L2VPN Pseudowire Switching

Last Updated: December 23, 2011

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, page 1
- Prerequisites for L2VPN Pseudowire Switching, page 1
- Restrictions for L2VPN Pseudowire Switching, page 2
- Information About L2VPN Pseudowire Switching, page 2
- How to Configure L2VPN Pseudowire Switching, page 3
- Configuration Examples for L2VPN Pseudowire Switching, page 6
- Additional References, page 11
- Feature Information for L2VPN Pseudowire Switching, page 12

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 Table at the end of this document.

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

Prerequisites for L2VPN 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+
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

- How L2VPN Pseudowire Switching Works, page 2
- 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 the two figures below.

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 the second figure below, 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 vfic** command.
• 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**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td><code>Router&gt; enable</code></td>
<td>Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td><code>Router# configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> l2 vfi name point-to-point</td>
<td>Creates a point-to-point Layer 2 virtual forwarding interface (VFI) and enters VFI configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td><code>Router(config)# l2 vfi atomtunnel point-to-point</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> neighbor ip-address vcid [encapsulation mpls</td>
<td>pw-class pw-class-name]</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td><code>Router(config-vfi)# neighbor 10.0.0.1 100 pw-class mpls</code></td>
<td>Specify the IP address and the VC ID of the remote router.</td>
</tr>
<tr>
<td></td>
<td>Also specify the pseudowire class to use for the emulated VC.</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Only two <code>neighbor</code> commands are allowed for each <code>l2 vfi</code> <code>point-to-point</code> command.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 5</strong> exit</td>
<td>Exits VFI configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config-vfi)# exit</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> exit</td>
<td>Exits global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# exit</td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> show mpls l2transport vc [vcid vc-id</td>
<td>vc-id-min vc-id-max]] [interface name local-circuit-id] [destination ip-address</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router# show mpls l2transport vc</td>
<td></td>
</tr>
<tr>
<td><strong>Step 8</strong> show vfi [vfi-name]</td>
<td>Verifies that a point-to-point VFI has been established.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router# show vfi atomtunnel</td>
<td></td>
</tr>
<tr>
<td><strong>Step 9</strong> ping [protocol] [tag] [host-name system-address]</td>
<td>When issued from the CE routers, verifies end-to-end connectivity.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router# ping 10.1.1.1</td>
<td></td>
</tr>
</tbody>
</table>

- **Examples, page 5**

### 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  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:
```
Configuration Examples for L2VPN Pseudowire Switching

- L2VPN Pseudowire Switching in an Inter-AS Configuration Example, page 6

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 the figure below.

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
!
l2 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
```

### 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$32jd$zQRfxXzjstr4llV9DcWf7/
!
ip subnet-zero
ip cef
no ip domain-lookup
mpls label protocol ldp
pseudowire-class SW-PW
encapsulation mpls
!
l2 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 Serial1/0
ip address 192.168.0.1 255.255.255.252
no ip directed-broadcast
mpls ip
```
A-P1

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$srtMnZiYnJxtMTp0O7KpQQ/
!
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
!
!

B-P1

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/5gxlW4nVXvniIJe1
!
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
!
### PE1

```
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
```

### PE2

```
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/OSr/
!
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
```
### CE1

- `version 12.0`
- `service timestamps debug uptime`
- `service timestamps log uptime`
- `service password-encryption`
- `hostname [ce1]`
- `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`

### CE2

- `version 12.0`
- `service timestamps debug uptime`
- `service timestamps log uptime`
- `service password-encryption`
- `hostname [ce2]`
- `enable secret 5 $1$YHo6$LQ4z5PdrF5B9dnL75Xvml`
- `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`
## Additional References

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Transport over MPLS</td>
<td>Any Transport over MPLS</td>
</tr>
<tr>
<td>Pseudowire redundancy</td>
<td><a href="http://www.cisco.com/univercd/cc/td/doc/product/">http://www.cisco.com/univercd/cc/td/doc/product/</a> software/ios120/120newft/120limit/120s/120s31/fsstitch.htm L2VPN Pseudowire Redundancy</td>
</tr>
<tr>
<td>High availability for AToM</td>
<td>AToM Graceful Restart</td>
</tr>
<tr>
<td>L2VPN interworking</td>
<td>L2VPN Interworking</td>
</tr>
<tr>
<td>Layer 2 local switching</td>
<td>Layer 2 Local Switching</td>
</tr>
<tr>
<td>PWE3 MIB</td>
<td>Pseudowire Emulation Edge-to-Edge MIBs for Ethernet and Frame Relay Services</td>
</tr>
<tr>
<td>Packet sequencing</td>
<td>Any Transport over MPLS (AToM) Sequencing Support</td>
</tr>
</tbody>
</table>

### Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>draft-ietf-pwe3-control-protocol-14.txt</td>
<td>Pseudowire Setup and Maintenance using LDP</td>
</tr>
<tr>
<td>draft-martini-pwe3-pw-switching-01.txt</td>
<td>Pseudo Wire Switching</td>
</tr>
</tbody>
</table>

### MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CISCO-IETF-PW-MIB</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:</td>
</tr>
<tr>
<td>• CISCO-IETF-PW-MPLS-MIB</td>
<td><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
<tr>
<td>• CISCO-IETF-PW-ENET-MIB</td>
<td></td>
</tr>
<tr>
<td>• CISCO-IETF-PW-FR-MIB</td>
<td></td>
</tr>
</tbody>
</table>

### RFCs

<table>
<thead>
<tr>
<th>RFCs</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>
Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</td>
<td></td>
</tr>
</tbody>
</table>

Feature Information for L2VPN Pseudowire Switching

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 1  Feature Information for L2VPN Pseudowire Switching

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2VPN Pseudowire Switching</td>
<td>12.0(31)S, 12.2(28)SB, 12.2(33)SRB, 12.2(33)SRD2, 12.2(33)SRE</td>
<td>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: <code>l2 vfi point-to-point</code>, <code>neighbor</code>(L2VPN Pseudowire Switching), <code>show vfi</code>.</td>
</tr>
</tbody>
</table>

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: [www.cisco.com/go/trademarks](http://www.cisco.com/go/trademarks). Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1110R)

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

© 2011 Cisco Systems, Inc. All rights reserved.