Chapter 12

Logical Routers

For many years, engineers have combined power supplies, routing hardware and software, forwarding hardware and software, and physical interfaces into a networking device known as a router. Networking vendors have created large routers and small routers, but all routers have been placed into service as individual devices. As a result, the router has been considered a single physical device for most of its history.

The concept of logical routers breaks with this tradition. With JUNOS software, you can partition a single router into multiple logical devices that perform independent routing tasks. Because logical routers perform a subset of the tasks once handled by the main router, logical routers offer an effective way to maximize the use of a single routing platform.

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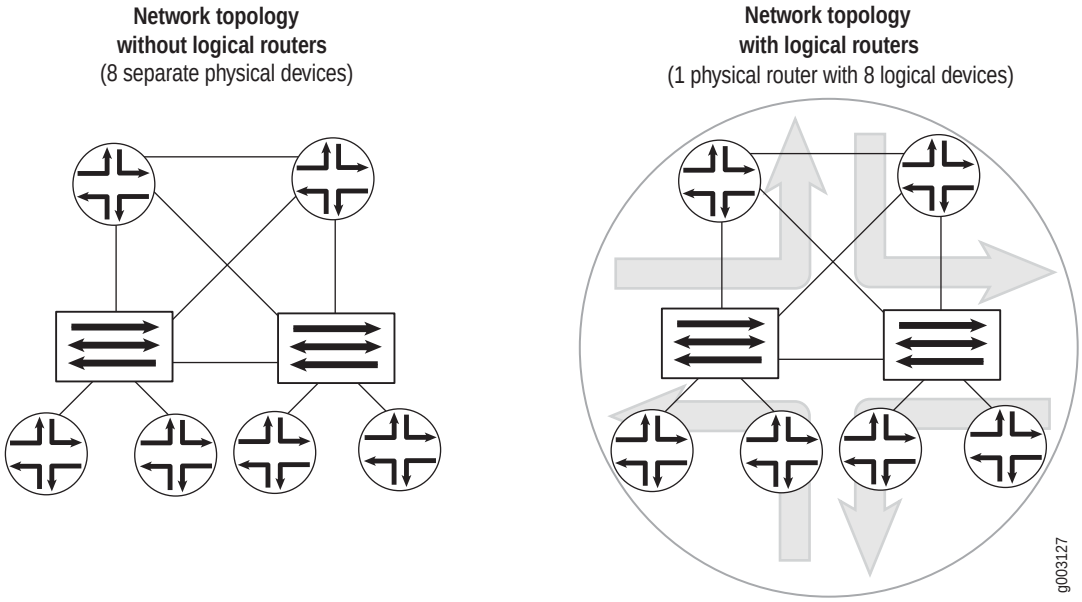
Overview

Traditionally, service provider network design requires multiple layers of switches and routers. These devices transport packet traffic between customers. As seen on the left side of Figure 32, access devices are connected to edge devices, which are in turn connected to core devices.

However, this complexity can lead to challenges in maintenance, configuration, and operation. To reduce such complexity, Juniper Networks now supports logical routers. Logical routers perform a subset of the actions of the main router and have their own unique routing tables, interfaces, policies, and routing instances. As shown on the right side of Figure 32, a set of logical routers within a single router can handle the functions previously performed by several small routers.

Figure 32: Logical Routers Concept



The following protocols and functions are supported on logical routers:

- Open Shortest Path First (OSPF), Intermediate System-to-Intermediate System (IS-IS), Routing Information Protocol (RIP), RIP next generation (RIPng), Border Gateway Protocol (BGP), Resource Reservation Protocol (RSVP), Label Distribution Protocol (LDP), static routes, and Internet Protocol version 4 (IPv4) and version 6 (IPv6) are supported at the [edit logical-routers *logical-router-name* protocols] hierarchy level.

- Multiprotocol Label Switching (MPLS) provider edge (PE) and core provider router functions, such as Layer 2 virtual private networks (VPNs), Layer 3 VPNs, circuit cross-connect (CCC), Layer 2 circuits, and virtual private LAN service (VPLS) are supported at the [edit logical-routers *logical-router-name* routing-instances] hierarchy level.

- Multicast protocols, such as Protocol Independent Multicast (PIM) and Distance Vector Multicast Routing Protocol (DVMRP) are supported at the [edit logical-routers *logical-router-name* protocols] hierarchy level.
- All policy-related statements available at the [edit policy-options] hierarchy level are supported at the [edit logical-routers policy-options] hierarchy level.
- Most routing options statements available at the [edit routing-options] hierarchy level are supported at the [edit logical-routers routing-options] hierarchy level. Only the route-record statement is not supported at the [edit logical-routers routing-options] hierarchy level.
- Graceful Routing Engine switchover is supported. For more information, see "Option: Enabling Graceful Routing Engine Switchover" on page 438.
- You can assign most interface types to a logical router, including SONET/SDH interfaces, Ethernet interfaces, Asynchronous Transfer Mode (ATM) interfaces, ATM2 intelligent queuing (IQ) interfaces, channelized IQ and Gigabit Ethernet IQ interfaces, aggregated interfaces, Link Services interfaces, and Multilink Services interfaces.
- Source class usage, destination class usage, unicast reverse-path forwarding, class of service, firewall filters, class-based forwarding, and policy-based accounting work with logical routers when you configure these features on the main router.

The following restrictions apply to logical routers:

- You can configure a maximum of 15 logical routers on a router.
- The router has only one configuration file which contains configuration information for the main router and all associated logical routers.
- If a logical router experiences an interruption of its routing protocol process (rpd), the core dump output is placed in a file in the following location: /var/tmp/rpd_*logical-router-name*.core-tarball.*number*.tgz. Likewise, if you issue the restart routing command in a logical router, only the routing protocol process (rpd) for the logical router is restarted.
- If you configure trace options for a logical router, the output log file is stored in the following location: /var/log/*logical-router-name.*
- The following Physical Interface Cards (PICs) are not supported with logical routers: Adaptive Services, ES, Monitoring Services, and Monitoring Services II.
- Sampling, port mirroring, IP Security (IPSec), and Generalized MPLS (GMPLS) are not supported.
- Rendezvous point (RP) and source designated router (DR) functionality for multicast protocols within a logical router is not supported.
- Label-switched path (LSP) ping and traceroute for autonomous system (AS) number lookup are not supported.

- Class of service (CoS) on logical tunnel (lt) or virtual loopback tunnel (vt) interfaces in a logical router is not supported.
- You cannot include the vrf-table-label statement on multiple logical routers if the core-facing interfaces are channelized or configured with multiple logical interfaces (Frame Relay DLCIs or Ethernet VLANs).

NOTE: A virtual router does not have the same capabilities as a logical router. A virtual router is a type of simplified routing instance that has a single routing table. A logical router is a partition of the main router and can contain multiple routing instances and routing tables. For example, a logical router can contain multiple virtual router routing instances. As a result, these two entities are not equivalent.

System Requirements

To implement logical routers, your system must meet these minimum requirements:

- JUNOS Release 7.0 or later to implement a logical tunnel (lt) interface on an integrated Adaptive Services Module in an M7i router
- JUNOS Release 6.1 or later, a Tunnel Services PIC, and an Enhanced FPC to implement a logical tunnel (lt) interface
- JUNOS Release 6.0 or later for basic logical router functionality
- One or more Juniper Networks M-series or T-series routing platforms
- A variety of PICs to assign interfaces to each logical router

Terms and Acronyms

- **logical router**—Segmentation of a router into multiple logical routing devices. Logical router configuration statements are found at the [edit logical-routers] hierarchy level.
- **main router**—The standard concept of a router. Main router configuration statements are found at the [edit] hierarchy level.

Configuring Logical Routers

To implement logical routers, you must configure the following:

- Configuring Interfaces and Assigning Logical Interfaces to the Logical Router on page 445
- Configuring Protocols, Routing, and Policy Statements for the Logical Router on page 446
- Option: Configuring Other Logical Router Statements on page 447

To apply your knowledge, see these sections:

- Example: Logical Router Configuration on page 449
- Checking Your Work on page 470

Configuring Interfaces and Assigning Logical Interfaces to the Logical Router

To add interfaces to a logical router, you must configure physical interface properties in the main router and assign logical interfaces to each logical router. Common physical interface properties include encapsulation types and interface-related options. To configure physical interface properties, include the desired statements at the [edit interfaces *interface-name*] hierarchy level.

After you configure the interfaces, you can assign logical interfaces to a logical router. To configure, include the unit statement at the [edit logical-routers *logical-router-name* interfaces *interface-name*] hierarchy level. Once you assign logical interfaces to a logical router, they are considered part of the logical router. If you do not assign a logical interface, it remains part of the main router. You can assign single logical interfaces only to one logical router at a time.

```
[edit]
logical-routers logical-router-name {
    interfaces {
        interface-name {
            logical-interface-statements;
            unit unit-number {
                family inet {
                    address ip-address;
                }
            }
        }
    }
}
interfaces {
    interface-name {
        physical-interface-statements;
    }
}
```

Configuring Protocols, Routing, and Policy Statements for the Logical Router

You can configure routing protocols (such as OSPF, BGP, and MPLS), policies (such as next-hop or load-balancing), routing options, and routing instances for a logical router.

To configure routing protocols, include the **protocols** statement at the [**edit logical-routers** *logical-router-name*] hierarchy level. To configure policies, include the **policy-options** statement at the [**edit logical-routers** *logical-router-name*] hierarchy level. To configure routing options, include the **routing-options** statement at the [**edit logical-routers** *logical-router-name*] hierarchy level. To configure routing instances, include the **routing-instances** statement at the [**edit logical-routers** *logical-router-name*] hierarchy level.

```
[edit]
logical-routers logical-router-name {
    protocols {
        ...
    }
    policy-options {
        ...
    }
    routing-options {
        ...
    }
    routing-instances {
        ...
    }
}
```

Option: Configuring Other Logical Router Statements

You can configure a variety of additional statements in conjunction with a logical router:

- Logical tunnel (lt) interface—You can connect different logical routers together within the same router with an lt interface. You can create an lt interface if you have a Tunnel Services PIC installed on an Enhanced FPC in your routing platform. On an M7i router, logical tunnel interfaces can be created by using the integrated Adaptive Services Module.

  You must treat each interface like a point-to-point connection because you can only connect one logical tunnel interface to another at any given time. Also, you must select an interface encapsulation type, specify a DLCI number or VLAN identifier, configure a corresponding protocol family, and set the logical interface unit number of the peering lt interface. To configure, include the dlci, encapsulation, family, peer-unit, and vlan-id statements at the following hierarchy levels:

  - Main router—[edit interfaces lt-*fpc/pic/*0 unit *unit-number*]
  - Logical router—[edit logical-routers *logical-router-name* interfaces lt-*fpc/pic/*0 unit *unit-number*]

```
[edit]
logical-routers logical-router-name {
    interfaces {
        lt-fpc/pic/0 {
            unit unit-number {
                encapsulation (ethernet | ethernet-ccc | ethernet-vpls | frame-relay |
                                frame-relay-ccc | vlan | vlan-ccc | vlan-vpls);
                peer-unit number; # The logical unit number of the peering lt interface.
                dlci dlci-number;
                vlan-id vlan-number;
                family (ccc | inet | inet6 | iso | mpls | tcc);
            }
        }
    }
}
```

NOTE: When you configure IPv6 addresses on a logical tunnel interface, you must configure unique IPv6 link local addresses for any logical interfaces that peer with one another. To configure a link local address, include a second IPv6 address with the address statement at the [edit interfaces lt-*fpc/pic/port* unit *unit-number* family inet6] hierarchy level. Link local addresses typically begin with the numbers fe80 (such as fe80::1111:1/64).

In addition, you can configure only Frame Relay interface encapsulation on a logical tunnel interface when it is configured with an IPv6 address.

- Dynamic Host Control Protocol (DHCP) relay, Bootstrap Protocol (BOOTP), Trivial File Transfer Protocol (TFTP), and Domain Name Service (DNS)—In a logical router, you can configure a DHCP or BOOTP server, and allow TFTP and DNS packets to be forwarded. To configure a DHCP or BOOTP server in a logical router, include the logical-router statement at the [edit forwarding-options helpers bootp interface *interface-name* server *ip-address*] hierarchy level. To configure TFTP packet forwarding in a logical router, include the logical-router statement at the [edit forwarding-options helpers tftp interface *interface-name* server *ip-address*] hierarchy level. To configure DNS packet forwarding in a logical router, include the logical-router statement at the [edit forwarding-options helpers domain interface *interface-name* server *ip-address*] hierarchy level. For more information about DHCP relay, BOOTP, TFTP, or DNS, see the *JUNOS Policy Framework Configuration Guide*.

- Filter-based forwarding—You can configure filter-based forwarding for a logical router or a routing instance within a logical router. To configure filter-based forwarding for a logical router, include the logical-router statement at the [edit firewall filter *filter-name* term *term-name* then] hierarchy level. To configure filter-based forwarding for a routing instance within a logical router, include the routing-instance option at the [edit firewall filter *filter-name* term *term-name* then logical-router *logical-router-name*] hierarchy level. For more information, see the *JUNOS Policy Framework Configuration Guide*.

- You can select to view only the operational mode hierarchy for a specific logical router. To configure a logical router view, issue the set cli logical-router *logical-router-name* command.

  When you enter logical router view mode and enter an operational mode command, the output of the command displays information related to the logical router only. For example, when you issue the show route command, the output shows only the routes that are assigned to the logical router.

  ```
  user@P0> set cli logical-router lr1
  Logical router: lr1

  user@P0:lr1>      # Note that the user is now restricted to a logical router view.
  ```

  To clear the logical router view and return to a full router view, issue the clear cli logical-router command.

  ```
  user@P0:lr1> clear cli logical-router
  Cleared default logical router

  user@P0>      # Note that the user can now view the entire router again.
  ```

  To achieve the same effect when using a JUNOScript client application, include the < set-logical-router > tag:

  ```
  <rpc>
    <set-logical-router>
      <logical-router>lr1</logical-router>
   </set-logical-router>
  </rpc>
  ```

  For more information about JUNOScript, see the *JUNOScript API Guide*.

Example: Logical Router Configuration

Figure 33: Logical Router Topology Diagram

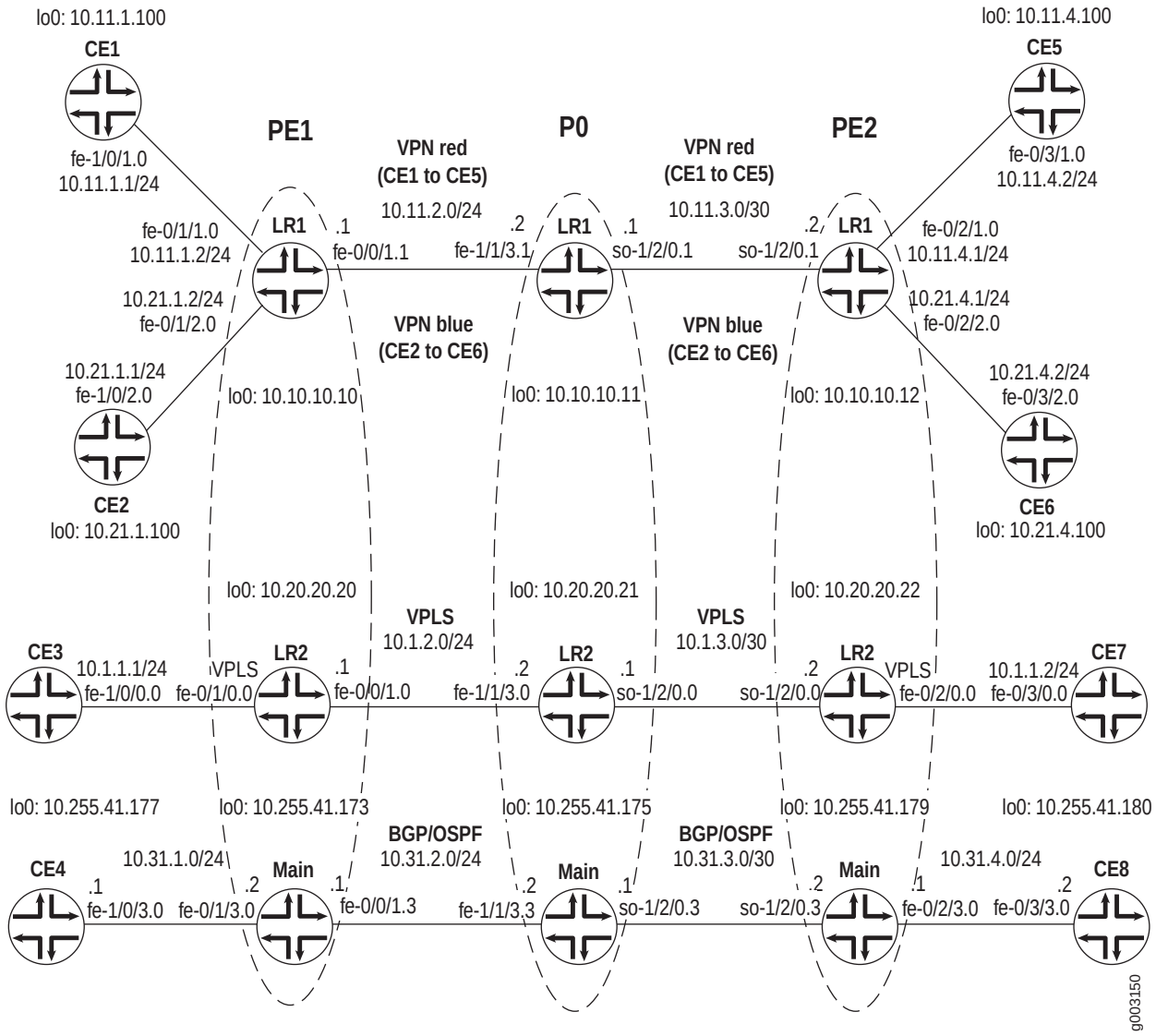


Figure 33 shows four pairs of customer edge (CE) routers that are connected across an MPLS backbone. Routers CE1 and CE5 are part of the red VPN, routers CE2 and CE6 are in the blue VPN, routers CE3 and CE7 belong to a VPLS domain, and routers CE4 and CE8 are connected with standard protocols. Two logical routers are configured on provider edge (PE) routers PE1 and PE2 and provider core Router P0. Each of these three routers has two logical routers: LR1 and LR2. To illustrate the concept of a logical router, both VPNs are part of logical router LR1, the VPLS instance belongs to LR2, and the remaining routers use the main router portion of routers PE1, P0, and PE2.

On Router CE1, configure OSPF to connect to the red VPN in logical router LR1 on Router PE1:

Router CE1

```
[edit]
interfaces {
    fe-1/0/1 {
        vlan-tagging;
        unit 0 {
            description "routing-instance red CE";
            vlan-id 101;
            family inet {
                address 10.11.1.1/24;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.11.1.100/32;
            }
        }
    }
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface fe-1/0/1.0;
            interface lo0.0;
        }
    }
}
```

On Router CE2, configure BGP to connect to the blue VPN in logical router LR1 on Router PE1:

Router CE2

```
[edit]
interfaces {
    fe-1/0/2 {
        vlan-tagging;
        unit 0 {
            description "routing-instance blue CE";
            vlan-id 102;
            family inet {
                address 10.21.1.1/24;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.21.1.100/32;
            }
        }
    }
}
```

```
routing-options {
    autonomous-system 200;
}
protocols {
    bgp {
      export export_loopback;
      group to_PE {
        type external;
        local-address 10.21.1.1;
        peer-as 100;
        neighbor 10.21.1.2;
      }
    }
}
policy-options {
    policy-statement export_loopback {
      from {
        route-filter 10.21.1.100/32 exact;
      }
      then accept;
    }
}
```

On Router CE3, configure the Fast Ethernet interface in VLAN 600 to connect with the VPLS routing instance in logical router LR2 on Router PE1:

Router CE3

```
[edit]
interfaces {
    fe-1/0/0 {
      vlan-tagging;
      unit 0 {
        description "vpls interface";
        vlan-id 600;
        family inet {
          address 10.1.1.1/24;
        }
      }
    }
}
```

On Router CE4, configure the Fast Ethernet interface to connect with the main router at Router PE1:

Router CE4

```
[edit]
interfaces {
    fe-1/0/3 {
      vlan-tagging;
      unit 0 {
        description "main router interface";
        vlan-id 103;
        family inet {
          address 10.31.1.1/24;
        }
      }
    }
```

```
    lo0 {
      unit 0 {
        family inet {
          address 10.255.41.177/32;
        }
      }
    }
}
```

On Router PE1, create two VPN routing and forwarding (VRF) routing instances in logical router LR1: red and blue. Configure the CE-facing logical interfaces so that traffic from Router CE1 is placed in the red VPN and traffic from Router CE2 is placed in the blue VPN. Next, create a logical interface at fe-0/0/1.1 to connect to logical router LR1 on Router P0.

Also on Router PE1, create a VPLS routing instance in logical router LR2. Configure a logical interface so that traffic from Router CE3 is sent into the VPLS domain and connects to logical router LR2 on Router P0.

Finally, configure a logical interface to interconnect Router CE4 with the main router portion of Router P0.

Router PE1

```
[edit]
logical-routers {
    lr1 {                    # The configuration for the first logical router begins here.
      interfaces {
        fe-0/0/1 {
          unit 1 {           # This is the core-facing interface for logical router LR1.
            description "lr1 interface";
            vlan-id 101;
            family inet {
              address 10.11.2.1/24;
            }
            family iso;
            family mpls;
          }
        }
        fe-0/1/1 {
          unit 0 {           # This logical interface connects to Router CE1.
            description "routing-instance red interface";
            vlan-id 101;
            family inet {
              address 10.11.1.2/24;
            }
          }
        }
        fe-0/1/2 {
          unit 0 {           # This logical interface connects to Router CE2.
            description "routing-instance blue interface";
            vlan-id 102;
            family inet {
              address 10.21.1.2/24;
            }
          }
        }
```

```
    lo0 {
      unit 1 {
        description "lr1 loopback";
        family inet {
          address 10.10.10.10/32;
        }
        family iso {
          address 47.1111.1111.1111.1111.00;
        }
      }
    }
}
protocols {   # You configure RSVP, MPLS, IS-IS, and BGP for logical router LR1.
    rsvp {
      interface all;
    }
    mpls {
      label-switched-path to_10.10.10.12 {
        to 10.10.10.12;
      }
      interface all;
    }
    bgp {
      group to_other_PE {
        type internal;
        local-address 10.10.10.10;
        family inet-vpn {
          any;
        }
        neighbor 10.10.10.12;
      }
    }
    isis {
      interface all;
    }
}
policy-options {
    policy-statement from_bgp_to_ospf {
      then accept;
    }
}
```

```
    routing-instances {
      blue {
        instance-type vrf;  # You configure instance blue within logical router LR1.
        interface fe-0/1/2.0;
        route-distinguisher 10.10.10.10:200;
        vrf-target target:20:20;
        protocols {
          bgp {             #BGP connects the blue instance with Router CE2.
            group to_CE {
              type external;
              local-address 10.21.1.2;
              peer-as 200;
              neighbor 10.21.1.1;
            }
          }
        }
      }
      red {
        instance-type vrf;     #You configure instance red within logical router LR1.
        interface fe-0/1/1.0;
        route-distinguisher 10.10.10.10:100;
        vrf-target target:10:10;
        protocols {
          ospf {                #OSPF connects the red instance with Router CE1.
            export from_bgp_to_ospf;
            area 0.0.0.0 {
              interface all;
            }
          }
        }
      }
    }
    routing-options {
      autonomous-system 100;
    }
}
lr2 {                  # The configuration for the second logical router begins here.
    interfaces {
      fe-0/0/1 {
        unit 0 {           # This is the core-facing interface for logical router LR2.
          description "lr2 interface";
          vlan-id 100;
          family inet {
            address 10.1.2.1/24;
          }
          family iso;
          family mpls;
        }
      }
      fe-0/1/0 {
        unit 0 {           # This logical interface connects to Router CE3.
          description "vpls interface";
          encapsulation vlan-vpls;
          vlan-id 600;
          family vpls;
        }
      }
```

```
    lo0 {
      unit 2 {
        description "lr2 loopback";
        family inet {
          address 10.20.20.20/32;
        }
        family iso {
          address 47.2222.2222.2222.2222.00;
        }
      }
    }
}
protocols {      #You configure RSVP, MPLS, IS-IS, and BGP for logical router LR2.
    rsvp {
      interface all;
    }
    mpls {
      label-switched-path to_10.20.20.22 {
        to 10.20.20.22;
      }
      interface all;
    }
    bgp {
      group to_VPLS_PE {
        type internal;
        local-address 10.20.20.20;
        family l2vpn {
          unicast;
        }
        neighbor 10.20.20.22;
      }
    }
    isis {
      interface fe-0/0/1.0;
      interface lo0.2;
    }
}
routing-instances {
    new {
      instance-type vpls;      #You configure VPLS within logical router LR2.
      interface fe-0/1/0.0;
      route-distinguisher 10.20.20.20:100;
      vrf-target target:30:30;
      protocols {
        vpls {
          site-range 10;
          site newPE {
            site-identifier 1;
          }
        }
      }
    }
}
```

```
        routing-options {
            autonomous-system 400;
        }
    }
}
interfaces {
    fe-0/0/1 {
        vlan-tagging;
        unit 3 {            # This is the core-facing interface for the main router of PE1.
            description "main router to P0";
            vlan-id 103;
            family inet {
                address 10.31.2.1/24;
            }
            family iso;
            family mpls;
        }
    }
    fe-0/1/3 {
        vlan-tagging;
        unit 0 {        # This logical interface in the main router of PE1 connects to CE4.
            description "main router to CE4";
            vlan-id 103;
            family inet {
                address 10.31.1.2/24;
            }
        }
    }
    fe-0/1/0 {          # You must always configure physical interface statements for
        vlan-tagging;   # logical router interfaces at the [edit interfaces] hierarchy level.
        encapsulation vlan-vpls;
    }
    fe-0/1/1 {
        vlan-tagging;
    }
    fe-0/1/2 {
        vlan-tagging;
    }
    lo0 {
        unit 0 {
            description "main router loopback";
            family inet {
                address 10.255.41.173/32;
            }
        }
    }
}
routing-options {
    static {
        route 10.255.41.177/32 next-hop 10.31.1.1;
    }
    autonomous-system 500;
}
```

```
protocols {
    bgp {            # The main router uses BGP as the exterior gateway protocol.
      group to_main_lr {
        type internal;
        local-address 10.255.41.173;
        export export_address;
        neighbor 10.255.41.179;
        neighbor 10.255.41.175;
      }
    }
    ospf {       # The main router uses OSPF as the interior gateway protocol.
      area 0.0.0.0 {
        interface lo0.0;
        interface fe-0/0/1.3;
      }
    }
}
policy-options {
    policy-statement export_address {
      from {
        route-filter 10.255.41.177/32 exact;
      }
      then accept;
    }
}
```

On Router P0, configure logical routers LR1, LR2, and the main router. For the logical router, you must configure physical interface properties at the main router [edit interfaces] hierarchy level and assign the logical interfaces to the logical routers. Next, you must configure protocols (such as RSVP, MPLS, BGP, and IS-IS), routing options, and policy options for the logical routers.

In this example, logical router LR1 transports traffic for the red VPN that exists between routers CE1 and CE5. LR1 also connects the blue VPN that exists between routers CE2 and CE6. Logical router LR2 transports VPLS traffic between routers CE3 and CE7.

For the main router on Router P0, you can configure the router as usual. In this example, the main router transports traffic between routers CE4 and CE8. As a result, configure the interfaces and routing protocols (OSPF, BGP) to connect to the main router portion of routers PE1 and PE2.

Router P0

```
[edit]
logical-routers {
    lr1 {                    # The configuration for the first logical router begins here.
      interfaces {
        fe-1/1/3 {
          unit 1 {           # This logical interface connects to LR1 on Router PE1.
            description "lr1 interface";
            vlan-id 101;
            family inet {
              address 10.11.2.2/24;
            }
            family iso;
            family mpls;
          }
        }
        so-1/2/0 {
          unit 1 {           # This logical interface connects to LR1 on Router PE2.
            description "lr1 interface";
            dlci 101;
            family inet {
              address 10.11.3.1/24;
            }
            family iso;
            family mpls;
          }
        }
        lo0 {
          unit 1 {
            description "lr1 loopback";
            family inet {
              address 10.10.10.11/32;
            }
            family iso {
              address 47.1111.1111.1111.1112.00;
            }
          }
        }
      }
```

```
    protocols {          #You configure RSVP, MPLS, and IS-IS for logical router LR1.
      rsvp {
        interface all;
      }
      mpls {
        interface all;
      }
      isis {
        interface all;
      }
    }
}
lr2 {                    # The configuration for the second logical router begins here.
    interfaces {
      fe-1/1/3 {
        unit 0 {         # This logical interface connects to LR2 on Router PE1.
          description "lr2 interface";
          vlan-id 100;
          family inet {
            address 10.1.2.2/24;
          }
          family iso;
          family mpls;
        }
      }
      so-1/2/0 {
        unit 0 {         # This logical interface connects to LR2 on Router PE2.
          description "lr2 interface";
          dlci 100;
          family inet {
            address 10.1.3.1/24;
          }
          family iso;
          family mpls;
        }
      }
      lo0 {
        unit 2 {
          description "lr2 loopback";
          family inet {
            address 10.20.20.21/32;
          }
          family iso {
            address 47.2222.2222.2222.2223.00;
          }
        }
      }
    }
```

```
        protocols {          #You configure RSVP, MPLS, and IS-IS for logical router LR2.
            rsvp {
                interface all;
            }
            mpls {
                interface all;
            }
            isis {
                interface fe-1/1/3.0;
                interface so-1/2/0.0;
                interface lo0.2;
            }
        }
    }
}
interfaces {
    fe-1/1/3 {
        vlan-tagging;
        unit 3 {      # This logical interface connects to the main router on Router PE1.
            description "main router interface";
            vlan-id 103;
            family inet {
                address 10.31.2.2/24;
            }
            family iso;
            family mpls;
        }
    }
    so-1/2/0 {
        dce;             # You must configure all physical interface statements for logical
        encapsulation frame-relay;# routers at the [edit interfaces] hierarchy level.
        unit 3 {      # This logical interface connects to the main router on Router PE2.
            description "main router interface";
            dlci 103;
            family inet {
                address 10.31.3.1/24;
            }
            family iso;
            family mpls;
        }
    }
    lo0 {
        unit 0 {
            description "main router loopback";
            family inet {
                address 10.255.41.175/32;
            }
        }
    }
}
routing-options {
    autonomous-system 500;
}
```

```
protocols {                    #You configure BGP and OSPF for the main router.
    bgp {
      group to_main_lr {
        type internal;
        local-address 10.255.41.175
        neighbor 10.255.41.179;
        neighbor 10.255.41.173;
      }
    }
    ospf {
      area 0.0.0.0 {
        interface lo0.0;
        interface fe-1/1/3.3;
        interface so-1/2/0.3;
      }
    }
}
```

On Router PE2, create two VRF routing instances in logical router LR1: red and blue. Configure the CE-facing logical interfaces so that traffic from Router CE5 is placed in the red VPN and traffic from Router CE6 is placed in the blue VPN. Next, create one logical interface on so-1/2/0.1 to connect to logical router LR1 on Router P0.

Also on Router PE2, create a VPLS routing instance in logical router LR2. Configure a logical interface so that traffic from Router CE7 is sent into the VPLS domain and connects to logical router LR2 on Router P0.

Finally, configure a logical interface to interconnect Router CE8 with the main router portion of Router P0.

Router PE2

```
[edit]
logical-routers {
    lr1 {                      # The configuration for the first logical router begins here.
      interfaces {
        fe-0/2/0 {
          unit 1 {             # This logical interface connects to Router CE5.
            description "routing-instance red interface";
            vlan-id 101;
            family inet {
              address 10.11.4.1/24;
            }
          }
          unit 2 {             # This logical interface connects to Router CE6.
            description "routing-instance blue interface";
            vlan-id 102;
            family inet {
              address 10.21.4.1/24;
            }
          }
        }
```

```
    so-1/2/0 {
      unit 1 {          # This is the core-facing interface for logical router LR1.
        description "lr1 interface";
        dlci 101;
        family inet {
          address 10.11.3.2/24;
        }
        family iso;
        family mpls;
      }
    }
    lo0 {
      unit 1 {
        description "lr1 loopback";
        family inet {
          address 10.10.10.12/32;
        }
        family iso {
          address 47.1111.1111.1111.1113.00;
        }
      }
    }
}
protocols {
    rsvp {      # You configure RSVP, MPLS, IS-IS, and BGP for logical router LR1.
      interface all;
    }
    mpls {
      label-switched-path to_10.10.10.10 {
        to 10.10.10.10;
      }
      interface all;
    }
    bgp {
      group to_other_PE {
        type internal;
        local-address 10.10.10.12;
        family inet {
          any;
        }
        family inet-vpn {
          any;
        }
        neighbor 10.10.10.10;
      }
    }
    isis {
      interface all;
    }
}
policy-options {
    policy-statement from_bgp_to_ospf {
      then accept;
    }
}
```

```
    routing-instances {
      blue {
        instance-type vrf;    # You configure instance blue within logical router LR1.
        interface fe-0/2/2.0;
        route-distinguisher 10.10.10.12:200;
        vrf-target target:20:20;
        protocols {
          bgp {               # BGP connects the blue instance with Router CE6.
            group to_CE {
              local-address 10.21.4.1;
              peer-as 300;
              neighbor 10.21.4.2;
            }
          }
        }
      }
      red {
        instance-type vrf;    # You configure instance red within logical router LR1.
        interface fe-0/2/1.0;
        route-distinguisher 10.10.10.12:100;
        vrf-target target:10:10;
        protocols {
          ospf {              # OSPF connects the red instance with Router CE5.
            export from_bgp_to_ospf;
            area 0.0.0.0 {
              interface all;
            }
          }
        }
      }
    }
    routing-options {
      autonomous-system 100;
    }
}
lr2 {                         # The configuration for the second logical router begins here.
    interfaces {
      fe-0/2/0 {
        unit 0 {              # This logical interface connects to Router CE7.
          description "vpls interface";
          encapsulation vlan-vpls;
          vlan-id 600;
          family vpls;
        }
      }
      so-1/2/0 {
        unit 0 {              # This is the core-facing interface for logical router LR2.
          description "lr2 interface";
          dlci 100;
          family inet {
            address 10.1.3.2/24;
          }
          family iso;
          family mpls;
        }
      }
```

```
        lo0 {
            unit 2 {
                description "lr2 loopback";
                family inet {
                    address 10.20.20.22/32;
                }
                family iso {
                    address 47.2222.2222.2222.2224.00;
                }
            }
        }
        protocols {    # You configure RSVP, MPLS, IS-IS, and BGP for logical router LR2.
            rsvp {
                interface all;
            }
            mpls {
                label-switched-path to_10.20.20.20 {
                    to 10.20.20.20;
                }
                interface all;
            }
            bgp {
                group to_VPLS_PE {
                    type internal;
                    local-address 10.20.20.22;
                    family l2vpn {
                        unicast;
                    }
                    neighbor 10.20.20.20;
                }
            }
            isis {
                interface so-1/2/0.0;
                interface lo0.2;
            }
        }
        routing-instances {
            new {
                instance-type vpls;      # You configure VPLS within logical router LR2.
                interface fe-0/2/0.0;
                route-distinguisher 10.20.20.22:100;
                vrf-target target:30:30;
                protocols {
                    vpls {
                        site-range 10;
                        site newPE {
                            site-identifier 2;
                        }
                    }
                }
            }
        }
        routing-options {
            autonomous-system 400;
        }
}
```

```
interfaces {
    fe-0/2/0 {          # You must always configure physical interface statements for
      vlan-tagging;     # logical router interfaces at the [edit interfaces] hierarchy level.
      encapsulation vlan-vpls;
    }
    fe-0/2/1 {
      vlan-tagging;
    }
    fe-0/2/2 {
      vlan-tagging;
    }
    fe-0/2/3 {
      vlan-tagging;
      unit 0 {      # This logical interface in the main router of PE2 connects to CE8.
        description "main router to CE8";
        vlan-id 103;
        family inet {
          address 10.31.4.1/24;
        }
      }
    }
    so-1/2/0 {
      encapsulation frame-relay;
      unit 3 {              # This is the core-facing interface for the main router of PE2.
        description "main router to P0";
        dlci 103;
        family inet {
          address 10.31.3.2/24;
        }
        family iso;
        family mpls;
      }
    }
    lo0 {
      unit 0 {
        description "main router loopback";
        family inet {
          address 10.155.41.179/32;
        }
      }
    }
}
routing-options {
    static {
      route 10.255.41.180/32 next-hop 10.31.4.2;
    }
    autonomous-system 500;
}
```

```
protocols {
    bgp {           # The main router uses BGP as the exterior gateway protocol.
      group to_main_lr {
        type internal;
        local-address 10.255.41.179;
        export export_address;
        neighbor 10.255.41.173;
        neighbor 10.255.41.175;
      }
    }
    ospf {          # The main router uses OSPF as the interior gateway protocol.
      area 0.0.0.0 {
        interface so-1/2/0.3;
        interface fe-0/2/3.0;
        interface lo0.0;
      }
    }
}
policy-options {
    policy-statement export_address {
      from {
        route-filter 10.255.41.180/32 exact;
      }
      then accept;
    }
}
```

On Router CE5, configure OSPF to connect to the red VPN in logical router LR1 on Router PE2:

Router CE5

```
[edit]
interfaces {
    fe-0/3/1 {
        vlan-tagging;
        unit 0 {
            description "routing-instance red CE";
            vlan-id 101;
            family inet {
                address 10.11.4.2/24;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.11.4.100/32;
            }
        }
    }
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface fe-0/3/1.0;
            interface lo0.0;
        }
    }
}
```

On Router CE6, configure BGP to connect to the blue VPN in logical router LR1 on Router PE2:

Router CE6

```
[edit]
interfaces {
    fe-0/3/2 {
        vlan-tagging;
        unit 0 {
            description "routing-instance blue CE";
            vlan-id 102;
            family inet {
                address 10.21.4.2/24;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.21.4.100/32;
            }
        }
    }
}
routing-options {
    autonomous-system 300;
}
protocols {
    bgp {
        export export_loopback;
        group to_PE {
            type external;
            local-address 10.21.4.2;
            peer-as 100;
            neighbor 10.21.4.1;
        }
    }
}
policy-options {
    policy-statement export_loopback {
        from {
            route-filter 10.21.4.100/32 exact;
        }
        then accept;
    }
}
```

On Router CE7, configure the Fast Ethernet interface in VLAN 600 to connect with the VPLS routing instance in logical router LR2 on Router PE2:

Router CE7

```
[edit]
interfaces {
    fe-0/3/0 {
        vlan-tagging;
        unit 0 {
            description "vpls interface";
            vlan-id 600;
            family inet {
                address 10.1.1.2/24;
            }
        }
    }
}
```

On Router CE8, configure the Fast Ethernet interface to connect with the main router at Router PE2:

Router CE8

```
[edit]
interfaces {
    fe-0/3/3 {
        vlan-tagging;
        unit 0 {
            description "main router interface";
            vlan-id 103;
            family inet {
                address 10.31.4.2/24;
            }
        }
    }
}
    lo0 {
        unit 0 {
            family inet {
                address 10.255.41.180/32;
            }
        }
    }
}
```

Checking Your Work

To verify the proper operation of logical routers, use the following commands:

- show bgp summary (logical-router *logical-router-name*)
- show isis adjacency (logical-router *logical-router-name*)
- show mpls lsp (logical-router *logical-router-name*)
- show ospf neighbor (logical-router *logical-router-name*)
- show route (logical-router *logical-router-name*)
- show route protocol protocol (logical-router *logical-router-name*)
- show rsvp session (logical-router *logical-router-name*)
- show vpls connections (logical-router *logical-router-name*)

The following sections show the output of commands used with the configuration example:

- Router CE1 Status on page 471
- Router CE2 Status on page 471
- Router CE3 Status on page 471
- Router PE1 Status: Main Router on page 472
- Router PE1 Status: LR1 on page 472
- Router PE1 Status: LR2 on page 474
- Router P0 Status: Main Router on page 474
- Router P0 Status: LR1 on page 475
- Router P0 Status: LR2 on page 475
- Router PE2 Status: Main Router on page 476
- Router PE2 Status: LR1 on page 477
- Router PE2 Status: LR2 on page 478
- Router CE5 Status on page 479
- Router CE6 Status on page 480
- Router CE7 Status on page 480
- Verifying That Each Routing Instance Has the Proper Connectivity on page 480

Router CE1 Status

```
user@CE1> show route table

inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.11.1.0/24       *[Direct/0] 00:20:20
                    > via fe-1/0/1.0
10.11.1.1/32       *[Local/0] 00:20:24
                       Local via fe-1/0/1.0
10.11.1.100/32     *[Direct/0] 00:21:53
                    > via lo0.0
10.11.4.0/24       *[OSPF/150] 00:18:30, metric 0, tag 3489661028
                    > to 10.11.1.2 via fe-1/0/1.0
10.11.4.100/32     *[OSPF/10] 00:18:30, metric 2
                    > to 10.11.1.2 via fe-1/0/1.0
224.0.0.5/32       *[OSPF/10] 00:21:58, metric 1
                       MultiRecv
```

Router CE2 Status

```
user@CE2> show route table

inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.21.1.0/24       *[Direct/0] 00:20:30
                    > via fe-1/0/2.0
10.21.1.1/32       *[Local/0] 00:20:34
                       Local via fe-1/0/2.0
10.21.1.100/32     *[Direct/0] 00:22:03
                    > via lo0.0
10.21.4.0/24       *[BGP/170] 00:18:43, localpref 100
                       AS path: 100 I
                    > to 10.21.1.2 via fe-1/0/2.0
10.21.4.100/32     *[BGP/170] 00:18:43, localpref 100
                       AS path: 100 300 I
                    > to 10.21.1.2 via fe-1/0/2.0
```

Router CE3 Status

```
user@CE3> show route table

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

10.1.1.0/24       *[Direct/0] 00:20:13
                    > via fe-1/0/0.0
10.1.1.1/32       *[Local/0] 00:20:17
                       Local via fe-1/0/0.0
```

Router PE1 Status: Main Router

```
user@PE1> show bgp summary
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 1          0          0          0          0          0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/DwnState|#Active/Received/Damped...
10.255.41.175     500          5          8       0       0        2:31 0/0/0                0/0/0
10.255.41.179     500          6          9       0       0        2:35 0/1/0                0/0/0

                    user@PE1> show route protocol bgp

                    inet.0: 20 destinations, 21 routes (20 active, 0 holddown, 0 hidden)
                    + = Active Route, - = Last Active, * = Both

                    10.255.41.180/32    [BGP/170] 00:02:48, localpref 100, from 10.255.41.179
                                          AS path: I
                                        > to 10.31.2.2 via fe-0/0/1.3

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

                    inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

                    user@PE1> show ospf neighbor
                      Address         Interface             State      ID              Pri  Dead
                    10.31.2.2        fe-0/0/1.3            Full      10.255.41.175    128   32

                    user@PE1> show isis adjacency
                    IS-IS instance is not running
```

Router PE1 Status: LR1

```
user@PE1> show bgp summary logical-router lr1
Groups: 2 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l3vpn.0            4          4          0          0          0          0
bgp.l3vpn.2            0          0          0          0          0          0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/DwnState|#Active/Received/Damped...
10.10.10.12       100         13         14       0       0        2:50 Establ
  bgp.l3vpn.0: 4/4/0
  bgp.l3vpn.2: 0/0/0
  blue.inet.0: 2/2/0
  red.inet.0: 2/2/0
10.21.1.1         200         13         14       0       0        4:33 Establ
  blue.inet.0: 1/1/0
```

red VPN

```
user@PE1> show route logical-router lr1 table red

red.inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.11.1.0/24       *[Direct/0] 00:04:51
                    > via fe-0/1/1.0
10.11.1.2/32       *[Local/0] 00:05:45
                      Local via fe-0/1/1.0
10.11.1.100/32     *[OSPF/10] 00:04:02, metric 1
                    > to 10.11.1.1 via fe-0/1/1.0
10.11.4.0/24       *[BGP/170] 00:03:05, localpref 100, from 10.10.10.12
                      AS path: I
                    > to 10.11.2.2 via fe-0/0/1.1, label-switched-path
to_10.10.10.12
10.11.4.100/32     *[BGP/170] 00:03:05, MED 1, localpref 100, from 10.10.10.12
                      AS path: I
                    > to 10.11.2.2 via fe-0/0/1.1, label-switched-path
to_10.10.10.12
224.0.0.5/32       *[OSPF/10] 00:07:02, metric 1
                      MultiRecv
```

blue VPN

```
user@PE1> show route logical-router lr1 table blue

blue.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.21.1.0/24       *[Direct/0] 00:05:29
                    > via fe-0/1/2.0
10.21.1.2/32       *[Local/0] 00:06:23
                      Local via fe-0/1/2.0
10.21.1.100/32     *[BGP/170] 00:05:26, localpref 100
                      AS path: 200 I
                    > to 10.21.1.1 via fe-0/1/2.0
10.21.4.0/24       *[BGP/170] 00:03:43, localpref 100, from 10.10.10.12
                      AS path: I
                    > to 10.11.2.2 via fe-0/0/1.1, label-switched-path
to_10.10.10.12
10.21.4.100/32     *[BGP/170] 00:03:43, localpref 100, from 10.10.10.12
                      AS path: 300 I
                    > to 10.11.2.2 via fe-0/0/1.1, label-switched-path
to_10.10.10.12

user@PE1> show route logical-router lr1 table inet.0

inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.10/32     *[Direct/0] 00:08:05
                    > via lo0.1
10.10.10.11/32     *[IS-IS/15] 00:05:07, metric 10
                    > to 10.11.2.2 via fe-0/0/1.1
10.10.10.12/32     *[IS-IS/15] 00:04:58, metric 20
                    > to 10.11.2.2 via fe-0/0/1.1
10.11.2.0/24       *[Direct/0] 00:05:38
                    > via fe-0/0/1.1
10.11.2.1/32       *[Local/0] 00:06:51
                      Local via fe-0/0/1.1
10.11.3.0/24       *[IS-IS/15] 00:05:07, metric 20
                    > to 10.11.2.2 via fe-0/0/1.1
```

```
user@PE1> ping logical-router lr1 routing-instance red 10.11.4.100
PING 10.11.4.100 (10.11.4.100): 56 data bytes
64 bytes from 10.11.4.100: icmp_seq=0 ttl=251 time=1.055 ms
^C
--- 10.11.4.100 ping statistics ---
1 packets transmitted, 1 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.055/1.055/1.055/0.000 ms
```

Router PE1 Status: LR2

```
user@PE1> show vpls connections logical-router lr2
Layer-2 VPN Connections:

Legend for connection status (St)
OR -- out of range              WE -- intf encaps != instance encaps
EI -- encapsulation invalid     Dn -- down
EM -- encapsulation mismatch    VC-Dn -- Virtual circuit down
CM -- control-word mismatch     -> -- only outbound conn is up
CN -- circuit not provisioned   <- -- only inbound conn is up
OL -- no outgoing label         Up -- operational
NC -- intf encaps not CCC/TCC   XX -- unknown
NP -- intf h/w not present

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

Instance: new
Local site: newPE (1)
    connection-site           Type  St     Time last up          # Up trans
    2                         rmt   Up     Jul 16 14:05:25 2003           1
      Local interface: vt-1/2/0.49152, Status: Up, Encapsulation: VPLS
      Remote PE: 10.20.20.22, Negotiated control-word: No
      Incoming label: 800001, Outgoing label: 800000
```

Router P0 Status: Main Router

```
user@P0> show interfaces terse lo0
Interface               Admin Link Proto Local                 Remote
lo0                     up    up
lo0.0                   up    up   inet  10.255.41.175       --> 0/0
                                        127.0.0.1           --> 0/0
                                   iso
47.0005.80ff.f800.0000.0108.0003.0102.5501.4175.00
                                   inet6 fe80::2a0:a5ff:fe12:2b09
                                         feee::10:255:14:175
lo0.1                   up    up   inet  10.10.10.11         --> 0/0
                                   iso   47.1111.1111.1111.1112.00
lo0.2                   up    up   inet  10.20.20.21         --> 0/0
                                   iso   47.2222.2222.2222.2223.00
lo0.16383               up    up   inet

user@P0> show ospf neighbor
  Address         Interface             State      ID               Pri  Dead
10.31.2.1       fe-1/1/3.3            Full      10.255.41.173    128   34
10.31.3.2       so-1/2/0.3            Full      10.255.41.179    128   37
```

Router P0 Status: LR1

```
user@P0> show isis adjacency logical-router lr1
Interface             System         L State       Hold (secs) SNPA
fe-1/1/3.1            PE1          2 Up                    21  0:90:69:9:4:1
fe-1/1/3.1            PE1          1 Up                    24  0:90:69:9:4:1
so-1/2/0.1            PE2           3 Up                    25

user@P0> show bgp summary logical-router lr1
BGP is not running

user@P0> show route protocol isis logical-router lr1

inet.0: 7 destinations, 7 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.10/32     *[IS-IS/15] 00:09:15, metric 10
                    > to 10.11.2.1 via fe-1/1/3.1
10.10.10.12/32     *[IS-IS/15] 00:09:39, metric 10
                    > to 10.11.3.2 via so-1/2/0.1

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

mpls.0: 7 destinations, 7 routes (7 active, 0 holddown, 0 hidden)
```

Router P0 Status: LR2

```
user@P0> show bgp summary logical-router lr2
BGP is not running

user@P0> show isis adjacency logical-router lr2
Interface             System         L State       Hold (secs) SNPA
fe-1/1/3.0            PE1            2 Up                    24  0:90:69:9:4:1
fe-1/1/3.0            PE1            1 Up                    23  0:90:69:9:4:1
so-1/2/0.0            PE2            3 Up                    24

user@P0> show route protocol isis logical-router lr2

inet.0: 7 destinations, 7 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.20.20.20/32     *[IS-IS/15] 00:09:44, metric 10
                    > to 10.1.2.1 via fe-1/1/3.0
10.20.20.22/32     *[IS-IS/15] 00:09:45, metric 10
                    > to 10.1.3.2 via so-1/2/0.0

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

mpls.0: 7 destinations, 7 routes (7 active, 0 holddown, 0 hidden)
```

Router PE2 Status: Main Router

```
user@PE2> show ospf neighbor
  Address         Interface             State      ID              Pri  Dead
10.31.4.2        fe-0/2/3.0            Full       10.255.41.180   128   38
10.31.3.1        so-1/2/0.3            Full       10.255.41.175   128   36

user@PE2> show interfaces terse lo0
Interface               Admin Link Proto Local                 Remote
lo0                     up    up
lo0.0                   up    up   inet  10.255.41.179       --> 0/0
                                        127.0.0.1           --> 0/0
                                   iso   47.0005.80ff.f800.0000.0108.0003.0102.5501.4179.00
                                   inet6 fe80::2a0:a5ff:fe12:29ff
                                         feee::10:255:14:179
lo0.1                   up    up   inet  10.10.10.12         --> 0/0
                                   iso   47.1111.1111.1111.1113.00
lo0.2                   up    up   inet  10.20.20.22         --> 0/0
                                   iso   47.2222.2222.2222.2224.00
lo0.16383               up    up   inet

user@PE2> show bgp summary
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 1          1          0          0          0          0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/DwnState|#Active/Received/Damped...
10.255.41.175     500         24         27       0       0       11:46 0/0/0                 0/0/0
10.255.41.173     500         25         25       0       0       11:11 1/1/0                 0/0/0

user@PE2> show route protocol ospf

inet.0: 20 destinations, 22 routes (19 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.41.175/32   *[OSPF/10] 00:00:20, metric 1
                    > via so-1/2/0.3
10.255.41.180/32    [OSPF/10] 00:00:20, metric 1
                    > to 10.31.4.2 via fe-0/2/3.0
10.255.41.173/32    *[OSPF/10] 00:00:20, metric 2
                    > via so-1/2/0.3
10.31.2.0/24       *[OSPF/10] 00:00:20, metric 2
                    > via so-1/2/0.3
10.31.3.0/24        [OSPF/10] 00:00:20, metric 1
                    > via so-1/2/0.3
224.0.0.5/32       *[OSPF/10] 00:13:46, metric 1
                      MultiRecv

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

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

user@PE2> show route protocol bgp

inet.0: 20 destinations, 22 routes (19 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.41.177/32   *[BGP/170] 00:11:23, localpref 100, from 10.255.41.173
                      AS path: I
                    > via so-1/2/0.3

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

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
```

Router PE2 Status: LR1

```
user@PE2> show bgp summary logical-router lr1
Groups: 2 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 0          0          0          0          0          0
inet.2                 0          0          0          0          0          0
bgp.l3vpn.0            4          4          0          0          0          0
bgp.l3vpn.2            0          0          0          0          0          0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.10.10.10       100         29         31       0       0       11:25 Establ
  bgp.l3vpn.0: 4/4/0
  bgp.l3vpn.2: 0/0/0
  blue.inet.0: 2/2/0
  red.inet.0: 2/2/0
10.21.4.2         300         27         28       0       0       11:40 Establ
  blue.inet.0: 1/1/0
```

red VPN

```
user@PE2> show route logical-router lr1 table red

red.inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.11.1.0/24       *[BGP/170] 00:12:02, localpref 100, from 10.10.10.10
                      AS path: I
                     > via so-1/2/0.1, label-switched-path to_10.10.10.10
10.11.1.100/32     *[BGP/170] 00:12:02, MED 1, localpref 100, from 10.10.10.10
                      AS path: I
                     > via so-1/2/0.1, label-switched-path to_10.10.10.10
10.11.4.0/24       *[Direct/0] 00:13:22
                     > via fe-0/2/1.0
10.11.4.1/32       *[Local/0] 00:13:29
                      Local via fe-0/2/1.0
10.11.4.100/32     *[OSPF/10] 00:12:35, metric 1
                     > to 10.11.4.2 via fe-0/2/1.0
224.0.0.5/32       *[OSPF/10] 00:15:02, metric 1
                      MultiRecv
```

blue VPN

```
user@PE2> show route logical-router lr1 table blue

blue.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.21.1.0/24       *[BGP/170] 00:13:12, localpref 100, from 10.10.10.10
                      AS path: I
                     > via so-1/2/0.1, label-switched-path to_10.10.10.10
10.21.1.100/32     *[BGP/170] 00:13:12, localpref 100, from 10.10.10.10
                      AS path: 200 I
                     > via so-1/2/0.1, label-switched-path to_10.10.10.10
10.21.4.0/24       *[Direct/0] 00:14:32
                     > via fe-0/2/2.0
10.21.4.1/32       *[Local/0] 00:14:39
                      Local via fe-0/2/2.0
10.21.4.100/32     *[BGP/170] 00:13:27, localpref 100
                      AS path: 300 I
                     > to 10.21.4.2 via fe-0/2/2.0
```

```
user@PE2> show mpls lsp logical-router lr1
Ingress LSP: 1 sessions
To              From            State Rt ActivePath       P     LSPname
10.10.10.10     10.10.10.12     Up     0                  *     to_10.10.10.10
Total 1 displayed, Up 1, Down 0

Egress LSP: 1 sessions
To              From            State Rt Style Labelin Labelout LSPname
10.10.10.12     10.10.10.10     Up     0 1 FF       3        - to_10.10.10.12
Total 1 displayed, Up 1, Down 0

Transit LSP: 0 sessions
Total 0 displayed, Up 0, Down 0

user@PE2> show rsvp session logical-router lr1
Ingress RSVP: 1 sessions
To              From            State Rt Style Labelin Labelout LSPname
10.10.10.10     10.10.10.12     Up     0 1 FF       -   100000 to_10.10.10.10
Total 1 displayed, Up 1, Down 0

Egress RSVP: 1 sessions
To              From            State Rt Style Labelin Labelout LSPname
10.10.10.12     10.10.10.10     Up     0 1 FF       3        - to_10.10.10.12
Total 1 displayed, Up 1, Down 0

Transit RSVP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

Router PE2 Status: LR2

```
user@PE2> show vpls connections logical-router lr2
Layer-2 VPN Connections:

Legend for connection status (St)
OR -- out of range              WE -- intf encaps != instance encaps
EI -- encapsulation invalid     Dn -- down
EM -- encapsulation mismatch    VC-Dn -- Virtual circuit down
CM -- control-word mismatch     -> -- only outbound conn is up
CN -- circuit not provisioned   <- -- only inbound  conn is up
OL -- no outgoing label         Up -- operational
NC -- intf encaps not CCC/TCC   XX -- unknown
NP -- intf h/w not present

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

Instance: new
Local site: newPE (2)
    connection-site           Type  St     Time last up          # Up trans
    1                         rmt   Up     Jul 16 14:05:25 2003           1
      Local interface: vt-1/1/0.40960, Status: Up, Encapsulation: VPLS
      Remote PE: 10.20.20.20, Negotiated control-word: No
      Incoming label: 800000, Outgoing label: 800001
```

```
user@PE2> show bgp summary logical-router lr2
Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l2vpn.0            1          1          0          0          0          0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/DwnState|#Active/Received/Damped...
10.20.20.20       400         29         31       0       0       13:29 Establ
  bgp.l2vpn.0: 1/1/0
  new.l2vpn.0: 1/1/0
```

```
user@PE2> show mpls lsp logical-router lr2
Ingress LSP: 1 sessions
To              From            State Rt ActivePath       P     LSPname
10.20.20.20     10.20.20.22     Up     0                  *     to_10.20.20.20
Total 1 displayed, Up 1, Down 0

Egress LSP: 1 sessions
To              From            State Rt Style Labelin Labelout LSPname
10.20.20.22     10.20.20.20     Up     0 1 FF       3        - to_10.20.20.22
Total 1 displayed, Up 1, Down 0

Transit LSP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

```
user@PE2> show rsvp session logical-router lr2
Ingress RSVP: 1 sessions
To              From            State Rt Style Labelin Labelout LSPname
10.20.20.20     10.20.20.22     Up     0 1 FF       -   100016 to_10.20.20.20
Total 1 displayed, Up 1, Down 0

Egress RSVP: 1 sessions
To              From            State Rt Style Labelin Labelout LSPname
10.20.20.22     10.20.20.20     Up     0 1 FF       3        - to_10.20.20.22
Total 1 displayed, Up 1, Down 0

Transit RSVP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

Router CE5 Status

```
user@CE5> show route table

inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.11.1.0/24       *[OSPF/150] 00:19:47, metric 0, tag 3489661028
                    > to 10.11.4.1 via fe-0/3/1.0
10.11.1.100/32     *[OSPF/10] 00:19:47, metric 2
                    > to 10.11.4.1 via fe-0/3/1.0
10.11.4.0/24       *[Direct/0] 00:21:12
                    > via fe-0/3/1.0
10.11.4.2/32       *[Local/0] 00:21:24
                       Local via fe-0/3/1.0
10.11.4.100/32     *[Direct/0] 00:22:37
                    > via lo0.0
224.0.0.5/32       *[OSPF/10] 00:22:44, metric 1
                       MultiRecv
```

Router CE6 Status

```
user@CE6> show route table

inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.21.1.0/24       *[BGP/170] 00:19:53, localpref 100
                      AS path: 100 I
                    > to 10.21.4.1 via fe-0/3/2.0
10.21.1.100/32     *[BGP/170] 00:19:53, localpref 100
                      AS path: 100 200 I
                    > to 10.21.4.1 via fe-0/3/2.0
10.21.4.0/24       *[Direct/0] 00:21:16
                    > via fe-0/3/2.0
10.21.4.2/32       *[Local/0] 00:21:28
                      Local via fe-0/3/2.0
10.21.4.100/32     *[Direct/0] 00:22:41
                    > via lo0.0
```

Router CE7 Status

```
user@CE7> show route table

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

10.1.1.0/24       *[Direct/0] 00:21:03
                    > via fe-0/3/0.0
10.1.1.2/32       *[Local/0] 00:21:15
                      Local via fe-0/3/0.0
```

Verifying That Each Routing Instance Has the Proper Connectivity

To verify that each pair of CE routers has end-to-end connectivity, issue the ping command on routers CE1, CE2, and CE3:

CE1 to CE5 (red VPN)

```
user@CE1> ping 10.11.4.100
PING 10.11.4.100 (10.11.4.100): 56 data bytes
64 bytes from 10.11.4.100: icmp_seq=0 ttl=252 time=1.216 ms
64 bytes from 10.11.4.100: icmp_seq=1 ttl=252 time=1.052 ms
^C
--- 10.11.4.100 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.052/1.134/1.216/0.082 ms
```

CE2 to CE6 (blue VPN)

```
user@CE2> ping 10.21.4.100
PING 10.21.4.100 (10.21.4.100): 56 data bytes
64 bytes from 10.21.4.100: icmp_seq=0 ttl=252 time=1.205 ms
64 bytes from 10.21.4.100: icmp_seq=1 ttl=252 time=1.021 ms
^C
--- 10.21.4.100 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.021/1.113/1.205/0.092 ms
```

CE3 to CE7 (VPLS)

```
user@CE3> ping 10.1.1.2
PING 10.1.1.2 (10.1.1.2): 56 data bytes
64 bytes from 10.1.1.2: icmp_seq=0 ttl=255 time=1.186 ms
64 bytes from 10.1.1.2: icmp_seq=1 ttl=255 time=1.091 ms
64 bytes from 10.1.1.2: icmp_seq=2 ttl=255 time=1.081 ms
^C
--- 10.1.1.2 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.081/1.119/1.186/0.047 ms
```

For More Information

Because the concepts that constitute logical routers cut across the entire JUNOS software documentation set, you will find the following manuals to be useful references:

- For additional information about routing protocols, see the *JUNOS Routing Protocols Configuration Guide.*
- For additional information about policies, see the *JUNOS Policy Framework Configuration Guide.*
- For additional information about interface configuration, see the *JUNOS Network Interfaces Configuration Guide.*
- For additional information about MPLS and related protocols, see the *JUNOS MPLS Applications Configuration Guide.*
- For additional information about VPN protocols, see the *JUNOS VPNs Configuration Guide.*
- For additional information about multicast protocols, see the *JUNOS Multicast Protocols Configuration Guide.*
- For additional information about operational mode commands and output, see the *JUNOS Interfaces Command Reference,* the *JUNOS Routing Protocols and Policies Command Reference*, and the *JUNOS System Basics and Services Command Reference.*

Revision History

14 September 2005—7.4R1 Release. Richard Hendricks.

13 June 2005—7.3R1 Release. Richard Hendricks.

5 April 2005—7.2R1 Release. Richard Hendricks.

2 February 2005—7.1R1 Release. Richard Hendricks.

6 October 2004—Added support for implementing logical tunnel (lt) interfaces on an integrated Adaptive Services Module in an M7i router, 7.0R1 Release. Richard Hendricks.

6 July 2004—6.4R1 Release. Richard Hendricks.

5 April 2004—Revised lt interface families and encapsulation types and added support for graceful Routing Engine switchover, 6.3R1 Release. Richard Hendricks.

22 December 2003—Added new protocol family and encapsulation types for logical tunnel interfaces, 6.2R1 Release. Richard Hendricks.

22 September 2003—Added a new example, the logical tunnel (lt) interface type, and interface hierarchy changes. 6.1R1 Release. Richard Hendricks.

30 June 2003—Initial document written, Release 6.0R1. Richard Hendricks.