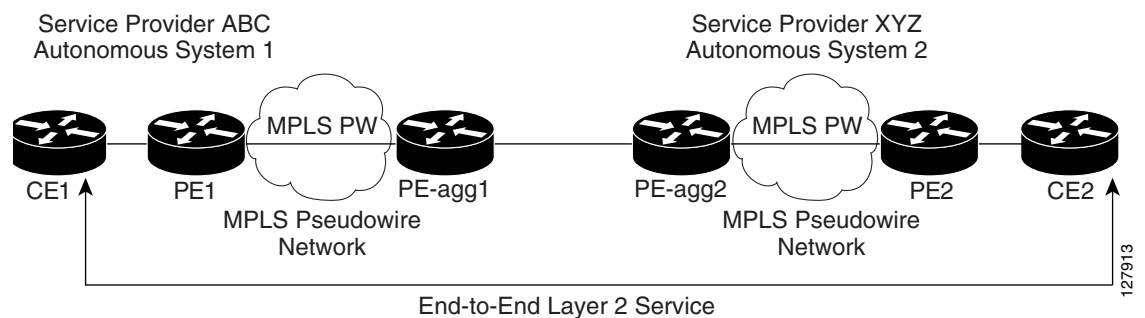
As shown in [Figure 2](#), L2VPN Pseudowire Switching enables you to keep the IP addresses of the edge PE routers private across inter-AS boundaries. You can use the IP address of the Autonomous System Boundary Routers (ASBRs) and treat them as pseudowire aggregation (PE-agg) routers. The ASBRs join the pseudowires of the two domains.

L2VPN Pseudowire Switching also enables you to keep different administrative or provisioning domains to manage the end-to-end service. At the boundaries of these networks, PE-agg routers delineate the management responsibilities.

**Figure 1** L2VPN Pseudowire Switching in an Intra-AS Topology



**Figure 2** L2VPN Pseudowire Switching in an Inter-AS Topology



## How Packets Are Manipulated at the L2VPN Pseudowire Switching Aggregation Point

Switching AToM packets between two AToM pseudowires is the same as switching any MPLS packet. The MPLS switching data path switches AToM packets between two AToM pseudowires. The following list explains exceptions:

- The outgoing virtual circuit (VC) label replaces the incoming VC label in the packet. New Internal Gateway Protocol (IGP) labels and Layer 2 encapsulation are added.

- The incoming VC label time-to-live (TTL) field is decremented by one and copied to the outgoing VC label TTL field.
- The incoming VC label EXP value is copied to the outgoing VC label EXP field.
- The outgoing VC label “Bottom of Stack” S bit in the outgoing VC label is set to 1.
- AToM control word processing is not performed at the L2VPN Pseudowire Switching aggregation point. Sequence numbers are not validated. Use the Router Alert label for LSP Ping; do not require control word inspection to determine an LSP Ping packet.

## How to Configure L2VPN Pseudowire Switching

Use the following procedure to configure L2VPN Pseudowire Switching on each of the PE-agg routers. In this configuration, you are limited to two **neighbor** commands after entering the **l2 vfi** command.

### Prerequisites

- This procedure assumes that you have configured basic AToM L2VPNs. This procedure does not explain how to configure basic AToM L2VPNs that transport Layer 2 packets over an MPLS backbone. For information on the basic configuration, see [Any Transport over MPLS](#).
- For interautonomous configurations, ASBRs require a labeled interface.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **l2 vfi name point-to-point**
4. **neighbor ip-address vcid** [**encapsulation mpls** | **pw-class pw-class-name**]
5. **exit**
6. **exit**
7. **show mpls l2transport vc** [**vcid** [*vc-id* | *vc-id-min vc-id-max*]] [**interface name** [*local-circuit-id*]] [**destination ip-address** | *name*] [**detail**]
8. **show vfi** [*vfi-name*]

9. ping [*protocol*] [*tag*] {*host-name* | *system-address*}

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<p><b>enable</b></p> <p><b>Example:</b> Router&gt; enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
Step 2	<p><b>configure terminal</b></p> <p><b>Example:</b> Router# configure terminal</p>	<p>Enters global configuration mode.</p>
Step 3	<p><b>l2 vfi name point-to-point</b></p> <p><b>Example:</b> Router(config)# l2 vfi atomtunnel point-to-point</p>	<p>Creates a point-to-point Layer 2 virtual forwarding interface (VFI) and enters VFI configuration mode.</p>
Step 4	<p><b>neighbor ip-address vcid [encapsulation mpls   pw-class pw-class-name]</b></p> <p><b>Example:</b> Router(config-vfi)# neighbor 10.0.0.1 100 pw-class mpls</p>	<p>Configures an emulated VC.</p> <ul style="list-style-type: none"> <li>Specify the IP address and the VC ID of the remote router.</li> <li>Also specify the pseudowire class to use for the emulated VC.</li> </ul> <p><b>Note</b> Only two <b>neighbor</b> commands are allowed for each <b>l2 vfi point-to-point</b> command.</p>
Step 5	<p><b>exit</b></p> <p><b>Example:</b> Router(config-vfi)# exit</p>	<p>Exits VFI configuration mode.</p>
Step 6	<p><b>exit</b></p> <p><b>Example:</b> Router(config)# exit</p>	<p>Exits global configuration mode.</p>
Step 7s	<p><b>show mpls l2transport vc [vcid [vc-id   vc-id-min vc-id-max]] [interface name [local-circuit-id]] [destination ip-address   name] [detail]</b></p> <p><b>Example:</b> Router# show mpls l2transport vc</p>	<p>Verifies that the L2VPN Pseudowire Switching session has been established.</p>

	Command or Action	Purpose
Step 8	<code>show vfi [vfi-name]</code>  <b>Example:</b> Router# <code>show vfi atomtunnel</code>	Verifies that a point-to-point VFI has been established.
Step 9	<code>ping [protocol] [tag] {host-name   system-address}</code>  <b>Example:</b> Router# <code>ping 10.1.1.1</code>	When issued from the CE routers, verifies end-to-end connectivity.

## Examples

The following example displays output from the `show mpls l2transport vc` command:

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

```
Local intf      Local circuit      Dest address      VC ID Status
-----
MPLS PW        10.0.1.1:100      10.0.1.1         100  UP
MPLS PW        10.0.1.1:100      10.0.1.1         100  UP
```

The following example displays output from the `show vfi` command:

```
Router# show vfi
```

```
VFI name: test, type: point-to-point
Neighbors connected via pseudowires:
Router ID      Pseudowire ID
10.0.1.1       100
10.0.1.1       100
```

# Configuration Examples for L2VPN Pseudowire Switching

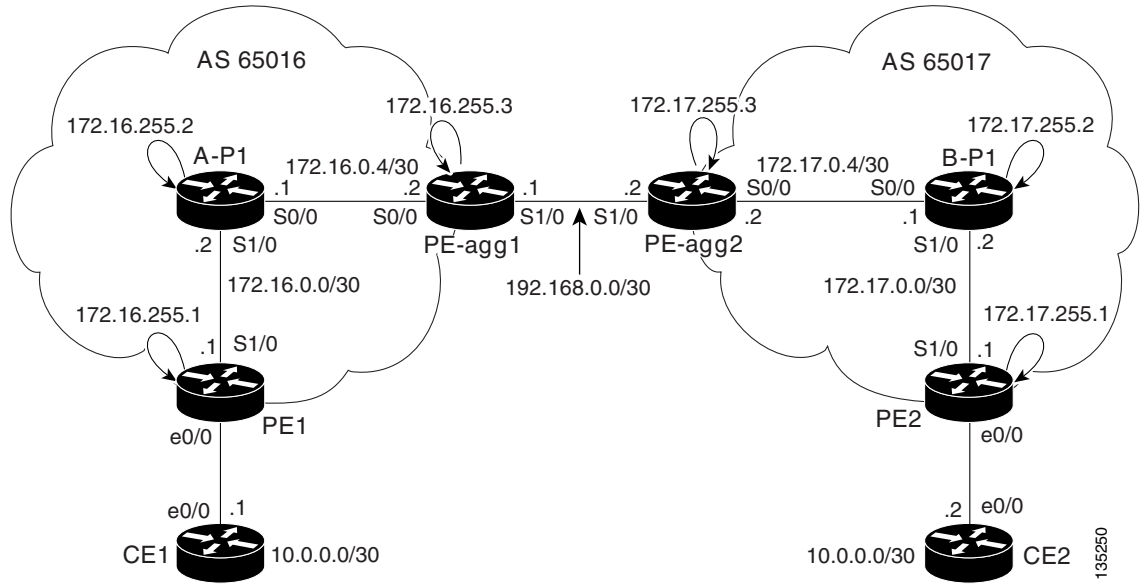
This section provides the following configuration example:

- [L2VPN Pseudowire Switching in an Inter-AS Configuration: Example, page 7](#)

## L2VPN Pseudowire Switching in an Inter-AS Configuration: Example

Two separate autonomous systems are able to pass L2VPN packets, because the two PE-agg routers have been configured with L2VPN Pseudowire Switching. This example configuration is shown in [Figure 3](#).

Figure 3 L2VPN Pseudowire Switching in an Interautonomous System





**PE-agg-1**

```

version 12.0
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
hostname [pe-agg1]
!
boot-start-marker
boot-end-marker
!
enable secret 5 $1$Q0Bb$32sIU82pHRgyddWaeB4zs/
!
ip subnet-zero
ip cef
no ip domain-lookup
mpls label protocol ldp
pseudowire-class SW-PW
  encapsulation mpls
!
12 vfi PW-SWITCH-1 point-to-point
  neighbor 172.17.255.3 100 pw-class SW-PW
  neighbor 172.16.255.1 16 pw-class SW-PW
!
interface Loopback0
  ip address 172.16.255.3 255.255.255.255
  no ip directed-broadcast
!
interface Serial0/0
  ip address 172.16.0.6 255.255.255.252
  no ip directed-broadcast
  mpls ip
!
interface Serial1/0
  ip address 192.168.0.1 255.255.255.252
  no ip directed-broadcast
  mpls bgp forwarding
!
router ospf 16
  log-adjacency-changes
  network 172.16.0.0 0.0.255.255 area 0
!
router bgp 65016
  no synchronization
  bgp log-neighbor-changes
  network 172.16.255.3 mask 255.255.255.255
  neighbor 192.168.0.2 remote-as 65017
  neighbor 192.168.0.2 send-label
  no auto-summary
!
ip classless
control-plane
!
line con 0
  exec-timeout 0 0
line aux 0
line vty 0 4
  login
!
no cns aaa enable
end

```

**PE-agg-2**

```

version 12.0
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
hostname [pe-agg2]
!
boot-start-marker
boot-end-marker
!
enable secret 5 $1$32jd$zQRfxXzjstr411V9DcWf7/
!
ip subnet-zero
ip cef
no ip domain-lookup
mpls label protocol ldp
pseudowire-class SW-PW
  encapsulation mpls
!
12 vfi PW-SWITCH-1 point-to-point
  neighbor 172.16.255.3 100 pw-class SW-PW
  neighbor 172.17.255.1 17 pw-class SW-PW
!
interface Loopback0
  ip address 172.17.255.3 255.255.255.255
  no ip directed-broadcast
!
interface Serial0/0
  ip address 172.17.0.6 255.255.255.252
  no ip directed-broadcast
  mpls ip
!
interface Serial1/0
  ip address 192.168.0.2 255.255.255.252
  no ip directed-broadcast
  mpls bgp forwarding
!
router ospf 17
  log-adjacency-changes
  network 172.17.0.0 0.0.255.255 area 0
!
router bgp 65017
  no synchronization
  bgp log-neighbor-changes
  network 172.17.255.3 mask 255.255.255.255
  neighbor 192.168.0.1 remote-as 65016
  neighbor 192.168.0.1 send-label
  no auto-summary
!
ip classless
control-plane
!
line con 0
  exec-timeout 0 0
line aux 0
line vty 0 4
  login
!
no cns aaa enable
end

```

A-P1	B-P1
<pre> version 12.0 service timestamps debug uptime service timestamps log uptime service password-encryption ! hostname [a-p1] ! boot-start-marker boot-end-marker ! enable secret 5 \$1\$eiUn\$rTMnZiYnJxtMTp00NKpQQ/ ! ip subnet-zero ip cef no ip domain-lookup mpls label protocol ldp ! interface Loopback0  ip address 172.16.255.2 255.255.255.255  no ip directed-broadcast ! interface Serial0/0  ip address 172.16.0.5 255.255.255.252  no ip directed-broadcast  mpls ip ! interface Serial1/0  ip address 172.16.0.2 255.255.255.252  no ip directed-broadcast  mpls ip ! router ospf 16  log-adjacency-changes  network 172.16.0.0 0.0.255.255 area 0 ! ip classless ! control-plane ! line con 0  exec-timeout 0 0 line aux 0 line vty 0 4  login ! no cns aaa enable end </pre>	<pre> version 12.0 service timestamps debug uptime service timestamps log uptime service password-encryption ! hostname [b-p1] ! boot-start-marker boot-end-marker ! enable secret 5 \$1\$svU/\$2JmJZ/5gx1W4nVXVniIJel ! ip subnet-zero ip cef no ip domain-lookup mpls label protocol ldp ! interface Loopback0  ip address 172.17.255.2 255.255.255.255  no ip directed-broadcast ! interface Serial0/0  ip address 172.17.0.5 255.255.255.252  no ip directed-broadcast  mpls ip ! interface Serial1/0  ip address 172.17.0.2 255.255.255.252  no ip directed-broadcast  mpls ip ! router ospf 17  log-adjacency-changes  network 172.17.0.0 0.0.255.255 area 0 ! ip classless ! control-plane ! line con 0  exec-timeout 0 0 line aux 0 line vty 0 4  login ! no cns aaa enable end </pre>

PE1	PE2
<pre> version 12.0 service timestamps debug uptime service timestamps log uptime service password-encryption ! hostname [pe1] ! boot-start-marker boot-end-marker ! enable secret 5 \$1\$9z8F\$2A1/YLc6NB6d.WLQXF0Bz1 ! ip subnet-zero ip cef no ip domain-lookup mpls label protocol ldp pseudowire-class ETH-PW encapsulation mpls ! interface Loopback0  ip address 172.16.255.1 255.255.255.255  no ip directed-broadcast ! interface Ethernet0/0  no ip address  no ip directed-broadcast  no cdp enable  xconnect 172.16.255.3 16 pw-class ETH-PW ! interface Serial1/0  ip address 172.16.0.1 255.255.255.252  no ip directed-broadcast  mpls ip ! router ospf 16  log-adjacency-changes  network 172.16.0.0 0.0.255.255 area 0 ! ip classless ! control-plane ! line con 0  exec-timeout 0 0 line aux 0 line vty 0 4  login ! no cns aaa enable end </pre>	<pre> version 12.0 service timestamps debug uptime service timestamps log uptime service password-encryption ! hostname [pe2] ! boot-start-marker boot-end-marker ! enable secret 5 \$1\$rT.V\$8Z6Dy/r8/eaRdx2TR/O5r/ ! ip subnet-zero ip cef no ip domain-lookup mpls label protocol ldp pseudowire-class ETH-PW encapsulation mpls ! interface Loopback0  ip address 172.17.255.1 255.255.255.255  no ip directed-broadcast ! interface Ethernet0/0  no ip address  no ip directed-broadcast  no cdp enable  xconnect 172.17.255.3 17 pw-class ETH-PW ! interface Serial1/0  ip address 172.17.0.1 255.255.255.252  no ip directed-broadcast  mpls ip ! router ospf 17  log-adjacency-changes  network 172.17.0.0 0.0.255.255 area 0 ! ip classless ! control-plane ! line con 0  exec-timeout 0 0 line aux 0 line vty 0 4  login ! no cns aaa enable end </pre>

CE1	CE2
<pre> version 12.0 service timestamps debug uptime service timestamps log uptime service password-encryption ! hostname [ce1] ! boot-start-marker boot-end-marker ! enable secret 5 \$1\$o9N6\$LSrxHufTn0vjCY0nW8hQX. ! ip subnet-zero ip cef no ip domain-lookup ! interface Ethernet0/0  ip address 10.0.0.1 255.255.255.252  no ip directed-broadcast ! ip classless ! control-plane ! line con 0  exec-timeout 0 0 line aux 0 line vty 0 4  login ! no cns aaa enable end </pre>	<pre> version 12.0 service timestamps debug uptime service timestamps log uptime service password-encryption ! hostname [ce2] ! boot-start-marker boot-end-marker ! enable secret 5 \$1\$YHo6\$LQ4z5PdrF5B9dnL75Xvvm1 ! ip subnet-zero ip cef no ip domain-lookup ! interface Ethernet0/0  ip address 10.0.0.2 255.255.255.252  no ip directed-broadcast ! ip classless ! control-plane ! line con 0  exec-timeout 0 0 line aux 0 line vty 0 4  login ! no cns aaa enable end </pre>

# Additional References

## Related Documents

Related Topic	Document Title
Any Transport over MPLS	<a href="#">Any Transport over MPLS</a>
Pseudowire redundancy	<a href="#">L2VPN Pseudowire Redundancy</a>
High availability for AToM	<a href="#">AToM Graceful Restart</a>
L2VPN interworking	<a href="#">L2VPN Interworking</a>
Layer 2 local switching	<a href="#">Layer 2 Local Switching</a>
PWE3 MIB	<a href="#">Pseudowire Emulation Edge-to-Edge MIBs for Ethernet and Frame Relay Services</a>
Packet sequencing	<a href="#">Any Transport over MPLS (AToM) Sequencing Support</a>

## Standards

Standard	Title
draft-ietf-pwe3-control-protocol-14.txt	<a href="#">Pseudowire Setup and Maintenance using LDP</a>
draft-martini-pwe3-pw-switching-01.txt	<a href="#">Pseudo Wire Switching</a>

## MIBs

MIB	MIBs Link
<ul style="list-style-type: none"> <li>• CISCO-IETF-PW-MIB</li> <li>• CISCO-IETF-PW-MPLS-MIB</li> <li>• CISCO-IETF-PW-ENET-MIB</li> <li>• CISCO-IETF-PW-FR-MIB</li> </ul>	<p>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:</p> <p><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></p>

## RFCs

RFCs	Title
None	—

## Technical Assistance

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<p><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></p>

# Feature Information for L2VPN Pseudowire Switching

Table 1 lists the features in this module and provides links to specific configuration information. Only features that were introduced or modified in Cisco IOS Releases 12.2(28)SB or 12.2(33)SRB or a later release appear in the table

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

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## Note

Table 1 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

**Table 1** Feature Information for L2VPN Pseudowire Switching

Feature Name	Releases	Feature Information
L2VPN Pseudowire Switching	12.0(31)S 12.2(28)SB 12.2(33)SRB 12.2(33)SRD2 12.2(33)SRE	This feature configures L2VPN Pseudowire Switching, which extends L2VPN pseudowires across an interautonomous system (inter-AS) boundary or across two separate MPLS networks.  In Cisco IOS Release 12.2(28)SB, support was added for the Cisco 7200 and 7301 series routers.  In 12.2(33)SRD2, support was added for ATM and TDM ACs.  The following commands were introduced or modified: <b>l2 vfi point-to-point, neighbor</b> (L2VPN Pseudowire Switching), <b>show vfi</b> .

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