



Junos[®] OS

Layer 2 VPNs Configuration Guide

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Junos® OS Layer 2 VPNs Configuration Guide

13.1

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About the Documentation

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Supported Platforms

For the features described in this document, the following platforms are supported:

- MX Series
- T Series
- M Series
- PTX Series

Using the Examples in This Manual

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

If the example configuration contains the top level of the hierarchy (or multiple hierarchies), the example is a *full example*. In this case, use the **load merge** command.

If the example configuration does not start at the top level of the hierarchy, the example is a *snippet*. In this case, use the **load merge relative** command. These procedures are described in the following sections.

Merging a Full Example

To merge a full example, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration example into a text file, save the file with a name, and copy the file to a directory on your routing platform.

For example, copy the following configuration to a file and name the file **ex-script.conf**. Copy the **ex-script.conf** file to the **/var/tmp** directory on your routing platform.

```
system {
  scripts {
    commit {
      file ex-script.xml;
    }
  }
}
interfaces {
  fxp0 {
    disable;
    unit 0 {
      family inet {
        address 10.0.0.1/24;
      }
    }
  }
}
```

2. Merge the contents of the file into your routing platform configuration by issuing the **load merge** configuration mode command:

```
[edit]
user@host# load merge /var/tmp/ex-script.conf
load complete
```

Merging a Snippet

To merge a snippet, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration snippet into a text file, save the file with a name, and copy the file to a directory on your routing platform.

For example, copy the following snippet to a file and name the file **ex-script-snippet.conf**. Copy the **ex-script-snippet.conf** file to the **/var/tmp** directory on your routing platform.

```
commit {
  file ex-script-snippet.xml; }
```

2. Move to the hierarchy level that is relevant for this snippet by issuing the following configuration mode command:

```
[edit]
user@host# edit system scripts
[edit system scripts]
```

3. Merge the contents of the file into your routing platform configuration by issuing the **load merge relative** configuration mode command:

```
[edit system scripts]
user@host# load merge relative /var/tmp/ex-script-snippet.conf
load complete
```

For more information about the **load** command, see the CLI User Guide.

Documentation Conventions

Table 1 on page xiii defines notice icons used in this guide.

Table 1: Notice Icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.

Table 2 on page xiii defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the configure command: user@host> configure
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> show chassis alarms No alarms currently active

Table 2: Text and Syntax Conventions (*continued*)

Convention	Description	Examples
<i>Italic text like this</i>	<ul style="list-style-type: none"> Introduces or emphasizes important new terms. Identifies book names. Identifies RFC and Internet draft titles. 	<ul style="list-style-type: none"> A policy <i>term</i> is a named structure that defines match conditions and actions. <i>Junos OS System Basics Configuration Guide</i> RFC 1997, <i>BGP Communities Attribute</i>
<i>Italic text like this</i>	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# set system domain-name <i>domain-name</i>
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none"> To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level. The console port is labeled CONSOLE.
< > (angle brackets)	Enclose optional keywords or variables.	stub <default-metric metric>;
(pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	broadcast multicast <i>(string1 string2 string3)</i>
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	rsvp { # Required for dynamic MPLS only
[] (square brackets)	Enclose a variable for which you can substitute one or more values.	community name members [community-ids]
Indentation and braces ({ })	Identify a level in the configuration hierarchy.	[edit] routing-options { static { route default { nexthop <i>address</i> ; retain; } } }
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
J-Web GUI Conventions		
Bold text like this	Represents J-Web graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none"> In the Logical Interfaces box, select All Interfaces. To cancel the configuration, click Cancel.
> (bold right angle bracket)	Separates levels in a hierarchy of J-Web selections.	In the configuration editor hierarchy, select Protocols>Ospf .

Documentation Feedback

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- Document or topic name
- URL or page number
- Software release version (if applicable)

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or JNASC support contract, or are covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at <http://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf>.
- Product warranties—For product warranty information, visit <http://www.juniper.net/support/warranty/>.
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

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- Search for known bugs: <http://www2.juniper.net/kb/>
- Find product documentation: <http://www.juniper.net/techpubs/>
- Find solutions and answer questions using our Knowledge Base: <http://kb.juniper.net/>
- Download the latest versions of software and review release notes: <http://www.juniper.net/customers/csc/software/>
- Search technical bulletins for relevant hardware and software notifications: <https://www.juniper.net/alerts/>

- Join and participate in the Juniper Networks Community Forum:
<http://www.juniper.net/company/communities/>
- Open a case online in the CSC Case Management tool: <http://www.juniper.net/cm/>

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: <https://tools.juniper.net/SerialNumberEntitlementSearch/>

Opening a Case with JTAC

You can open a case with JTAC on the Web or by telephone.

- Use the Case Management tool in the CSC at <http://www.juniper.net/cm/>.
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see <http://www.juniper.net/support/requesting-support.html>.

PART 1

Overview

- [Introduction to Layer 2 VPNs on page 3](#)
- [Introduction to Layer 2 VPNs Configuration Example on page 7](#)

CHAPTER 1

Introduction to Layer 2 VPNs

- [Layer 2 VPN Overview on page 3](#)
- [Enabling BGP Path Selection for Layer 2 VPNs and VPLS on page 4](#)

Layer 2 VPN Overview

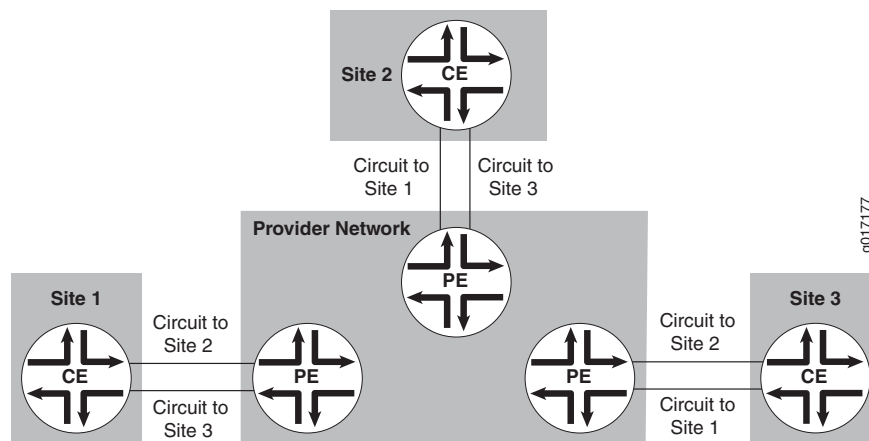
Implementing a Layer 2 VPN on a router is similar to implementing a VPN using a Layer 2 technology such as Asynchronous Transfer Mode (ATM) or Frame Relay. However, for a Layer 2 VPN on a router, traffic is forwarded to the router in a Layer 2 format. It is carried by MPLS over the service provider's 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.

On a Layer 2 VPN, routing occurs on the customer's routers, typically 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 it 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.

Customers need to know only which VPN interfaces connect to which of their own sites. [Figure 1 on page 4](#) illustrates a Layer 2 VPN in which each site has a VPN interface linked to each of the other customer sites.

Figure 1: Layer 2 VPN Connecting CE Routers



Implementing a Layer 2 MPLS VPN includes the following benefits:

- Service providers do not have to invest in separate Layer 2 equipment to provide Layer 2 VPN service. A Layer 2 MPLS VPN allows you to provide Layer 2 VPN service over an existing IP and MPLS backbone.
- 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.

Enabling BGP Path Selection for Layer 2 VPNs and VPLS

Layer 2 VPNs and VPLS share the same path selection process for determining the optimal path to reach all of the destinations shared within a single routing instance. For Layer 2 VPN and VPLS topologies that do not include multihomed PE routers, the path selection process is straightforward since there is just a single path from each PE router to each CE device. However, if multihoming is configured for one or more of the CE devices, the path selection process becomes more complex, since there can be two or more valid paths to reach each multihomed CE device.

The Layer 2 VPN and VPLS path selection process uses the following path selection algorithms:

- On the Provider routers within the service providers network, the standard BGP path selection algorithm is used. Using the standard BGP path selection for Layer 2 VPN and VPLS routes allows service providers to leverage their existing Layer 3 VPN network infrastructure to also support Layer 2 VPNs and VPLS. The BGP path selection algorithm also helps to ensure that the service provider's network behaves predictably with regard to Layer 2 VPN and VPLS path selection. This is particularly important in networks employing route reflectors and multihoming.

When a Provider router receives multiple paths for the same destination prefix (for example, a multihomed CE device), one path is selected based on the BGP path

selection algorithm and placed in the `bgp.l2vpn.0` routing table and the appropriate `instance.l2vpn.0` routing table. However, all of the available paths (including the backup paths for multihomed CE devices) are advertised to the intermediate BGP routers and the PE routers in the Layer 2 VPN or VPLS routing instances.

For more information about the BGP path selection process, see [Understanding BGP Path Selection](#).

- Once a PE router receives all of the available paths to each CE device, it runs the designated forwarder path selection algorithm to select the preferred path to reach each CE device, independently of the results of the earlier BGP path selection algorithm run on the Provider router. The VPLS designated forwarder algorithm uses the D-bit, preference, and PE router identifier to determine which of the valid paths to each CE device to use. The PE router might select a path to reach a CE device which is different from the path selected by the BGP-based Provider routers. In this scenario, the following is the expected behavior for traffic sent to the multihomed CE device:
 1. If the path selected by the remote PE router is available, traffic will traverse the network to the multihomed CE device using the remote PE router's preferred path (again, ignoring the path selected by the BGP-based Provider routers).
 2. If the path selected by the remote PE router fails, the Provider routers switch the traffic destined for the multihomed CE device to the alternate path as soon as failure is detected. They then notify the remote PE router of the path failure. The remote PE router updates its routing table accordingly.

For more information about the VPLS designated forwarder path selection algorithm, see [VPLS Path Selection Process for PE Routers](#). This algorithm is also described in the Internet draft `draft-ietf-l2vpn-vpls-multihoming-03.txt`, *BGP based Multi-homing in Virtual Private LAN Service*.

**Related
Documentation**

- [Understanding BGP Path Selection](#)
- [VPLS Path Selection Process for PE Routers](#)

CHAPTER 2

Introduction to Layer 2 VPNs Configuration Example

- [Layer 2 VPN to Layer 2 VPN Connections on page 7](#)

Layer 2 VPN to Layer 2 VPN Connections

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. Junos OS enables you to terminate Layer 2 VPN into Layer 2 VPN (also known as Layer 2 VPN stitching) using the Layer 2 interworking (iw0) interface.

Another way to do this is to use 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 software interface avoids the need for the Tunnel Services PIC and overcomes the limitation of bandwidth constraints imposed by the Tunnel Services PIC.

Related Documentation

- [Example: Interconnecting a Layer 2 VPN with a Layer 2 VPN on page 58](#)

PART 2

Configuration

- [Configuring Layer 2 VPNs on page 11](#)
- [Layer 2 VPNs Configuration Examples on page 25](#)

CHAPTER 3

Configuring Layer 2 VPNs

- [Introduction to Configuring Layer 2 VPNs on page 11](#)
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- [Configuring CCC Encapsulation for Layer 2 VPNs on page 21](#)
- [Configuring TCC Encapsulation for Layer 2 VPNs and Layer 2 Circuits on page 22](#)
- [Configuring Traffic Policing in Layer 2 VPNs on page 23](#)
- [Disabling the Control Word for Layer 2 VPNs on page 24](#)

Introduction to Configuring Layer 2 VPNs

To configure Layer 2 virtual private network (VPN) functionality, you must enable Layer 2 VPN support on the provider edge (PE) router. You must also configure PE routers to distribute routing information to the other PE routers in the VPN and configure the circuits between the PE routers and the customer edge (CE) routers.

Each Layer 2 VPN is configured under a routing instance of type **l2vpn**. An **l2vpn** routing instance can transparently carry Layer 3 traffic across the service provider's network. As with other routing instances, all logical interfaces belonging to a Layer 2 VPN routing instance are listed under that instance.

The configuration of the CE routers is not relevant to the service provider. The CE routers need to provide only appropriate Layer 2 circuits (with appropriate circuit identifiers, such as data-link connection identifier [DLCI], virtual path identifier/virtual channel identifier [VPI/VCI], or virtual LAN [VLAN] ID) to send traffic to the PE router.

To configure Layer 2 VPNs, include the following statements:

```
description text;  
instance-type l2vpn;  
interface interface-name;  
route-distinguisher (as-number:id| ip-address:id);  
vrf-export [ policy-names ];  
vrf-import [ policy-names ];  
vrf-target {  
    community;  
    import community-name;  
    export community-name;
```

```
}
protocols {
  l2vpn {
    (control-word | no-control-word);
    encapsulation-type type;
    site site-name {
      interface interface-name {
        description text;
        remote-site-id remote-site-id;
      }
      site-identifier identifier;
      site-preference preference-value {
        backup;
        primary;
      }
    }
  }
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
}
```

You can include these statements at the following hierarchy levels:

- [edit routing-instances *routing-instance-name*]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name*]

For Layer 2 VPNs, only some of the statements in the [edit routing-instances] hierarchy are valid. For the full hierarchy, see the Junos OS Routing Protocols Configuration Guide.

In addition to these statements, you must configure MPLS label-switched paths (LSPs) between the PE routers, IBGP sessions between the PE routers, and an interior gateway protocol (IGP) on the PE and provider (P) routers. You must also configure the statements that are required for all types of VPN configuration.

By default, Layer 2 VPNs are disabled.

Many of the configuration procedures for Layer 2 VPNs are identical to the procedures for Layer 3 VPNs and virtual private LAN service (VPLS).

Configuring the Local Site on PE Routers in Layer 2 VPNs

For each local site, the PE router advertises a set of VPN labels to the other PE routers servicing the Layer 2 VPN. The VPN labels constitute a single block of contiguous labels; however, to allow for reprovisioning, more than one such block can be advertised. Each label block consists of a label base, a range (the size of the block), and a remote site ID that identifies the sequence of remote sites that connect to the local site using this label block (the remote site ID is the first site identifier in the sequence). The encapsulation type is also advertised along with the label block.

The following sections explain how to configure the connections to the local site on the PE router:

- [Configuring a Layer 2 VPN Routing Instance on page 13](#)
- [Configuring the Site on page 14](#)
- [Configuring the Remote Site ID on page 14](#)
- [Configuring the Encapsulation Type on page 16](#)
- [Configuring a Site Preference and Layer 2 VPN Multihoming on page 16](#)
- [Tracing Layer 2 VPN Traffic and Operations on page 17](#)

Configuring a Layer 2 VPN Routing Instance

To configure a Layer 2 VPN on your network, configure a Layer 2 VPN routing instance on the PE router by including the `l2vpn` statement:

```
l2vpn {
  (control-word | no-control-word);
  encapsulation-type type;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
  site site-name {
    site-identifier identifier;
    site-preference preference-value {
      backup;
      primary;
    }
    interface interface-name {
      description text;
      remote-site-id remote-site-id;
    }
  }
}
```

You can include this statement at the following hierarchy levels:

- [edit routing-instances *routing-instance-name* protocols]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols]



NOTE: You cannot configure a routing protocol (OSPF, RIP, IS-IS or BGP) inside a Layer 2 VPN routing instance (instance-type `l2vpn`). The Junos CLI disallows this configuration.

Instructions for how to configure the remaining statements are included in the sections that follow.

Configuring the Site

All the Layer 2 circuits provisioned for a local site are listed as the set of logical interfaces (specified by including the **interface** statement) within the **site** statement.

On each PE router, you must configure each site that has a circuit to the PE router. To do this, include the **site** statement:

```
site site-name {  
  site-identifier identifier;  
  site-preference preference-value {  
    backup;  
    primary;  
  }  
  interface interface-name {  
    description text;  
    remote-site-id remote-site-ID;  
  }  
}
```

You can include this statement at the following hierarchy levels:

- [edit routing-instances *routing-instance-name* protocols l2vpn]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn]

You must configure the following for each site:

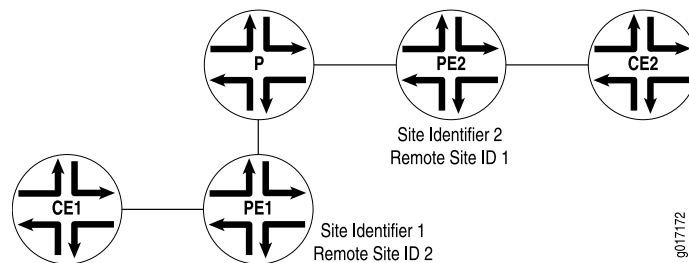
- **site-name**—Name of the site.
- **site-identifier** *identifier*—Unsigned 16-bit number greater than zero that uniquely identifies the local Layer 2 VPN site. The site identifier corresponds to the remote site ID configured on another site within the same VPN.
- **interface** *interface-name*—The name of the interface and, optionally, a remote site ID for remote site connections. See [“Configuring the Remote Site ID” on page 14](#).

Configuring the Remote Site ID

The remote site ID allows you to configure a sparse Layer 2 VPN topology. A sparse topology means that each site does not have to connect to all the other sites in the VPN; thus it is unnecessary to allocate circuits for all the remote sites. Remote site IDs are particularly important if you configure a topology more complicated than full-mesh, such as a hub-and-spoke topology.

The remote site ID (configured with the **remote-site-id** statement) corresponds to the site ID (configured with the **site-identifier** statement) configured at a separate site. [Figure 2 on page 15](#) illustrates the relationship between the site identifier and the remote site ID.

Figure 2: Relationship Between the Site Identifier and the Remote Site ID



As illustrated by the figure, the configuration for Router PE1 connected to Router CE1 is as follows:

```
site-identifier 1;
interface so-0/0/0 {
  remote-site-id 2;
}
```

The configuration for Router PE2 connected to Router CE2 is as follows:

```
site-identifier 2;
interface so-0/0/1 {
  remote-site-id 1;
}
```

The remote site ID (2) on Router PE1 corresponds to the site identifier (2) on Router PE2. On Router PE2, the remote site ID (1) corresponds to the site identifier (1) on Router PE1.

To configure the remote site ID, include the **remote-site-id** statement:

```
remote-site-id remote-site-id;
```

You can include this statement at the following hierarchy levels:

- [edit routing-instances *routing-instance-name* protocols l2vpn site *site-name* interface *interface-name*]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn site *site-name* interface *interface-name*]

If you do not explicitly include the **remote-site-id** statement for the interface configured at the [edit routing-instances *routing-instance-name* protocols l2vpn site *site-name*] hierarchy level, a remote site ID is assigned to that interface.

The remote site ID for an interface is automatically set to 1 higher than the remote site ID for the previous interface. The order of the interfaces is based on their **site-identifier** statements. For example, if the first interface in the list does not have a remote site ID, its ID is set to 1. The second interface in the list has its remote site ID set to 2, and the third has its remote site ID set to 3. The remote site IDs of any interfaces that follow are incremented in the same manner if you do not explicitly configure them.

Configuring the Encapsulation Type

The encapsulation type you configure at each Layer 2 VPN site varies depending on which Layer 2 protocol you choose to configure. If you configure **ethernet-vlan** as the encapsulation type, you need to use the same protocol at each Layer 2 VPN site.

You do not need to use the same protocol at each Layer 2 VPN site if you configure any of the following encapsulation types:

- **atm-aal5**—Asynchronous Transfer Mode (ATM) Adaptation Layer (AAL5)
- **atm-cell**—ATM cell relay
- **atm-cell-port-mode**—ATM cell relay port promiscuous mode
- **atm-cell-vc-mode**—ATM virtual circuit (VC) cell relay nonpromiscuous mode
- **atm-cell-vp-mode**—ATM virtual path (VP) cell relay promiscuous mode
- **cisco-hdlc**—Cisco Systems-compatible High-Level Data Link Control (HDLC)
- **ethernet**—Ethernet
- **ethernet-vlan**—Ethernet virtual LAN (VLAN)
- **frame-relay**—Frame Relay
- **frame-relay-port-mode**—Frame Relay port mode
- **interworking**—Layer 2.5 interworking VPN
- **ppp**—Point-to-Point Protocol (PPP)

If you configure different protocols at your Layer 2 VPN sites, you need to configure a translational cross-connect (TCC) encapsulation type. For more information, see [“Configuring TCC Encapsulation for Layer 2 VPNs and Layer 2 Circuits” on page 22](#).

To configure the Layer 2 protocol accepted by the PE router, specify the encapsulation type by including the **encapsulation-type** statement:

encapsulation-type *type*;

You can include this statement at the following hierarchy levels:

- [edit routing-instances *routing-instance-name* protocols l2vpn]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn]

Configuring a Site Preference and Layer 2 VPN Multihoming

You can specify the preference value advertised for a particular Layer 2 VPN site. The site preference value is encoded in the BGP local preference attribute. When a PE router receives multiple advertisements with the same CE device identifier, the advertisement with the highest local preference value is preferred.

You can also use the **site-preference** statement to enable multihoming for Layer 2 VPNs. Multihoming allows you to connect a CE device to multiple PE routers. In the event that a connection to the primary PE router fails, traffic can be automatically switched to the backup PE router.

To configure a site preference for a Layer 2 VPN, include the **site-preference** statement:

```
site-preference preference-value {
    backup;
    primary;
}
```

You can include this statement at the following hierarchy levels:

- [edit routing-instances *routing-instance-name* protocols l2vpn site *site-name*]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn site *site-name*]

You can also specify either the **backup** option or the **primary** option for the **site-preference** statement. The backup option specifies the preference value as 1, the lowest possible value, ensuring that the Layer 2 VPN site is the least likely to be selected. The primary option specifies the preference value as 65,535, the highest possible value, ensuring that the Layer 2 VPN site is the most likely to be selected.

For Layer 2 VPN multihoming configurations, specifying the **primary** option for a Layer 2 VPN site designates the connection from the PE router to the CE device as the preferred connection if the CE device is also connected to another PE router. Specifying the **backup** option for a Layer 2 VPN site designates the connection from the PE router to the CE device as the secondary connection if the CE device is also connected to another PE router.

Tracing Layer 2 VPN Traffic and Operations

To trace Layer 2 VPN protocol traffic, specify options for the **traceoptions** statement in the Layer 2 VPN configuration:

```
traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
}
```

You can include this statement at the following hierarchy levels:

- [edit routing-instances *routing-instance-name* protocols l2vpn]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn]

The following trace flags display the operations associated with Layer 2 VPNs:

- **all**—All Layer 2 VPN tracing options.
- **connections**—Layer 2 connections (events and state changes).
- **error**—Error conditions.

- **general**—General events.
- **nlri**—Layer 2 advertisements received or sent by means of the BGP.
- **normal**—Normal events.
- **policy**—Policy processing.
- **route**—Routing information.
- **state**—State transitions.
- **task**—Routing protocol task processing.
- **timer**—Routing protocol timer processing.
- **topology**—Layer 2 VPN topology changes caused by reconfiguration or advertisements received from other PE routers using BGP.

Disabling Normal TTL Decrementing for VPNs

To diagnose networking problems related to VPNs, it can be useful to disable normal time-to-live (TTL) decrementing. In Junos, you can do this with the **no-propagate-ttl** and **no-decrement-ttl** statements. However, when you are tracing VPN traffic, only the **no-propagate-ttl** statement is effective.

For the **no-propagate-ttl** statement to have an effect on VPN behavior, you need to clear the PE-router-to-PE-router BGP session, or disable and then enable the VPN routing instance.

For more information about the **no-propagate-ttl** and **no-decrement-ttl** statements, see the Junos OS MPLS Applications Configuration Guide.

Enabling BGP Path Selection for Layer 2 VPNs and VPLS

Layer 2 VPNs and VPLS share the same path selection process for determining the optimal path to reach all of the destinations shared within a single routing instance. For Layer 2 VPN and VPLS topologies, the path selection process is straightforward if there is just a single path from each PE router to each CE device. However, the path selection process becomes more complex if the PE routers receive two or more valid paths to reach a specific CE device.

The following network scenarios provide examples of what might cause a PE router to receive more than one valid path to reach a specific CE device:

- **Multihoming**—One or more CE devices within a routing instance are multihomed to two or more PE routers. Each multihomed CE device has at least two valid paths.
- **Route reflectors**—There are multiple route reflectors deployed within the same network and they are supporting PE routers within the same routing instance. Due to time delays in large complex networks, the route reflectors can separately receive a different valid path to reach a CE device at different times. When they readvertise these valid paths, a PE router could receive two or more separate but apparently valid paths to the same CE device.

By default, Juniper Networks routers use just the designated forwarder path selection algorithm to select the best path to reach each Layer 2 VPN or VPLS routing instance destination (for more information, see *VPLS Path Selection Process for PE Routers*). However, you can also configure the routers in your network to use both the BGP path selection algorithm and the designated forwarder path selection algorithm as follows:

- On the Provider routers within the service providers network, the standard BGP path selection algorithm is used (for more information, see *Understanding BGP Path Selection*). Using the standard BGP path selection for Layer 2 VPN and VPLS routes allows a service provider to leverage the existing Layer 3 VPN network infrastructure to also support Layer 2 VPNs and VPLS. The BGP path selection algorithm also helps to ensure that the service provider's network behaves predictably with regard to Layer 2 VPN and VPLS path selection. This is particularly important in networks employing route reflectors and multihoming.

When a Provider router receives multiple paths for the same destination prefix (for example, a multihomed CE device), one path is selected based on the BGP path selection algorithm and placed in the `bgp.l2vpn.0` routing table and the appropriate *instance.l2vpn.0* routing table.

- When a PE router receives all of the available paths to each CE device, it runs the designated forwarder path selection algorithm to select the preferred path to reach each CE device, independently of the results of the earlier BGP path selection algorithm run on the Provider router. The VPLS designated forwarder algorithm uses the D-bit, preference, and PE router identifier to determine which of the valid paths to each CE device to use. The PE router might select a path to reach a CE device which is different from the path selected by the BGP-based Provider routers. In this scenario, the following is the expected behavior for traffic sent to the multihomed CE device:
 - If the path selected by the remote PE router is available, traffic will traverse the network to the multihomed CE device using the remote PE router's preferred path (again, ignoring the path selected by the BGP-based Provider routers).
 - If the path selected by the remote PE router fails:
 1. The Provider routers switch the traffic destined for the multihomed CE device to the alternate path as soon as failure is detected.
 2. The Provider routers notify the remote PE routers of the path failure.
 3. The remote PE routers update their routing tables accordingly.

For more information about the VPLS designated forwarder path selection algorithm, see VPLS Path Selection Process for PE Routers. This algorithm is also described in the Internet draft draft-kompella-l2vpn-vpls-multihoming-03.txt, *Multi-homing in BGP-based Virtual Private LAN Service*.

To enable the BGP path selection algorithm for Layer 2 VPN and VPLS routing instances, complete the following steps:

1. Run Junos OS Release 12.3 or later on all of the PE and Provider routers participating in Layer 2 VPN or VPLS routing instances.

Attempting to enable this functionality on a network with a mix of routers that both do and do not support this feature can result in anomalous behavior.

2. Specify a unique route distinguisher on each PE router participating in a Layer 2 VPN or VPLS routing instance.
3. Configure the `l2vpn-use-bgp-rules` statement on all of the PE and Provider routers participating in Layer 2 VPN or VPLS routing instances.

You can configure this statement at the `[edit protocols bgp path-selection]` hierarchy level to apply this behavior to all of the routing instances on the router or at the `[edit routing-instances routing-instance-name protocols bgp path-selection]` hierarchy level to apply this behavior to a specific routing instance.

Related Documentation

- Understanding BGP Path Selection
- VPLS Path Selection Process for PE Routers
- [l2vpn-use-bgp-rules on page 120](#)
- route-distinguisher

Configuring CCC Encapsulation for Layer 2 VPNs

You need to specify a circuit cross-connect (CCC) encapsulation type for each PE-router-to-CE-router interface running a Layer 2 VPN. This encapsulation type should match the encapsulation type configured under the routing instance. For information about how to configure the encapsulation type under the routing instance, see [“Configuring the Encapsulation Type” on page 16](#).



NOTE: A Layer 2 VPN or Layer 2 circuit is not supported if the PE-router-to-P-router interface has VLAN-tagging enabled and uses a nonenhanced Flexible PIC Concentrator (FPC).

For Layer 2 VPNs, you need to configure the CCC encapsulation on the logical interface. You also need to configure an encapsulation on the physical interface. The physical interface encapsulation does not have to be a CCC encapsulation. However, it should match the logical interface encapsulation. For example, if you configure an ATM CCC encapsulation type on the logical interface, you should configure a compatible ATM encapsulation on the physical interface.

To configure the CCC encapsulation type, include the **encapsulation-type** statement:

```
encapsulation-type ccc-encapsulation-type;
```

To configure the CCC encapsulation type on the physical interface, include this statement at the following hierarchy levels:

- **[edit interfaces *interface-name*]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name*]**

To configure the CCC encapsulation type on the logical interface, include this statement at the following hierarchy levels:

- **[edit interfaces *interface-name* unit *logical-unit-number*]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]**

You configure the encapsulation type at the **[edit interfaces]** hierarchy level differently from the **[edit routing-instances]** hierarchy level. For example, you specify the encapsulation as **frame-relay** at the **[edit routing-instances]** hierarchy level and as **frame-relay-ccc** at the **[edit interfaces]** hierarchy level.

You can run both standard Frame Relay and CCC Frame Relay on the same device. If you specify Frame Relay encapsulation (**frame-relay-ccc**) for the interface, you should also configure the encapsulation at the **[edit interfaces *interface-name* unit *unit-number*]** hierarchy level as **frame-relay-ccc**. Otherwise, the logical interface unit defaults to standard Frame Relay.

For more information about how to configure interfaces and interface encapsulations, see the Junos® OS Network Interfaces.

Configuring TCC Encapsulation for Layer 2 VPNs and Layer 2 Circuits

Also known as Layer 2.5 VPNs, the translation cross-connect (TCC) encapsulation types allow you to configure different encapsulation types at the ingress and egress of a Layer 2 VPN or the ingress and egress of a Layer 2 circuit. For example, a CE router at the ingress of a Layer 2 VPN path can send traffic in a Frame Relay encapsulation. A CE router at the egress of that path can receive the traffic in an ATM encapsulation.

For information about how to configure encapsulations for Layer 2 circuits, see [Configuring Interfaces for Layer 2 Circuits](#).

The configuration for TCC encapsulation types is similar to the configuration for CCC encapsulation types. For Layer 2 VPNs, you specify a TCC encapsulation type for each PE-router-to-CE-router interface. The encapsulation type configured for the interface should match the encapsulation type configured under the routing instance. For information about how to configure the encapsulation type under the routing instance, see [“Configuring the Encapsulation Type” on page 16](#).

You need to configure the TCC encapsulation on both the physical and logical interfaces. To configure the TCC encapsulation type, include the **encapsulation-type** statement:

```
encapsulation-type tcc-encapsulation-type;
```

To configure the TCC encapsulation type on the physical interface, include this statement at the following hierarchy levels:

- **[edit interfaces *interface-name*]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name*]**

To configure the TCC encapsulation type on the logical interface, include this statement at the following hierarchy levels:

- **[edit interfaces *interface-name* unit *logical-unit-number*]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]**

You configure the encapsulation type at the **[edit interfaces]** hierarchy level differently than at the **[edit routing-instances]** hierarchy level. For example, you specify the encapsulation as **frame-relay** at the **[edit routing-instances]** hierarchy level and as **frame-relay-tcc** at the **[edit interfaces]** hierarchy level.

For Layer 2.5 VPNs employing an Ethernet interface as the TCC router, you can configure an Ethernet TCC or an extended VLAN TCC.

To configure an Ethernet TCC or an extended VLAN TCC, include the **proxy** and **remote** statements:

```
proxy inet-address;  
remote (inet-address | mac-address);
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family tcc]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family tcc]

The **proxy inet-address** address statement defines the IP address for which the TCC router is acting as proxy.

The **remote (inet-address | mac-address)** statement defines the location of the remote router.

Ethernet TCC is supported on interfaces that carry IP version 4 (IPv4) traffic only. However, Ethernet TCC encapsulation is not supported on 8-port, 12-port, and 48-port Fast Ethernet PICs.

For more information about how to configure interfaces and interface encapsulations, see the Junos® OS Network Interfaces.

Configuring Traffic Policing in Layer 2 VPNs

You can use policing to control the amount of traffic flowing over the interfaces servicing a Layer 2 VPN. If policing is disabled on an interface, all the available bandwidth on a Layer 2 VPN tunnel can be used by a single CCC or TCC interface.

For more information about the **policer** statement, see the Routing Policy Configuration Guide.

To enable Layer 2 VPN policing on an interface, include the **policer** statement:

```
policer {
  input policer-template-name;
  output policer-template-name;
}
```

If you configure CCC encapsulation, you can include the **policer** statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family ccc]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family ccc]

If you configure TCC encapsulation, you can include the **policer** statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family tcc]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family tcc]

For information about how to configure the encapsulation type, see [“Configuring the Encapsulation Type” on page 16](#).

Disabling the Control Word for Layer 2 VPNs

A 4-byte control word provides support for the emulated VC encapsulation for Layer 2 VPNs. This control word is added between the Layer 2 protocol data unit (PDU) being transported and the VC label that is used for demultiplexing. Various networking formats (ATM, Frame Relay, Ethernet, and so on) use the control word in a variety of ways.

On networks with equipment that does not support the control word, you can disable it by including the **no-control-word** statement:

no-control-word;

You can include this statement at the following hierarchy levels:

- [edit routing-instances *routing-instance-name* protocols l2vpn]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn]

For more information about configuring the control word, see *Configuring Interfaces for Layer 2 Circuits* and the *Layer 2 Circuits Feature Guide*.



NOTE: Use the **no-control-word** statement to disable the control word when the topology uses generic routing encapsulation (GRE) as the connection mechanism between PEs, and one of the PEs is an M Series router.

Related Documentation

- [Configuring Interfaces for Layer 2 Circuits](#)
- [control-word on page 106](#)
- [l2vpn on page 119](#)

CHAPTER 4

Layer 2 VPNs Configuration Examples

- [Layer 2 VPN Overview on page 25](#)
- [Layer 2 VPN Applications on page 26](#)
- [Layer 2 VPN Configuration Example on page 27](#)
- [Example: Configuring MPLS-Based Layer 2 VPNs on page 43](#)
- [Using the Layer 2 Interworking Interface to Interconnect a Layer 2 VPN to a Layer 2 VPN on page 56](#)
- [Example: Interconnecting a Layer 2 VPN with a Layer 2 VPN on page 58](#)
- [Interconnecting Layer 2 VPNs with Layer 3 VPNs Overview on page 75](#)
- [Example: Interconnecting a Layer 2 VPN with a Layer 3 VPN on page 76](#)

Layer 2 VPN Overview

As the need to link different Layer 2 services to one another for expanded service offerings grows, Layer 2 Multiprotocol Label Switching (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 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 needs 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 26](#)
- 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 56](#)
- [Interconnecting Layer 2 VPNs with Layer 3 VPNs Overview on page 75](#)
- [Example: Interconnecting a Layer 2 VPN with a Layer 2 VPN on page 58](#)
- Example: Interconnecting a Layer 2 Circuit with a Layer 2 VPN
- [Example: Interconnecting a Layer 2 VPN with a Layer 3 VPN on page 76](#)

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 25](#)
- 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 56](#)
- Example: Interconnecting a Layer 2 Circuit with a Layer 2 VPN

- [Example: Interconnecting a Layer 2 VPN with a Layer 2 VPN on page 58](#)
- [Example: Interconnecting a Layer 2 VPN with a Layer 3 VPN on page 76](#)

Layer 2 VPN Configuration Example

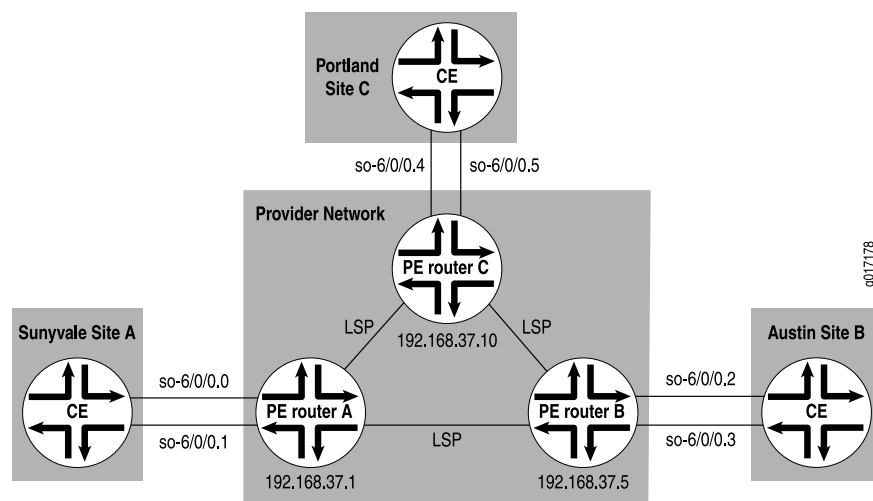
The following sections explain how to configure Layer 2 VPN functionality on the provider edge (PE) routers connected to each site:

- [Simple Full-Mesh Layer 2 VPN Overview on page 27](#)
- [Enabling an IGP on the PE Routers on page 28](#)
- [Configuring MPLS LSP Tunnels Between the PE Routers on page 28](#)
- [Configuring IBGP on the PE Routers on page 29](#)
- [Configuring Routing Instances for Layer 2 VPNs on the PE Routers on page 31](#)
- [Configuring CCC Encapsulation on the Interfaces on page 32](#)
- [Configuring VPN Policy on the PE Routers on page 33](#)
- [Layer 2 VPN Configuration Summarized by Router on page 36](#)

Simple Full-Mesh Layer 2 VPN Overview

In the sections that follow, you configure a simple full-mesh Layer 2 VPN spanning three sites: Sunnyvale, Austin, and Portland. Each site connects to a PE router. The customer edge (CE) routers at each site use Frame Relay to carry Layer 2 traffic to the PE routers. Since this example uses a full-mesh topology between all three sites, each site requires two logical interfaces (one for each of the other CE routers), although only one physical link is needed to connect each PE router to each CE router. [Figure 3 on page 27](#) illustrates the topology of this Layer 2 VPN.

Figure 3: Example of a Simple Full-Mesh Layer 2 VPN Topology



Enabling an IGP on the PE Routers

To allow the PE routers to exchange routing information among themselves, you must configure an interior gateway protocol (IGP) or static routes on these routers. You configure the IGP on the master instance of the routing protocol process (rpd) (that is, at the **[edit protocols]** hierarchy level), not within the Layer 2 VPN routing instance (that is, not at the **[edit routing-instances]** hierarchy level). Turn on traffic engineering on the IGP.

You configure the IGP in the standard way. This example does not include this portion of the configuration.

Configuring MPLS LSP Tunnels Between the PE Routers

In this configuration example, RSVP is used for MPLS signaling. Therefore, in addition to configuring RSVP, you must create an MPLS label-switched path (LSP) to tunnel the VPN traffic.

On Router A, enable RSVP and configure one end of the MPLS LSP tunnel to Router B. When configuring the MPLS LSP, include all interfaces using the **interface all** statement.

```
[edit]
protocols {
  rsvp {
    interface all;
  }
  mpls {
    interface all;
    label-switched-path RouterA-to-RouterB {
      to 192.168.37.5;
      primary Path-to-RouterB;
    }
    label-switched-path RouterA-to-RouterC {
      to 192.168.37.10;
      primary Path-to-RouterC;
    }
  }
}
```

On Router B, enable RSVP and configure the other end of the MPLS LSP tunnel. Again, configure the interfaces by using the **interface all** statement.

```
[edit]
protocols {
  rsvp {
    interface all;
  }
  mpls {
    interface all;
    label-switched-path RouterB-to-RouterA {
      to 192.168.37.1;
      primary Path-to-RouterA;
    }
    label-switched-path RouterB-to-RouterC {
```

```

        to 192.168.37.10;
        primary Path-to-RouterC;
    }
}

```

On Router C, enable RSVP and configure the other end of the MPLS LSP tunnel. Again, configure all interfaces using the **interface all** statement.

```

[edit]
protocols {
  rsvp {
    interface all;
  }
  mpls {
    interface all;
    label-switched-path RouterC-to-RouterA {
      to 192.168.37.1;
      primary Path-to-RouterA;
    }
    label-switched-path RouterC-to-RouterB {
      to 192.168.37.5;
      primary Path-to-RouterB;
    }
  }
}

```

Configuring IBGP on the PE Routers

On the PE routers, configure an IBGP session with the following parameters:

- Layer 2 VPN—To indicate that the IBGP session is for a Layer 2 VPN, include the **family l2vpn** statement.
- Local address—The IP address in the **local-address** statement is the same as the address configured in the **to** statement at the **[edit protocols mpls label-switched-path lsp-path-name]** hierarchy level on the remote PE router. The IBGP session for Layer 2 VPNs runs through this address.
- Neighbor address—Include the **neighbor** statement, specifying the IP address of the neighboring PE router.

On Router A, configure IBGP:

```

[edit]
protocols {
  bgp {
    import match-all;
    export match-all;
    group pe-pe {
      type internal;
      neighbor 192.168.37.5 {
        local-address 192.168.37.1;
        family l2vpn {
          signaling;
        }
      }
    }
  }
}

```

```
    }
    neighbor 192.168.37.10 {
      local-address 192.168.37.1;
      family l2vpn {
        signaling;
      }
    }
  }
}
```

On Router B, configure IBGP:

```
[edit]
protocols {
  bgp {
    local-address 192.168.37.5;
    import match-all;
    export match-all;
    group pe-pe {
      type internal;
      neighbor 192.168.37.1 {
        local-address 192.168.37.5;
        family l2vpn {
          signaling;
        }
      }
      neighbor 192.168.37.10 {
        local-address 192.168.37.5;
        family l2vpn {
          signaling;
        }
      }
    }
  }
}
```

On Router C, configure IBGP:

```
[edit]
protocols {
  bgp {
    local-address 192.168.37.10;
    import match-all;
    export match-all;
    group pe-pe {
      type internal;
      neighbor 192.168.37.1 {
        local-address 192.168.37.10;
        family l2vpn {
          signaling;
        }
      }
      neighbor 192.168.37.5 {
        local-address 192.168.37.10;
        family l2vpn {
          signaling;
        }
      }
    }
  }
}
```

```

    }
  }
}

```

Configuring Routing Instances for Layer 2 VPNs on the PE Routers

The three PE routers service the Layer 2 VPN, so you need to configure a routing instance on each router. For the VPN, you must define the following in each routing instance:

- Route distinguisher, which must be unique for each routing instance on the PE router. It is used to distinguish the addresses in one VPN from those in another VPN.
- Instance type of **l2vpn**, which configures the router to run a Layer 2 VPN.
- Interfaces connected to the CE routers.
- VPN routing and forwarding (VRF) import and export policies, which must be the same on each PE router that services the same VPN and are used to control the network topology. Unless the import policy contains only a **then reject** statement, it must include a reference to a community. Otherwise, when you attempt to commit the configuration, the commit operation fails.

On Router A, configure the following routing instance for the Layer 2 VPN:

```

[edit]
routing-instances {
  VPN-Sunnyvale-Portland-Austin {
    instance-type l2vpn;
    interface so-6/0/0.0;
    interface so-6/0/0.1;
    route-distinguisher 100:1;
    vrf-import vpn-SPA-import;
    vrf-export vpn-SPA-export;
    protocols {
      l2vpn {
        encapsulation-type frame-relay;
        site Sunnyvale {
          site-identifier 1;
          interface so-6/0/0.0 {
            remote-site-id 2;
          }
          interface so-6/0/0.1 {
            remote-site-id 3;
          }
        }
      }
    }
  }
}

```

On Router B, configure the following routing instance for the Layer 2 VPN:

```

[edit]
routing-instances {
  VPN-Sunnyvale-Portland-Austin {

```

```
instance-type l2vpn;
interface so-6/0/0.2;
interface so-6/0/0.3;
route-distinguisher 100:1;
vrf-import vpn-SPA-import;
vrf-export vpn-SPA-export;
protocols {
  l2vpn {
    encapsulation-type frame-relay;
    site Austin {
      site-identifier 2;
      interface so-6/0/0.2 {
        remote-site-id 1;
      }
      interface so-6/0/0.3 {
        remote-site-id 3;
      }
    }
  }
}
```

On Router C, configure the following routing instance for the Layer 2 VPN:

```
[edit]
routing-instances {
  VPN-Sunnyvale-Portland-Austin {
    instance-type l2vpn;
    interface so-6/0/0.4;
    interface so-6/0/0.5;
    route-distinguisher 100:1;
    vrf-import vpn-SPA-import;
    vrf-export vpn-SPA-export;
    protocols {
      l2vpn {
        encapsulation-type frame-relay;
        site Portland {
          site-identifier 3;
          interface so-6/0/0.4 {
            remote-site-id 1;
          }
          interface so-6/0/0.5 {
            remote-site-id 2;
          }
        }
      }
    }
  }
}
```

Configuring CCC Encapsulation on the Interfaces

You need to specify a circuit cross-connect (CCC) encapsulation type for each PE-router-to-CE-router interface running in the Layer 2 VPN. This encapsulation type should match the encapsulation type configured under the routing instance.

Configure the following CCC encapsulation types for the interfaces on Router A:

```
[edit]
interfaces so-6/0/0 {
  encapsulation frame-relay-ccc;
  unit 0 {
    encapsulation frame-relay-ccc;
  }
}
interfaces so-6/0/0 {
  encapsulation frame-relay-ccc;
  unit 1 {
    encapsulation frame-relay-ccc;
  }
}
```

Configure the following CCC encapsulation types for the interfaces on Router B:

```
[edit]
interfaces so-6/0/0 {
  encapsulation frame-relay-ccc;
  unit 2 {
    encapsulation frame-relay-ccc;
  }
}
interfaces so-6/0/0 {
  encapsulation frame-relay-ccc;
  unit 3 {
    encapsulation frame-relay-ccc;
  }
}
```

Configure the following CCC encapsulation types for the interfaces on Router C:

```
[edit]
interface so-6/0/0 {
  encapsulation frame-relay-ccc;
  unit 4 {
    encapsulation frame-relay-ccc;
  }
}
interface so-6/0/0 {
  encapsulation frame-relay-ccc;
  unit 5 {
    encapsulation frame-relay-ccc;
  }
}
```

Configuring VPN Policy on the PE Routers

You must configure VPN import and export policies on each of the PE routers so that they install the appropriate routes in their VRF tables, which the routers use to forward packets within the VPN.



NOTE: Use the `community add community-name` statement at the `[edit policy-options policy-statement policy-statement-name term term-name then]` hierarchy level to facilitate Layer 2 VPN VRF export policies.

On Router A, configure the following VPN import and export policies:

```
[edit]
policy-options {
  policy-statement match-all {
    term acceptable {
      then accept;
    }
  }
  policy-statement vpn-SPA-export {
    term a {
      then {
        community add SPA-com;
        accept;
      }
    }
    term b {
      then reject;
    }
  }
  policy-statement vpn-SPA-import {
    term a {
      from {
        protocol bgp;
        community SPA-com;
      }
      then accept;
    }
    term b {
      then reject;
    }
  }
  community SPA-com members target:69:100;
}
```

On Router B, configure the following VPN import and export policies:

```
[edit]
policy-options {
  policy-statement match-all {
    term acceptable {
      then accept;
    }
  }
  policy-statement vpn-SPA-import {
    term a {
      from {
        protocol bgp;
        community SPA-com;
      }
    }
  }
}
```

```

        then accept;
    }
    term b {
        then reject;
    }
}
policy-statement vpn-SPA-export {
    term a {
        then {
            community add SPA-com;
            accept;
        }
    }
    term b {
        then reject;
    }
}
community SPA-com members target:69:100;
}

```

On Router C, configure the following VPN import and export policies:

```

[edit]
policy-options {
    policy-statement match-all {
        term acceptable {
            then accept;
        }
    }
    policy-statement vpn-SPA-import {
        term a {
            from {
                protocol bgp;
                community SPA-com;
            }
            then accept;
        }
        term b {
            then reject;
        }
    }
    policy-statement vpn-SPA-export {
        term a {
            then {
                community add SPA-com;
                accept;
            }
        }
        term b {
            then reject;
        }
    }
    community SPA-com members target:69:100;
}

```

To apply the VPN policies on the routers, include the **vrf-export** and **vrf-import** statements when you configure the routing instance. The VRF import and export policies handle the route distribution across the IBGP session running between the PE routers.

To apply the VPN policies on Router A, include the following statements:

```
[edit]
routing-instances {
  VPN-Sunnyvale-Portland-Austin {
    vrf-import vpn-SPA-import;
    vrf-export vpn-SPA-export;
  }
}
```

To apply the VPN policies on Router B, include the following statements:

```
[edit]
routing-instances {
  VPN-Sunnyvale-Portland-Austin {
    vrf-import vpn-SPA-import;
    vrf-export vpn-SPA-export;
  }
}
```

To apply the VPN policies on Router C, include the following statements:

```
[edit]
routing-instances {
  VPN-Sunnyvale-Portland-Austin {
    vrf-import vpn-SPA-import;
    vrf-export vpn-SPA-export;
  }
}
```

Layer 2 VPN Configuration Summarized by Router

For a summary of the configuration on each router in the examples in this chapter, see the following sections:

- [Summary for Router A \(PE Router for Sunnyvale\) on page 36](#)
- [Summary for Router B \(PE Router for Austin\) on page 38](#)
- [Summary for Router C \(PE Router for Portland\) on page 41](#)

Summary for Router A (PE Router for Sunnyvale)

Routing Instance for Layer 2 VPN

```
[edit]
routing-instances {
  VPN-Sunnyvale-Portland-Austin {
    instance-type l2vpn;
    interface so-6/0/0.0;
    interface so-6/0/0.1;
    route-distinguisher 100:1;
    vrf-import vpn-SPA-import;
    vrf-export vpn-SPA-export;
    protocols {
      l2vpn {
```

```

        encapsulation-type frame-relay;
        site Sunnyvale {
            site-identifier 1;
            interface so-6/0/0.0 {
                remote-site-id 2;
            }
            interface so-6/0/0.1 {
                remote-site-id 3;
            }
        }
    }
}

Configure CCC Encapsulation Types for Interfaces
interfaces {
    interface so-6/0/0 {
        encapsulation frame-relay-ccc;
        unit 0 {
            encapsulation frame-relay-ccc;
        }
    }
    interface so-6/0/0 {
        encapsulation frame-relay-ccc;
        unit 1 {
            encapsulation frame-relay-ccc;
        }
    }
}

Master Protocol Instance
protocols {
}

Enable RSVP
rsvp {
    interface all;
}

Configure MPLS LSPs
mpls {
    label-switched-path RouterA-to-RouterB {
        to 192.168.37.5;
        primary Path-to-RouterB {
            cspf;
        }
    }
    label-switched-path RouterA-to-RouterC {
        to 192.168.37.10;
        primary Path-to-RouterC {
            cspf;
        }
    }
    interface all;
}

Configure IBGP
bgp {
    import match-all;
}

```

```
export match-all;
group pe-pe {
  type internal;
  neighbor 192.168.37.5 {
    local-address 192.168.37.1;
    family l2vpn {
      signaling;
    }
  }
  neighbor 192.168.37.10 {
    local-address 192.168.37.1;
    family l2vpn {
      signaling;
    }
  }
}
}
```

Configure VPN Policy

```
policy-options {
  policy-statement match-all {
    term acceptable {
      then accept;
    }
  }
  policy-statement vpn-SPA-export {
    term a {
      then {
        community add SPA-com;
        accept;
      }
    }
    term b {
      then reject;
    }
  }
  policy-statement vpn-SPA-import {
    term a {
      from {
        protocol bgp;
        community SPA-com;
      }
      then accept;
    }
    term b {
      then reject;
    }
  }
  community SPA-com members target:69:100;
}
```

Summary for Router B (PE Router for Austin)

**Routing Instance for
VPN**

```
[edit]
routing-instances {
  VPN-Sunnyvale-Portland-Austin {
```

	<pre> instance-type l2vpn; interface so-6/0/0.2; interface so-6/0/0.3; route-distinguisher 100:1; vrf-import vpn-SPA-import; vrf-export vpn-SPA-export; } } </pre>
Configure Layer 2 VPN	<pre> protocols { l2vpn { encapsulation-type frame-relay; site Austin { site-identifier 2; interface so-6/0/0.2 { remote-site-id 1; } interface so-6/0/0.3 { remote-site-id 3; } } } } </pre>
Configure CCC Encapsulation Types for Interfaces	<pre> [edit] interfaces { interface so-6/0/0 { encapsulation frame-relay-ccc; unit 2 { encapsulation frame-relay-ccc; } } interface so-6/0/0 { encapsulation frame-relay-ccc; unit 3 { encapsulation frame-relay-ccc; } } } </pre>
Master Protocol Instance	<pre> protocols { } </pre>
Enable RSVP	<pre> rsvp { interface all; } </pre>
Configure MPLS LSPs	<pre> mpls { label-switched-path RouterB-to-RouterA { to 192.168.37.1; primary Path-to-RouterA { cspf; } } label-switched-path RouterB-to-RouterC { </pre>

```
        to 192.168.37.10;
        primary Path-to-RouterC {
            cspf;
        }
    }
    interface all;
}
```

Configure IBGP

```
bgp {
    local-address 192.168.37.5;
    import match-all;
    export match-all;
    group pe-pe {
        type internal;
        neighbor 192.168.37.1 {
            local-address 192.168.37.5;
            family l2vpn {
                signaling;
            }
        }
        neighbor 192.168.37.10 {
            local-address 192.168.37.5;
            family l2vpn {
                signaling;
            }
        }
    }
}
```

Configure VPN Policy

```
policy-options {
    policy-statement match-all {
        term acceptable {
            then accept;
        }
    }
    policy-statement vpn-SPA-import {
        term a {
            from {
                protocol bgp;
                community SPA-com;
            }
            then accept;
        }
        term b {
            then reject;
        }
    }
    policy-statement vpn-SPA-export {
        term a {
            then {
                community add SPA-com;
                accept;
            }
        }
        term b {
```



```

        then reject;
    }
}
community SPA-com members target:69:100;
}

```

Summary for Router C (PE Router for Portland)

Routing Instance for VPN	<pre> [edit] routing-instances { VPN-Sunnyvale-Portland-Austin { instance-type l2vpn; interface so-6/0/0.3; interface so-6/0/0.4; route-distinguisher 100:1; vrf-import vpn-SPA-import; vrf-export vpn-SPA-export; } } </pre>
Configure Layer 2 VPN	<pre> protocols { l2vpn { encapsulation-type frame-relay; site Portland { site-identifier 3; interface so-6/0/0.4 { remote-site-id 1; } interface so-6/0/0.5 { remote-site-id 2; } } } } </pre>
Configure CCC Encapsulation Types for Interfaces	<pre> [edit] interfaces { interface so-6/0/0 { encapsulation frame-relay-ccc; unit 4 { encapsulation frame-relay-ccc; } } interface so-6/0/0 { encapsulation frame-relay-ccc; unit 5 { encapsulation frame-relay-ccc; } } } </pre>
Master Protocol Instance	<pre> protocols { } </pre>
Enable RSVP	<pre> rsvp { </pre>

```
        interface all;
    }

Configure MPLS LSPs    mpls {
        label-switched-path RouterC-to-RouterA {
            to 192.168.37.1;
            primary Path-to-RouterA {
                cspf;
            }
        }
        label-switched-path RouterC-to-RouterB {
            to 192.168.37.5;
            primary Path-to-RouterB {
                cspf;
            }
        }
        interface all;
    }

Configure IBGP        bgp {
        local-address 192.168.37.10;
        import match-all;
        export match-all;
        group pe-pe {
            type internal;
            neighbor 192.168.37.1 {
                local-address 192.168.37.10;
                family l2vpn {
                    signaling;
                }
            }
            neighbor 192.168.37.5 {
                local-address 192.168.37.10;
                family l2vpn {
                    signaling;
                }
            }
        }
    }

Configure VPN Policy  policy-options {
        policy-statement match-all {
            term acceptable {
                then accept;
            }
        }
        policy-statement vpn-SPA-import {
            term a {
                from {
                    protocol bgp;
                    community SPA-com;
                }
                then accept;
            }
            term b {
```

```

        then reject;
    }
}
policy-statement vpn-SPA-export {
    term a {
        then {
            community add SPA-com;
            accept;
        }
    }
    term b {
        then reject;
    }
}
community SPA-com members target:69:100;
}

```

Example: Configuring MPLS-Based Layer 2 VPNs

You can implement an MPLS-based Layer 2 virtual private network (VPN) using Junos OS routing devices to interconnect customer sites with Layer 2 technology. Layer 2 VPNs give customers complete control of their own routing. To support an MPLS-based Layer 2 VPN, you need to add components to the configuration of the two provider edge (PE) routing devices. You do not need to change the configuration of the provider devices.

This example shows how to configure an MPLS-based Layer 2 VPN.



NOTE: You can configure both an MPLS-based Layer 2 VPN and an MPLS-based Layer 3 VPN on the same device. However, you cannot configure the same customer edge interface to support both a Layer 2 VPN and a Layer 3 VPN. The core interfaces and the loopback interfaces are configured in the same way for Layer 2 VPNs and Layer 3 VPNs.

- [Requirements on page 44](#)
- [Overview and Topology on page 44](#)
- [Configuring the Local PE Routing Device on page 47](#)
- [Configuring the Remote PE Routing Device on page 50](#)
- [Verification on page 53](#)

Requirements

This example uses the following hardware and software components:

- Junos OS Release 11.1 or later if you are using EX Series switches
- Two PE routing devices

Before you configure the Layer 2 VPN components, configure the basic components for an MPLS network:

- Configure two PE routing devices. See *Configuring MPLS on Provider Edge Switches Using Circuit Cross-Connect (CLI Procedure)*.
- Configure one or more provider devices. See *Configuring MPLS on Provider Switches (CLI Procedure)*.



NOTE: A Layer 2 VPN requires that the PE routing devices be configured using circuit cross-connect (CCC). The provider routing devices are configured in the same way for MPLS using CCC and for IP over MPLS.

Overview and Topology

A Layer 2 VPN provides complete separation between the provider's network and the customer's network—that is, the PE devices and the CE devices do not exchange routing information. Some benefits of a Layer 2 VPN are that it is private, secure, and flexible.

This example shows how to configure Layer 2 VPN components on the local and remote PE devices. This example does not include configuring a provider device, because there are no specific Layer 2 VPN components on the provider devices.

In the basic MPLS configuration of the PE devices using a circuit cross-connect (CCC), the PE devices are configured to use an interior gateway protocol (IGP), such as OSPF or IS-IS, as the routing protocol between the MPLS devices and LDP or RSVP as the signaling protocol. Traffic engineering is enabled. A label-switched path (LSP) is configured within the **[edit protocols]** hierarchy. However, unlike the basic MPLS configuration using a CCC, you do not need to associate the LSP with the customer edge interface. When you are configuring a Layer 2 VPN, you must use BGP signaling. The BGP signaling automates the connections, so manual configuration of the association between the LSP and the customer edge interface is not required.

The following components must be added to the PE routing devices for an MPLS-based Layer 2 VPN:

- BGP group with **family l2vpn signaling**
- Routing instance using instance type **l2vpn**
- The physical layer encapsulation type (**ethernet**) must be specified on the customer edge interface and the encapsulation type must also be specified in the configuration of the routing instance.

Figure 4 on page 45 illustrates the topology of this MPLS-based Layer 2 VPN.

Figure 4: MPLS-Based Layer 2 VPN

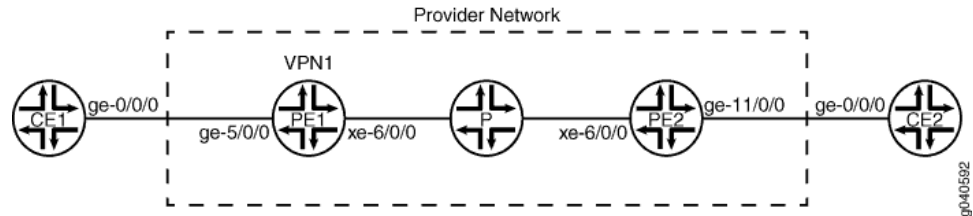


Table 3 on page 45 shows the settings of the customer edge interface on the local CE device.

Table 3: Local CE Routing Device in the MPLS-Based Layer 2 VPN Topology

Property	Settings	Description
Local CE routing device hardware	Routing device	CE1
Customer edge interface	ge-0/0/0 unit 0 family inet address 11.0.0.2/16	Interface that connects CE1 to PE1.

Table 4 on page 45 shows the settings of the customer edge interface on the remote CE routing device.

Table 4: Remote CE Routing Device in the MPLS-Based Layer 2 VPN Topology

Property	Settings	Description
Remote CE routing device hardware	Routing device	CE2
Customer edge interface	ge-0/0/0 unit 0 family inet address 11.0.0.1/16	Interface that connects CE2 to PE2.

Table 5 on page 46 shows the Layer 2 VPN components of the local PE routing device.

Table 5: Layer 2 VPN Components of the Local PE Routing Device

Property	Settings	Description
Local PE routing device hardware	Routing device	PE1
Customer edge interface	<code>ge-5/0/0</code> <code>encapsulation ethernet-ccc</code> <code>unit 0</code> <code>family ccc</code>	Connects PE1 to CE1. For the Layer 2 VPN, add ethernet-ccc as the physical layer encapsulation type. NOTE: The family ccc should already have been completed as part of the basic MPLS configuration of a PE routing device for circuit cross-connect. It is included here to show what was specified for that portion of the configuration.
Core interface	<code>xe-6/0/0 unit 0</code> <code>family inet address 60.0.0.60/16</code> <code>family iso</code> <code>family mpls</code>	Connects PE1 to P. NOTE: This portion of the configuration should already have been completed as part of the basic MPLS configuration. It is included here to show what was specified for that portion of the configuration.
Loopback interface	<code>lo0 unit 0</code> <code>family inet address 21.21.21.21/32</code> <code>family iso address 49.0001.2102.2021.0210.00</code>	NOTE: This portion of the configuration should already have been completed as part of the basic MPLS configuration. It is included here to show what was specified for that portion of the configuration.
BGP	<code>bgp</code>	Added for the Layer 2 VPN configuration.
Routing instance	<code>vpn1</code>	Added for the Layer 2 VPN configuration.

Table 6 on page 47 shows the Layer 2 VPN components of the remote PE routing device.

Table 6: Layer 2 VPN Components of the Remote PE Routing Device

Property	Settings	Description
PE routing device hardware	Routing device	PE2
Customer edge interface	<code>ge-11/0/0</code> <code>encapsulation ethernet-ccc</code> <code>unit 0</code> <code>family ccc</code>	Connects PE2 to CE2. For the Layer 2 VPN, add ethernet-ccc as the physical layer encapsulation type. NOTE: The family ccc should already have been completed as part of the basic MPLS configuration of a PE routing device for circuit cross-connect. It is included here to show what was specified for that portion of the configuration.
Core interface	<code>xe-6/0/0</code> <code>unit 0</code> <code>family inet</code> <code>address 60.2.0.61/16</code> <code>family iso</code> <code>family mpls</code>	Connects PE2 to P. NOTE: This portion of the configuration should already have been completed as part of the basic MPLS configuration. It is included here to show what was specified for that portion of the configuration.
Loopback interface	<code>lo0</code> <code>unit 0</code> <code>family inet</code> <code>address 22.22.22.22/32</code> <code>family iso</code> <code>address 49.0001.2202.2022.0220.00</code>	NOTE: This portion of the configuration should already have been completed as part of the basic MPLS configuration. It is included here to show what was specified for that portion of the configuration.
BGP	<code>bgp</code>	Added for the Layer 2 VPN configuration.
Routing instance	<code>vpn1</code>	Added for the Layer 2 VPN configuration.

Configuring the Local PE Routing Device

CLI Quick Configuration

To quickly configure the Layer 2 VPN components on the local PE routing device, copy the following commands and paste them into the routing device terminal window:

```
[edit]
set interfaces ge-5/0/0 encapsulation ethernet-ccc
set protocols bgp local-address 21.21.21.21 family l2vpn signaling
set protocols bgp group ibgp type internal
set protocols bgp neighbor 22.22.22.22
set routing-instances vpn1 instance-type l2vpn
set routing-instances vpn1 interface ge-5/0/0
set routing-instances vpn1 route-distinguisher 21.21.21.21:21
set routing-instances vpn1 vrf-target target:21:21
set routing-instances vpn1 protocols l2vpn encapsulation-type ethernet
set routing-instances vpn1 protocols l2vpn interface ge-5/0/0.0 description "BETWEEN PE1 AND PE2"
```

Step-by-Step Procedure

```
set routing-instances vpn1 protocols l2vpn site JE-V21 site-identifier 21 remote-site-id 26
```

To configure the Layer 2 VPN components on the local PE routing device:

1. Configure the customer edge interface to use the physical encapsulation type **ethernet-ccc**:

[edit]
user@PE1# **set interfaces ge-5/0/0 encapsulation ethernet-ccc**
2. Configure BGP, specifying the loopback address as the local address and enabling **family l2vpn signaling**:

[edit protocols bgp]
user@PE1# **set local-address 21.21.21.21 family l2vpn signaling**
3. Configure the BGP group, specifying the group name and type:

[edit protocols bgp]
user@PE1# **set group ibgp type internal**
4. Configure the BGP neighbor, specifying the loopback address of the remote PE routing device as the neighbor's address:

[edit protocols bgp]
user@PE1# **set neighbor 22.22.22.22**
5. Configure the routing instance, specifying the routing-instance name and using **l2vpn** as the instance type:

[edit routing-instances]
user@PE1# **set vpn1 instance-type l2vpn**
6. Configure the routing instance to apply to the customer edge interface:

[edit routing-instances]
user@PE1# **set vpn1 interface ge-5/0/0**
7. Configure the routing instance to use a route distinguisher:

[edit routing-instances]
user@PE1# **set vpn1 route-distinguisher 21.21.21.21**
8. Configure the VPN routing and forwarding (VRF) target of the routing instance:

[edit routing-instances]
user@PE1# **set vpn1 vrf-target target:21:21**



NOTE: You can create more complex policies by explicitly configuring VRF import and export policies using the import and export options. See the [Junos OS VPNs Configuration Guide](#).

9. Configure the protocols and encapsulation type used by the routing instance:

[edit routing-instances]
user@PE1# **set vpn1 protocols l2vpn encapsulation-type ethernet**
10. Apply the routing instance to a customer edge interface and specify a description for it:

[edit routing-instances]
user@PE1# **set vpn1 protocols interface ge-5/0/0.0 description "BETWEEN PE1 AND PE2"**
11. Configure the routing-instance protocols site:

[edit routing-instances]
user@PE1# **set vpn1 protocols l2vpn site JE-V21 site-identifier 21 remote-site-id 26**



NOTE: The remote site ID (configured with the `remote-site-id` statement) corresponds to the site ID (configured with the `site-identifier` statement) configured on the other PE routing device.

Results Display the results of the configuration:

```
user@PE1# show

interfaces {
  ge-5/0/0 {
    encapsulation ethernet-ccc;
    unit 0 {
      family ccc;
    }
  }
  xe-6/0/0 {
    unit 0 {
      family inet {
        address 60.0.0.60/16;
      }
      family mpls;
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 21.21.21.21/32;
      }
      family iso {
        address 49.0001.2102.2021.0210.00;
      }
    }
  }
}

protocols {
  rsvp {
    interface lo0.0;
    interface xe-0/0/6.0;
  }
  mpls {
    label-switched-path lsp_to_pe2 {
      to 22.22.22.22;
    }
    interface xe-0/0/6.0;
  }
  bgp {
    local-address 21.21.21.21;
    family l2vpn {
      signaling;
    }
    group ibgp {
      type internal;
      neighbor 22.22.22.22;
    }
  }
}
```

```

    }
  }
  routing-instances {
    vpn1 {
      instance-type l2vpn;
      interface ge-5/0/0.0;
      route-distinguisher 21.21.21.21;
      vrf-target target:21:21;
      protocols {
        l2vpn {
          encapsulation-type ethernet;
          interface ge-5/0/0.0 {
            description "BETWEEN PE1 AND PE2";
          }
          site JE-V21 {
            site-identifier 21;
            interface ge-5/0/0.0 {
              remote-site-id 26;
            }
          }
        }
      }
    }
  }
}

```

Configuring the Remote PE Routing Device

CLI Quick Configuration To quickly configure the Layer 2 VPN components on the remote PE routing device, copy the following commands and paste them into the routing device terminal window:

```

[edit]
set interfaces ge-11/0/0 encapsulation ethernet-ccc
set protocols bgp local-address 22.22.22.22 family l2vpn signaling
set protocols bgp group ibgp type internal
set protocols bgp neighbor 21.21.21.21
set routing-instances vpn1 instance-type l2vpn
set routing-instances vpn1 interface ge-11/0/0
set routing-instances vpn1 route-distinguisher 21.21.21.21
set routing-instances vpn1 vrf-target target:21:21
set routing-instances vpn1 protocols l2vpn encapsulation-type ethernet
set routing-instances vpn1 protocols l2vpn interface ge-11/0/0.0 description "BETWEEN PE1 AND PE2"
set routing-instances vpn1 protocols l2vpn site T26-VPN1 site-identifier 26 remote-site-id 21

```

Step-by-Step Procedure To configure the Layer 2 VPN components on the remote PE routing device:

1. Configure the customer edge interface to use the physical encapsulation type **ethernet-ccc**:

```

[edit]
user@PE1# set interfaces ge-11/0/0 encapsulation ethernet-ccc

```
2. Configure BGP, specifying the loopback address as the **local-address** and specifying **family l2vpn signaling**:

```

[edit protocols bgp]
user@PE2# set local-address 22.22.22.22 family l2vpn signaling

```
3. Configure the BGP group, specifying the group name and type:

```

[edit protocols bgp]

```

- ```

user@PE2# set group ibgp type internal

```
4. Configure the BGP neighbor, specifying the loopback address of the remote PE routing device as the neighbor's address:
 

```

[edit protocols bgp]
user@PE2# set neighbor 21.21.21.21

```
  5. Configure the routing instance, specifying the routing-instance name and using **l2vpn** as the **instance-type**:
 

```

[edit routing-instances]
user@PE2# set vpn1 instance-type l2vpn

```
  6. Configure the routing instance to apply to the customer edge interface:
 

```

[edit routing-instances]
user@PE2# set vpn1 interface ge-11/0/0.0

```
  7. Configure the routing instance to use a route distinguisher, using the format *ip-address:number*:
 

```

[edit routing-instances]
user@PE2# set vpn1 route-distinguisher 21.21.21.21

```
  8. Configure the VPN routing and forwarding (VRF) target of the routing instance:
 

```

[edit routing-instances]
user@PE2# set vpn1 vrf-target target:21:21

```
  9. Configure the protocols and encapsulation type used by the routing instance:
 

```

[edit routing-instances]
user@PE2# set vpn1 protocols l2vpn encapsulation-type ethernet

```
  10. Apply the routing instance to a customer edge interface and specify a description for it:
 

```

[edit routing-instances]
user@PE1# set vpn1 protocols interface ge-11/0/0.0 description "BETWEEN PE1 AND PE2"

```
  11. Configure the routing-instance protocols site:
 

```

[edit routing-instances]
user@PE2# set vpn1 protocols l2vpn site T26-VPN1 site-identifier 26 remote-site-id 21

```



**NOTE:** The remote site ID (configured with the `remote-site-id` statement) corresponds to the site ID (configured with the `site-identifier` statement) configured on the other PE routing device.

**Results** Display the results of the configuration:

```

user@PE2# show

interfaces {
 ge-11/0/0 {
 encapsulation ethernet-ccc;
 unit 0 {
 family ccc;
 }
 }
 xe-6/0/0 {
 unit 0 {
 family inet {

```

```

 address 60.2.0.61/16;
 }
 family mpls;
}
}
lo0 {
 unit 0 {
 family inet {
 address 22.22.22.22/32;
 }
 family iso {
 address 49.0001.2202.2022.0220.00;
 }
 }
}
protocols {
 rsvp {
 interface lo0.0;
 interface xe-0/0/6.0;
 }
 mpls {
 label-switched-path lsp_to_pe1 {
 to 21.21.21.21;
 }
 }
 interface xe-0/0/6.0;
 bgp {
 local-address 22.22.22.22;
 family l2vpn {
 signaling;
 }
 group ibgp {
 type internal;
 neighbor 21.21.21.21;
 }
 }
}
routing-instances {
 vpn1 {
 instance-type l2vpn;
 interface ge-11/0/0.0;
 route-distinguisher 21.21.21.21:21;
 vrf-target target:21:21;
 protocols {
 l2vpn {
 encapsulation-type ethernet;
 interface ge-11/0/0.0 {
 description "BETWEEN PE1 AND PE2";
 }
 site T26-VPN1 {
 site-identifier 26;
 interface ge-11/0/0.0 {
 remote-site-id 21;
 }
 }
 }
 }
 }
}
}

```

## Verification

To confirm that the MPLS-based Layer 2 VPN is working properly, perform these tasks:

- [Verifying the Layer 2 VPN Connection on page 53](#)
- [Verifying the Status of MPLS Label-Switched Paths on page 54](#)
- [Verifying BGP Status on page 54](#)
- [Verifying the Status of the RSVP Sessions on page 54](#)
- [Verifying the Routes in the Routing Table on page 55](#)
- [Pinging the Layer 2 VPN Connections on page 56](#)

### Verifying the Layer 2 VPN Connection

**Purpose** Verify that the Layer 2 VPN connection is up.

**Action** user@PE1> show l2vpn connections

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 available              |
| BK -- Backup connection          | ST -- Standby connection                       |
| PF -- Profile parse failure      | PB -- Profile busy                             |
| RS -- remote site standby        | SN -- Static Neighbor                          |

Legend for interface status

Up -- operational  
Dn -- down

Instance: vpn1

Local site: JE-V21 (21)

| connection-site                                                  | Type | St | Time last up         | # Up trans |
|------------------------------------------------------------------|------|----|----------------------|------------|
| 26                                                               | rmt  | Up | Apr 16 05:53:21 2010 | 1          |
| Remote PE: 22.22.22.22, Negotiated control-word: Yes (Null)      |      |    |                      |            |
| Incoming label: 800000, Outgoing label: 800001                   |      |    |                      |            |
| Local interface: ge-5/0/0.0, Status: Up, Encapsulation: ETHERNET |      |    |                      |            |

**Meaning** The **St** field in the output shows that the Layer 2 VPN connection to **Remote PE (22.22.22.22)** is up.

### Verifying the Status of MPLS Label-Switched Paths

**Purpose** Verify that the MPLS label-switched paths (ingress and egress) are up.

**Action** user@PE1> show mpls lsp  
Ingress LSP: 1 sessions

| To          | From        | State | Rt | P | ActivePath | LSPname    |
|-------------|-------------|-------|----|---|------------|------------|
| 22.22.22.22 | 21.21.21.21 | Up    | 0  | * |            | lsp_to_pe2 |

Total 1 displayed, Up 1, Down 0

Egress LSP: 1 sessions

| To          | From        | State | Rt | Style | Labelin | Labelout | LSPname    |
|-------------|-------------|-------|----|-------|---------|----------|------------|
| 21.21.21.21 | 22.22.22.22 | Up    | 0  | 1 FF  | 3       | -        | lsp_to_pe1 |

Total 1 displayed, Up 1, Down 0

Transit LSP: 0 sessions

Total 0 displayed, Up 0, Down 0

**Meaning** The **State** field in the output shows that the Ingress LSP to **Remote PE (22.22.22.22)** is up, and the Egress LSP from the remote PE routing device to this PE routing device (21.21.21.21) is also up.

### Verifying BGP Status

**Purpose** Verify that BGP is up.

**Action** user@PE1> show bgp summary

Groups: 1 Peers: 1 Down peers: 0

| Table       | Tot Paths | Act Paths | Suppressed | History | Damp  | State | Pending |
|-------------|-----------|-----------|------------|---------|-------|-------|---------|
| bgp.12vpn.0 | 1         | 1         | 0          | 0       | 0     | 0     | 0       |
| Peer        | AS        | InPkt     | OutPkt     | OutQ    | Flaps | Last  | Up/Dwn  |
| 22.22.22.22 | 10        | 33        | 34         | 0       | 1     | 13:24 |         |

Establ

bgp.12vpn.0: 1/1/1/0

vpn2.12vpn.0: 1/1/1/0

**Meaning** The output shows that the remote PE routing device (22.22.22.22) is listed as the BGP peer and that a protocol session has been established. It also shows the number of packets received from the remote PE routing device (33) and the number of packets sent (34) to the remote PE routing device.

### Verifying the Status of the RSVP Sessions

**Purpose** Verify that the RSVP sessions (ingress and egress) are up.

**Action** user@PE1> show rsvp session

Ingress RSVP: 1 sessions

| To          | From        | State | Rt | Style | Labelin | Labelout | LSPname    |
|-------------|-------------|-------|----|-------|---------|----------|------------|
| 22.22.22.22 | 21.21.21.21 | Up    | 0  | 1 FF  | -       | 462880   | lsp_to_pe2 |

Total 1 displayed, Up 1, Down 0

Egress RSVP: 1 sessions

| To          | From        | State | Rt | Style | Labelin | Labelout | LSPname    |
|-------------|-------------|-------|----|-------|---------|----------|------------|
| 21.21.21.21 | 22.22.22.22 | Up    | 0  | 1 FF  | 3       | -        | lsp_to_pe1 |

Total 1 displayed, Up 1, Down 0

Transit RSVP: 0 sessions

Total 0 displayed, Up 0, Down 0

**Meaning** The output shows that both the ingress RSVP session and the egress RSVP session are up.

### Verifying the Routes in the Routing Table

**Purpose** On routing device PE1, use the **show route table** command to verify that the routing table is populated with the Layer 2 VPN routes used to forward the traffic.

**Action** user@PE1> show route table bgp.l2vpn.0

bgp.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

+ = Active Route, - = Last Active, \* = Both

2:2:27:27/96

\*[BGP/170] 00:13:55, localpref 100, from 22.22.22.22

AS path: I

&gt; to 60.2.0.24 via ge-6/0/46.0, label-switched-path lsp\_to\_pe2

## user@PE1&gt; show route table vpn1.l2vpn.0

vpn1.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

+ = Active Route, - = Last Active, \* = Both

2:2:27:27/96

\*[BGP/170] 00:14:00, localpref 100, from 22.22.22.22

AS path: I

&gt; to 60.2.0.24 via ge-6/0/46.0, label-switched-path lsp\_to\_pe2

2:2:28:27/96

\*[L2VPN/170/-101] 00:15:55, metric2 1

Indirect

**Meaning** The command **show route table bgp.l2vpn.0** displays all Layer 2 VPN routes that have been created on this routing device. The command **show route table vpn1.l2vpn.0** shows the Layer 2 VPN routes that have been created for the routing instance **vpn1**.

### Pinging the Layer 2 VPN Connections

---

**Purpose** Verify connectivity.

**Action**

```
user@PE1> ping mpls l2vpn interface xe-6/0/0.0 reply-mode ip-udp
!!!!
--- lsping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss

user@PE1> ping mpls l2vpn instance vpn1 remote-site-id 26 local-site-id 21 detail
Request for seq 1, to interface 68, labels <800001, 100176>
Reply for seq 1, return code: Egress-ok
Request for seq 2, to interface 68, labels <800001, 100176>
Reply for seq 2, return code: Egress-ok
Request for seq 3, to interface 68, labels <800001, 100176>
Reply for seq 3, return code: Egress-ok
Request for seq 4, to interface 68, labels <800001, 100176>
Reply for seq 4, return code: Egress-ok
Request for seq 5, to interface 68, labels <800001, 100176>
Reply for seq 5, return code: Egress-ok

--- lsping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
```

**Meaning** The output shows that connectivity is established.

**Related Documentation**

- Example: Configuring MPLS on EX Series Switches
- Example: Configuring MPLS-Based Layer 3 VPNs on EX Series Switches
- Configuring an MPLS-Based Layer 2 VPN (CLI Procedure)

### 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 25](#)
  - [Layer 2 VPN Applications on page 26](#)
  - [Example: Interconnecting a Layer 2 VPN with a Layer 2 VPN on page 58](#)

---

## 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 on page 58](#)
- [Overview and Topology on page 58](#)
- [Configuration on page 60](#)

### Requirements

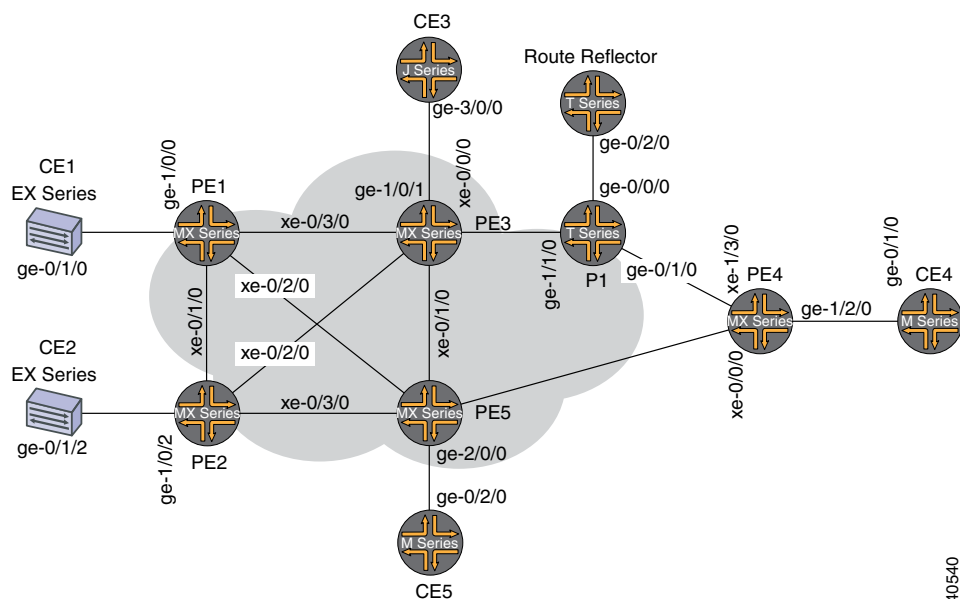
This example uses the following hardware and software components:

- 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 5 on page 59](#).

g040540



9040542

CE1  
EX Series

PE1  
MX Series

Layer 2 VPN

CE3  
J Series

PE3  
MX Series

Route Reflector  
T Series

P1

Layer 2 VPN

PE5  
M Series

CE5  
M Series

CE1 to CE5 End-to-End Connectivity

Layer 2 VPN from PE5 Terminating the Layer 2 VPN from PE1 on PE3

## 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 60](#)
- [Verifying the Layer 2 VPN to Layer 2 VPN Connection on Router PE3 on page 65](#)
- [Verifying the Layer 2 VPN to Layer 2 VPN Connection on Router PE3 on page 68](#)
- [Results on page 70](#)

### 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 **fxp0.0**. 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 **fxp0.0**. 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 **fxp0.0**. 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;
 }
 }
}
```

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 {
 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.

```
[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

```

- 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        |

- 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

```

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 available           |
| 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 |
|---|-----|----|

- 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, metric 2
 > 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

- 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

```

- 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
1.1.1.1 100.0 1.1.1.1:0 44
2.2.2.2 100.0 2.2.2.2:0 42
4.4.4.4 100.0 4.4.4.4:0 31
5.5.5.5 100.0 5.5.5.5:0 44

```

- 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.12vpn.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.12vpn.0: 2/2/2/0
 L2VPN-PE1.12vpn.0: 2/2/2/0
 L2VPN-PE5.12vpn.0: 2/2/2/0

```

- 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

```

- 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, metric 2 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, metric 2 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, metric 2 1
 > to 10.10.1.1 via xe-0/3/0.0, Push 800000 Offset: -4
iw0.1 *[L2VPN/7] 01:39:13, metric 2 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)

- 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;
 }
 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;
 }
 }
 }
 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;
 }
 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;
 }
 }
 }
 }
 }
}
```

- Related Documentation**
- [Layer 2 VPN Overview on page 25](#)
  - [Layer 2 VPN Applications on page 26](#)
  - [Using the Layer 2 Interworking Interface to Interconnect a Layer 2 VPN to a Layer 2 VPN on page 56](#)

---

## Interconnecting Layer 2 VPNs with Layer 3 VPNs Overview

---

As MPLS-based Layer 2 services grow in demand, new challenges arise for service providers to be able to interoperate with Layer 2 and Layer 3 services and give their customers value-added services. Junos OS has various features to address the needs of service providers. One of these features is the use of a logical tunnel interface. This Junos OS functionality makes use of a tunnel PIC to loop packets out and back from the Packet Forwarding Engine to link the Layer 2 network with the Layer 3 network. The solution is limited by the logical tunnel bandwidth constraints imposed by the tunnel PIC.

### Interconnecting Layer 2 VPNs with Layer 3 VPNs Applications

Interconnecting a Layer 2 VPN with a Layer 3 VPN provides the following benefits:

- **A single access line to provide multiple services**—Traditional VPNs over Layer 2 circuits require the provisioning and maintenance of separate networks for IP and for VPN services. In contrast, Layer 2 VPNs enable the sharing of a provider's core network infrastructure between IP and Layer 2 VPN services, thereby reducing the cost of providing those services.
- **Flexibility**—Many different types of networks can be accommodated by the service provider. If all sites in a VPN are owned by the same enterprise, this is an intranet. If various sites are owned by different enterprises, the VPN is an extranet. A site can be located in more than one VPN.
- **Wide range of possible policies**—You can give every site in a VPN a different route to every other site, or you can force traffic between certain pairs of sites routed via a third site and so pass certain traffic through a firewall.
- **Scalable network**—This design enhances the scalability because it eliminates the need for provider edge (PE) routers to maintain all of the service provider's VPN routes. Each PE router maintains a VRF table for each of its directly connected sites. Each customer connection (such as a Frame Relay PVC, an ATM PVC, or a VLAN) is mapped to a specific VRF table. Thus, it is a port on the PE router and not a site that is associated with a VRF table. Multiple ports on a PE router can be associated with a single VRF table. It is the ability of PE routers to maintain multiple forwarding tables that supports the per-VPN segregation of routing information.
- **Use of route reflectors**—Provider edge routers can maintain IBGP sessions to route reflectors as an alternative to a full mesh of IBGP sessions. Deploying multiple route reflectors enhances the scalability of the RFC 2547bis model because it eliminates the need for any single network component to maintain all VPN routes.
- **Multiple VPNs are kept separate and distinct from each other**—The customer edge routers do not peer with each other. Two sites have IP connectivity over the common

backbone only, and only if there is a VPN which contains both sites. This feature keeps the VPNs separate and distinct from each other, even if two VPNs have an overlapping address space.

- Simple for customers to use—Customers can obtain IP backbone services from a service provider, and they do not need to maintain their own backbones.

**Related  
Documentation**

- [Layer 2 VPN Overview on page 25](#)
- [Layer 3 VPN Overview](#)
- [Example: Interconnecting a Layer 2 VPN with a Layer 3 VPN on page 76](#)

---

## Example: Interconnecting a Layer 2 VPN with a Layer 3 VPN

This example provides a step-by-step procedure and commands for interconnecting and verifying a Layer 2 VPN with a Layer 3 VPN. It contains the following sections:

- [Requirements on page 76](#)
- [Overview and Topology on page 76](#)
- [Configuration on page 79](#)
- [Verification on page 94](#)

### Requirements

This example uses the following hardware and software components:

- Junos OS Release 9.3 or later
- Five MX Series routers
- Three M Series routers
- Two T Series routers

### Overview and Topology

A Layer 2 VPN is a type of virtual private network (VPN) that uses MPLS labels to transport data. The communication occurs between the provider edge (PE) routers.

Layer 2 VPNs use BGP as the signaling protocol and, consequently, have a simpler design and require less provisioning overhead than traditional VPNs over Layer 2 circuits. BGP signaling also enables autodiscovery of Layer 2 VPN peers. Layer 2 VPNs can have either a full-mesh or a hub-and-spoke topology. The tunneling mechanism in the core network is, typically, MPLS. However, Layer 2 VPNs can also use other tunneling protocols, such as GRE.

Layer 3 VPNs are based on RFC 2547bis, *BGP/MPLS IP VPNs*. RFC 2547bis defines a mechanism by which service providers can use their IP backbones to provide VPN services to their customers. A Layer 3 VPN is a set of sites that share common routing information and whose connectivity is controlled by a collection of policies. The sites that make up a Layer 3 VPN are connected over a provider's existing public Internet backbone. RFC

2547bis VPNs are also known as BGP/MPLS VPNs because BGP is used to distribute VPN routing information across the provider's backbone, and MPLS is used to forward VPN traffic across the backbone to remote VPN sites.

Customer networks, because they are private, can use either public addresses or private addresses, as defined in RFC 1918, *Address Allocation for Private Internets*. When customer networks that use private addresses connect to the public Internet infrastructure, the private addresses might overlap with the same private addresses used by other network users. MPLS/BGP VPNs solve this problem by adding a *route distinguisher*. A route distinguisher is a VPN identifier prefix that is added to each address from a particular VPN site, thereby creating an address that is unique both within the VPN and within the Internet.

In addition, each VPN has its own VPN-specific routing table that contains the routing information for that VPN only. To separate a VPN's routes from routes in the public Internet or those in other VPNs, the PE router creates a separate routing table for each VPN called a VPN routing and forwarding (VRF) table. The PE router creates one VRF table for each VPN that has a connection to a customer edge (CE) router. Any customer or site that belongs to the VPN can access only the routes in the VRF tables for that VPN. Every VRF table has one or more extended community attributes associated with it that identify the route as belonging to a specific collection of routers. One of these, the *route target* attribute, identifies a collection of sites (VRF tables) to which a PE router distributes routes. The PE router uses the route target to constrain the import of remote routes into its VRF tables.

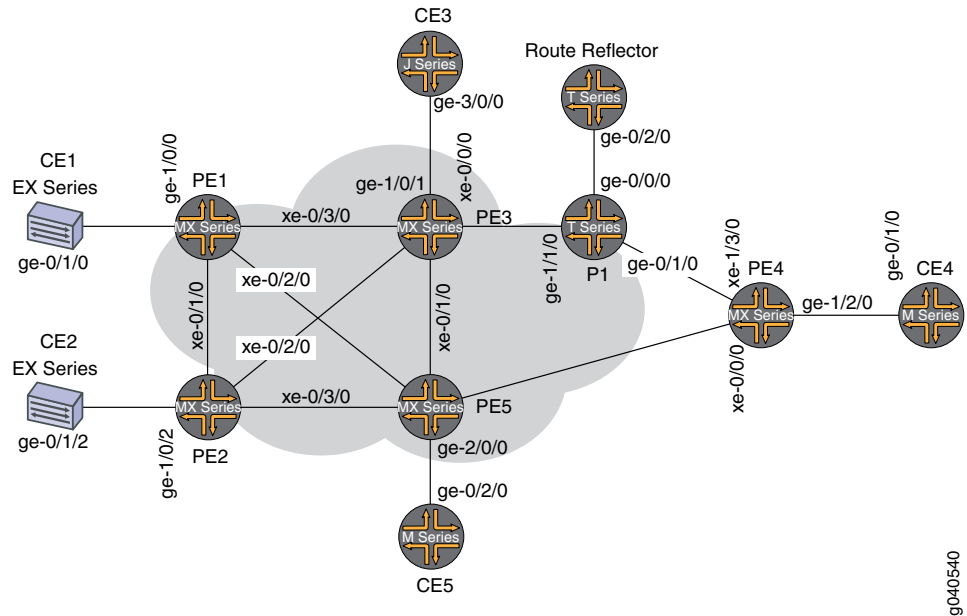
When an ingress PE router receives routes advertised from a directly connected CE router, it checks the received route against the VRF export policy for that VPN.

- If it matches, the route is converted to VPN-IPv4 format—that is, the route distinguisher is added to the route. The PE router then announces the route in VPN-IPv4 format to the remote PE routers. It also attaches a route target to each route learned from the directly connected sites. The route target attached to the route is based on the value of the VRF table's configured export target policy. The routes are then distributed using IBGP sessions, which are configured in the provider's core network.
- If the route from the CE router does not match, it is not exported to other PE routers, but it can still be used locally for routing, for example, if two CE routers in the same VPN are directly connected to the same PE router.

When an egress PE router receives a route, it checks it against the import policy on the IBGP session between the PE routers. If it is accepted, the router places the route into its `bgp.l3vpn.0` table. At the same time, the router checks the route against the VRF import policy for the VPN. If it matches, the route distinguisher is removed from the route and the route is placed into the VRF table (the *routing-instance-name.inet.0* table) in IPv4 format.

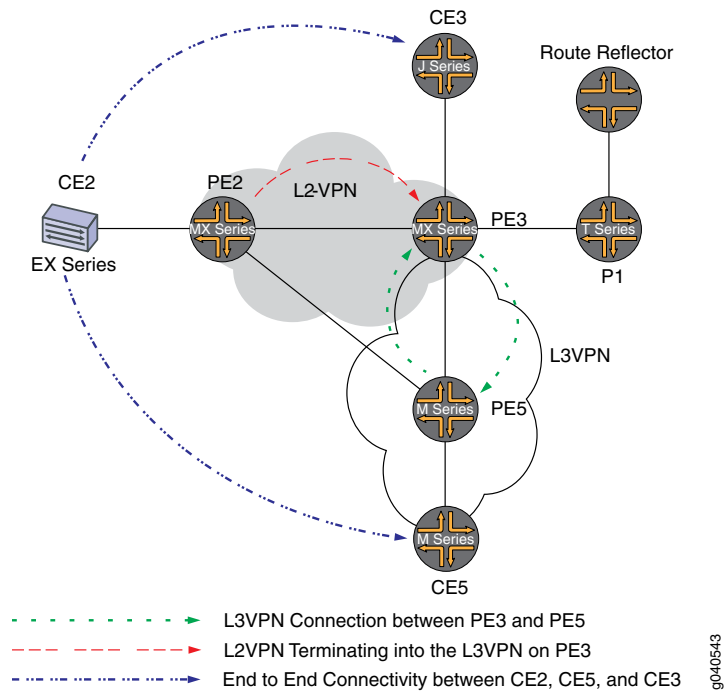
[Figure 7 on page 78](#) shows the physical topology of a Layer 2 VPN-to-Layer 3 VPN interconnection.

Figure 7: Physical Topology of a Layer 2 VPN Terminating into a Layer 3 VPN



The logical topology of a Layer 2 VPN-to-Layer 3 VPN interconnection is shown in [Figure 8 on page 78](#).

Figure 8: Logical Topology of a Layer 2 VPN Terminating into a Layer 3 VPN



The following definitions describe the meaning of the device abbreviations used in [Figure 7 on page 78](#) and [Figure 8 on page 78](#).

- Customer edge (CE) device—A device at the customer premises that provides access to the service provider's VPN over a data link to one or more provider edge (PE) routers.

Typically the CE device is an IP router that establishes an adjacency with its directly connected PE routers. After the adjacency is established, the CE router advertises the site's local VPN routes to the PE router and learns remote VPN routes from the PE router.

- Provider edge (PE) device—A device, or set of devices, at the edge of the provider network that presents the provider's view of the customer site.

PE routers exchange routing information with CE routers. PE routers are aware of the VPNs that connect through them, and PE routers maintain VPN state. A PE router is only required to maintain VPN routes for those VPNs to which it is directly attached. After learning local VPN routes from CE routers, a PE router exchanges VPN routing information with other PE routers using IBGP. Finally, when using MPLS to forward VPN data traffic across the provider's backbone, the ingress PE router functions as the ingress label-switching router (LSR) and the egress PE router functions as the egress LSR.

- Provider (P) device—A device that operates inside the provider's core network and does not directly interface to any CE.

Although the P device is a key part of implementing VPNs for the service provider's customers and may provide routing for many provider-operated tunnels that belong to different VPNs, it is not itself VPN-aware and does not maintain VPN state. Its principal role is allowing the service provider to scale its VPN offerings, for example, by acting as an aggregation point for multiple PE routers.

P routers function as MPLS transit LSRs when forwarding VPN data traffic between PE routers. P routers are required only to maintain routes to the provider's PE routers; they are not required to maintain specific VPN routing information for each customer site.

## Configuration

To interconnect a Layer 2 VPN with a Layer 3 VPN, perform these tasks:

- [Configuring the Base Protocols and Interfaces on page 79](#)
- [Configuring the VPN Interfaces on page 83](#)

### Configuring the Base Protocols and Interfaces

#### Step-by-Step Procedure

1. On each PE and P router, configure OSPF with traffic engineering extensions on all interfaces. Disable OSPF on the fxp0.0 interface.

```
[edit protocols]
ospf {
 traffic-engineering;
 area 0.0.0.0 {
 interface all;
```

```
 interface fxp0.0 {
 disable;
 }
 }
}
```

2. On all the core routers, enable MPLS on all interfaces. Disable MPLS on the fxp0.0 interface.

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

3. On all the core routers, create an internal BGP peer group and specify the route reflector address (7.7.7.7) as the neighbor. Also enable BGP to carry Layer 2 VPLS network layer reachability information (NLRI) messages for this peer group by including the **signaling** statement at the **[edit protocols bgp group group-name family l2vpn]** hierarchy level.

```
[edit protocols]
bgp {
 group RR {
 type internal;
 local-address 2.2.2.2;
 family l2vpn {
 signaling;
 }
 neighbor 7.7.7.7;
 }
}
```

4. On Router PE3, create an internal BGP peer group and specify the route reflector IP address (7.7.7.7) as the neighbor. Enable BGP to carry Layer 2 VPLS NLRI messages for this peer group and enable the processing of VPN-IPv4 addresses by including the **unicast** statement at the **[edit protocols bgp group group-name family inet-vpn]** hierarchy level.

```
[edit protocols]
bgp {
 group RR {
 type internal;
 local-address 3.3.3.3;
 family inet-vpn {
 unicast;
 }
 family l2vpn {
 signaling;
 }
 neighbor 7.7.7.7;
 }
}
```



5. For the Layer 3 VPN domain on Router PE3 and Router PE5, enable RSVP on all interfaces. Disable RSVP on the fxp0.0 interface.

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

6. On Router PE3 and Router PE5, create label-switched paths (LSPs) to the route reflector and the other PE routers. The following example shows the configuration on Router PE5.

```
[edit protocols]
mpls {
 label-switched-path to-RR {
 to 7.7.7.7;
 }
 label-switched-path to-PE2 {
 to 2.2.2.2;
 }
 label-switched-path to-PE3 {
 to 3.3.3.3;
 }
 label-switched-path to-PE4 {
 to 4.4.4.4;
 }
 label-switched-path to-PE1 {
 to 1.1.1.1;
 }
}
```

7. On Routers PE1, PE2, PE3, and PE5, configure the core interfaces with an IPv4 address and enable the MPLS address family. The following example shows the configuration of the xe-0/1/0 interface on Router PE2.

```
[edit]
interfaces {
 xe-0/1/0 {
 unit 0 {
 family inet {
 address 10.10.2.2/30;
 }
 family mpls;
 }
 }
}
```

8. On Router PE2 and Router PE3, configure LDP for the Layer 2 VPN MPLS signaling protocol for all interfaces. Disable LDP on the fxp0.0 interface. (RSVP can also be used.)

```
[edit protocols]
ldp {
 interface all;
```

```
interface fxp0.0 {
 disable;
}
}
```

9. On the route reflector, create an internal BGP peer group and specify the PE routers IP addresses as the neighbors.

```
[edit]
protocols {
 bgp {
 group RR {
 type internal;
 local-address 7.7.7.7;
 family inet {
 unicast;
 }
 family inet-vpn {
 unicast;
 }
 family l2vpn {
 signaling;
 }
 cluster 7.7.7.7;
 neighbor 1.1.1.1;
 neighbor 2.2.2.2;
 neighbor 4.4.4.4;
 neighbor 5.5.5.5;
 neighbor 3.3.3.3;
 }
 }
}
```

10. On the route reflector, configure MPLS LSPs towards Routers PE3 and PE5 to resolve the BGP next hops from inet.3 routing table.

```
[edit]
protocols {
 mpls {
 label-switched-path to-pe3 {
 to 3.3.3.3;
 }
 label-switched-path to-pe5 {
 to 5.5.5.5;
 }
 interface all;
 }
}
```

### Configuring the VPN Interfaces

#### Step-by-Step Procedure

Router PE2 is one end of the Layer 2 VPN. Router PE3 is performing the Layer 2 VPN stitching between the Layer 2 VPN and the Layer 3 VPN. Router PE3 uses the logical tunnel interface (lt interface) configured with different logical interface units applied under two different Layer 2 VPN instances. The packet is looped though the lt interface configured on Router PE3. The configuration of Router PE5 contains the PE-CE interface.

1. On Router PE2, configure the ge-1/0/2 interface encapsulation. Include the encapsulation statement and specify the **ethernet-ccc** option (**vlan-ccc** encapsulation is also supported) at the **[edit interfaces ge-1/0/2]** hierarchy level. The encapsulation should be the same in a whole Layer 2 VPN domain (Routers PE2 and PE3). Also, configure interface lo0.

```
[edit]
interfaces {
 ge-1/0/2 {
 encapsulation ethernet-ccc;
 unit 0;
 }
 lo0 {
 unit 0 {
 family inet {
 address 2.2.2.2/32;
 }
 }
 }
}
```

2. On Router PE2, configure the routing instance at the **[edit routing-instances]** hierarchy level. Also, configure the Layer 2 VPN protocol at the **[edit routing-instances routing-instances-name protocols]** hierarchy level. Configure the remote site ID as 3. Site ID 3 represents Router PE3 (Hub-PE). The Layer 2 VPN is using LDP as the signaling protocol. Be aware that in the following example, both the routing instance and the protocol are named **l2vpn**.

```
[edit]
routing-instances {
 l2vpn { # routing instance
 instance-type l2vpn;
 interface ge-1/0/2.0;
 route-distinguisher 65000:2;
 vrf-target target:65000:2;
 protocols {
 l2vpn { # protocol
 encapsulation-type ethernet;
 site CE2 {
 site-identifier 2;
 interface ge-1/0/2.0 {
 remote-site-id 3;
 }
 }
 }
 }
 }
}
```

```
}
}
```

3. On Router PE5, configure the Gigabit Ethernet interface for the PE-CE link **ge-2/0/0** and configure the **lo0** interface.

```
[edit interfaces]
ge-2/0/0 {
 unit 0 {
 family inet {
 address 80.80.80.1/24;
 }
 }
}
lo0 {
 unit 0 {
 }
}
```

4. On Router PE5, configure the Layer 3 VPN routing instance (**L3VPN**) at the **[edit routing-instances]** hierarchy level. Also configure BGP at the **[edit routing-instances L3VPN protocols]** hierarchy level.

```
[edit]
routing-instances {
 L3VPN {
 instance-type vrf;
 interface ge-2/0/0.0;
 route-distinguisher 65000:5;
 vrf-target target:65000:2;
 vrf-table-label;
 protocols {
 bgp {
 group ce5 {
 neighbor 80.80.80.2 {
 peer-as 200;
 }
 }
 }
 }
 }
}
```

5. In an MX Series router, such as Router PE3, you must create the tunnel services interface to be used for tunnel services. To create the tunnel service interface, include the **bandwidth** statement and specify the amount of bandwidth to reserve for tunnel services in gigabits per second at the **[edit chassis fpc slot-number pic slot-number tunnel-services]** hierarchy level.

```
[edit]
chassis {
 dump-on-panic;
 fpc 1 {
 pic 1 {
 tunnel-services {
 bandwidth 1g;
 }
 }
 }
}
```

```

 }
 }
}

```

6. On Router PE3, configure the Gigabit Ethernet interface.

Include the **address** statement at the **[edit interfaces ge-1/0/1.0 family inet]** hierarchy level and specify **90.90.90.1/24** as the IP address.

```

[edit]
interfaces {
 ge-1/0/1 {
 unit 0 {
 family inet {
 address 90.90.90.1/24;
 }
 }
 }
}

```

7. On Router PE3, configure the **lt-1/1/10.0** logical tunnel interface at the **[edit interfaces lt-1/1/10 unit 0]** hierarchy level. Router PE3 is the router that is *stitching* the Layer 2 VPN to the Layer 3 VPN using the logical tunnel interface. The configuration of the peer unit interfaces is what makes the interconnection.

To configure the interface, include the **encapsulation** statement and specify the **ethernet-ccc** option. Include the **peer-unit** statement and specify the logical interface unit 1 as the peer tunnel interface. Include the **family** statement and specify the **ccc** option.

```

[edit]
interfaces {
 lt-1/1/10 {
 unit 0 {
 encapsulation ethernet-ccc;
 peer-unit 1;
 family ccc;
 }
 }
}

```

8. On Router PE3, configure the **lt-1/1/10.1** logical tunnel interface at the **[edit interfaces lt-1/1/10 unit 1]** hierarchy level.

To configure the interface, include the **encapsulation** statement and specify the **ethernet** option. Include the **peer-unit** statement and specify the logical interface unit 0 as the peer tunnel interface. Include the **family** statement and specify the **inet** option. Include the **address** statement at the **[edit interfaces lt-1/1/10 unit 0]** hierarchy level and specify **70.70.70.1/24** as the IPv4 address.

```

[edit]
interfaces {
 lt-1/1/10 {
 unit 1 {
 encapsulation ethernet;
 peer-unit 0;
 family inet {

```

```

 address 70.70.70.1/24;
 }
}
}

```

9. On Router PE3, add the **lt** interface unit 1 to the routing instance at the **[edit routing-instances L3VPN]** hierarchy level. Configure the instance type as **vrf** with **lt** peer-unit 1 as a PE-CE interface to terminate the Layer 2 VPN on Router PE2 into the Layer 3 VPN on Router PE3.

```

[edit]
routing-instances {
 L3VPN {
 instance-type vrf;
 interface ge-1/0/1.0;
 interface lt-1/1/10.1;
 route-distinguisher 65000:33;
 vrf-target target:65000:2;
 vrf-table-label;
 protocols {
 bgp {
 export direct;
 group ce3 {
 neighbor 90.90.90.2 {
 peer-as 100;
 }
 }
 }
 }
 }
}

```

10. On Router PE3, add the **lt** interface unit 0 to the routing instance at the **[edit routing-instances protocols l2vpn]** hierarchy level. Also configure the same vrf target for the Layer 2 VPN and Layer 3 VPN routing instances, so that the routes can be leaked between the instances. The example configuration in the previous step shows the vrf target for the **L3VPN** routing instance. The following example shows the vrf target for the **l2vpn** routing instance.

```

[edit]
routing-instances {
 l2vpn {
 instance-type l2vpn;
 interface lt-1/1/10.0;
 route-distinguisher 65000:3;
 vrf-target target:65000:2;
 protocols {
 l2vpn {
 encapsulation-type ethernet;
 site CE3 {
 site-identifier 3;
 interface lt-1/1/10.0 {
 remote-site-id 2;
 }
 }
 }
 }
 }
}

```

```

 }
 }
}

```

11. On Router PE3, configure the **policy-statement** statement to export the routes learned from the directly connected **lt** interface unit 1 to all the CE routers for connectivity, if needed.

```

[edit]
policy-options {
 policy-statement direct {
 term 1 {
 from protocol direct;
 then accept;
 }
 }
}

```

**Results** The following output shows the full configuration of Router PE2:

```

Router PE2 interfaces {
 xe-0/1/0 {
 unit 0 {
 family inet {
 address 10.10.2.2/30;
 }
 family mpls;
 }
 }
 xe-0/2/0 {
 unit 0 {
 family inet {
 address 10.10.5.1/30;
 }
 family mpls;
 }
 }
 xe-0/3/0 {
 unit 0 {
 family inet {
 address 10.10.4.1/30;
 }
 family mpls;
 }
 }
 ge-1/0/2 {
 encapsulation ethernet-ccc;
 unit 0;
 }
 fxp0 {
 apply-groups [re0 re1];
 }
 lo0 {
 unit 0 {
 family inet {

```

```
 address 2.2.2.2/32;
 }
}
}
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 2.2.2.2;
 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;
 }
 }
}
routing-instances {
 l2vpn {
 instance-type l2vpn;
 interface ge-1/0/2.0;
 route-distinguisher 65000:2;
 vrf-target target:65000:2;
 protocols {
 l2vpn {
 encapsulation-type ethernet;
 site CE2 {
 site-identifier 2;
 interface ge-1/0/2.0 {
```



```

 remote-site-id 3;
 }
}
}
}
}
}

```

The following output shows the final configuration of Router PE5:

```

Router PE5 interfaces {
 ge-0/0/0 {
 unit 0 {
 family inet {
 address 10.10.4.2/30;
 }
 family mpls;
 }
 }
 xe-0/1/0 {
 unit 0 {
 family inet {
 address 10.10.6.2/30;
 }
 family mpls;
 }
 }
 ge-1/0/0 {
 unit 0 {
 family inet {
 address 10.10.9.1/30;
 }
 family mpls;
 }
 }
 xe-1/1/0 {
 unit 0 {
 family inet {
 address 10.10.3.2/30;
 }
 family mpls;
 }
 }
 ge-2/0/0 {
 unit 0 {
 family inet {
 address 80.80.80.1/24;
 }
 }
 }
 lo0 {
 unit 0 {
 family inet {
 address 5.5.5.5/32;
 }
 }
 }
}

```

```
 }
 }
 routing-options {
 static {
 route 172.0.0.0/8 next-hop 172.19.59.1;
 }
 autonomous-system 65000;
 }
 protocols {
 rsvp {
 interface all {
 link-protection;
 }
 interface fxp0.0 {
 disable;
 }
 }
 mpls {
 label-switched-path to-RR {
 to 7.7.7.7;
 }
 label-switched-path to-PE2 {
 to 2.2.2.2;
 }
 label-switched-path to-PE3 {
 to 3.3.3.3;
 }
 label-switched-path to-PE4 {
 to 4.4.4.4;
 }
 label-switched-path to-PE1 {
 to 1.1.1.1;
 }
 interface all;
 interface fxp0.0 {
 disable;
 }
 }
 bgp {
 group to-rr {
 type internal;
 local-address 5.5.5.5;
 family inet-vpn {
 unicast;
 }
 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;
 }
}
}
routing-instances {
 L3VPN {
 instance-type vrf;
 interface ge-2/0/0.0;
 route-distinguisher 65000:5;
 vrf-target target:65000:2;
 vrf-table-label;
 protocols {
 bgp {
 group ce5 {
 neighbor 80.80.80.2 {
 peer-as 200;
 }
 }
 }
 }
 }
}
}
}

```

The following output shows the final configuration of Router PE3:

```

Router PE3 chassis {
 dump-on-panic;
 fpc 1 {
 pic 1 {
 tunnel-services {
 bandwidth 1g;
 }
 }
 }
 network-services ip;
 }
 interfaces {
 ge-1/0/1 {
 unit 0 {
 family inet {
 address 90.90.90.1/24;
 }
 }
 }
 lt-1/1/10 {
 unit 0 {
 encapsulation ethernet-ccc;
 peer-unit 1;
 family ccc;
 }
 }
 }
 }
 }

```

```
 }
 unit 1 {
 encapsulation ethernet;
 peer-unit 0;
 family inet {
 address 70.70.70.1/24;
 }
 }
}
xe-2/0/0 {
 unit 0 {
 family inet {
 address 10.10.20.2/30;
 }
 family mpls;
 }
}
xe-2/1/0 {
 unit 0 {
 family inet {
 address 10.10.6.1/30;
 }
 family mpls;
 }
}
xe-2/2/0 {
 unit 0 {
 family inet {
 address 10.10.5.2/30;
 }
 family mpls;
 }
}
xe-2/3/0 {
 unit 0 {
 family inet {
 address 10.10.1.2/30;
 }
 family mpls;
 }
}
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 {
```

```

rsvp {
 interface all;
 interface fxp0.0 {
 disable;
 }
}
mpls {
 label-switched-path to-RR {
 to 7.7.7.7;
 }
 label-switched-path to-PE2 {
 to 2.2.2.2;
 }
 label-switched-path to-PE5 {
 to 5.5.5.5;
 }
 label-switched-path to-PE4 {
 to 4.4.4.4;
 }
 label-switched-path to-PE1 {
 to 1.1.1.1;
 }
 interface all;
 interface fxp0.0 {
 disable;
 }
}
bgp {
 group RR {
 type internal;
 local-address 3.3.3.3;
 family inet-vpn {
 unicast;
 }
 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;
 }
}
}

```

```
policy-options {
 policy-statement direct {
 term 1 {
 from protocol direct;
 then accept;
 }
 }
}
routing-instances {
 L3VPN {
 instance-type vrf;
 interface ge-1/0/1.0;
 interface lt-1/1/10.1;
 route-distinguisher 65000:33;
 vrf-target target:65000:2;
 vrf-table-label;
 protocols {
 bgp {
 export direct;
 group ce3 {
 neighbor 90.90.90.2 {
 peer-as 100;
 }
 }
 }
 }
 }
 l2vpn {
 instance-type l2vpn;
 interface lt-1/1/10.0;
 route-distinguisher 65000:3;
 vrf-target target:65000:2;
 protocols {
 l2vpn {
 encapsulation-type ethernet;
 site CE3 {
 site-identifier 3;
 interface lt-1/1/10.0 {
 remote-site-id 2;
 }
 }
 }
 }
 }
}
```

## Verification

Verify the Layer 2 VPN-to-Layer 3 VPN interconnection:

- [Verifying Router PE2 VPN Interface on page 95](#)
- [Verifying Router PE3 VPN Interface on page 96](#)
- [Verifying End-to-End connectivity from Router CE2 to Router CE5 and Router CE3 on page 98](#)

### Verifying Router PE2 VPN Interface

**Purpose** Check that the Layer 2 VPN is up and working at the Router PE2 interface and that all the routes are there.

- Action** 1. Use the **show l2vpn connections** command to verify that the connection site ID is 3 for Router PE3 and that the status is **Up**.

```
user@PE2> show l2vpn connections
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 available
BK -- Backup connection ST -- Standby connection
PF -- Profile parse failure PB -- Profile busy
RS -- remote site standby
```

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

```
Instance: l2vpn
Local site: CE2 (2)
 connection-site Type St Time last up # Up trans
 3 rmt Up Jan 7 14:14:37 2010 1
 Remote PE: 3.3.3.3, Negotiated control-word: Yes (Null)
 Incoming label: 800000, Outgoing label: 800001
 Local interface: ge-1/0/2.0, Status: Up, Encapsulation: ETHERNET
```

2. Use the **show route table** command to verify that the Layer 2 VPN route is present and that there is a next hop of **10.10.5.2** through the **xe-0/2/0.0** interface. The following output verifies that the Layer 2 VPN routes are present in the **l2vpn.l2vpn.0** table. Similar output should be displayed for Router PE3.

```
user@PE2> show route table l2vpn.l2vpn.0
l2vpn.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

65000:2:2:3/96
 *[L2VPN/170/-101] 02:40:35, metric2 1
 Indirect
65000:3:3:1/96
 *[BGP/170] 02:40:35, localpref 100, from 7.7.7.7
 AS path: I
 > to 10.10.5.2 via xe-0/2/0.0
```

3. Verify that Router PE2 has a Layer 2 VPN MPLS label pointing to the LDP label to Router PE3 in both directions (PUSH and POP).

```

user@PE2> show route table mpls.0
mpls.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0 *[MPLS/0] 1w3d 08:57:41, metric 1
 Receive
1 *[MPLS/0] 1w3d 08:57:41, metric 1
 Receive
2 *[MPLS/0] 1w3d 08:57:41, metric 1
 Receive
300560 *[LDP/9] 19:45:53, metric 1
 > to 10.10.2.1 via xe-0/1/0.0, Pop
300560(S=0) *[LDP/9] 19:45:53, metric 1
 > to 10.10.2.1 via xe-0/1/0.0, Pop
301008 *[LDP/9] 19:45:53, metric 1
 > to 10.10.4.2 via xe-0/3/0.0, Swap 299856
301536 *[LDP/9] 19:45:53, metric 1
 > to 10.10.4.2 via xe-0/3/0.0, Pop
301536(S=0) *[LDP/9] 19:45:53, metric 1
 > to 10.10.4.2 via xe-0/3/0.0, Pop
301712 *[LDP/9] 16:14:52, metric 1
 > to 10.10.5.2 via xe-0/2/0.0, Swap 315184
301728 *[LDP/9] 16:14:52, metric 1
 > to 10.10.5.2 via xe-0/2/0.0, Pop
301728(S=0) *[LDP/9] 16:14:52, metric 1
 > to 10.10.5.2 via xe-0/2/0.0, Pop
800000 *[L2VPN/7] 02:40:35
 > via ge-1/0/2.0, Pop Offset: 4
ge-1/0/2.0 *[L2VPN/7] 02:40:35, metric 2 1
 > to 10.10.5.2 via xe-0/2/0.0, Push 800001 Offset: -4

```

**Meaning** The `l2vpn` routing instance is up at interface `ge-1/0/2` and the Layer 2 VPN route is shown in table `l2vpn.l2vpn.0`. Table `mpls.0` shows the Layer 2 VPN routes used to forward the traffic using an LDP label.

### Verifying Router PE3 VPN Interface

**Purpose** Check that the Layer 2 VPN connection from Router PE2 and Router PE3 is **Up** and working.

**Action** 1. Verify that the BGP session with the route reflector for the family `l2vpn-signaling` and the family `inet-vpn` is established.

```

user@PE3> show bgp summary
Groups: 2 Peers: 2 Down peers: 0
Table Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l2vpn.0 1 1 0 0 0
bgp.L3VPN.0 1 1 0 0 0
Peer AS InPkt OutPkt OutQ Flaps Last Up/Dwn State|#Active
/Received/Accepted/Damped...
7.7.7.7 65000 2063 2084 0 1 15:35:16 Establ
bgp.l2vpn.0: 1/1/1/0
bgp.L3VPN.0: 1/1/1/0
L3VPN.inet.0: 1/1/1/0
l2vpn.l2vpn.0: 1/1/1/0

```

2. The following output shows the `L3VPN.inet.0` routing table, which has Routers CE1, CE3, and CE5 listed.



```

user@PE3> show route table L3VPN.inet.0
L3VPN.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

70.70.70.0/24 *[Direct/0] 02:45:16
 > via lt-1/1/10.1
70.70.70.1/32 *[Local/0] 14:45:42
 Local via lt-1/1/10.1
80.80.80.0/24 *[BGP/170] 02:47:51, localpref 100, from 7.7.7.7
 AS path: I
 > to 10.10.6.2 via xe-2/1/0.0, Push 16
90.90.90.0/24 *[Direct/0] 15:26:24
 > via ge-1/0/1.0
90.90.90.1/32 *[Local/0] 15:26:24
 Local via ge-1/0/1.0

```

3. The following output verifies the Layer 2 VPN route and the label associated with it.

```

user@PE3> show route table l2vpn.l2vpn.0 detail
l2vpn.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
65000:2:2:3/96 (1 entry, 1 announced)
 *BGP Preference: 170/-101
 Route Distinguisher: 65000:2
 Next hop type: Indirect
 Next-hop reference count: 4
 Source: 7.7.7.7
 Protocol next hop: 2.2.2.2
 Indirect next hop: 2 no-forward
 State: <Secondary Active Int Ext>
 Local AS: 65000 Peer AS: 65000
 Age: 2:45:52 Metric2: 1
 Task: BGP_65000.7.7.7+60585
 Announcement bits (1): 0-l2vpn-l2vpn
 AS path: I (Originator) Cluster list: 7.7.7.7
 AS path: Originator ID: 2.2.2.2
 Communities: target:65000:2 Layer2-info: encaps:ETHERNET,
control flags:Control-Word, mtu: 0, site preference: 100 Accepted
 Label-base: 800000, range: 2, status-vector: 0x0
 Localpref: 100
 Router ID: 7.7.7.7
 Primary Routing Table bgp.l2vpn.0

```

4. The following output show the L2VPN MPLS.0 route in the mpls.0 route table.

```

user@PE3> show route table mpls.0
mpls.0: 21 destinations, 21 routes (21 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0 *[MPLS/0] 1w3d 09:05:41, metric 1
 Receive
1 *[MPLS/0] 1w3d 09:05:41, metric 1
 Receive
2 *[MPLS/0] 1w3d 09:05:41, metric 1
 Receive
16 *[VPN/0] 15:59:24
 to table L3VPN.inet.0, Pop
315184 *[LDP/9] 16:21:53, metric 1
 > to 10.10.20.1 via xe-2/0/0.0, Pop
315184(S=0) *[LDP/9] 16:21:53, metric 1
 > to 10.10.20.1 via xe-2/0/0.0, Pop
315200 *[LDP/9] 01:13:44, metric 1
 to 10.10.20.1 via xe-2/0/0.0, Swap 625297

```

```

315216 > to 10.10.6.2 via xe-2/1/0.0, Swap 299856
 *[LDP/9] 16:21:53, metric 1
315216(S=0) > to 10.10.6.2 via xe-2/1/0.0, Pop
 *[LDP/9] 16:21:53, metric 1
315232 > to 10.10.6.2 via xe-2/1/0.0, Pop
 *[LDP/9] 16:21:45, metric 1
315232(S=0) > to 10.10.1.1 via xe-2/3/0.0, Pop
 *[LDP/9] 16:21:45, metric 1
315248 > to 10.10.1.1 via xe-2/3/0.0, Pop
 *[LDP/9] 16:21:53, metric 1
315248(S=0) > to 10.10.5.1 via xe-2/2/0.0, Pop
 *[LDP/9] 16:21:53, metric 1
315312 > to 10.10.5.1 via xe-2/2/0.0, Pop
 *[LDP/9] 16:21:53, metric 1
315312(S=0) > to 10.10.6.2 via xe-2/1/0.0, label-switched-path to-pe5
 *[RSVP/7] 15:02:40, metric 1
315328 > to 10.10.6.2 via xe-2/1/0.0, label-switched-path to-pe5
 *[RSVP/7] 15:02:40, metric 1
315360 > to 10.10.20.1 via xe-2/0/0.0, label-switched-path to-RR
 *[RSVP/7] 15:02:40, metric 1
316272 > to 10.10.20.1 via xe-2/0/0.0, label-switched-path to-RR
 *[RSVP/7] 01:13:27, metric 1
 > to 10.10.6.2 via xe-2/1/0.0, label-switched-path
Bypass->10.10.9.1
316272(S=0) *[RSVP/7] 01:13:27, metric 1
 > to 10.10.6.2 via xe-2/1/0.0, label-switched-path
Bypass->10.10.9.1
800001 *[L2VPN/7] 02:47:33
 > via lt-1/1/10.0, Pop Offset: 4
lt-1/1/10.0 *[L2VPN/7] 02:47:33, metric2 1
 > to 10.10.5.1 via xe-2/2/0.0, Push 800000 Offset: -4

```

5. Use the **show route table mpls.0** command with the **detail** option to see the BGP attributes of the route such as next-hop type and label operations.

```

user@PE5> show route table mpls.0 detail
lt-1/1/10.0 (1 entry, 1 announced)
 *L2VPN Preference: 7
 Next hop type: Indirect
 Next-hop reference count: 2
 Next hop type: Router, Next hop index: 607
 Next hop: 10.10.5.1 via xe-2/2/0.0, selected
 Label operation: Push 800000 Offset: -4
 Protocol next hop: 2.2.2.2
 Push 800000 Offset: -4
 Indirect next hop: 8cae0a0 1048574
 State: <Active Int>
 Age: 2:46:34 Metric2: 1
 Task: Common L2 VC
 Announcement bits (2): 0-KRT 2-Common L2 VC
 AS path: I
 Communities: target:65000:2 Layer2-info: encaps:ETHERNET,
control flags:Control-Word, mtu: 0, site preference: 100

```

### Verifying End-to-End connectivity from Router CE2 to Router CE5 and Router CE3

**Purpose** Check the connectivity between Routers CE2, CE3, and CE5.

**Action** 1. Ping the Router CE3 IP address from Router CE2.

```
user@CE2> ping 90.90.90.2 # CE3 IP address
PING 90.90.90.2 (90.90.90.2): 56 data bytes
64 bytes from 90.90.90.2: icmp_seq=0 ttl=63 time=0.708 ms
64 bytes from 90.90.90.2: icmp_seq=1 ttl=63 time=0.610 ms
```

2. Ping the Router CE5 IP address from Router CE2.

```
user@CE2> ping 80.80.80.2 # CE5 IP address
PING 80.80.80.2 (80.80.80.2): 56 data bytes
64 bytes from 80.80.80.2: icmp_seq=0 ttl=62 time=0.995 ms
64 bytes from 80.80.80.2: icmp_seq=1 ttl=62 time=1.005 ms
```

**Related  
Documentation**

- [Layer 2 VPN Overview on page 25](#)
- [Layer 3 VPN Overview](#)
- [Interconnecting Layer 2 VPNs with Layer 3 VPNs Overview on page 75](#)



## PART 3

# Administration

- [Layer 2 VPNs Reference on page 103](#)
- [Summary of Layer 2 VPNs Configuration Statements on page 105](#)



## CHAPTER 5

# Layer 2 VPNs Reference

- [Supported Layer 2 VPN Standard on page 103](#)

### Supported Layer 2 VPN Standard

---

Junos OS substantially supports the following Internet drafts, which define standards for Layer 2 virtual private networks (VPNs).

- Internet draft draft-kompella-l2vpn-vpls-multihoming, *Multi-homing in BGP-based Virtual Private LAN Service*
- Internet draft draft-kompella-ppvpn-l2vpn-03.txt, *Layer 2 VPNs Over Tunnels*

#### **Related Documentation**

- [Supported Carrier-of-Carriers and Interprovider VPN Standards](#)
- [Supported Layer 2 Circuit Standards](#)
- [Supported Layer 3 VPN Standards](#)
- [Supported Multicast VPN Standards](#)
- [Supported VPLS Standards](#)
- [Accessing Standards Documents on the Internet](#)





## CHAPTER 6

# Summary of Layer 2 VPNs Configuration Statements


### control-channel (Protocols OAM)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>control-channel {<br/>  pwe3-control-word;<br/>  pw-label-ttl-1;<br/>  router-alert-label;<br/>}</pre>                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn oam],<br>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols vpls oam],<br>[edit routing-instances <i>routing-instance-name</i> protocols l2vpn oam],<br>[edit routing-instances <i>routing-instance-name</i> protocols vpls oam] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | Configure the Virtual Circuit Connection Verification (VCCV) BFD control channel. VCCV provides a control channel associated with a pseudowire. You can configure a number of different CV types for this control channel, based on the configuration of the pseudowire.                                                                                                                                |
| <b>Options</b>                  | <p><b>pwe3-control-word</b>—For BGP-based pseudowires that send OAM packets with a control word that has 0001b as the first nibble.</p> <p><b>pw-label-ttl-1</b>—For BGP-based pseudowires that send OAM packets with a router alert label.</p> <p><b>router-alert-label</b>—For BGP-based pseudowires that send OAM packets with the MPLS pseudowire label, time-to-live (TTL), set to 1.</p>          |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>Configuring BFD for VCCV for Layer 2 VPNs, Layer 2 Circuits, and VPLS</li></ul>                                                                                                                                                                                                                                                                                   |

## control-word (Protocols Layer 2 VPN)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | control-word;                                                                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols <a href="#">l2vpn</a> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <a href="#">l2vpn</a> ]                                                                                                                    |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | Specify the control word. The control word is 4 bytes long and is inserted between the Layer 2 protocol data unit (PDU) being transported and the virtual connection (VC) label that is used for demultiplexing.                                                                                                                                |
|                                 | <div> <b>NOTE:</b> The following configuration statements are ignored for time-division multiplexing pseudowires at the [edit protocols l2vpn] hierarchy level:</div> <ul style="list-style-type: none"><li>• control-word</li><li>• no-control-word</li></ul> |
| <b>Default</b>                  | The control word is enabled by default. You can also configure the control word explicitly using the <b>control-word</b> statement.                                                                                                                                                                                                             |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Disabling the Control Word for Layer 2 VPNs on page 24</a></li><li>• <a href="#">no-control-word on page 121</a></li></ul>                                                                                                                                                                  |

## description (Protocols Layer 2 VPN)

|                                 |                                                                                                                                                                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>description text;</code>                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn site <i>site-name</i> interface <i>interface-name</i> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols l2vpn site <i>site-name</i> interface <i>interface-name</i> ] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 11.1 for EX Series switches.                                                                                                                                                                               |
| <b>Description</b>              | Describe the VPN or virtual private LAN service (VPLS) routing instance.                                                                                                                                                                                                                                 |
| <b>Options</b>                  | <b>text</b> —Provide a text description. If the text includes one or more spaces, enclose it in quotation marks (" "). Any descriptive text you include is displayed in the output of the <b>show route instance detail</b> command and has no effect on operation.                                      |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Site on page 14</a></li> <li>• Configuring an MPLS-Based Layer 2 VPN (CLI Procedure)</li> </ul>                                                                                                                                     |

## encapsulation (Logical Interface)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | encapsulation (atm-ccc-cell-relay   atm-ccc-vc-mux   atm-cisco-nlpid   atm-mlppp-llc   atm-nlpid   atm-ppp-llc   atm-ppp-vc-mux   atm-snap   atm-tcc-snap   atm-tcc-vc-mux   atm-vc-mux   ether-over-atm-llc   ether-vpls-over-atm-llc   ether-vpls-over-fr   ether-vpls-over-ppp   ethernet   ethernet-ccc   ethernet-vpls   ethernet-vpls-fr   frame-relay-ccc   frame-relay-ether-type   frame-relay-ether-type-tcc   frame-relay-ppp   frame-relay-tcc   gre-fragmentation   multilink-frame-relay-end-to-end   multilink-ppp   ppp-over-ether   ppp-over-ether-over-atm-llc   vlan-bridge   vlan-ccc   vlan-vci-ccc   vlan-tcc   vlan-vpls);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ],<br>[edit interfaces rlsq <i>number</i> unit <i>logical-unit-number</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Switches ( <b>vlan-ccc</b> and <b>vlan-tcc</b> options only).<br>Statement introduced in Junos OS Release 12.2 for the ACX Series Universal Access Routers. Only the <b>atm-ccc-cell-relay</b> and <b>atm-ccc-vc-mux</b> options are supported on ACX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>         | Configure a logical link-layer encapsulation type.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>             | <p><b>atm-ccc-cell-relay</b>—Use ATM cell-relay encapsulation.</p> <p><b>atm-ccc-vc-mux</b>—Use ATM virtual circuit (VC) multiplex encapsulation on CCC circuits. When you use this encapsulation type, you can configure the <b>ccc</b> family only.</p> <p><b>atm-cisco-nlpid</b>—Use Cisco ATM network layer protocol identifier (NLPID) encapsulation. When you use this encapsulation type, you can configure the <b>inet</b> family only.</p> <p><b>atm-mlppp-llc</b>—For ATM2 IQ interfaces only, use Multilink Point-to-Point (MLPPP) over AAL5 LLC. For this encapsulation type, your router must be equipped with a Link Services or Voice Services PIC. MLPPP over ATM encapsulation is not supported on ATM2 IQ OC48 interfaces.</p> <p><b>atm-nlpid</b>—Use ATM NLPID encapsulation. When you use this encapsulation type, you can configure the <b>inet</b> family only.</p> <p><b>atm-ppp-llc</b>—(ATM2 IQ interfaces and MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP only) Use PPP over AAL5 LLC encapsulation.</p> <p><b>atm-ppp-vc-mux</b>—(ATM2 IQ interfaces and MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP only) Use PPP over ATM AAL5 multiplex encapsulation.</p> <p><b>atm-snap</b>—(All interfaces including MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP) Use ATM subnetwork attachment point (SNAP) encapsulation.</p> <p><b>atm-tcc-snap</b>—Use ATM SNAP encapsulation on translational cross-connect (TCC) circuits.</p> |

**atm-tcc-vc-mux**—Use ATM VC multiplex encapsulation on TCC circuits. When you use this encapsulation type, you can configure the **tcc** family only.

**atm-vc-mux**—(All interfaces including MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP) Use ATM VC multiplex encapsulation. When you use this encapsulation type, you can configure the **inet** family only.

**ether-over-atm-llc**—(All IP interfaces including MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP) For interfaces that carry IP traffic, use Ethernet over ATM LLC encapsulation. When you use this encapsulation type, you cannot configure multipoint interfaces.

**ether-vpls-over-atm-llc**—For ATM2 IQ interfaces only, use the Ethernet virtual private LAN service (VPLS) over ATM LLC encapsulation to bridge Ethernet interfaces and ATM interfaces over a VPLS routing instance (as described in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*). Packets from the ATM interfaces are converted to standard ENET2/802.3 encapsulated Ethernet frames with the frame check sequence (FCS) field removed.

**ether-vpls-over-fr**—For E1, T1, E3, T3, and SONET interfaces only, use the Ethernet virtual private LAN service (VPLS) over Frame Relay encapsulation to support Bridged Ethernet over Frame Relay encapsulated TDM interfaces for VPLS applications, per RFC 2427, *Multiprotocol Interconnect over Frame Relay*.



**NOTE:** The SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP, the Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP, and the DS3/E3 MIC do not support Ethernet over Frame Relay encapsulation.

**ether-vpls-over-ppp**—For E1, T1, E3, T3, and SONET interfaces only, use the Ethernet virtual private LAN service (VPLS) over Point-to-Point Protocol (PPP) encapsulation to support Bridged Ethernet over PPP-encapsulated TDM interfaces for VPLS applications.

**ethernet**—Use Ethernet II encapsulation (as described in RFC 894, *A Standard for the Transmission of IP Datagrams over Ethernet Networks*).

**ethernet-ccc**—Use Ethernet CCC encapsulation on Ethernet interfaces.

**ethernet-vpls**—Use Ethernet VPLS encapsulation on Ethernet interfaces that have VPLS enabled and that must accept packets carrying standard Tag Protocol ID (TPID) values.



**NOTE:** The built-in Gigabit Ethernet PIC on an M7i router does not support extended VLAN VPLS encapsulation.

**ethernet-vpls-fr**—Use in a VPLS setup when a CE device is connected to a PE device over a time-division multiplexing (TDM) link. This encapsulation type enables the PE device to terminate the outer layer 2 Frame Relay connection, use the 802.1p bits inside the inner Ethernet header to classify the packets, look at the MAC address from the Ethernet header, and use the MAC address to forward the packet into a given VPLS instance.

**frame-relay-ccc**—Use Frame Relay encapsulation on CCC circuits. When you use this encapsulation type, you can configure the **ccc** family only.

**frame-relay-ether-type**—Use Frame Relay ether type encapsulation for compatibility with Cisco Frame Relay. The physical interface must be configured with flexible-frame-relay encapsulation.

**frame-relay-ether-type-tcc**—Use Frame Relay ether type TCC for Cisco-compatible Frame Relay on TCC circuits to connect different media. The physical interface must be configured with flexible-frame-relay encapsulation.

**frame-relay-ppp**—Use PPP over Frame Relay circuits. When you use this encapsulation type, you can configure the **ppp** family only. J Series routers do not support frame-relay-ppp encapsulation.

**frame-relay-tcc**—Use Frame Relay encapsulation on TCC circuits for connecting different media. When you use this encapsulation type, you can configure the **tcc** family only.

**gre-fragmentation**—For adaptive services interfaces only, use GRE fragmentation encapsulation to enable fragmentation of IPv4 packets in GRE tunnels. This encapsulation clears the do not fragment (DF) bit in the packet header. If the packet's size exceeds the tunnel's maximum transmission unit (MTU) value, the packet is fragmented before encapsulation.

**multilink-frame-relay-end-to-end**—Use MLFR FRF.15 encapsulation. This encapsulation is used only on multilink, link services, and voice services interfaces and their constituent T1 or E1 interfaces, and is supported on LSQ and redundant LSQ interfaces.

**multilink-ppp**—Use MLPPP encapsulation. This encapsulation is used only on multilink, link services, and voice services interfaces and their constituent T1 or E1 interfaces.

**ppp-over-ether**—For underlying Ethernet interfaces on J Series routers, use PPP over Ethernet encapsulation. When you use this encapsulation type, you cannot configure the interface address. Instead, configure the interface address on the PPP interface. You also use PPP over Ethernet encapsulation to configure an underlying Ethernet interface for a dynamic PPPoE logical interface on M120 and M320 routers with Intelligent Queuing 2 (IQ2) PICs, and on MX Series routers with MPCs.

**ppp-over-ether-over-atm-llc**—(J Series routers and MX Series routers with MPCs using the ATM MIC with SFP only) For underlying ATM interfaces, use PPP over Ethernet over ATM LLC encapsulation. When you use this encapsulation type, you cannot configure the interface address. Instead, configure the interface address on the PPP interface.

**vlan-bridge**—Use Ethernet VLAN bridge encapsulation on Ethernet interfaces that have IEEE 802.1Q tagging, flexible-ethernet-services, and bridging enabled and that must accept packets carrying TPID 0x8100 or a user-defined TPID.

**vlan-ccc**—Use Ethernet virtual LAN (VLAN) encapsulation on CCC circuits. When you use this encapsulation type, you can configure the **ccc** family only.

**vlan-vci-ccc**—Use ATM-to-Ethernet interworking encapsulation on CCC circuits. When you use this encapsulation type, you can configure the **ccc** family only.

**vlan-tcc**—Use Ethernet VLAN encapsulation on TCC circuits. When you use this encapsulation type, you can configure the **tcc** family only.

**vlan-vpls**—Use Ethernet VLAN encapsulation on VPLS circuits.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring Layer 2 Switching Cross-Connects Using CCC
- Configuring the Encapsulation for Layer 2 Switching TCCs
- Configuring Interface Encapsulation on Logical Interfaces
- Configuring MPLS LSP Tunnel Cross-Connects Using CCC
- Circuit and Translational Cross-Connects Overview
- Identifying the Access Concentrator
- Configuring ATM Interface Encapsulation
- Configuring VLAN Encapsulation
- Configuring Extended VLAN Encapsulation
- Configuring ISDN Logical Interface Properties
- Configuring ATM-to-Ethernet Interworking
- Configuring Interface Encapsulation on PTX Series Packet Transport Switches
- [Configuring CCC Encapsulation for Layer 2 VPNs on page 21](#)
- [Configuring TCC Encapsulation for Layer 2 VPNs and Layer 2 Circuits on page 22](#)
- Configuring ATM for Subscriber Access
- Junos Services Interfaces Configuration Release 12.3
- CoS on ATM IMA Pseudowire Interfaces Overview
- Configuring Policing on an ATM IMA Pseudowire

## encapsulation (Physical Interface)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | encapsulation (atm-ccc-cell-relay   atm-pvc   cisco-hdlc   cisco-hdlc-ccc   cisco-hdlc-tcc   ethernet-bridge   ethernet-ccc   ethernet-over-atm   ethernet-tcc   ethernet-vpls   ethernet-vpls-fr   ether-vpls-over-atm-llc   ethernet-vpls-ppp   extended-frame-relay-ccc   extended-frame-relay-ether-type-tcc   extended-frame-relay-tcc   extended-vlan-bridge   extended-vlan-ccc   extended-vlan-tcc   extended-vlan-vpls   flexible-ethernet-services   flexible-frame-relay   frame-relay   frame-relay-ccc   frame-relay-ether-type   frame-relay-ether-type-tcc   frame-relay-port-ccc   frame-relay-tcc   generic-services   multilink-frame-relay-uni-nni   ppp   ppp-ccc   ppp-tcc   vlan-ccc   vlan-vci-ccc   vlan-vpls);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> ],<br>[edit interfaces rlsq <i>number:number</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 11.1 for EX Series switches.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Switches ( <b>flexible-ethernet-services</b> , <b>ethernet-ccc</b> , and <b>ethernet-tcc</b> options only).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>         | Specify the physical link-layer encapsulation type. Not all encapsulation types are supported on the switches. See the switch CLI.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Default</b>             | <b>ppp</b> —Use serial PPP encapsulation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Options</b>             | <p><b>atm-ccc-cell-relay</b>—Use ATM cell-relay encapsulation.</p> <p><b>atm-pvc</b>—Use ATM PVC encapsulation.</p> <p><b>cisco-hdlc</b>—Use Cisco-compatible High-Level Data Link Control (HDLC) framing.</p> <p><b>cisco-hdlc-ccc</b>—Use Cisco-compatible HDLC framing on CCC circuits.</p> <p><b>cisco-hdlc-tcc</b>—Use Cisco-compatible HDLC framing on TCC circuits for connecting different media.</p> <p><b>ethernet-bridge</b>—Use Ethernet bridge encapsulation on Ethernet interfaces that have bridging enabled and that must accept all packets.</p> <p><b>ethernet-ccc</b>—Use Ethernet CCC encapsulation on Ethernet interfaces that must accept packets carrying standard Tag Protocol ID (TPID) values. For 8-port, 12-port, and 48-port Fast Ethernet PICs, CCC is not supported.</p> <p><b>ethernet-over-atm</b>—For interfaces that carry IPv4 traffic, use Ethernet over ATM encapsulation. When you use this encapsulation type, you cannot configure multipoint interfaces. As defined in RFC 2684, <i>Multiprotocol Encapsulation over ATM Adaptation Layer 5</i>, this encapsulation type allows ATM interfaces to connect to devices that support only bridge protocol data units (BPDUs). Junos OS does not completely support bridging, but accepts BPDUs packets as a default gateway. If you use the router as an edge device, then the router acts as a default gateway. It accepts Ethernet LLC/SNAP frames with IP or ARP in the payload, and drops the rest. For packets destined to the Ethernet LAN, a route lookup is done using the destination</p> |



IP address. If the route lookup yields a full address match, the packet is encapsulated with an LLC/SNAP and MAC header, and the packet is forwarded to the ATM interface.

**ethernet-tcc**—For interfaces that carry IPv4 traffic, use Ethernet TCC encapsulation on interfaces that must accept packets carrying standard TPID values. For 8-port, 12-port, and 48-port Fast Ethernet PICs, TCC is not supported.

**ethernet-vpls**—Use Ethernet VPLS encapsulation on Ethernet interfaces that have VPLS enabled and that must accept packets carrying standard TPID values. On M Series routers, except the M320 router, the 4-port Fast Ethernet TX PIC and the 1-port, 2-port, and 4-port, 4-slot Gigabit Ethernet PICs can use the Ethernet VPLS encapsulation type.

**ethernet-vpls-fr**—Use in a VPLS setup when a CE device is connected to a PE device over a time division multiplexing (TDM) link. This encapsulation type enables the PE device to terminate the outer layer 2 Frame Relay connection, use the 802.1p bits inside the inner Ethernet header to classify the packets, look at the MAC address from the Ethernet header, and use the MAC address to forward the packet into a given VPLS instance.

**ethernet-vpls-ppp**—Use in a VPLS setup when a CE device is connected to a PE device over a time division multiplexing (TDM) link. This encapsulation type enables the PE device to terminate the outer layer 2 PPP connection, use the 802.1p bits inside the inner Ethernet header to classify the packets, look at the MAC address from the Ethernet header, and use it to forward the packet into a given VPLS instance.

**ether-vpls-over-atm-llc**—For ATM intelligent queuing (IQ) interfaces only, use the Ethernet virtual private LAN service (VPLS) over ATM LLC encapsulation to bridge Ethernet interfaces and ATM interfaces over a VPLS routing instance (as described in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*). Packets from the ATM interfaces are converted to standard ENET2/802.3 encapsulated Ethernet frames with the frame check sequence (FCS) field removed.

**extended-frame-relay-ccc**—Use Frame Relay encapsulation on CCC circuits. This encapsulation type allows you to dedicate DLCIs 1 through 1022 to CCC.

**extended-frame-relay-ether-type-tcc**—Use extended Frame Relay ether type TCC for Cisco-compatible Frame Relay for DLCIs 1 through 1022. This encapsulation type is used for circuits with different media on either side of the connection.

**extended-frame-relay-tcc**—Use Frame Relay encapsulation on TCC circuits to connect different media. This encapsulation type allows you to dedicate DLCIs 1 through 1022 to TCC.

**extended-vlan-bridge**—Use extended VLAN bridge encapsulation on Ethernet interfaces that have IEEE 802.1Q VLAN tagging and bridging enabled and that must accept packets carrying TPID 0x8100 or a user-defined TPID.

**extended-vlan-ccc**—Use extended VLAN encapsulation on CCC circuits with Gigabit Ethernet and 4-port Fast Ethernet interfaces that must accept packets carrying 802.1Q values. For 8-port, 12-port, and 48-port Fast Ethernet PICs, extended VLAN CCC is not supported. For 4-port Gigabit Ethernet PICs, extended VLAN CCC is not supported.

**extended-vlan-tcc**—For interfaces that carry IPv4 traffic, use extended VLAN encapsulation on TCC circuits with Gigabit Ethernet interfaces on which you want to use 802.1Q tagging. For 4-port Gigabit Ethernet PICs, extended VLAN TCC is not supported.

**extended-vlan-vpls**—Use extended VLAN VPLS encapsulation on Ethernet interfaces that have VLAN 802.1Q tagging and VPLS enabled and that must accept packets carrying TPIDs 0x8100, 0x9100, and 0x9901. On M Series routers, except the M320 router, the 4-port Fast Ethernet TX PIC and the 1-port, 2-port, and 4-port, 4-slot Gigabit Ethernet PICs can use the Ethernet VPLS encapsulation type.



**NOTE:** The built-in Gigabit Ethernet PIC on an M7i router does not support extended VLAN VPLS encapsulation.

**flexible-ethernet-services**—For Gigabit Ethernet IQ interfaces and Gigabit Ethernet PICs with small form-factor pluggable transceivers (SFPs) (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), use flexible Ethernet services encapsulation when you want to configure multiple per-unit Ethernet encapsulations. Aggregated Ethernet bundles can use this encapsulation type. This encapsulation type allows you to configure any combination of route, TCC, CCC, Layer 2 virtual private networks (VPNs), and VPLS encapsulations on a single physical port. If you configure flexible Ethernet services encapsulation on the physical interface, VLAN IDs from 1 through 511 are no longer reserved for normal VLANs.

**flexible-frame-relay**—For IQ interfaces only, use flexible Frame Relay encapsulation when you want to configure multiple per-unit Frame Relay encapsulations. This encapsulation type allows you to configure any combination of TCC, CCC, and standard Frame Relay encapsulations on a single physical port. Also, each logical interface can have any DLCI value from 1 through 1022.

**frame-relay**—Use Frame Relay encapsulation.

**frame-relay-ccc**—Use Frame Relay encapsulation on CCC circuits.

**frame-relay-ether-type**—Use Frame Relay ether type encapsulation for compatibility with the Cisco Frame Relay.

**frame-relay-ether-type-tcc**—Use Frame Relay ether type TCC for Cisco-compatible Frame Relay on TCC circuits to connect different media.

**frame-relay-port-ccc**—Use Frame Relay port CCC encapsulation to transparently carry all the DLCIs between two customer edge (CE) routers without explicitly configuring each DLCI on the two provider edge (PE) routers with Frame Relay transport. When you use this encapsulation type, you can configure the **ccc** family only.

**frame-relay-tcc**—Use Frame Relay encapsulation on TCC circuits to connect different media.

**generic-services**—Use generic services encapsulation for services with a hierarchical scheduler.

**multilink-frame-relay-uni-nni**—Use MLFR UNI NNI encapsulation. This encapsulation is used on link services, voice services interfaces functioning as FRF.16 bundles, and their constituent T1 or E1 interfaces, and is supported on LSQ and redundant LSQ interfaces.

**ppp**—Use serial PPP encapsulation.

**ppp-ccc**—Use serial PPP encapsulation on CCC circuits. When you use this encapsulation type, you can configure the **ccc** family only.

**ppp-tcc**—Use serial PPP encapsulation on TCC circuits for connecting different media. When you use this encapsulation type, you can configure the **tcc** family only.

**vlan-ccc**—Use Ethernet VLAN encapsulation on CCC circuits.

**vlan-vci-ccc**—Use ATM-to-Ethernet interworking encapsulation on CCC circuits. When you use this encapsulation type, you can configure the **ccc** family only. All logical interfaces configured on the Ethernet interface must also have the encapsulation type set to **vlan-vci-ccc**.

**vlan-vpls**—Use VLAN VPLS encapsulation on Ethernet interfaces with VLAN tagging and VPLS enabled. Interfaces with VLAN VPLS encapsulation accept packets carrying standard TPID values only. On M Series routers, except the M320 router, the 4-port Fast Ethernet TX PIC and the 1-port, 2-port, and 4-port, 4-slot Gigabit Ethernet PICs can use the Ethernet VPLS encapsulation type.



**NOTE:** Label-switched interfaces (LSIs) do not support VLAN VPLS encapsulation. Therefore, you can only use VLAN VPLS encapsulation on a PE-router-to-CE-router interface and not a core-facing interface.

|                                 |                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | <b>interface</b> —To view this statement in the configuration.<br><b>interface-control</b> —To add this statement to the configuration. |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|

**Related  
Documentation**

- Configuring Interface Encapsulation on Physical Interfaces
- [Configuring CCC Encapsulation for Layer 2 VPNs on page 21](#)
- Configuring Layer 2 Switching Cross-Connects Using CCC
- [Configuring TCC Encapsulation for Layer 2 VPNs and Layer 2 Circuits on page 22](#)
- Configuring ATM Interface Encapsulation
- Configuring ATM-to-Ethernet Interworking
- Configuring VLAN Encapsulation
- Configuring Extended VLAN Encapsulation
- Configuring Encapsulation for Layer 2 Wholesale VLAN Interfaces
- Configuring Interfaces for Layer 2 Circuits
- Configuring Interface Encapsulation on PTX Series Packet Transport Switches
- Configuring an MPLS-Based Layer 2 VPN (CLI Procedure)
- Configuring MPLS LSP Tunnel Cross-Connects Using CCC
- Configuring TCC
- Configuring VPLS Interface Encapsulation
- Configuring Interfaces for VPLS Routing
- Defining the Encapsulation for Switching Cross-Connects
- Understanding Encapsulation on an Interface

## encapsulation-type (Layer 2 VPNs)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>encapsulation-type (atm-aal5   atm-cell   atm-cell-port-mode   atm-cell-vc-mode   atm-cell-vp-mode   cesop   cisco-hdlc   ethernet   ethernet-vlan   frame-relay   frame-relay-port-mode   interworking   ppp   satop-e1   satop-e3   satop-t1   satop-t3);</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>     | <p>[edit logical-systems <i>logical-system-name</i> protocols l2circuit neighbor <i>address</i> interface <i>interface-name</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn neighbor <i>address</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols vpls],</p> <p>[edit protocols l2circuit neighbor <i>address</i> interface <i>interface-name</i>],</p> <p>[edit routing-instances <i>routing-instance-name</i> protocols l2vpn],</p> <p>[edit routing-instances <i>routing-instance-name</i> protocols l2vpn neighbor <i>address</i>],</p> <p>[edit routing-instances <i>routing-instance-name</i> protocols vpls],</p> <p>[edit routing-instances <i>routing-instance-name</i> protocols vpls neighbor <i>address</i>]</p> |
| <b>Release Information</b> | <p>Statement introduced in Junos OS Release 9.2.</p> <p>Statement introduced in Junos OS Release 11.1 for EX Series switches.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>         | Specify the type of Layer 2 traffic originating from the CE device. Only the <b>ethernet</b> and <b>ethernet-vlan</b> encapsulation types are supported for VPLS. Not all encapsulation types are supported on the switches. See the switch CLI.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Options</b>             | <p><b>atm-aal5</b>—ATM Adaptation Layer (AAL/5)</p> <p><b>atm-cell</b>—ATM cell relay</p> <p><b>atm-cell-port-mode</b>—ATM cell relay port promiscuous mode</p> <p><b>atm-cell-vc-mode</b>—ATM VC cell relay nonpromiscuous mode</p> <p><b>atm-cell-vp-mode</b>—ATM virtual path (VP) cell relay promiscuous mode</p> <p><b>cesop</b>—CESOP-based Layer 2 VPN</p> <p><b>cisco-hdlc</b>—Cisco Systems-compatible HDLC</p> <p><b>ethernet</b>—Ethernet</p> <p><b>ethernet-vlan</b>—Ethernet VLAN</p> <p><b>frame-relay</b>—Frame Relay</p> <p><b>frame-relay-port-mode</b>—Frame Relay port mode</p> <p><b>interworking</b>—Layer 2.5 interworking VPN</p> <p><b>ppp</b>—PPP</p> <p><b>satsop-e1</b>—SATSOP-E1-based Layer 2 VPN</p>                                                                                                                                                                                                                                                                      |

**satsop-e3**—SATSOP-E3-based Layer 2 VPN

**satsop-t1**—SATSOP-T1-based Layer 2 VPN

**satsop-t3**—SATSOP-T3-based Layer 2 VPN

**Default:** For VPLS networks, the default encapsulation type is **ethernet**.

**Required Privilege Level** routing—To view this statement in the configuration.  
routing-control—To add this statement to the configuration.

**Related Documentation**

- [Configuring the Encapsulation Type on page 16](#)
- Configuring VPLS Routing Instances
- Configuring Interfaces for Layer 2 Circuits
- Configuring an MPLS-Based Layer 2 VPN (CLI Procedure)

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## interface (Protocols Layer 2 VPN)

---

**Syntax** `interface interface-name {  
    description text;  
    remote-site-id remote-site-id;  
}`

**Hierarchy Level** [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn],  
[edit routing-instances *routing-instance-name* protocols l2vpn]

**Release Information** Statement introduced before Junos OS Release 7.4.

**Description** Configure an interface to handle traffic for a circuit configured for the Layer 2 VPN.

**Options** *interface-name*—Name of the interface used for the Layer 2 VPN.  
  
The remaining statements are explained separately.

**Required Privilege Level** routing—To view this statement in the configuration.  
routing-control—To add this statement to the configuration.

**Related Documentation**

- [Configuring the Site on page 14](#)
- [Configuring the Remote Site ID on page 14](#)

## l2vpn

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> l2vpn {   (control-word   no-control-word);   encapsulation-type type;   traceoptions {     file filename &lt;files number&gt; &lt;size size&gt; &lt;world-readable   no-world-readable&gt;;     flag flag &lt;flag-modifier&gt; &lt;disable&gt;;   }   site site-name {     site-identifier identifier;     site-preference preference-value {       backup;       primary;     }     interface interface-name {       description text;       remote-site-id remote-site-id;     }   } } </pre> |
| <b>Hierarchy Level</b>          | <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols],</p> <p>[edit routing-instances <i>routing-instance-name</i> protocols]</p>                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 11.1 for EX Series switches.</p>                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>              | <p>Enable a Layer 2 VPN routing instance on a PE router or switch.</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring a Layer 2 VPN Routing Instance on page 13</a></li> <li>• <a href="#">Configuring an MPLS-Based Layer 2 VPN (CLI Procedure)</a></li> </ul>                                                                                                                                                                                                                                                                                              |


## l2vpn-use-bgp-rules

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|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | l2vpn-use-bgp-rules;                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit logical-systems <i>logical-system-name</i> protocols bgp path-selection],<br>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols<br>bgp path-selection],<br>[edit protocols bgp path-selection],<br>[edit routing-instances <i>routing-instance-name</i> protocols bgp path-selection]                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.<br>Statement introduced in Junos OS Release 12.3 for ACX Series routers.                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | Enable routers to use both the BGP path selection algorithm and the designated forwarder path selection algorithm when selecting the preferred path to each destination in a Layer 2 VPN or VPLS routing instance. The BGP path selection algorithm is used by all of the Provider routers participating in the routing instance. The designated forwarder path selection algorithm is used by the PE router participating in the routing instance. |
| <b>Default</b>                  | By default, the designated forwarder path selection algorithm is used to select the best path to reach each destination within Layer 2 VPN and VPLS routing instances.                                                                                                                                                                                                                                                                              |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Enabling BGP Path Selection for Layer 2 VPNs and VPLS on page 19</a></li><li>• route-distinguisher</li></ul>                                                                                                                                                                                                                                                                                    |



## no-control-word (Protocols Layer 2 VPN)

|                                 |                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-control-word;                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols <a href="#">l2vpn</a> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <a href="#">l2vpn</a> ]                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Disable the control word. This might be necessary on networks with equipment that does not support the control word.                                                                                                                                                                                                                                                        |
|                                 | <div>  <p><b>NOTE:</b> The following configuration statements are ignored for time-division multiplexing pseudowires at the [edit protocols <a href="#">l2vpn</a>] hierarchy level:</p> <ul style="list-style-type: none"> <li>• control-word</li> <li>• no-control-word</li> </ul> </div> |
| <b>Default</b>                  | The control word is enabled by default. Use the <b>no-control-word</b> statement to disable the control word.                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Disabling the Control Word for Layer 2 VPNs on page 24</a></li> <li>• <a href="#">control-word on page 106</a></li> </ul>                                                                                                                                                                                              |

## oam

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|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>oam {<br/>  ping-interval;<br/>  bfd-liveness-detection {<br/>    detection-time {<br/>      threshold <i>milliseconds</i>;<br/>    }<br/>    minimum-interval <i>milliseconds</i>;<br/>    minimum-receive-interval <i>milliseconds</i>;<br/>    multiplier <i>number</i>;<br/>    no-adaptation;<br/>    transmit-interval {<br/>      minimum-interval <i>milliseconds</i>;<br/>      threshold <i>milliseconds</i>;<br/>    }<br/>    version <i>bfd-protocol-version</i>;<br/>  }<br/>  control-channel {<br/>    pwe3-control-word;<br/>    pseudowire-label-ttl-1;<br/>    router-alert-label;<br/>  }<br/>}</pre> |
| <b>Hierarchy Level</b>          | [edit routing-instances <i>routing-instance-name</i> protocols l2vpn],<br>[edit routing-instances <i>routing-instance-name</i> protocols vpls],<br>[edit routing-instances <i>routing-instance-name</i> protocols vpls neighbor <i>address</i> ],<br>[edit protocols l2circuit neighbor <i>address</i> interface <i>interface-name</i> ]                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.<br>Support for VPLS FEC 129 introduced in Junos OS Release 12.2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | Allows you to configure bidirectional forwarding detection (BFD) and a control channel for a pseudowire, in addition to the corresponding operations and management functions to be used over that control channel. BFD provides a low resource fault detection mechanism for the continuous monitoring of the pseudowire data path and for detecting data plane failures. The <b>control-channel</b> statement is not applicable to Layer 2 circuit pseudowires.                                                                                                                                                              |
| <b>Options</b>                  | The <b>bfd-liveness-detection</b> statement and substatements are described in the Junos OS Routing Protocols Configuration Guide.<br><br>The other statements are explained separately.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>Configuring BFD for VCCV for Layer 2 VPNs, Layer 2 Circuits, and VPLS</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## ping-interval

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | ping-interval;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | <p>[edit logical-systems <i>logical-system-name</i> protocols l2circuit neighbor <i>address</i> interface <i>interface-name</i> oam],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>instance-name</i> protocols l2vpn oam],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>instance-name</i> protocols vpls neighbor <i>address</i> oam],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>instance-name</i> protocols vpls mesh-group <i>mesh-group-name</i> neighbor <i>address</i> oam],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>instance-name</i> protocols vpls oam],</p> <p>[edit protocols l2circuit neighbor <i>address</i> interface <i>interface-name</i> oam],</p> <p>[edit routing-instances <i>instance-name</i> protocols l2vpn oam],</p> <p>[edit routing-instances <i>instance-name</i> protocols vpls neighbor <i>address</i> oam],</p> <p>[edit routing-instances <i>instance-name</i> protocols vpls mesh-group <i>mesh-group-name</i> neighbor <i>address</i> oam],</p> <p>[edit routing-instances <i>instance-name</i> protocols vpls oam]</p> |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 10.0.</p> <p>Support for FEC 129 VPLS added in Junos OS Release 12.2.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | Configure the time interval between ping messages for bidirectional forwarding detection (BFD) sessions enabled over pseudowires inside a VPN.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Options</b>                  | <p><i>seconds</i>—Time interval between ping messages.</p> <p><b>Range:</b> 30 through 3600</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>Configuring BFD for VCCV for Layer 2 VPNs, Layer 2 Circuits, and VPLS in the Junos OS VPNs Configuration Guide</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

## policer (Layer 2 VPN)

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|                                 |                                                                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>policer {<br/>    input <i>policer-template-name</i>;<br/>    output <i>policer-template-name</i>;<br/>}</pre>                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family (ccc   inet   tcc)],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family (ccc   inet   tcc)]            |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                             |
| <b>Description</b>              | Use policing to control the amount of traffic flowing over the interfaces servicing a Layer 2 VPN.                                                                                                                                                            |
| <b>Options</b>                  | <p><b>input <i>policer-template-name</i></b>—Name of one policer to evaluate when packets are received on the interface.</p> <p><b>output <i>policer-template-name</i></b>—Name of one policer to evaluate when packets are transmitted on the interface.</p> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Traffic Policing in Layer 2 VPNs on page 23</a></li><li>• Routing Policy Configuration Guide</li><li>• Junos® OS Network Interfaces</li></ul>                                                 |

## proxy (Interfaces)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>proxy inet-address <i>address</i>;</code>                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family tcc],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family tcc]                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | For Layer 2.5 VPNs using an Ethernet interface as the TCC router, configure the IP address for which the TCC router is proxying. Ethernet TCC is supported on interfaces that carry IPv4 traffic only. Ethernet TCC encapsulation is supported on 1-port Gigabit Ethernet, 2-port Gigabit Ethernet, 4-port Gigabit Ethernet, and 4-port Fast Ethernet PICs only. Ethernet TCC is not supported on the T640 routing node. |
| <b>Options</b>                  | <b>inet-address <i>address</i></b> —IP address for which the TCC router is acting as a proxy.                                                                                                                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring TCC Encapsulation for Layer 2 VPNs and Layer 2 Circuits on page 22</a></li> </ul>                                                                                                                                                                                                                                                                       |

## remote

|                                 |                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>remote (inet-address   mac-address) <i>address</i>;</code>                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family tcc],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family tcc]                                                                                                                               |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | For Layer 2.5 VPNs employing an Ethernet interface as the TCC router, configure the location of the remote router. Ethernet TCC is supported on interfaces that carry IPv4 traffic only. Ethernet TCC encapsulation is supported on 1-port Gigabit Ethernet, 2-port Gigabit Ethernet, 4-port Gigabit Ethernet, and 4-port Fast Ethernet PICs only. |
| <b>Options</b>                  | <b>inet-address <i>address</i></b> —The IP address of the remote site.<br><br><b>mac-address <i>address</i></b> —The MAC address of the remote site.                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring TCC Encapsulation for Layer 2 VPNs and Layer 2 Circuits on page 22</a></li> </ul>                                                                                                                                                                                                 |

## remote-site-id

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|                                 |                                                                                                                                                                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>remote-site-id remote-site-ID;</code>                                                                                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn site <i>site-name</i> interface <i>interface-name</i> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols l2vpn site <i>site-name</i> interface <i>interface-name</i> ] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 11.1 for EX Series switches.                                                                                                                                                                               |
| <b>Description</b>              | Control the remote interface to which the interface should connect. If you do not explicitly configure the remote site ID, the order of the interfaces configured for the site determines the default value. This statement is optional.                                                                 |
| <b>Options</b>                  | <i>remote-site-ID</i> —Identifier specifying the interface on the remote PE router the Layer 2 VPN routing instance connects to.                                                                                                                                                                         |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Remote Site ID on page 14</a></li><li>• <a href="#">Configuring an MPLS-Based Layer 2 VPN (CLI Procedure)</a></li></ul>                                                                                                              |

## site (Layer 2 Circuits)

|                                 |                                                                                                                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> site <i>site-name</i> {   site-identifier <i>identifier</i>;   site-preference <i>preference-value</i> {     backup;     primary;   }   interface <i>interface-name</i> {     description <i>text</i>;     remote-site-id <i>remote-site-ID</i>;   } }</pre> |
| <b>Hierarchy Level</b>          | [edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn],<br>[edit routing-instances <i>routing-instance-name</i> protocols l2vpn]                                                                         |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 11.1 for EX Series switches.                                                                                                                                         |
| <b>Description</b>              | Specify the site name, site identifier, and interfaces connecting to the site. Allows you to configure a remote site ID for remote sites.                                                                                                                          |
| <b>Options</b>                  | <p><b>site-identifier <i>identifier</i></b>—Numerical identifier for the site used as a default reference for the remote site ID.</p> <p><b><i>site-name</i></b>—Name of the site.</p> <p>The remaining statements are explained separately.</p>                   |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Site on page 14</a></li> <li>• Configuring an MPLS-Based Layer 2 VPN (CLI Procedure)</li> </ul>                                                                                               |

## site-identifier (Layer 2 Circuits)

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|                                 |                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | site-identifier <i>identifier</i> ;                                                                                                                                                                                                      |
| <b>Hierarchy Level</b>          | [edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn site <i>site-name</i> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols l2vpn site <i>site-name</i> ] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 11.1 for EX Series switches.                                                                                                               |
| <b>Description</b>              | Specify the numerical identifier for the local Layer 2 VPN site.                                                                                                                                                                         |
| <b>Options</b>                  | <i>identifier</i> —The numerical identifier for the Layer 2 VPN site, which can be any number from 1 through 65,534.                                                                                                                     |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Site on page 14</a></li><li>• <a href="#">Configuring an MPLS-Based Layer 2 VPN (CLI Procedure)</a></li></ul>                                                        |



## site-preference (Layer 2 Circuits)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>site-preference <i>preference-value</i> {     backup;     primary; }</pre>                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn site <i>site-name</i> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols l2vpn site <i>site-name</i> ],                                                                                                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.1.                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>              | Specify the preference value advertised for a particular Layer 2 VPN site. The site preference value is encoded in the BGP local preference attribute. When a PE router receives multiple advertisements with the same VE identifier, the advertisement with the highest local preference value is preferred. You can use this statement to enable multihoming for Layer 2 VPNs. |
| <b>Options</b>                  | <p><b><i>preference-value</i></b>—Specify the preference value advertised for a Layer 2 VPN.</p> <p><b>Range:</b> 1 through 65,535</p> <p><b>backup</b>—Set the preference value to 1.</p> <p><b>primary</b>—Set the preference value to 65,535.</p>                                                                                                                             |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring a Site Preference and Layer 2 VPN Multihoming on page 16</a></li> </ul>                                                                                                                                                                                                                                         |

## traceoptions (Protocols Layer 2 VPN)

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|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <pre>traceoptions {<br/>    file <i>filename</i> &lt;files <i>number</i>&gt; &lt;size <i>size</i>&gt; &lt;world-readable   no-world-readable&gt;;<br/>    flag <i>flag</i> &lt;<i>flag-modifier</i>&gt; &lt;disable&gt;;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>     | [edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn],<br>[edit routing-instances <i>routing-instance-name</i> protocols l2vpn]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>         | Trace traffic flowing through a Layer 2 VPN.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Options</b>             | <p><b>disable</b>—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as <b>all</b>.</p> <p><b>file <i>filename</i></b>—Name of the file to receive the output of the tracing operation. Enclose the name in quotation marks (" ").</p> <p><b>files <i>number</i></b>—(Optional) Maximum number of trace files. When a trace file named <i>trace-file</i> reaches its maximum size, it is renamed <i>trace-file.0</i>, then <i>trace-file.1</i>, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.</p> <p>If you specify a maximum number of files, you also must specify a maximum file size with the <b>size</b> option.</p> <p><b>Range:</b> 2 through 1000 files</p> <p><b>Default:</b> 2 files</p> <p><b>flag <i>flag</i></b>—Tracing operation to perform. To specify more than one tracing operation, include multiple <b>flag</b> statements.</p> <ul style="list-style-type: none"><li>• <b>all</b>—All Layer 2 VPN tracing options</li><li>• <b>connections</b>—Layer 2 connections (events and state changes)</li><li>• <b>error</b>—Error conditions</li><li>• <b>general</b>—General events</li><li>• <b>nlri</b>—Layer 2 advertisements received or sent by means of the BGP</li><li>• <b>normal</b>—Normal events</li><li>• <b>policy</b>—Policy processing</li><li>• <b>route</b>—Routing information</li><li>• <b>state</b>—State transitions</li><li>• <b>task</b>—Routing protocol task processing</li></ul> |

- **timer**—Routing protocol timer processing
- **topology**—Layer 2 VPN topology changes caused by reconfiguration or advertisements received from other PE routers using BGP

**flag-modifier**—(Optional) Modifier for the tracing flag. You can specify the following modifier:

- **detail**—Provide detailed trace information
- **receive**—Trace received packets
- **send**—Trace transmitted packets

**no-world-readable**—(Optional) Prevents any user from reading the trace file.

**size size**—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named *trace-file* reaches this size, it is renamed *trace-file.0*. When *trace-file* again reaches its maximum size, *trace-file.0* is renamed *trace-file.1* and *trace-file* is renamed *trace-file.0*. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

**Syntax:** *xk* to specify kilobytes, *xm* to specify megabytes, or *xg* to specify gigabytes

**Range:** 10 KB through the maximum file size supported on your system

**Default:** 1 MB

**world-readable**—(Optional) Allow any user to read the trace file.

**Default:** The default is **no-world-readable**.

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Tracing Layer 2 VPN Traffic and Operations on page 17</a></li></ul> |

## traceoptions (Egress Protection)

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|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>traceoptions {<br/>    file <i>filename</i> &lt;files <i>number</i>&gt; &lt;size <i>size</i>&gt; &lt;world-readable   no-world-readable&gt;;<br/>    flag <i>flag</i>;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>          | [edit protocols mpls egress-protection],                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.4R3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | Configure tracing operations for egress protection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Options</b>                  | <p><b><i>filename</i></b> —Name of the file to receive the output of the tracing operation.</p> <p><b><i>files number</i></b>—(Optional) Maximum number of trace files. If you specify a maximum number of files, you must also include the <b>size</b> statement to specify the maximum file size. When a trace file named <i>trace-file</i> reaches its maximum size, it is renamed <i>trace-file.0</i>, then <i>trace-file.1</i>, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.</p> <p><b>Range:</b> 2 through 1000</p> <p><b>Default:</b> 2 files</p> <p><b><i>flag</i></b>—Tracing operation to perform. To specify more than one tracing operation, include multiple <b><i>flag</i></b> statements.</p> <ul style="list-style-type: none"><li>• <b>all</b>—Trace all operations</li><li>• <b>error</b>—Trace error conditions</li><li>• <b>route</b>—Trace route transitions</li><li>• <b>state</b>—Trace state transitions</li></ul> |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• Example: Configuring Egress Protection for Layer 3 VPN Services</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## PART 4

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