Network Configuration Example

Configuring BGP Autodiscovery for LDP VPLS

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Table of Contents

CHAPTER 1

Configuring BGP Autodiscovery for LDP VPLS

About This Network Configuration Example

This network configuration example describes how to configure BGP autodiscovery for LDP VPLS and user-defined mesh groups for BGP autodiscovery for LDP VPLS as specified in Forwarding Equivalence Class 129.

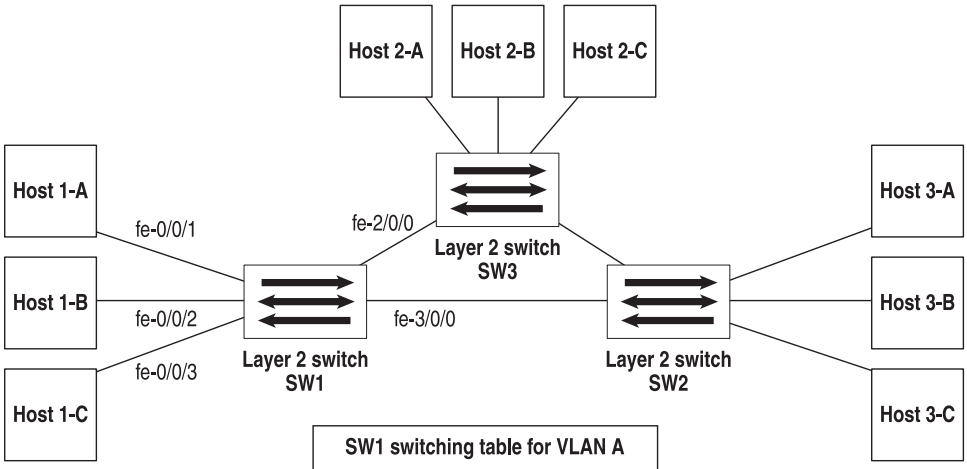
Virtual Private LAN Service Overview

Ethernet is an increasingly important component of a service provider's slate of service offerings. Many customers are requesting the ability to connect LAN locations around the world. To fulfill customer needs, service providers have had to set up complex point-to-point Layer 2 virtual private networks (VPNs) or connect expensive Layer 2 switches to handle traffic.

Virtual private LAN service (VPLS) meets the growing Ethernet needs of service providers and their customers. VPLS is an Ethernet-based multipoint-to-multipoint Layer 2 VPN. With VPLS, multiple Ethernet LAN sites can be connected to each other across an MPLS backbone. To the customer, all sites interconnected by VPLS appear to be on the same Ethernet LAN (even though traffic travels across a service provider network).

Before VPLS, the only way you could connect Ethernet LAN sites together was to set up a non-VPLS Layer 2 VPN or install multiple Layer 2 Ethernet switches. Figure 1 on page 6 shows how three switches can be connected to each other.

Figure 1: Ethernet Switching Example



SW1 switching table for VLAN A

Port	MAC Address
fe-0/0/1	1a1a.1a1a.1a1a
fe-2/0/0	2a2a.2a2a.2a2a
fe-3/0/0	3a3a.3a3a.3a3a

SW1 switching table for VLAN B

Port	MAC Address
fe-0/0/2	1b1b.1b1b.1b1b
fe-2/0/0	2b2b.2b2b.2b2b
fe-3/0/0	3b3b.3b3b.3b3b

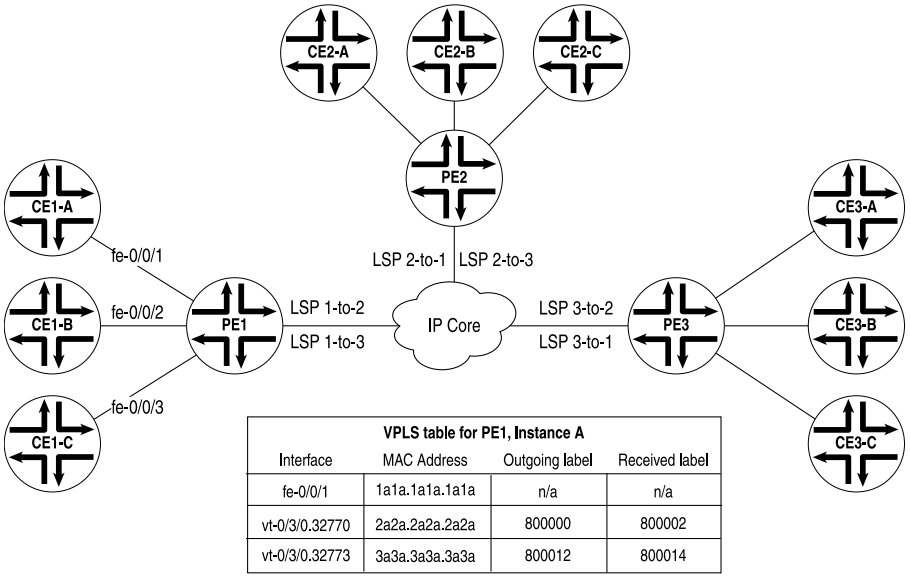
SW1 switching table for VLAN C

Port	MAC Address
fe-0/0/3	1c1c.1c1c.1c1c
fe-2/0/0	2c2c.2c2c.2c2c
fe-3/0/0	3c3c.3c3c.3c3c

A typical switch builds its Layer 2 switching table with media access control (MAC) address and interface information learned from traffic received from other switches. If a switch does not have an exit port associated with a particular destination, it floods traffic for that destination to all ports except the port where the traffic originated. When reachability information for a destination is received, this information is added to the switching table. If the switching table has an entry for the destination, the switch sends the traffic directly to the intended recipient through the associated port listed in the switching table.

Figure 2 on page 7 shows a VPLS network comparable to the switch example and explains how VPLS functions similarly to Ethernet switches (assuming a Spanning Tree Protocol (STP) is configured).

Figure 2: VPLS Introductory Example



VPLS table for PE1, Instance A

Interface	MAC Address	Outgoing label	Received label
fe-0/0/1	1a1a.1a1a.1a1a	n/a	n/a
vt-0/3/0.32770	2a2a.2a2a.2a2a	800000	800002
vt-0/3/0.32773	3a3a.3a3a.3a3a	800012	800014

VPLS table for PE1, Instance B

Interface	MAC Address	Outgoing label	Received label
fe-0/0/2	1b1b.1b1b.1b1b	n/a	n/a
vt-0/3/0.32771	2b2b.2b2b.2b2b	800004	800006
vt-0/3/0.32774	3b3b.3b3b.3b3b	800016	800018

VPLS table for PE1, Instance C

Interface	MAC Address	Outgoing label	Received label
fe-0/0/3	1c1c.1c1c.1c1c	n/a	n/a
vt-0/3/0.32772	2c2c.2c2c.2c2c	800008	800010
vt-0/3/0.32775	3c3c.3c3c.3c3c	800020	800022

Notice that Layer 2 information gathered by a switch (for example, MAC addresses and interface ports) is included in the VPLS instance table. However, instead of requiring all VPLS interfaces to be physical switch ports, the router allows remote traffic for a VPLS instance to be delivered across an MPLS label-switched path (LSP) and arrive on a virtual port. The virtual port emulates a local, physical port. Traffic can be learned, forwarded, or flooded to the virtual port similar to the way traffic is sent to a local port.

The VPLS table learns MAC address and interface information for both physical and virtual ports. If no activity is seen for a particular MAC address, it is purged from the table over time.

As shown in Figure 2 on page 7, the main difference between a physical port and a virtual port is that the router captures additional information from a virtual port—an outgoing MPLS label used to reach the remote site, and an incoming MPLS label for VPLS traffic received from the remote site.

When you configure VPLS on a routing platform, a virtual port is generated as a logical interface on a virtual loopback tunnel (**vt**) interface or a label-switched interface (LSI). On Juniper Networks M Series Multiservice Edge Routers and Juniper Networks T Series Core Routers, virtual ports are created dynamically on **vt** interfaces if you install a PIC that supports virtual tunnels. With VPLS, you must install at least one Tunnel Services, Link Services, or Adaptive Services PIC in each VPLS provider edge (PE) router. On Juniper Networks MX Series 3D Universal Edge Routers, virtual ports are created dynamically on **vt** interfaces if you configure tunnel services on one of the four Packet Forwarding Engines

(PFEs) included in each Dense Port Concentrator (DPC). If your routing platform does not offer tunnel services through a PIC or PFE, you can configure VPLS to create virtual ports on LSI logical interfaces.

One property of flooding behavior in VPLS is that traffic received from remote PE routers is never forwarded to other PE routers. This restriction helps prevent loops in the core network. If a customer edge (CE) Ethernet switch has redundant connections to the same PE router, you must enable the STP to prevent loops.

The paths that emulate a Layer 2 point-to-point connection over a packet-switched network are called *pseudowires*. The pseudowires are signaled using either BGP or LDP.

Related Documentation

- *Example: VPLS Configuration (BGP Signaling)*
- Example: Configuring BGP Autodiscovery for LDP VPLS with User-Defined Mesh Groups on page 26
- *Example: Configuring Inter-AS VPLS with MAC Processing at the ASBR*
- *Example: VPLS Configuration (BGP Signaling)*
- *Example: VPLS Configuration (BGP and LDP Interworking)*

VPLS Protocol Operation

VPLS provides a multipoint-to-multipoint Ethernet service that can span one or more metropolitan areas and provides connectivity between multiple sites as if these sites were attached to the same Ethernet LAN.

VPLS uses an IP and MPLS service provider infrastructure. From a service provider's point of view, use of IP and MPLS routing protocols and procedures instead of the Spanning Tree Protocol (STP), and MPLS labels instead of VLAN IDs, significantly improves the scalability of the VPLS service.

VPLS carries Ethernet traffic across a service provider network, so the provider network must mimic an Ethernet network in some ways. When a PE router configured with a VPLS routing instance receives a packet from a CE device, it first determines whether it has an exit port associated with the destination of the VPLS packet. If it does, it forwards the packet to the appropriate PE router or CE device. If it does not, it broadcasts the packet to all the other PE routers and CE devices that are members of that VPLS routing instance. In both cases, the CE device receiving the packet must be different from the device sending the packet.

When a PE router receives a packet from another PE router, it first determines whether it has an exit port associated with the destination of the VPLS packet. The PE router either forwards the packet or drops it, depending on whether the destination is a local or remote CE device. The PE router has three options (scenarios):

- If the destination is a local CE device, the PE router forwards the packet to it.
- If the destination is a remote CE device (connected to another PE router), it discards the packet.

- If the PE router cannot determine the destination of the VPLS packet, it floods the packet to its attached CE devices.

A VPLS can be directly connected to an Ethernet switch. Layer 2 information gathered by an Ethernet switch, such as media access control (MAC) addresses and interface ports, is included in the VPLS routing instance table. However, instead of all VPLS interfaces being physical switch ports, the router allows remote traffic for a VPLS instance to be delivered across an MPLS LSP and to arrive on a virtual port. The virtual port emulates a local, physical port. Traffic can be learned, forwarded, or flooded to the virtual port in a similar way as traffic sent to a local port.

The VPLS routing table is populated with MAC addresses and interface information for both physical and virtual ports. One difference between a physical port and a virtual port is that on a virtual port, the router captures the outgoing MPLS label used to reach the remote site, and an incoming MPLS label for VPLS traffic received from the remote site. The virtual port is generated dynamically on a Tunnel Services PIC when you configure VPLS on a Juniper Networks M Series Multiservice Edge Router or T Series Core Router. A Tunnel Services PIC is required on each M Series or T Series VPLS router.

If your router has an Enhanced FPC installed, you can configure VPLS without a Tunnel Services PIC. To do so, use a label-switched interface (LSI) to provide VPLS functionality. An LSI MPLS label is used as the inner label for VPLS. This label maps to a VPLS routing instance. On the PE router, the LSI label is stripped and then mapped to a logical LSI interface. The Layer 2 Ethernet frame is then forwarded using the LSI interface to the correct VPLS routing instance.

One restriction on flooding behavior in VPLS is that traffic received from remote PE routers is never forwarded to other PE routers. This restriction helps prevent loops in the core network. This also means that the core network of PE routers must be fully meshed. Additionally, if a CE Ethernet switch has two or more connections to the same PE router, you must enable the STP on the CE switch to prevent loops.

Junos OS supports both forwarding equivalency class (FEC) 128 and FEC 129. FEC 128 requires manually configured pseudowires. FEC 129 uses VPLS autodiscovery to convey endpoint information. After PE routers are autodiscovered, pseudowires are created automatically.

Related Documentation

- *Example: VPLS Configuration (BGP and LDP Interworking)*
- Example: Configuring BGP Autodiscovery for LDP VPLS (FEC 129) on page 10
- Example: Configuring BGP Autodiscovery for LDP VPLS with User-Defined Mesh Groups on page 26

Example: Configuring BGP Autodiscovery for LDP VPLS (FEC 129)

This example describes how to configure BGP autodiscovery for LDP VPLS, as specified in forwarding equivalency class (FEC) 129. FEC 129 uses BGP autodiscovery to convey endpoint information, so you do not need to manually configure pseudowires.

Requirements

This example uses the following hardware and software components:

- Four MX Series 3D Universal Edge Routers
- Junos OS Release 10.4R2 or later

NOTE: This configuration example has been tested using the software release listed and is assumed to work on all later releases.

If you are using M Series or T Series routers, the PE routers must have either virtual loopback tunnel (**vt**) interfaces or label-switched interfaces (LSIs). On M Series and T Series routers, VPLS uses tunnel-based PICs to create virtual ports on **vt** interfaces. If you do not have a tunnel-based PIC installed on your M Series or T Series router, you can still configure VPLS by using LSIs to support the virtual ports. Use of LSIs requires Ethernet-based PICs installed in an Enhanced Flexible PIC Concentrator (FPC).

You do not need to use routers for the CE devices. For example, the CE devices can be EX Series Ethernet Switches.

Overview

All PE routers in a VPLS network operate like a large, distributed Ethernet switch to provide Layer 2 services to attached devices. This example shows a minimum configuration for PE routers and CE devices to create an autodiscovered VPLS network. The topology consists of five routers: two PE routers, two CE routers, and an optional route reflector (RR). The PE routers use BGP to autodiscover two different VPLS instances that are configured on both PE routers. Then the PE routers use LDP to automatically signal two pseudowires between the discovered end points. Finally, the PE routers bring up both VPLS instances for forwarding traffic. Each CE device is configured with two VLANs, with each VLAN belonging to different VPLS instances in the PE routers.

This example includes the following settings:

- **auto-discovery-only**—Allows the router to process only the autodiscovery network layer reachability information (NLRI) update messages for LDP-based Layer 2 VPN and VPLS update messages (BGP_L2VPN_AD_NLRI) (FEC 129). Specifically, the **auto-discovery-only** statement notifies the routing process (rpd) to expect autodiscovery-related NLRI messages so that information can be deciphered and used by LDP and VPLS. You can configure this statement at the global, group, and neighbor levels for BGP. The **auto-discovery-only** statement must be configured on all PE routers in the VPLS. If you configure route reflection, the **auto-discovery-only** statement is also required on P routers that act as the route reflector in supporting FEC 129-related updates.

  The **signaling** statement is not included in this example but is discussed here for completeness. The **signaling** statement allows the router to process only the BGP_L2VPN_NLRIs used for BGP-based Layer 2 VPNs (FEC 128).

  For interoperation scenarios in which a PE router must support both types of NLRI (FEC 128 and FEC 129), you can configure both the **signaling** statement and the **auto-discovery-only** statement. For example, a single PE router might need to process a combination of BGP-signaled virtual private wire service (VPWS) and LDP-signaled VPLS assisted by BGP autodiscovery. Configuring both the **signaling** statement and the **auto-discovery-only** statement together allows both types of signaling to run independently. The **signaling** statement is supported at the same hierarchy levels as the **auto-discovery-only** statement.

- **cluster**—Configuring a route reflector is optional for FEC 129 autodiscovered PE routers. In this example, the **cluster** statement configures Router RR to be a route reflector in the IBGP group. For inbound updates, BGP autodiscovery NLRI messages are accepted if the router is configured to be a route reflector or if the **keep all** statement is configured in the IBGP group.

- **l2vpn-id**—Specifies a globally unique Layer 2 VPN community identifier for the instance. This statement is configurable for routing instances of type **vpls**.

  You can configure the following formats for the community identifier:

  - Autonomous system (AS) number format—**l2vpn-id:*as-number:2-byte-number***. For example: **l2vpn-id:100:200**. The AS number can be in the range from 1 through 65,535.
  - IPv4 format—**l2vpn-id:*ip-address:2-byte-number***. For example: **l2vpn-id:10.1.1.1:2**.

- **vrf-target**—Defines the import and export route targets for the NLRI. You must either configure the **vrf-target** statement or the **vrf-import** and **vrf-export** statements to define the instance import and export policy or the import and export route targets for the NLRI. This example uses the **vrf-target** statement.

- **route-distinguisher**—Forms part of the BGP autodiscovery NLRI and distinguishes to which VPN or VPLS routing instance each route belongs. Each route distinguisher is a 6-byte value. You must configure a unique route distinguisher for each routing instance.

  You can configure the following formats for the route distinguisher:

  - AS number format—***as-number:2-byte-number***

- IPv4 format—***ip-address:2-byte-number***

Two notable statements are included in this example. These statements are important for interoperability with other vendors' equipment. The interoperability statements are not necessary for the topology that is used in this example, but they are included for completeness.

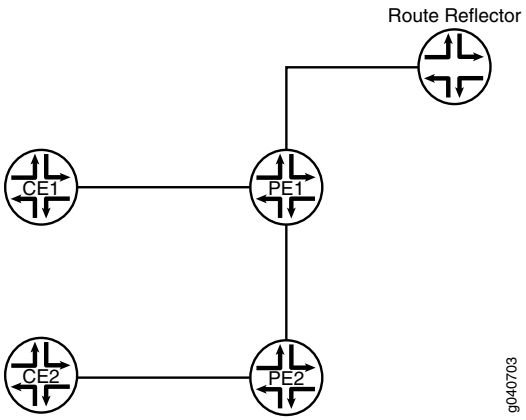
The interoperability statements are as follows:

- **input-vlan-map pop**—Removes an outer VLAN tag from the top of the VLAN tag stack.
- **output-vlan-map push**—Adds an outer VLAN tag in front of the existing VLAN tag.

Topology Diagram

Figure 3 on page 12 shows the topology used in this example.

Figure 3: BGP Autodiscovery for LDP VPLS



Configuration

CLI Quick Configuration

To quickly configure BGP autodiscovery for LDP VPLS, copy the following commands, remove any line breaks, and then paste the commands into the CLI of each device.

On Router PE1:

```
[edit]
set interfaces ge-0/1/0 vlan-tagging
set interfaces ge-0/1/0 encapsulation flexible-ethernet-services
set interfaces ge-0/1/0 unit 100 encapsulation vlan-vpls
set interfaces ge-0/1/0 unit 100 vlan-id 100
set interfaces ge-0/1/0 unit 100 input-vlan-map pop
set interfaces ge-0/1/0 unit 100 output-vlan-map push
set interfaces ge-0/1/0 unit 100 family vpls
set interfaces ge-0/1/0 unit 200 encapsulation vlan-vpls
set interfaces ge-0/1/0 unit 200 vlan-id 200
set interfaces ge-0/1/0 unit 200 family vpls
set interfaces ge-0/1/1 unit 0 description "PE1 to PE2"
set interfaces ge-0/1/1 unit 0 family inet address 8.0.40.100/24
set interfaces ge-0/1/1 unit 0 family iso
set interfaces ge-0/1/1 unit 0 family mpls
```

```
set interfaces ge-0/3/0 unit 0 description "PE1 to RR"
set interfaces ge-0/3/0 unit 0 family inet address 8.0.70.100/24
set interfaces ge-0/3/0 unit 0 family iso
set interfaces ge-0/3/0 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 8.0.0.100/32
set routing-options router-id 8.0.0.100
set routing-options autonomous-system 100
set protocols mpls interface lo0.0
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols bgp group int type internal
set protocols bgp group int local-address 8.0.0.100
set protocols bgp group int family l2vpn auto-discovery-only
set protocols bgp group int neighbor 8.0.0.107
set protocols isis level 1 disable
set protocols isis interface all
set protocols isis interface fxp0.0 disable
set protocols isis interface lo0.0
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set protocols ldp interface lo0.0
set routing-instances vpls100 instance-type vpls
set routing-instances vpls100 interface ge-0/1/0.100
set routing-instances vpls100 route-distinguisher 8.0.0.100:100
set routing-instances vpls100 l2vpn-id l2vpn-id:100:100
set routing-instances vpls100 vrf-target target:100:100
set routing-instances vpls100 protocols vpls no-tunnel-services
set routing-instances vpls200 instance-type vpls
set routing-instances vpls200 interface ge-0/1/0.200
set routing-instances vpls200 route-distinguisher 8.0.0.100:200
set routing-instances vpls200 l2vpn-id l2vpn-id:100:200
set routing-instances vpls200 vrf-target target:100:208
set routing-instances vpls200 protocols vpls no-tunnel-services
```

On Device CE1:

```
[edit]
set interfaces ge-1/2/1 vlan-tagging
set interfaces ge-1/2/1 mtu 1400
set interfaces ge-1/2/1 unit 100 vlan-id 100
set interfaces ge-1/2/1 unit 100 family inet address 3.0.100.103/24
set interfaces ge-1/2/1 unit 200 vlan-id 200
set interfaces ge-1/2/1 unit 200 family inet address 3.0.200.103/24
set protocols ospf area 0.0.0.0 interface ge-1/2/1.100
set protocols ospf area 0.0.0.0 interface ge-1/2/1.200
```

On Router PE2:

```
[edit]
set interfaces ge-1/1/0 vlan-tagging
set interfaces ge-1/1/0 encapsulation flexible-ethernet-services
set interfaces ge-1/1/0 unit 100 encapsulation vlan-vpls
set interfaces ge-1/1/0 unit 100 vlan-id 100
set interfaces ge-1/1/0 unit 100 input-vlan-map pop
set interfaces ge-1/1/0 unit 100 output-vlan-map push
set interfaces ge-1/1/0 unit 100 family vpls
set interfaces ge-1/1/0 unit 200 encapsulation vlan-vpls
```

```
set interfaces ge-1/1/0 unit 200 vlan-id 200
set interfaces ge-1/1/0 unit 200 family vpls
set interfaces ge-1/2/1 unit 0 description "PE2 to PE1"
set interfaces ge-1/2/1 unit 0 family inet address 8.0.40.104/24
set interfaces ge-1/2/1 unit 0 family iso
set interfaces ge-1/2/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 8.0.0.104/32
set routing-options router-id 8.0.0.104
set routing-options autonomous-system 100
set protocols mpls interface lo0.0
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols bgp group int type internal
set protocols bgp group int local-address 8.0.0.104
set protocols bgp group int family l2vpn auto-discovery-only
set protocols bgp group int neighbor 8.0.0.107
set protocols isis level 1 disable
set protocols isis interface ge-1/2/1.0
set protocols isis interface lo0.0
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set protocols ldp interface lo0.0
set routing-instances vpls100 instance-type vpls
set routing-instances vpls100 interface ge-1/1/0.100
set routing-instances vpls100 route-distinguisher 8.0.0.104:100
set routing-instances vpls100 l2vpn-id l2vpn-id:100:100
set routing-instances vpls100 vrf-target target:100:100
set routing-instances vpls100 protocols vpls no-tunnel-services
set routing-instances vpls200 instance-type vpls
set routing-instances vpls200 interface ge-1/1/0.200
set routing-instances vpls200 route-distinguisher 8.0.0.104:200
set routing-instances vpls200 l2vpn-id l2vpn-id:100:200
set routing-instances vpls200 vrf-target target:100:208
set routing-instances vpls200 protocols vpls no-tunnel-services
```

On Device CE2:

```
[edit]
set interfaces ge-1/1/0 vlan-tagging
set interfaces ge-1/1/0 mtu 1400
set interfaces ge-1/1/0 unit 100 vlan-id 100
set interfaces ge-1/1/0 unit 100 family inet address 3.0.100.105/24
set interfaces ge-1/1/0 unit 200 vlan-id 200
set interfaces ge-1/1/0 unit 200 family inet address 3.0.200.105/24
set protocols ospf area 0.0.0.0 interface ge-1/1/0.100
set protocols ospf area 0.0.0.0 interface ge-1/1/0.200
```

On Router RR:

```
[edit]
set interfaces ge-1/3/2 unit 0 description "RR to PE1"
set interfaces ge-1/3/2 unit 0 family inet address 8.0.70.107/24
set interfaces ge-1/3/2 unit 0 family iso
set interfaces ge-1/3/2 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 8.0.0.107/32
set routing-options router-id 8.0.0.107
set routing-options autonomous-system 100
```



```
set protocols bgp group int type internal
set protocols bgp group int local-address 8.0.0.107
set protocols bgp group int family l2vpn auto-discovery-only
set protocols bgp group int cluster 107.107.107.107
set protocols bgp group int neighbor 8.0.0.100
set protocols bgp group int neighbor 8.0.0.104
set protocols isis level 1 disable
set protocols isis interface all
set protocols isis interface fxp0.0 disable
set protocols isis interface lo0.0
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set protocols ldp interface lo0.0
```

Router PE1

Step-by-Step Procedure

To configure Router PE1:

1. Configure the interfaces, the interface encapsulation, and the protocol families.

```
[edit interfaces]
user@PE1# set ge-0/1/0 encapsulation flexible-ethernet-services
user@PE1# set ge-0/1/0 unit 100 encapsulation vlan-vpls
user@PE1# set ge-0/1/0 unit 100 family vpls
user@PE1# set ge-0/1/0 unit 200 encapsulation vlan-vpls
user@PE1# set ge-0/1/0 unit 200 family vpls
user@PE1# set ge-0/1/1 unit 0 description "PE1 to PE2"
user@PE1# set ge-0/1/1 unit 0 family inet address 8.0.40.100/24
user@PE1# set ge-0/1/1 unit 0 family iso
user@PE1# set ge-0/1/1 unit 0 family mpls
user@PE1# set ge-0/3/0 unit 0 description "PE1 to RR"
user@PE1# set ge-0/3/0 unit 0 family inet address 8.0.70.100/24
user@PE1# set ge-0/3/0 unit 0 family iso
user@PE1# set ge-0/3/0 unit 0 family mpls
user@PE1# set lo0 unit 0 family inet address 8.0.0.100/32
```

2. Configure the VLANs.

```
[edit interfaces]
user@PE1# set ge-0/1/0 vlan-tagging
user@PE1# set ge-0/1/0 unit 100 vlan-id 100
user@PE1# set ge-0/1/0 unit 100 input-vlan-map pop
user@PE1# set ge-0/1/0 unit 100 output-vlan-map push
user@PE1# set ge-0/1/0 unit 200 vlan-id 200
user@PE1# exit
```

3. Configure the protocol-independent properties.

   We recommend that the router ID be the same as the local address. (See the **local-address** statement in Step 4.)

```
[edit routing-options]
user@PE1# set router-id 8.0.0.100
user@PE1# set autonomous-system 100
user@PE1# exit
```

4. Configure IBGP, including the **auto-discovery-only** statement.

```
[edit]
user@PE1# edit protocols
[edit protocols]
user@PE1# set bgp group int type internal
user@PE1# set bgp group int local-address 8.0.0.100
user@PE1# set bgp group int family l2vpn auto-discovery-only
user@PE1# set bgp group int neighbor 8.0.0.107
```

5. Configure MPLS, LDP, and an IGP.

```
[edit protocols]
user@PE1# set mpls interface lo0.0
user@PE1# set mpls interface all
user@PE1# set mpls interface fxp0.0 disable
user@PE1# set isis level 1 disable
user@PE1# set isis interface all
user@PE1# set isis interface fxp0.0 disable
user@PE1# set isis interface lo0.0
user@PE1# set ldp interface all
user@PE1# set ldp interface fxp0.0 disable
user@PE1# set ldp interface lo0.0
user@PE1# exit
```

6. Configure the routing instances.

   The **no-tunnel-services** statement is required if you are using LSI interfaces for VPLS instead of **vt** interfaces.

```
[edit]
user@PE1# edit routing-instances
[edit routing-instances]
user@PE1# set vpls100 instance-type vpls
user@PE1# set vpls100 interface ge-0/1/0.100
user@PE1# set vpls100 route-distinguisher 8.0.0.100:100
user@PE1# set vpls100 l2vpn-id l2vpn-id:100:100
user@PE1# set vpls100 vrf-target target:100:100
user@PE1# set vpls100 protocols vpls no-tunnel-services
user@PE1# set vpls200 instance-type vpls
user@PE1# set vpls200 interface ge-0/1/0.200
user@PE1# set vpls200 route-distinguisher 8.0.0.100:200
user@PE1# set vpls200 l2vpn-id l2vpn-id:100:200
user@PE1# set vpls200 vrf-target target:100:208
user@PE1# set vpls200 protocols vpls no-tunnel-services
```

7. If you are done configuring the device, commit the configuration.

```
[edit]
user@PE1# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show routing-instances** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE1# show interfaces
ge-0/1/0 {
   vlan-tagging;
```

```
    encapsulation flexible-ethernet-services;
    unit 100 {
      encapsulation vlan-vpls;
      vlan-id 100;
      input-vlan-map pop;
      output-vlan-map push;
      family vpls;
    }
    unit 200 {
      encapsulation vlan-vpls;
      vlan-id 200;
      family vpls;
    }
}
ge-0/1/1 {
    unit 0 {
      description "PE1 to PE2";
      family inet {
        address 8.0.40.100/24;
      }
      family iso;
      family mpls;
    }
}
ge-0/3/0 {
    unit 0 {
      description "PE1 to RR";
      family inet {
        address 8.0.70.100/24;
      }
      family iso;
      family mpls;
    }
}
lo0 {
    unit 0 {
      family inet {
        address 8.0.0.100/32;
      }
    }
}

user@PE1# show protocols
mpls {
    interface lo0.0;
    interface all;
    interface fxp0 disable;
}
bgp {
    group int {
      type internal;
      local-address 8.0.0.100;
      family l2vpn {
        auto-discovery-only;
      }
      neighbor 8.0.0.107;
```

```
    }
  }
  isis {
    level 1 disable;
    interface all;
    interface lo0.0;
    interface fxp0 disable;
  }
  ldp {
    interface lo0.0;
    interface all;
    interface fxp0 disable;
  }
```

```
user@PE1# show routing-options
router-id 8.0.0.100;
autonomous-system 100;
```

```
user@PE1# show routing-instances
vpls100 {
  instance-type vpls;
  interface ge-0/1/0.100;
  route-distinguisher 8.0.0.100:100;
  l2vpn-id l2vpn-id:100:100;
  vrf-target target:100:100;
  protocols {
    vpls {
      no-tunnel-services;
    }
  }
}
vpls200 {
  instance-type vpls;
  interface ge-0/1/0.200;
  route-distinguisher 8.0.0.100:200;
  l2vpn-id l2vpn-id:100:200;
  vrf-target target:100:208;
  protocols {
    vpls {
      no-tunnel-services;
    }
  }
}
```

Device CE1

Step-by-Step Procedure

To configure Device CE1:

Configure interface addresses and the interface maximum transmission unit (MTU).

1.
```
[edit]
user@CE1# edit interfaces
[edit interfaces]
user@CE1# set ge-1/2/1 mtu 1400
user@CE1# set ge-1/2/1 unit 100 family inet address 3.0.100.103/24
user@CE1# set ge-1/2/1 unit 200 family inet address 3.0.200.103/24
```

2. Configure VLANs.

```
[edit interfaces]
user@CE1# set ge-1/2/1 vlan-tagging
user@CE1# set ge-1/2/1 unit 100 vlan-id 100
user@CE1# set ge-1/2/1 unit 200 vlan-id 200
user@CE1# exit
```

3. Configure an IGP.

```
user@CE1# edit protocols
[edit protocols]
user@CE1# set ospf area 0.0.0.0 interface ge-1/2/1.100
user@CE1# set ospf area 0.0.0.0 interface ge-1/2/1.200
user@CE1# exit
```

4. If you are done configuring the device, commit the configuration.

```
[edit]
user@CE1# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces** and **show protocols** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@CE1# show interfaces
ge-1/2/1 {
    vlan-tagging;
    mtu 1400;
    unit 100 {
        vlan-id 100;
        family inet {
            address 3.0.100.103/24;
        }
    }
    unit 200 {
        vlan-id 200;
        family inet {
            address 3.0.200.103/24;
        }
    }
}
```

```
user@CE1# show protocols
ospf {
    area 0.0.0.0 {
        interface ge-1/2/1.100;
        interface ge-1/2/1.200;
    }
}
```

Router PE2

Step-by-Step Procedure To configure Router PE2:

1. Configure the interfaces, the interface encapsulation, and the protocol families.

```
[edit]
user@PE2# edit interfaces
[edit interfaces]
user@PE2# set ge-1/1/0 encapsulation flexible-ethernet-services
user@PE2# set ge-1/1/0 unit 100 encapsulation vlan-vpls
user@PE2# set ge-1/1/0 unit 100 family vpls
user@PE2# set ge-1/1/0 unit 200 encapsulation vlan-vpls
user@PE2# set ge-1/1/0 unit 200 family vpls
user@PE2# set ge-1/2/1 unit 0 description "PE2 to PE1"
user@PE2# set ge-1/2/1 unit 0 family inet address 8.0.40.104/24
user@PE2# set ge-1/2/1 unit 0 family iso
user@PE2# set ge-1/2/1 unit 0 family mpls
user@PE2# set lo0 unit 0 family inet address 8.0.0.104/32
```

2. Configure the VLANs.

```
[edit interfaces]
user@PE2# set ge-1/1/0 vlan-tagging
user@PE2# set ge-1/1/0 unit 100 vlan-id 100
user@PE2# set ge-1/1/0 unit 100 input-vlan-map pop
user@PE2# set ge-1/1/0 unit 100 output-vlan-map push
user@PE2# set ge-1/1/0 unit 200 vlan-id 200
user@PE2# exit
```

3. Configure the protocols-independent properties.

   We recommend that the router ID be the same as the local address. (See the **local-address** statement in Step 4.)

```
[edit]
user@PE2# edit routing-options
[edit routing-options]
user@PE2# set router-id 8.0.0.104
user@PE2# set autonomous-system 100
```

4. Configure IBGP, including the **auto-discovery-only** statement.

```
[edit]
user@PE2# edit protocols
[edit protocols]
user@PE2# set bgp group int type internal
user@PE2# set bgp group int local-address 8.0.0.104
user@PE2# set bgp group int family l2vpn auto-discovery-only
user@PE2# set bgp group int neighbor 8.0.0.107
```

5. Configure MPLS, LDP, and an IGP.

```
[edit protocols]
user@PE2# set mpls interface lo0.0
user@PE2# set mpls interface all
user@PE2# set mpls interface fxp0.0 disable
user@PE2# set isis level 1 disable
user@PE2# set isis interface ge-1/2/1.0
user@PE2# set isis interface lo0.0
user@PE2# set ldp interface all
user@PE2# set ldp interface fxp0.0 disable
user@PE2# set ldp interface lo0.0
user@PE2# exit
```


6. Configure the routing instances.

   The **no-tunnel-services** statement is required if you are using LSI interfaces for VPLS instead of **vt** interfaces.

   ```
   [edit]
   user@PE2# edit routing-instances
   [edit routing-instances]
   user@PE2# set vpls100 instance-type vpls
   user@PE2# set vpls100 interface ge-1/1/0.100
   user@PE2# set vpls100 route-distinguisher 8.0.0.104:100
   user@PE2# set vpls100 l2vpn-id l2vpn-id:100:100
   user@PE2# set vpls100 vrf-target target:100:100
   user@PE2# set vpls100 protocols vpls no-tunnel-services
   user@PE2# set vpls200 instance-type vpls
   user@PE2# set vpls200 interface ge-1/1/0.200
   user@PE2# set vpls200 route-distinguisher 8.0.0.104:200
   user@PE2# set vpls200 l2vpn-id l2vpn-id:100:200
   user@PE2# set vpls200 vrf-target target:100:208
   user@PE2# set vpls200 protocols vpls no-tunnel-services
   ```

7. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@PE2# commit
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show routing-instances** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE2# show interfaces
ge-1/1/0 {
  vlan-tagging;
  encapsulation flexible-ethernet-services;
  unit 100 {
    encapsulation vlan-vpls;
    vlan-id 100;
    input-vlan-map pop;
    output-vlan-map push;
    family vpls;
  }
  unit 200 {
    encapsulation vlan-vpls;
    vlan-id 200;
    family vpls;
  }
}
ge-1/2/1 {
  unit 0 {
    description "PE2 to PE1";
    family inet {
      address 8.0.40.104/24;
    }
    family iso;
    family mpls;
```

```
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 8.0.0.104/32;
      }
    }
  }
```

```
user@PE2# show protocols
mpls {
    interface lo0.0;
    interface all;
    interface fxp0 disable;
}
bgp {
    group int {
        type internal;
        local-address 8.0.0.104;
        family l2vpn {
            auto-discovery-only;
        }
        neighbor 8.0.0.107;
    }
}
isis {
    level 1 disable;
    interface ge-1/2/1.0;
    interface lo0.0;
}
ldp {
    interface lo0.0;
    interface all;
    interface fxp0 disable;
}
```

```
user@PE2# show routing-options
router-id 8.0.0.104;
autonomous-system 100;
```

```
user@PE2# show routing-instances
vpls100 {
    instance-type vpls;
    interface ge-1/1/0.100;
    route-distinguisher 8.0.0.104:100;
    l2vpn-id l2vpn-id:100:100;
    vrf-target target:100:100;
    protocols {
        vpls {
            no-tunnel-services;
        }
    }
}
vpls200 {
    instance-type vpls;
    interface ge-1/1/0.200;
```

```
    route-distinguisher 8.0.0.104:200;
    l2vpn-id l2vpn-id:100:200;
    vrf-target target:100:208;
    protocols {
      vpls {
        no-tunnel-services;
      }
    }
  }
```

Device CE2

Step-by-Step Procedure

To configure Device CE2:

1. Configure VLAN interfaces.

```
[edit]
user@CE2# edit interfaces ge-1/1/0
[edit interfaces ge-1/1/0]
user@CE2# set vlan-tagging
user@CE2# set mtu 1400
user@CE2# set unit 100 vlan-id 100
user@CE2# set unit 100 family inet address 3.0.100.105/24
user@CE2# set unit 200 vlan-id 200
user@CE2# set unit 200 family inet address 3.0.200.105/24
user@CE2# exit
```

2. Configure OSPF on the interfaces.

```
[edit]
user@CE2# edit protocols ospf area 0.0.0.0
[edit protocols ospf area 0.0.0.0]
user@CE2# set interface ge-1/1/0.100
user@CE2# set interface ge-1/1/0.200
user@CE2# exit
```

3. If you are done configuring the device, commit the configuration.

```
[edit]
user@CE2# commit
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces** and **show protocols** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@CE2# show interfaces
ge-1/1/0 {
  vlan-tagging;
  mtu 1400;
  unit 100 {
    vlan-id 100;
    family inet {
      address 3.0.100.105/24;
    }
  }
  unit 200 {
    vlan-id 200;
```

```
      family inet {
        address 3.0.200.105/24;
      }
    }
  }
```

```
user@CE2# show protocols
ospf {
  area 0.0.0.0 {
    interface ge-1/1/0.100;
    interface ge-1/1/0.200;
  }
}
```

Router RR

Step-by-Step Procedure

To configure Router RR:

1. Configure interface addresses and the protocol families.

```
[edit]
user@RR# edit interfaces
[edit interfaces]
user@RR# set ge-1/3/2 unit 0 description "RR to PE1"
user@RR# set ge-1/3/2 unit 0 family inet address 8.0.70.107/24
user@RR# set ge-1/3/2 unit 0 family iso
user@RR# set ge-1/3/2 unit 0 family mpls
user@RR# set lo0 unit 0 family inet address 8.0.0.107/32
user@RR# exit
```

2. Configure the autonomous systems and the router ID.

```
[edit]
user@RR# edit routing-options
[edit routing-options]
user@RR# set autonomous-system 100
user@RR# set router-id 8.0.0.107
user@RR# exit
```

3. Configure BGP and set this router to be the route reflector. Route reflection is optional for FEC 129.

```
[edit]
user@RR# edit protocols bgp group int
[edit protocols bgp group int]
user@RR# set type internal
user@RR# set local-address 8.0.0.107
user@RR# set family l2vpn auto-discovery-only
user@RR# set cluster 107.107.107.107
user@RR# set neighbor 8.0.0.100
user@RR# set neighbor 8.0.0.104
user@RR# exit
```

4. Configure IS-IS for the IGP.

```
[edit]
user@RR# edit protocols isis
[edit protocols isis]
```

```
user@RR# set level 1 disable
user@RR# set interface all
user@RR# set interface fxp0.0 disable
user@RR# set interface lo0.0
user@RR# exit
```

5. Configure LDP for the MPLS signaling protocol.

```
[edit]
user@RR# edit protocols ldp
[edit protocols ldp]
user@RR# set interface all
user@RR# set interface fxp0.0 disable
user@RR# set interface lo0.0
user@RR# exit
```

6. If you are done configuring the device, commit the configuration.

```
[edit]
user@RR# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@RR# show interfaces
ge-1/3/2 {
    unit 0 {
        description "RR to PE1";
        family inet {
            address 8.0.70.107/24;
        }
        family iso;
        family mpls;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 8.0.0.107/32;
        }
    }
}
```

```
user@RR# show protocols
bgp {
    group int {
        type internal;
        local-address 8.0.0.107;
        family l2vpn {
            auto-discovery-only;
        }
        cluster 107.107.107.107;
        neighbor 8.0.0.100;
        neighbor 8.0.0.104;
    }
}
```

```
isis {
    level 1 disable;
    interface lo0.0;
    interface all;
    interface fxp0 disable;
}
ldp {
    interface lo0.0;
    interface all;
    interface fxp0 disable;
}
```

```
user@RR# show routing-options
router-id 8.0.0.107;
autonomous-system 100;
```

Verification

To verify the operation, use the following commands:

- **show route extensive**
- **show route advertising-protocol bgp *neighbor***
- **show route receive-protocol bgp *neighbor***
- **show route table bgp.l2vpn.0**
- **show route table vpls100.l2vpn.0**
- **show route table vpls200.l2vpn.0**
- **show vpls connections extensive**
- **show vpls mac-table detail**
- **show vpls statistics**

AD in the routing table output indicates autodiscovery NLRI.

Related Documentation

- Example: Configuring BGP Autodiscovery for LDP VPLS with User-Defined Mesh Groups on page 26
- *Configuring Interoperability Between BGP Signaling and LDP Signaling in VPLS*
- About This Network Configuration Example on page 5
- VPLS Protocol Operation on page 8

Example: Configuring BGP Autodiscovery for LDP VPLS with User-Defined Mesh Groups

This example describes how to configure user-defined mesh groups for BGP autodiscovery for LDP VPLS, as specified in forwarding equivalency class (FEC) 129. FEC 129 uses BGP autodiscovery to convey endpoint information, so you do not need to manually configure pseudowires. You configure mesh groups on the border router to group the sets of PE routers that are automatically fully meshed and that share the same signaling protocol,

either BGP or LDP. You can configure multiple mesh groups to map each fully meshed LDP-signaled or BGP-signaled VPLS domain to a mesh group.

Requirements

This example uses the following hardware and software components:

- Three MX Series 3D Universal Edge Routers
- Junos OS Release 10.4R2 or later

NOTE: **This configuration example has been tested using the software release listed and is assumed to work on all later releases.**

Before you begin, configure BGP autodiscovery for LDP VPLS. See "Example: Configuring BGP Autodiscovery for LDP VPLS (FEC 129)" on page 10.

You will need to adapt the example configuration to the topology used in this example.

Overview

Configuration for a mesh group for FEC 129 is very similiar to the mesh-group configuration for FEC 128.

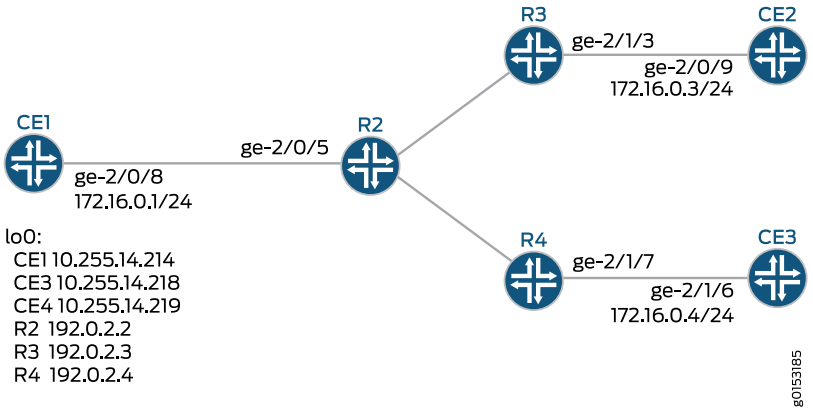
Note the following differences for FEC 129:

- Each user-defined mesh group must have a unique route distinguisher. Do not use the route distinguisher that is defined for the default mesh group at the **[edit routing-intances]** hierarchy level.
- Each user-defined mesh group must have its own import and export route target.
- Each user-defined mesh group can have a unique Layer 2 VPN ID. By default, all the mesh groups that are configured for a VPLS routing instance use the same Layer 2 VPN ID as the one that you configure at the **[edit routing-instances]** hierarchy level.

Topology Diagram

Figure 4 on page 28 shows a topology that includes a user-defined mesh group.

Figure 4: BGP Autodiscovery for LDP VPLS with a User-Defined Mesh Group



"CLI Quick Configuration" on page 28 shows the configuration for all of the devices in Figure 4 on page 28. The section "Step-by-Step Procedure" on page 30 describes the steps on Device R2.

Configuration

CLI Quick Configuration

To quickly configure a mesh group, copy the following commands, remove any line breaks, and then paste the commands into the CLI of each device.

Device CE1

```
set interfaces ge-2/0/8 unit 0
set interfaces lo0 unit 0 family inet address 10.255.14.214/32
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-2/0/8.0
```

Device CE3

```
set interfaces ge-2/0/9 unit 0
set interfaces lo0 unit 0 family inet address 10.255.14.218/32
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-2/0/9.0
```

Device CE4

```
set interfaces ge-2/1/6 unit 0
set interfaces lo0 unit 0 family inet address 10.255.14.219/32
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-2/1/6.0
```

Device R2

```
set interfaces ge-2/0/5 encapsulation ethernet-vpls
set interfaces ge-2/0/5 unit 0 description to_CE1
set interfaces ge-2/0/5 unit 0 family vpls
set interfaces ge-2/0/10 unit 0 description to_R3
set interfaces ge-2/0/10 unit 0 family inet address 10.10.4.2/30
set interfaces ge-2/0/10 unit 0 family mpls
set interfaces ge-2/0/11 unit 0 description to_R4
set interfaces ge-2/0/11 unit 0 family inet address 10.10.5.1/30
set interfaces ge-2/0/11 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 2.2.2.2/32
set protocols mpls interface ge-2/0/10.0
set protocols mpls interface ge-2/0/11.0
set protocols bgp local-address 2.2.2.2
```

```
set protocols bgp group pe-pe type internal
set protocols bgp group pe-pe connect-retry-interval 1
set protocols bgp group pe-pe family l2vpn auto-discovery-only
set protocols bgp group pe-pe family l2vpn signaling
set protocols bgp group pe-pe neighbor 3.3.3.3
set protocols bgp group pe-pe neighbor 4.4.4.4
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-2/0/10.0
set protocols ospf area 0.0.0.0 interface ge-2/0/11.0
set protocols ldp interface ge-2/0/10.0
set protocols ldp interface ge-2/0/11.0
set protocols ldp interface lo0.0
set routing-instances inst512 instance-type vpls
set routing-instances inst512 interface ge-2/0/5.0
set routing-instances inst512 route-distinguisher 100:100
set routing-instances inst512 l2vpn-id l2vpn-id:1:2
set routing-instances inst512 vrf-target target:1:1
set routing-instances inst512 protocols vpls mesh-group metro1 vrf-target target:2:1
set routing-instances inst512 protocols vpls mesh-group metro1 route-distinguisher
  100:200
set routing-options autonomous-system 64510
```

Device R3

```
set interfaces ge-2/0/10 unit 0 description to_R2
set interfaces ge-2/0/10 unit 0 family inet address 10.10.4.1/30
set interfaces ge-2/0/10 unit 0 family mpls
set interfaces ge-2/1/3 encapsulation ethernet-vpls
set interfaces ge-2/1/3 unit 0 description to_CE3
set interfaces ge-2/1/3 unit 0 family vpls
set interfaces lo0 unit 0 family inet address 3.3.3.3/32
set protocols mpls interface ge-2/0/10.0
set protocols bgp local-address 3.3.3.3
set protocols bgp group pe-pe type internal
set protocols bgp group pe-pe connect-retry-interval 1
set protocols bgp group pe-pe family l2vpn auto-discovery-only
set protocols bgp group pe-pe family l2vpn signaling
set protocols bgp group pe-pe neighbor 2.2.2.2
set protocols bgp group pe-pe neighbor 4.4.4.4
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface ge-2/0/10.0
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ldp interface ge-2/0/10.0
set protocols ldp interface lo0.0
set routing-instances inst512 instance-type vpls
set routing-instances inst512 interface ge-2/1/3.0
set routing-instances inst512 route-distinguisher 100:100
set routing-instances inst512 l2vpn-id l2vpn-id:1:2
set routing-instances inst512 vrf-target target:1:1
set routing-instances inst512 protocols vpls
set routing-options autonomous-system 64510
```

Device R4

```
set interfaces ge-2/0/10 unit 0 description to_R2
set interfaces ge-2/0/10 unit 0 family inet address 10.10.5.2/30
set interfaces ge-2/0/10 unit 0 family mpls
set interfaces ge-2/1/7 encapsulation ethernet-vpls
```

```
set interfaces ge-2/1/7 unit 0 description to_CE4
set interfaces ge-2/1/7 unit 0 family vpls
set interfaces lo0 unit 0 family inet address 4.4.4.4/32
set protocols mpls interface ge-2/0/10.0
set protocols bgp local-address 4.4.4.4
set protocols bgp group pe-pe type internal
set protocols bgp group pe-pe connect-retry-interval 1
set protocols bgp group pe-pe family l2vpn auto-discovery-only
set protocols bgp group pe-pe family l2vpn signaling
set protocols bgp group pe-pe neighbor 2.2.2.2
set protocols bgp group pe-pe neighbor 3.3.3.3
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface ge-2/0/10.0
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ldp interface ge-2/0/10.0
set protocols ldp interface lo0.0
set routing-instances inst512 instance-type vpls
set routing-instances inst512 interface ge-2/1/7.0
set routing-instances inst512 route-distinguisher 100:100
set routing-instances inst512 l2vpn-id l2vpn-id:1:2
set routing-instances inst512 vrf-target target:1:1
set routing-instances inst512 protocols vpls
set routing-options autonomous-system 64510
```

Step-by-Step Procedure

To configure a mesh group:

1. Configure the interfaces.

```
[edit interfaces]
user@R2# set ge-2/0/5 encapsulation ethernet-vpls
user@R2# set ge-2/0/5 unit 0 description to_CE1
user@R2# set ge-2/0/5 unit 0 family vpls

user@R2# set ge-2/0/10 unit 0 description to_R3
user@R2# set ge-2/0/10 unit 0 family inet address 10.10.4.2/30
user@R2# set ge-2/0/10 unit 0 family mpls

user@R2# set ge-2/0/11 unit 0 description to_R4
user@R2# set ge-2/0/11 unit 0 family inet address 10.10.5.1/30
user@R2# set ge-2/0/11 unit 0 family mpls

user@R2# set lo0 unit 0 family inet address 2.2.2.2/32
```

2. Configure MPLS on the interfaces.

```
[edit protocols mpls]
user@R2# set interface ge-2/0/10.0
user@R2# set interface ge-2/0/11.0
```

3. Configure BGP.

```
[edit protocols bgp]
user@R2# set local-address 2.2.2.2

[edit protocols bgp group pe-pe]
user@R2# set type internal
```

```
user@R2# set connect-retry-interval 1
user@R2# set family l2vpn auto-discovery-only
user@R2# set family l2vpn signaling
user@R2# set neighbor 3.3.3.3
user@R2# set neighbor 4.4.4.4
```

4. Set the import and export route target for the default mesh group.

```
[edit protocols ospf]
user@R2# set traffic-engineering
user@R2# set area 0.0.0.0 interface lo0.0 passive
user@R2# set area 0.0.0.0 interface ge-2/0/10.0
user@R2# set area 0.0.0.0 interface ge-2/0/11.0
```

5. Configure LDP on the core-facing interfaces and on the loopback interface.

```
[edit protocols ldp]
user@R2# set interface ge-2/0/10.0
user@R2# set interface ge-2/0/11.0
user@R2# set interface lo0.0
```

6. Configure the VPLS routing instance.

   Make sure that the route distinguisher in the mesh group is unique.

```
[edit routing-instances inst512]
user@R2# set instance-type vpls
user@R2# set interface ge-2/0/5.0
user@R2# set route-distinguisher 100:100
user@R2# set l2vpn-id l2vpn-id:1:2
user@R2# set vrf-target target:1:1
user@R2# set protocols vpls mesh-group metro1 vrf-target target:2:1
user@R2# set protocols vpls mesh-group metro1 route-distinguisher 100:200
```

7. Configure the autonomous system (AS) number.

```
[edit routing-options]
user@R2# set autonomous-system 64510
```

8. If you are done configuring the device, commit the configuration.

```
[edit]
user@R2# commit
```

Results From configuration mode, confirm your configuration by entering the **show routing-instances** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
ge-2/0/5 {
   encapsulation ethernet-vpls;
   unit 0 {
      description PE1_to_CE1;
      family vpls;
   }
}
ge-2/0/10 {
   unit 0{
      description to_R3;
```

```
      family inet {
        address 10.10.4.2/30;
      }
      family mpls;
    }
  }
  ge-2/0/11 {
    unit 0 {
      description to_R4;
      family inet {
        address 10.10.5.1/30;
      }
      family mpls;
    }
  }
  lo0 {
    unit 0{
      family inet {
        address 2.2.2.2/32;
      }
    }
  }
```

```
user@R2# show protocols
mpls {
  interface ge-2/0/10.0;
  interface ge-2/0/11.0;
}
bgp {
  local-address 2.2.2.2;
  group pe-pe {
    type internal;
    connect-retry-interval 1;
    family l2vpn {
      auto-discovery-only;
      signaling;
    }
    neighbor 3.3.3.3;
    neighbor 4.4.4.4;
  }
}
ospf {
  traffic-engineering;
  area 0.0.0.0 {
    interface lo0.0 {
      passive;
    }
    interface ge-2/0/10.0;
    interface ge-2/0/11.0;
  }
}
ldp {
  interface ge-2/0/10.0;
  interface ge-2/0/11.0;
  interface lo0.0;
}
```

```
user@R2# show routing-instances
inst512 {
   instance-type vpls;
   interface ge-2/0/5.0;
   route-distinguisher 100:100;
   l2vpn-id l2vpn-id:1:2;
   vrf-target target:1:1;
   protocols {
      vpls {
         mesh-group metro1 {
            vrf-target target:2:1;
            route-distinguisher 100:200;
         }
      }
   }
}

user@R2# show routing-options
autonomous-system 64510;
```

Verification

Confirm that the configuration is working properly.

Verifying the Routes

Purpose Verify that the expected routes are learned.

Action From operational mode, enter the **show route** command.

```
user@R2> show route
inet.0: 9 destinations, 9 routes (9 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2.2.2.2/32          *[Direct/0] 4d 02:42:47
                     > via lo0.0
3.3.3.3/32          *[OSPF/10] 4d 02:41:56, metric 1
                     > to 10.10.4.1 via ge-2/0/10.0
4.4.4.4/32          *[OSPF/10] 4d 02:42:01, metric 1
                     > to 10.10.5.2 via ge-2/0/11.0
10.10.3.2/32        *[Local/0] 4d 02:42:47
                        Reject
10.10.4.0/30        *[Direct/0] 4d 02:42:46
                     > via ge-2/0/10.0
10.10.4.2/32        *[Local/0] 4d 02:42:47
                        Local via ge-2/0/10.0
10.10.5.0/30        *[Direct/0] 4d 02:42:46
                     > via ge-2/0/11.0
10.10.5.1/32        *[Local/0] 4d 02:42:47
                        Local via ge-2/0/11.0
224.0.0.5/32        *[OSPF/10] 4d 02:42:49, metric 1
```

```
                    MultiRecv

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

3.3.3.3/32         *[LDP/9] 4d 02:01:06, metric 1
                    > to 10.10.4.1 via ge-2/0/10.0
4.4.4.4/32         *[LDP/9] 4d 02:01:06, metric 1
                    > to 10.10.5.2 via ge-2/0/11.0

mpls.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                  *[MPLS/0] 4d 02:42:49, metric 1
                      Receive
1                  *[MPLS/0] 4d 02:42:49, metric 1
                      Receive
2                  *[MPLS/0] 4d 02:42:49, metric 1
                      Receive
13                 *[MPLS/0] 4d 02:42:49, metric 1
                      Receive
299776             *[LDP/9] 4d 02:01:06, metric 1
                    > to 10.10.5.2 via ge-2/0/11.0, Pop
299776(S=0)        *[LDP/9] 4d 02:01:06, metric 1
                    > to 10.10.5.2 via ge-2/0/11.0, Pop
299792             *[LDP/9] 4d 02:01:06, metric 1
                    > to 10.10.4.1 via ge-2/0/10.0, Pop
299792(S=0)        *[LDP/9] 4d 02:01:06, metric 1
                    > to 10.10.4.1 via ge-2/0/10.0, Pop
800000             *[VPLS/7] 4d 02:01:05
                    > via vt-2/0/10.185597952, Pop
800001             *[VPLS/7] 4d 02:01:05
                    > via vt-2/0/10.185597953, Pop
vt-2/0/10.185597953*[VPLS/7] 4d 02:01:05, metric2 1
                    > to 10.10.5.2 via ge-2/0/11.0, Push 800001
vt-2/0/10.185597952*[VPLS/7] 4d 02:01:05, metric2 1
                    > to 10.10.4.1 via ge-2/0/10.0, Push 800001

bgp.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

100:100:3.3.3.3/96 AD
                   *[BGP/170] 4d 02:32:41, localpref 100, from 3.3.3.3
                      AS path: I, validation-state: unverified
                    > to 10.10.4.1 via ge-2/0/10.0
100:100:4.4.4.4/96 AD
                   *[BGP/170] 4d 02:32:41, localpref 100, from 4.4.4.4
                      AS path: I, validation-state: unverified
                    > to 10.10.5.2 via ge-2/0/11.0

inst512.l2vpn.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

100:100:2.2.2.2/96 AD
                   *[VPLS/170] 4d 02:01:05, metric2 1
                      Indirect
100:100:3.3.3.3/96 AD
                   *[BGP/170] 4d 02:32:41, localpref 100, from 3.3.3.3
                      AS path: I, validation-state: unverified
                    > to 10.10.4.1 via ge-2/0/10.0
100:100:4.4.4.4/96 AD
```

```
                    *[BGP/170] 4d 02:32:41, localpref 100, from 4.4.4.4
                      AS path: I, validation-state: unverified
                     > to 10.10.5.2 via ge-2/0/11.0
100:200:2.2.2.2/96 AD
                    *[VPLS/170] 4d 02:01:05, metric2 1
                      Indirect
3.3.3.3:NoCtrlWord:5:1:2:2.2.2.2:3.3.3.3/176
                    *[VPLS/7] 4d 02:01:05, metric2 1
                     > to 10.10.4.1 via ge-2/0/10.0
3.3.3.3:NoCtrlWord:5:1:2:3.3.3.3:2.2.2.2/176
                    *[LDP/9] 4d 02:01:05
                      Discard
4.4.4.4:NoCtrlWord:5:1:2:2.2.2.2:4.4.4.4/176
                    *[VPLS/7] 4d 02:01:05, metric2 1
                     > to 10.10.5.2 via ge-2/0/11.0
4.4.4.4:NoCtrlWord:5:1:2:4.4.4.4:2.2.2.2/176
                    *[LDP/9] 4d 02:01:05
                      Discard

ldp.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

3.3.3.3:NoCtrlWord:5:1:2:3.3.3.3:2.2.2.2/176
                    *[LDP/9] 4d 02:01:05
                      Discard
4.4.4.4:NoCtrlWord:5:1:2:4.4.4.4:2.2.2.2/176
                    *[LDP/9] 4d 02:01:05
                      Discard
```

Meaning The output shows all the learned routes, including the autodiscovered (AD) routes.

Checking Connectivity

Purpose Verify that Device CE1 can ping Device CE3 and Device CE4.

Action

```
user@CE1> ping 10.255.14.218
PING 10.255.14.218 (10.255.14.218): 56 data bytes
64 bytes from 10.255.14.218: icmp_seq=0 ttl=64 time=0.787 ms
64 bytes from 10.255.14.218: icmp_seq=1 ttl=64 time=0.651 ms
^C
--- 10.255.14.218 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.651/0.719/0.787/0.068 ms

user@CE1> ping 10.255.14.219
PING 10.255.14.219 (10.255.14.219): 56 data bytes
64 bytes from 10.255.14.219: icmp_seq=0 ttl=64 time=1.054 ms
64 bytes from 10.255.14.219: icmp_seq=1 ttl=64 time=0.669 ms
^C
--- 10.255.14.219 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.669/0.862/1.054/0.193 ms
```

Meaning The output shows that VPLS is operational.

Checking the VPLS Connections

Purpose Make sure that all of the FEC 129 VPLS connections come up correctly.

Action

```
user@R2> show vpls connections
Instance: inst512
  L2vpn-id: 1:2
  Local-id: 2.2.2.2
  Mesh-group connections: __ves__
    Remote-id                Type  St     Time last up          # Up trans
    4.4.4.4                  rmt   Up     Oct 26 15:11:56 2012           1
      Remote PE: 4.4.4.4, Negotiated control-word: No
      Incoming label: 800001, Outgoing label: 800001
      Local interface: vt-2/0/10.185597953, Status: Up, Encapsulation: ETHERNET
        Description: Intf - vpls inst512 local-id 2.2.2.2 remote-id 4.4.4.4
neighbor 4.4.4.4
    3.3.3.3                  rmt   Up     Oct 26 15:11:56 2012           1
      Remote PE: 3.3.3.3, Negotiated control-word: No
      Incoming label: 800000, Outgoing label: 800001
      Local interface: vt-2/0/10.185597952, Status: Up, Encapsulation: ETHERNET
        Description: Intf - vpls inst512 local-id 2.2.2.2 remote-id 3.3.3.3
neighbor 3.3.3.3
```

Meaning As expected, the connections are up.

Display Learned VPLS MAC Address Information

Purpose Verify that all CE devices' MAC addresses are learned and installed.

Action

```
user@R2> show vpls mac-table

MAC flags (S -static MAC, D -dynamic MAC, L -locally learned, C -Control MAC
           SE -Statistics enabled, NM -Non configured MAC, R -Remote PE MAC)

Logical system   : R2
Routing instance : inst512
 Bridging domain : __inst512__, VLAN : NA
   MAC                 MAC      Logical          NH     RTR
   address             flags    interface        Index  ID
   00:21:59:0f:35:32   D        ge-2/0/5.0
   00:21:59:0f:35:33   D        vt-2/0/10.185597952
   00:21:59:0f:35:d5   D        vt-2/0/10.185597953
```

Related Documentation

- About This Network Configuration Example on page 5
- VPLS Protocol Operation on page 8
- Example: Configuring BGP Autodiscovery for LDP VPLS (FEC 129) on page 10