Network Configuration Example

Interconnecting a Layer 2 VPN with a Layer 2 VPN

Release
11.3

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Juniper Networks hardware and software products are Year 2000 compliant. The Junos OS has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.

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Introduction

This configuration example provides configuration and verification commands for interconnecting a Layer 2 VPN with a Layer 2 VPN using the Layer 2 interworking (iw0) interface. The Junos OS can make use of a Tunnel Services PIC to loop packets out and back from the Packet Forwarding Engine (PFE), to link together Layer 2 networks. The Layer 2 interworking interface avoids the need for the Tunnel Services PIC and overcomes the limitation of bandwidth constraints imposed by the Tunnel Services PIC.

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Layer 2 VPN Overview

As the need to link different Layer 2 services to one another for expanded service offerings grows, Layer 2 MPLS VPN services are increasingly in demand.

Implementing a Layer 2 VPN on a router is similar to implementing a VPN using a Layer 2 technology, such as Asynchronous Transfer Mode (ATM). However, for a Layer 2 VPN on a router, traffic is forwarded to the router in a Layer 2 format. It is carried by Multiprotocol Label Switching (MPLS) over the service provider's network, and then converted back to Layer 2 format at the receiving site. You can configure different Layer 2 formats at the sending and receiving sites. The security and privacy of an MPLS Layer 2 VPN are equal to those of an ATM or Frame Relay VPN. The service provisioned with Layer 2 VPNs is also known as Virtual Private Wire Service (VPWS).

On a Layer 2 VPN, routing typically occurs on the customer edge (CE) router. The CE router connected to a service provider on a Layer 2 VPN must select the appropriate circuit on which to send traffic. The provider edge (PE) router receiving the traffic sends the traffic across the service provider's network to the PE router connected to the receiving site. The PE routers do not need to store or process the customer's routes; they only need to be configured to send data to the appropriate tunnel. For a Layer 2 VPN, customers need to configure their own routers to carry all Layer 3 traffic. The service provider needs to know only how much traffic the Layer 2 VPN will need to carry. The service provider's routers carry traffic between the customer's sites using Layer 2 VPN interfaces. The VPN topology is determined by policies configured on the PE routers.

Because Layer 2 VPNs use BGP as the signaling protocol, they have a simpler design and require less overhead than traditional VPNs over Layer 2 circuits. BGP signaling also enables autodiscovery of Layer 2 VPN peers. Layer 2 VPNs are similar to BGP or MPLS VPNs and VPLS in many respects; all three types of services employ BGP for signaling.

Related Documentation

- Layer 2 VPN Applications on page 5
- Using the Layer 2 Interworking Interface to Interconnect a Layer 2 Circuit to a Layer 2 VPN
- Using the Layer 2 Interworking Interface to Interconnect a Layer 2 VPN to a Layer 2 VPN on page 7
- Interconnecting Layer 2 VPNs with Layer 3 VPNs Overview
- Example: Interconnecting a Layer 2 VPN with a Layer 2 VPN on page 9
- Example: Interconnecting a Layer 2 Circuit with a Layer 2 VPN
- Example: Interconnecting a Layer 2 VPN with a Layer 3 VPN

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Layer 2 VPN Applications

Implementing a Layer 2 VPN includes the following benefits:

- Terminating a Layer 2 VPN into a Layer 2 VPN using the interworking (iw0) software interface eliminates the limitation of bandwidth on the tunnel interfaces used for these configuration scenarios. Instead of using a physical Tunnel PIC for looping the packet received from the Layer 2 VPN to another Layer 2 VPN, Junos OS is used to link both the Layer 2 VPN routes.
- Layer 2 VPNs enable the sharing of a provider's core network infrastructure between IP and Layer 2 VPN services, reducing the cost of providing those services. A Layer 2 MPLS VPN allows you to provide Layer 2 VPN service over an existing IP and MPLS backbone.
- From a service provider's point of view, a Layer 2 MPLS VPN allows the use of a single Layer 3 VPN (such as RFC 2547bis), MPLS traffic engineering, and Differentiated Services (DiffServ).
- Service providers do not have to invest in separate Layer 2 equipment to provide Layer 2 VPN service. You can configure the PE router to run any Layer 3 protocol in addition to the Layer 2 protocols. Customers who prefer to maintain control over most of the administration of their own networks might want Layer 2 VPN connections with their service provider instead of a Layer 3 VPN.

Related Documentation

- Layer 2 VPN Overview on page 3
- Using the Layer 2 Interworking Interface to Interconnect a Layer 2 Circuit to a Layer 2 VPN
- Using the Layer 2 Interworking Interface to Interconnect a Layer 2 VPN to a Layer 2 VPN on page 7
- Example: Interconnecting a Layer 2 Circuit with a Layer 2 VPN
- Example: Interconnecting a Layer 2 VPN with a Layer 2 VPN on page 9
- Example: Interconnecting a Layer 2 VPN with a Layer 3 VPN

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Using the Layer 2 Interworking Interface to Interconnect a Layer 2 VPN to a Layer 2 VPN

Instead of using a physical Tunnel PIC for looping the packet received from the Layer 2 VPN to another Layer 2 VPN, the Layer 2 Interworking interface uses Junos OS to stitch together both Layer 2 VPN routes.

To configure the interworking interface, include the **iw0** statement. The **iw0** statement is configured at the **[edit interfaces]** hierarchy level.

```
[edit interfaces]
iw0 {
   unit 0 {
      peer 1;
   }
   unit 1 {
      peer 0;
   }
}
```

The configuration of an interworking (iw) interface is similar to the configuration of a logical tunnel (lt) interface. In this example, the logical interfaces must be associated with the endpoints of both Layer 2 VPN connections terminating on this router. To make the association, include the **interfaces** statement and specify **iw0** as the interface name. Include the statement at the **[edit routing-instances *routing-instances-name* protocols l2vpn site *site-name*]** hierarchy level for each routing instance. The **routing-instances** statement is configured at the **[edit routing-instances]** hierarchy level.

```
[edit routing-instances]
L2VPN-PE1 {
   instance-type l2vpn;
   interface iw0.0;
   route-distinguisher 65000:3;
   vrf-target target:65000:2;
   protocols {
      l2vpn {
         encapsulation-type ethernet;
         site CE3 {
            site-identifier 3;
            interface iw0.0 {
               remote-site-id 1;
            }
         }
      }
   }
}
L2VPN-PE5 {
   instance-type l2vpn;
   interface iw0.1;
   route-distinguisher 65000:33;
   vrf-target target:65000:2;
   protocols {
      l2vpn {
         encapsulation-type ethernet;
         site CE3 {
```

```
                site-identifier 3;
                interface iw0.1 {
                    remote-site-id 5;
                }
            }
        }
    }
}
```

In addition to the **iw0** interface configuration, Layer 2 interworking **l2iw** protocols need to be configured. Without the **l2iw** configuration, the **l2iw** routes will not be formed, regardless of whether any **iw** interfaces are present. Only standard trace options can be configured within the l2iw protocol. The minimum configuration necessary for the feature to work is shown below:

```
[edit]
protocols {
    l2iw;
}
```

Related Documentation

- Layer 2 VPN Overview on page 3
- Layer 2 VPN Applications on page 5
- Example: Interconnecting a Layer 2 VPN with a Layer 2 VPN on page 9

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Example: Interconnecting a Layer 2 VPN with a Layer 2 VPN

This example provides a step-by-step procedure for interconnecting and verifying a Layer 2 VPN with a Layer 2 VPN. It contains the following sections:

Requirements

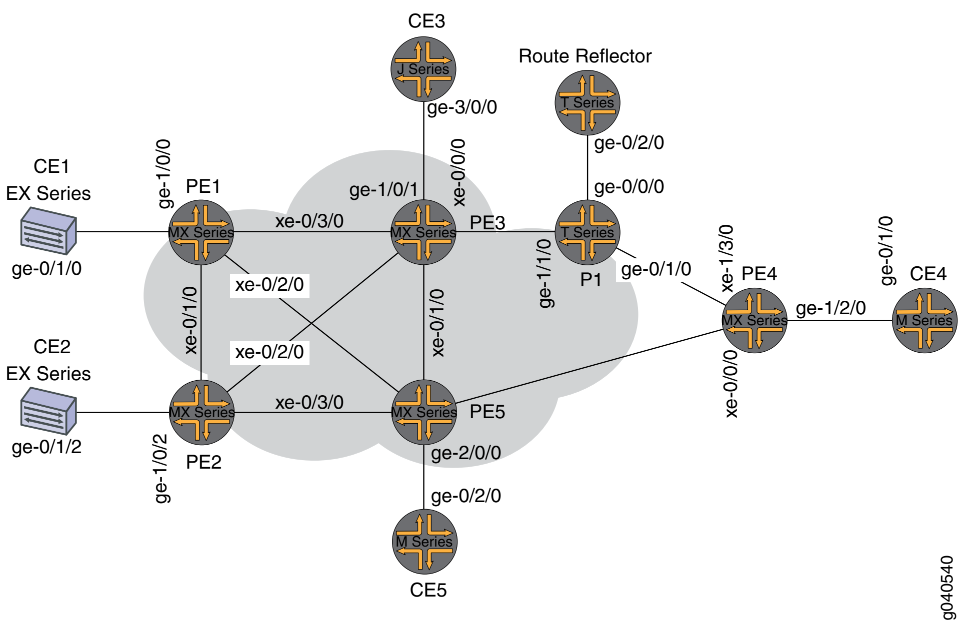
This example uses the following hardware and software components:

- Junos OS Release 9.3 or later
- 2 MX Series 3D Universal Edge Routers
- 2 M Series Multiservice Edge Routers
- 1 T Series Core Routers
- 1 EX Series Ethernet Switches
- 1 J Series Services Routers

Overview and Topology

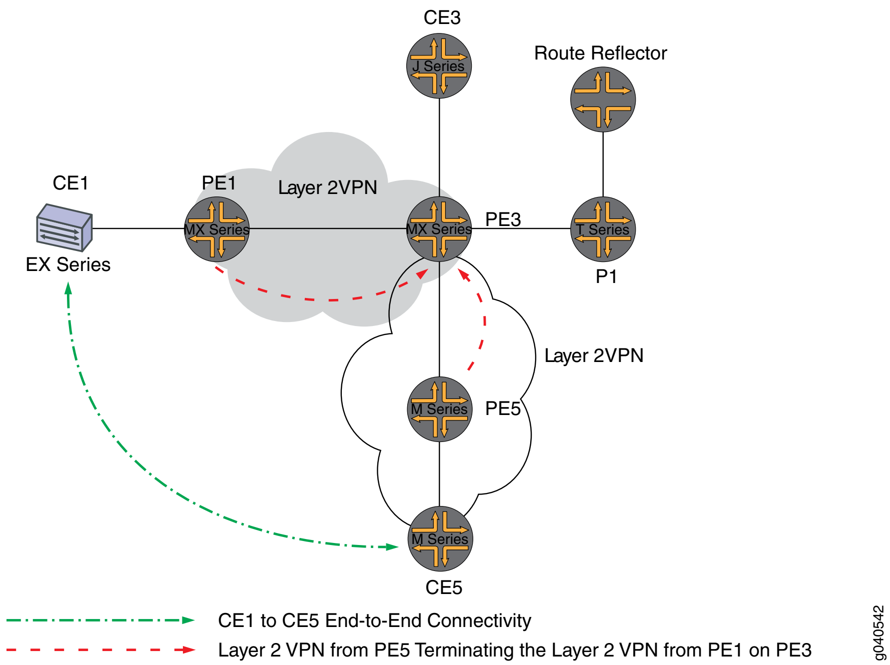
The physical topology of the Layer 2 VPN to Layer 2 VPN connection example is shown in Figure 1 on page 9.

Figure 1: Physical Topology of a Layer 2 VPN to Layer 2 VPN Connection



The logical topology of a Layer 2 VPN to Layer 2 VPN connection is shown in Figure 2 on page 10.

Figure 2: Logical Topology of a Layer 2 VPN to Layer 2 VPN Connection



Configuration

NOTE: In any configuration session, it is good practice to verify periodically that the configuration can be committed using the **commit check** command.

In this example, the router being configured is identified using the following command prompts:

- **CE1** identifies the customer edge 1 (CE1) router
- **PE1** identifies the provider edge 1 (PE1) router
- **CE3** identifies the customer edge 3 (CE3) router
- **PE3** identifies the provider edge 3 (PE3) router
- **CE5** identifies the customer edge 5 (CE5) router
- **PE5** identifies the provider edge 5 (PE5) router

This example is organized in the following sections:

- Configuring Protocols on the PE and P Routers on page 11
- Verifying the Layer 2 VPN to Layer 2 VPN Connection on Router PE3 on page 16
- Verifying the Layer 2 VPN to Layer 2 VPN Connection on Router PE3 on page 18

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Configuring Protocols on the PE and P Routers

Step-by-Step Procedure

All of the PE routers and P routers are configured with OSPF as the IGP protocol. The MPLS, LDP, and BGP protocols are enabled on all of the interfaces except **fxp.0**. Core-facing interfaces are enabled with the MPLS address and inet address.

1. Configure all the PE and P routers with OSPF as the IGP. Enable the MPLS, LDP, and BGP protocols on all interfaces except **fxp.0**. The following configuration snippet shows the protocol configuration for Router PE1:

```
[edit]
protocols {
  mpls {
    interface all;
    interface fxp0.0 {
      disable;
    }
  }
  bgp {
    group RR {
      type internal;
      local-address 1.1.1.1;
      family l2vpn {
        signaling;
      }
      neighbor 7.7.7.7;
    }
  }
  ospf {
    traffic-engineering;
    area 0.0.0.0 {
      interface all;
      interface fxp0.0 {
        disable;
      }
    }
  }
  ldp {
    interface all;
    interface fxp0.0 {
      disable;
    }
  }
}
```

2. Configure the PE and P routers with OSPF as the IGP. Enable the MPLS, LDP, and BGP protocols on all interfaces except **fxp.0**. The following configuration snippet shows the protocol configuration for Router PE3:

```
[edit]
protocols {
  mpls {
    interface all;
    interface fxp0.0 {
      disable;
```

```
      }
    }
    bgp {
      group RR {
        type internal;
        local-address 3.3.3.3;
        family l2vpn {
          signaling;
        }
        neighbor 7.7.7.7;
      }
    }
    ospf {
      traffic-engineering;
      area 0.0.0.0 {
        interface all;
        interface fxp0.0 {
          disable;
        }
      }
    }
    ldp {
      interface all;
      interface fxp0.0 {
        disable;
      }
    }
  }
```

Step-by-Step Procedure

Configuring the Layer 2 VPN Protocol and Interfaces

1. On Router PE1, configure the **ge-1/0/0** interface encapsulation. To configure the interface encapsulation, include the **encapsulation** statement and specify the **ethernet-ccc** option (vlan-ccc encapsulation is also supported). Configure the **ge-1/0/0.0** logical interface family for circuit cross-connect functionality. To configure the logical interface family, include the **family** statement and specify the **ccc** option. The encapsulation should be configured the same way for all routers in the Layer 2 VPN domain.

```
[edit interfaces]
ge-1/0/0 {
  encapsulation ethernet-ccc;
  unit 0 {
    family ccc;
  }
}
lo0 {
  unit 0 {
    family inet {
      address 1.1.1.1/32;
    }
  }
}
```

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2. On Router PE1, configure the Layer 2 VPN protocols. Configure the remote site ID as 3. Site ID 3 represents Router PE3 (Hub-PE). To configure the Layer 2 VPN protocols, include the **l2vpn** statement at the **[edit routing-instances *routing-instances-name* protocols]** hierarchy level. Layer 2 VPNs use BGP as the signaling protocol.

```
[edit routing-instances]
L2VPN {
   instance-type l2vpn;
   interface ge-1/0/0.0;
   route-distinguisher 65000:1;
   vrf-target target:65000:2;
   protocols {
      l2vpn {
         encapsulation-type ethernet;
         site CE1 {
            site-identifier 1;
            interface ge-1/0/0.0 {
               remote-site-id 3;
            }
         }
      }
   }
}
```

3. On Router PE5, configure the **ge-2/0/0** interface encapsulation by including the **encapsulation** statement and specify the **ethernet-ccc** option. Configure the ge-1/0/0.0 logical interface family for circuit cross-connect functionality by including the **family** statement and specifying the **ccc** option.

```
[edit interfaces]
ge-2/0/0 {
   encapsulation ethernet-ccc;
   unit 0 {
      family ccc;
   }
}
lo0 {
   unit 0 {
      family inet {
         address 5.5.5.5/32;
      }
   }
}
```

4. On Router PE5, configure the Layer 2 VPN protocols by including the **l2vpn** statement at the **[edit routing-instances *routing-instances-name* protocols]** hierarchy level. Configure the remote site ID as **3**.

```
[edit routing-instances]
L2VPN {
   instance-type l2vpn;
   interface ge-2/0/0.0;
   route-distinguisher 65000:5;
   vrf-target target:65000:2;
   protocols {
```

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```
        l2vpn {
            encapsulation-type ethernet;
            site CE5 {
                site-identifier 5;
                interface ge-2/0/0.0 {
                    remote-site-id 3;
                }
            }
        }
    }
}
```

5. On Router PE3, configure the **iw0** interface with two logical interfaces. To configure the **iw0** interface, include the **interfaces** statement and specify **iw0** as the interface name. For the unit 0 logical interface, include the **peer-unit** statement and specify the logical interface **unit 1** as the peer interface. For the unit 1 logical interface, include the **peer-unit** statement and specify the logical interface **unit 0** as the peer interface.

```
[edit interfaces]
iw0 {
    unit 0 {
        encapsulation ethernet-ccc;
        peer-unit 1;
    }
    unit 1 {
        encapsulation ethernet-ccc;
        peer-unit 0;
    }
}
```

6. On Router PE3, configure the edge-facing **ge-1/0/1** interface encapsulation by including the **encapsulation** statement and specifying the **ethernet-ccc** option.

```
[edit interfaces]
ge-1/0/1 {
    encapsulation ethernet-ccc;
    unit 0 {
        family ccc;
    }
}
```

7. On Router PE3, configure the logical loopback interface. The loopback interface is used to establish the targeted LDP sessions to Routers PE1 and Router PE5.

```
[edit interfaces]
lo0 {
    unit 0 {
        family inet {
            address 3.3.3.3/32;
        }
    }
}
```

8. On Router PE3, enable the Layer 2 interworking protocol. To enable the Layer 2 interworking protocol, include the **l2iw** statement at the **[edit protocols]** hierarchy level.

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```
[edit protocols]
l2iw;
```

9. On Router PE3, configure two Layer 2 VPN routing instances to terminate the Layer 2 VPN virtual circuits from Router PE1 and Router PE5, as shown.

```
[edit routing-instances]
L2VPN-PE1 {
   instance-type l2vpn;
   interface iw0.0;
   route-distinguisher 65000:3;
   vrf-target target:65000:2;
   protocols {
      l2vpn {
         encapsulation-type ethernet;
         site CE3 {
            site-identifier 3;
            interface iw0.0 {
               remote-site-id 1;
            }
         }
      }
   }
}
L2VPN-PE5 {
   instance-type l2vpn;
   interface iw0.1;
   route-distinguisher 65000:33;
   vrf-target target:65000:2;
   protocols {
      l2vpn {
         encapsulation-type ethernet;
         site CE3 {
            site-identifier 3;
            interface iw0.1 {
               remote-site-id 5;
            }
         }
      }
   }
}
```

Verifying the Layer 2 VPN to Layer 2 VPN Connection on Router PE3

Step-by-Step Procedure

1. BGP is used for control plane signaling in a Layer 2 VPN. On Router PE1, use the **show bgp** command to verify that the BGP control plane for the Layer 2 VPN, has established a neighbor relationship with the route reflector that has IP address **7.7.7.7**.

   Three Layer 2 VPN routes are received from the route reflector for each PE router in the topology.

```
user@PE1> show bgp summary

Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l2vpn.0            3          3          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
7.7.7.7               65000        190        192       0       0     1:24:40 Establ
  bgp.l2vpn.0: 3/3/3/0
  L2VPN.l2vpn.0: 3/3/3/0
```

2. On Router PE1, use the **show route** command to verify that the BGP Layer 2 VPN routes are stored in the **L2VPN.l2vpn.0** routing table for each PE router.

```
user@PE1> show route table L2VPN.l2vpn.0

L2VPN.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
65000:1:1:3/96
                   *[L2VPN/170/-101] 01:31:53, metric2 1
                      Indirect
65000:3:3:1/96
                   *[BGP/170] 01:24:58, localpref 100, from 7.7.7.7
                      AS path: I
                    > to 10.10.1.2 via xe-0/3/0.0
65000:5:5:3/96
                   *[BGP/170] 01:24:58, localpref 100, from 7.7.7.7
                      AS path: I
                    > to 10.10.3.2 via xe-0/2/0.0
65000:33:3:5/96
                   *[BGP/170] 01:24:58, localpref 100, from 7.7.7.7
                      AS path: I
                    > to 10.10.1.2 via xe-0/3/0.0
```

3. On Router PE1, use the **show ldp session** command to verify that targeted LDP sessions are established to the PE routers in the network and that the state is **Operational**.

```
user@PE1> show ldp session

  Address           State        Connection     Hold time
2.2.2.2             Operational  Open             24
3.3.3.3             Operational  Open             22
5.5.5.5             Operational  Open             28
```

4. On Router PE1, use the **show l2vpn connections** command to verify that the Layer 2 VPN to site 3 on Router PE3 (Hub-PE) is **Up**.

```
user@PE1> show l2vpn connections
```

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```
Layer-2 VPN connections:

Legend for connection status (St)
EI -- encapsulation invalid      NC -- interface encapsulation not CCC/TCC/VPLS
EM -- encapsulation mismatch     WE -- interface and instance encaps not same
VC-Dn -- Virtual circuit down    NP -- interface hardware not present
CM -- control-word mismatch      -> -- only outbound connection is up
CN -- circuit not provisioned    <- -- only inbound connection is up
OR -- out of range               Up -- operational
OL -- no outgoing label          Dn -- down
LD -- local site signaled down   CF -- call admission control failure
RD -- remote site signaled down  SC -- local and remote site ID collision
LN -- local site not designated  LM -- local site ID not minimum designated
RN -- remote site not designated RM -- remote site ID not minimum designated
XX -- unknown connection status  IL -- no incoming label
MM -- MTU mismatch               MI -- Mesh-Group ID not availble
BK -- Backup connection          ST -- Standby connection
PF -- Profile parse failure      PB -- Profile busy

Legend for interface status
Up -- operational
Dn -- down

Instance: L2VPN
  Local site: CE1 (1)
    connection-site           Type  St     Time last up          # Up trans
    3                         rmt   Up     Jan  5 18:08:25 2010           1
      Remote PE: 3.3.3.3, Negotiated control-word: Yes (Null)
      Incoming label: 800000, Outgoing label: 800000
      Local interface: ge-1/0/0.0, Status: Up, Encapsulation: ETHERNET
    5                         rmt   OR
```

5. On Router PE1, use the **show route** command to verify that the **mpls.0** routing table is populated with the Layer 2 VPN routes used to forward the traffic using an LDP label. Notice that in this example, the router is pushing label **8000000**.

```
user@PE1> show route table mpls.0

[edit]
mpls.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                  *[MPLS/0] 1w1d 11:36:44, metric 1
                      Receive
1                  *[MPLS/0] 1w1d 11:36:44, metric 1
                      Receive
2                  *[MPLS/0] 1w1d 11:36:44, metric 1
                      Receive
300432             *[LDP/9] 3d 04:25:02, metric 1
                    > to 10.10.2.2 via xe-0/1/0.0, Pop
300432(S=0)        *[LDP/9] 3d 04:25:02, metric 1
                    > to 10.10.2.2 via xe-0/1/0.0, Pop
300768             *[LDP/9] 3d 04:25:02, metric 1
                    > to 10.10.3.2 via xe-0/2/0.0, Pop
300768(S=0)        *[LDP/9] 3d 04:25:02, metric 1
                    > to 10.10.3.2 via xe-0/2/0.0, Pop
300912             *[LDP/9] 3d 04:25:02, metric 1
                    > to 10.10.3.2 via xe-0/2/0.0, Swap 299856
301264             *[LDP/9] 3d 04:24:58, metric 1
```

```
                        > to 10.10.1.2 via xe-0/3/0.0, Swap 308224
301312                 *[LDP/9] 3d 04:25:01, metric 1
                        > to 10.10.1.2 via xe-0/3/0.0, Pop
301312(S=0)            *[LDP/9] 3d 04:25:01, metric 1
                        > to 10.10.1.2 via xe-0/3/0.0, Pop
800000        *[L2VPN/7] 01:25:28
              > via ge-1/0/0.0, Pop     Offset: 4
ge-1/0/0.0    *[L2VPN/7] 01:25:28, metric2 1
              > to 10.10.1.2 via xe-0/3/0.0, Push 800000 Offset: -4
```

Verifying the Layer 2 VPN to Layer 2 VPN Connection on Router PE3

Step-by-Step Procedure

1. On Router PE3, use the **show l2vpn connections** command to verify that the Layer 2 VPN connections from Router PE1 and Router PE5 are **Up** and are using the **iw0** interface.

```
user@PE3> show l2vpn connections

Instance: L2VPN-PE1
  Local site: CE3 (3)
    connection-site           Type  St     Time last up          # Up trans
    1                         rmt   Up     Jan  5 18:08:22 2010           1
      Remote PE: 1.1.1.1, Negotiated control-word: Yes (Null)
      Incoming label: 800000, Outgoing label: 800000
      Local interface: iw0.0, Status: Up, Encapsulation: ETHERNET
    5                         rmt   OR

Instance: L2VPN-PE5
  Local site: CE3 (3)
    connection-site           Type  St     Time last up          # Up trans
    1                         rmt   CN
    5                         rmt   Up     Jan  5 18:08:22 2010           1
      Remote PE: 5.5.5.5, Negotiated control-word: Yes (Null)
      Incoming label: 800002, Outgoing label: 800000
      Local interface: iw0.1, Status: Up, Encapsulation: ETHERNET
```

2. On Router PE3, use the **show ldp neighbor** command to verify that the targeted LDP session neighbor IP addresses are shown.

```
user@PE3> show ldp neighbor

Address            Interface          Label space ID         Hold time
1.1.1.1            lo0.0              1.1.1.1:0                44
2.2.2.2            lo0.0              2.2.2.2:0                42
4.4.4.4            lo0.0              4.4.4.4:0                31
5.5.5.5            lo0.0              5.5.5.5:0                44
```

3. On Router PE3, use the **show bgp summary** command to verify that the BGP control plane for the Layer 2 VPN, has established a neighbor relationship with the route reflector that has IP address **7.7.7.7**.

```
user@PE3> show bgp summary

Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l2vpn.0            2          2          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
7.7.7.7               65000      10092      10195       0       0  3d 4:23:27 Establ
  bgp.l2vpn.0: 2/2/2/0
```

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```
L2VPN-PE1.l2vpn.0: 2/2/2/0
L2VPN-PE5.l2vpn.0: 2/2/2/0
```

4. On Router PE3, use the **show ldp session** command to verify that targeted LDP sessions are established to all of the PE routers in the network and that the state is **Operational**.

```
user@PE3>  show ldp session

Address          State        Connection     Hold time
1.1.1.1            Operational  Open              24
2.2.2.2            Operational  Open              22
4.4.4.4            Operational  Open              20
5.5.5.5            Operational  Open              24
```

5. On Router PE3, use the **show route** command to verify that the **mpls.0** routing table is populated with the Layer 2 VPN routes used to forward the traffic using an LDP label. Notice that in this example, the router is swapping label **800000**. Also notice the two **iw0** interfaces that are used for the Layer 2 interworking routes.

```
user@PE3>show route table mpls.0

mpls.0: 16 destinations, 18 routes (16 active, 2 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                  *[MPLS/0] 1w1d 11:50:14, metric 1
                      Receive
1                  *[MPLS/0] 1w1d 11:50:14, metric 1
                      Receive
2                  *[MPLS/0] 1w1d 11:50:14, metric 1
                      Receive
308160             *[LDP/9] 3d 04:38:45, metric 1
                    > to 10.10.1.1 via xe-0/3/0.0, Pop
308160(S=0)        *[LDP/9] 3d 04:38:45, metric 1
                    > to 10.10.1.1 via xe-0/3/0.0, Pop
308176             *[LDP/9] 3d 04:38:44, metric 1
                    > to 10.10.6.2 via xe-0/1/0.0, Pop
308176(S=0)        *[LDP/9] 3d 04:38:44, metric 1
                    > to 10.10.6.2 via xe-0/1/0.0, Pop
308192             *[LDP/9] 00:07:18, metric 1
                    > to 10.10.20.1 via xe-0/0/0.0, Swap 601649
                      to 10.10.6.2 via xe-0/1/0.0, Swap 299856
308208             *[LDP/9] 3d 04:38:44, metric 1
                    > to 10.10.5.1 via xe-0/2/0.0, Pop
308208(S=0)        *[LDP/9] 3d 04:38:44, metric 1
                    > to 10.10.5.1 via xe-0/2/0.0, Pop
308224             *[LDP/9] 3d 04:38:42, metric 1
                    > to 10.10.20.1 via xe-0/0/0.0, Pop
308224(S=0)        *[LDP/9] 3d 04:38:42, metric 1
                    > to 10.10.20.1 via xe-0/0/0.0, Pop
800000        *[L2IW/6] 01:39:13, metric2 1
        > to 10.10.6.2 via xe-0/1/0.0, Swap 800000
        [L2VPN/7] 01:39:13
        > via iw0.0, Pop     Offset: 4
800002        *[L2IW/6] 01:39:13, metric2 1
        > to 10.10.1.1 via xe-0/3/0.0, Swap 800000
        [L2VPN/7] 01:39:13
        > via iw0.1, Pop     Offset: 4
iw0.0         *[L2VPN/7] 01:39:13, metric2 1
        > to 10.10.1.1 via xe-0/3/0.0, Push 800000 Offset: -4
```

```
iw0.1          *[L2VPN/7] 01:39:13, metric2 1
                > to 10.10.6.2 via xe-0/1/0.0, Push 800000 Offset: -4
```

Step-by-Step Procedure

Testing Layer 2 VPN to Layer 2 VPN Connectivity (CE1 to CE5)

1. On Router CE1, use the **ping** command to test connectivity to Router CE5. Notice that the response time is in milliseconds, confirming that the ping response is returned.

```
user@CE1>ping 40.40.40.11

PING 40.40.40.11 (40.40.40.11): 56 data bytes
64 bytes from 40.40.40.11: icmp_seq=1 ttl=64 time=22.425 ms
64 bytes from 40.40.40.11: icmp_seq=2 ttl=64 time=1.299 ms
64 bytes from 40.40.40.11: icmp_seq=3 ttl=64 time=1.032 ms
64 bytes from 40.40.40.11: icmp_seq=4 ttl=64 time=1.029 ms
```

2. On Router CE5, use the **ping** command to test connectivity to Router CE1. Notice that the response time is in milliseconds, confirming that the ping response is returned.

```
user@CE5>ping 40.40.40.1

PING 40.40.40.1 (40.40.40.1): 56 data bytes
64 bytes from 40.40.40.1: icmp_seq=0 ttl=64 time=1.077 ms
64 bytes from 40.40.40.1: icmp_seq=1 ttl=64 time=0.957 ms
64 bytes from 40.40.40.1: icmp_seq=2 ttl=64 time=1.057 ms 1.017 ms
```

Results

The configuration and verification of this example have been completed. The following section is for your reference.

The relevant sample configuration for Router PE1 follows.

Router PE1

```
chassis {
  dump-on-panic;
  fpc 1 {
    pic 3 {
      tunnel-services {
        bandwidth 1g;
      }
    }
  }
  network-services ethernet;
}
  interfaces {
    xe-0/1/0 {
      unit 0 {
        family inet {
          address 10.10.2.1/30;
        }
        family mpls;
      }
    }
    xe-0/2/0 {
      unit 0 {
        family inet {
          address 10.10.3.1/30;
```

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```
            }
            family mpls;
        }
    }
    xe-0/3/0 {
        unit 0 {
            family inet {
                address 10.10.1.1/30;
            }
            family mpls;
        }
    }
    ge-1/0/0 {
        encapsulation ethernet-ccc;
        unit 0 {
            family ccc;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 1.1.1.1/32;
            }
        }
    }
}
routing-options {
    static {
        route 172.0.0.0/8 next-hop 172.19.59.1;
    }
    autonomous-system 65000;
}
protocols {
    mpls {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
    bgp {
        group RR {
            type internal;
            local-address 1.1.1.1;
            family l2vpn {
                signaling;
            }
            neighbor 7.7.7.7;
        }
    }
    ospf {
        traffic-engineering;
        area 0.0.0.0 {
            interface all;
            interface fxp0.0 {
                disable;
            }
```

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```
            }
        }
        ldp {
            interface all;
            interface fxp0.0 {
                disable;
            }
        }
    }
    routing-instances {
        L2VPN {
            instance-type l2vpn;
            interface ge-1/0/0.0;
            route-distinguisher 65000:1;
            vrf-target target:65000:2;
            protocols {
                l2vpn {
                    encapsulation-type ethernet;
                    site CE1 {
                        site-identifier 1;
                        interface ge-1/0/0.0 {
                            remote-site-id 3;
                        }
                    }
                }
            }
        }
    }
```

The relevant sample configuration for Router PE3 follows.

Router PE3

```
chassis {
    dump-on-panic;
    fpc 1 {
        pic 3 {
            tunnel-services {
                bandwidth 1g;
            }
        }
    }
    network-services ethernet;
}
interfaces {
    xe-0/0/0 {
        unit 0 {
            family inet {
                address 10.10.20.2/30;
            }
            family mpls;
        }
    }
    xe-0/1/0 {
        unit 0 {
            family inet {
                address 10.10.6.1/30;
            }
```


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```
            family mpls;
        }
    }
    xe-0/2/0 {
        unit 0 {
            family inet {
                address 10.10.5.2/30;
            }
            family mpls;
        }
    }
    xe-0/3/0 {
        unit 0 {
            family inet {
                address 10.10.1.2/30;
            }
            family mpls;
        }
    }
    ge-1/0/1 {
        encapsulation ethernet-ccc;
        unit 0 {
            family ccc;
        }
    }
    iw0 {
        unit 0 {
            encapsulation ethernet-ccc;
            peer-unit 1;
        }
        unit 1 {
            encapsulation ethernet-ccc;
            peer-unit 0;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 3.3.3.3/32;
            }
        }
    }
}
routing-options {
    static {
        route 172.0.0.0/8 next-hop 172.19.59.1;
    }
    autonomous-system 65000;
}
protocols {
    l2iw;
    mpls {
        interface all;
        interface fxp0.0 {
            disable;
        }
```

```
        }
        bgp {
            group RR {
                type internal;
                local-address 3.3.3.3;
                family l2vpn {
                    signaling;
                }
                neighbor 7.7.7.7;
            }
        }
        ospf {
            area 0.0.0.0 {
                interface all;
                interface fxp0.0 {
                    disable;
                }
            }
        }
        ldp {
            interface all;
            interface fxp0.0 {
                disable;
            }
        }
    }
    routing-instances {
        L2VPN-PE1 {
            instance-type l2vpn;
            interface iw0.0;
            route-distinguisher 65000:3;
            vrf-target target:65000:2;
            protocols {
                l2vpn {
                    encapsulation-type ethernet;
                    site CE3 {
                        site-identifier 3;
                        interface iw0.0 {
                            remote-site-id 1;
                        }
                    }
                }
            }
        }
        L2VPN-PE5 {
            instance-type l2vpn;
            interface iw0.1;
            route-distinguisher 65000:33;
            vrf-target target:65000:2;
            protocols {
                l2vpn {
                    encapsulation-type ethernet;
                    site CE3 {
                        site-identifier 3;
                        interface iw0.1 {
                            remote-site-id 5;
```

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```
                }
              }
            }
          }
        }
      }
```

Related Documentation

- Layer 2 VPN Overview on page 3
- Layer 2 VPN Applications on page 5
- Using the Layer 2 Interworking Interface to Interconnect a Layer 2 VPN to a Layer 2 VPN on page 7

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