JUNIPER NETWORKS

Network Configuration Example

Implementing Interprovider Layer 3 VPN Option A

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Interprovider Layer 3 VPN Option A Overview

This document describes one of four recommended interprovider and carrier-of-carriers solutions for situations in which the customer of a VPN service provider might be another service provider rather than an end customer. The customer service provider depends on the virtual private network (VPN) service provider (SP) to deliver a VPN transport service between the customer service provider's points of presence (POPs) or regional networks.

If the customer service provider's sites have different autonomous system (AS) numbers, then the VPN transit service provider supports carrier-of-carriers VPN service for the interprovider VPN service. This functionality might be used by a VPN customer who has connections to several different Internet service providers (ISPs), or different connections to the same ISP in different geographic regions, each of which has a different AS number.

Applications

A customer might require VPN services for different sites, yet the same SP is not available for all of those sites.

RFC 4364 suggests several methods to resolve this problem, including:

- Interprovider VRF-to-VRF connections at the AS boundary routers (ASBR) (not very scalable). This option is presented in *Implementing Interprovider Layer 3 VPN Option A*.
- Interprovider EBGP redistribution of labeled VPN-IPv4 routes from AS to neighboring AS (somewhat scalable). This option is presented in *Implementing Interprovider Layer 3 VPN Option B*.
- Interprovider multihop EBGP redistribution of labeled VPN-IPv4 routes between source and destination ASs, with EBGP redistribution of labeled IPv4 routes from AS to neighboring AS (very scalable). This option is presented in *Implementing Interprovider Layer 3 VPN Option C*.

Solutions might include elements of both the interprovider VPN solutions and the carrier-of-carriers solution. For example, a transit carrier might supply a service provider whose sites have different AS numbers, which makes the solution topology look like an interprovider solution (due to the different AS numbers). However, it is the same service for the transit carrier, so it really is a carrier-of-carriers service. This type of service solution is referred to as carrier-of-carriers VPN service for the interprovider VPN service.

In contrast, if the customer service provider's sites have the same AS number, then the VPN transit service provider delivers a carrier-of-carriers VPN service.

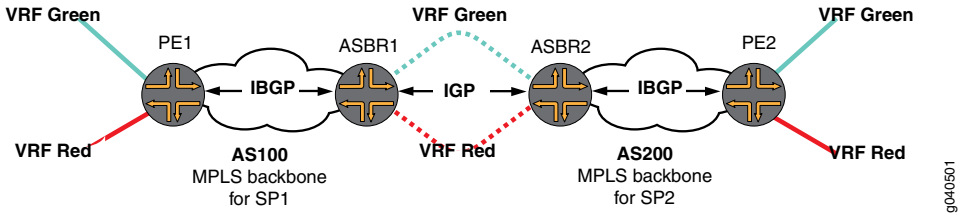
In addition to resolving the initial problem described above, carrier-of-carriers or interprovider VPN solutions may be used to solve other problems such as scalability and merging two service providers.

Implementation

This solution is the same as a regular VPN solution. There is no need to send MPLS packets to the neighboring AS. If SP1 and SP2 are connected to each other using a transit SP, the transit SP may provide a tunnel between SP1 and SP2 using a layer-2 VPN or any other IP tunneling technology.

The logical topology of the network is shown in Figure 1 on page 2.

Figure 1: Logical Topology of Interprovider Layer 3 VPN Option A



Related Documentation

- Example: Configuring Interprovider Layer 3 VPN Option A on page 3

Example: Configuring Interprovider Layer 3 VPN Option A

This example provides a step-by-step procedure to configure interprovider Layer 3 VPN option A, which is one of the recommended implementations of MPLS VPN when that service is required by a customer that has more than one AS and but not all of the customer's ASs can be serviced by the same service provider. It is organized in the following sections:

Requirements

This example uses the following hardware and software components:

- Junos OS Release 9.5 or later.
- Eight M Series, T Series, TX Series, or MX Series Juniper Networks routers.

Configuration Overview and Topology

This is the simplest and least scalable interprovider VPN solution to the problem of providing VPN services to a customer that has different sites, not all of which can use the same service provider (SP).

RFC 4364, section 10, refers to this method as Interprovider VRF-to-VRF connections at the AS border routers.

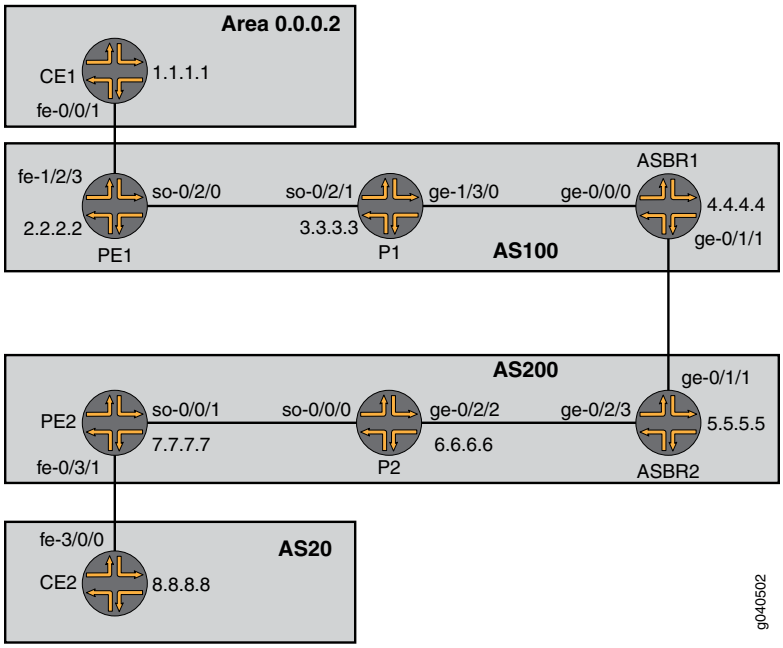
In this configuration:

- The VPN routing and forwarding (VRF) table in the ASBR of one AS is linked to the VRF table in the ASBR in the other AS. Each ASBR must contain a VRF instance for every VPN configured in both service provider networks. Then an IGP or BGP must be configured between the ASBRs. This has the disadvantage of limiting scalability.
- In this configuration, the autonomous system boundary routers (ASBRs) at both SPs are configured as regular PE routers, and provide MPLS L3 VPN service to the neighbor SP.
- Each PE router treats the other as if it were a customer edge (CE) router. ASBRs play the role of regular CE routers for the ASBR of the remote SP. ASBRs see each other as CE devices.
- A provider edge (PE) router in one autonomous system (AS) attaches directly to a PE router in another AS.
- The two PE routers are attached by multiple sub-interfaces, at least one for each of the VPNs whose routes need to be passed from AS to AS.
- The PE routers associate each sub-interface with a VPN routing and forwarding (VRF) table, and use EBGP to distribute unlabeled IPv4 addresses to each other.

- In this solution, all common VPNs defined at both PEs must also be defined at one or more ASBRs between the two SPs. This is not a very scalable methodology, especially when a transit SP is used by two regional SPs for interconnection.
- This is a procedure that is simple to configure and it does not require MPLS at the border between ASs. Additionally, it does not scale as well as other recommended procedures.

The topology of the network is shown in Figure 2 on page 4.

Figure 2: Physical Topology of Interprovider Layer 3 VPN Option A



Configuration

NOTE: The procedure presented here is written with the assumption that the reader is already familiar with MPLS MVPN configuration. This example focuses on explaining the unique configuration required for carrier-of-carriers solutions for VPN services to different sites.

To configure interprovider layer 3 VPN option A, perform the following tasks:

Configuring Router CE1

Step-by-Step Procedure

1. On Router CE1, configure the IP address and protocol family on the Fast Ethernet interface for the link between Router CE1 and Router PE1. Specify the **inet** address family type.

```
[edit interfaces fe-0/0/1.0]
family inet {
  address 18.18.18.1/30;
}
```

2. On Router CE1, configure the IP address and protocol family on the loopback interface. Specify the **inet** address family type.

```
[edit interfaces lo0]
unit 0 {
  family inet {
    address 1.1.1.1/32;
  }
}
```

3. On Router CE1, configure an IGP. The IGP can be a static route, RIP, OSPF, ISIS, or EBGP. In this example we configure OSPF. Include the Fast Ethernet interface for the link between Router CE1 and Router PE1 and the logical loopback interface of Router CE1.

```
[edit protocols]
ospf {
  area 0.0.0.2 {
    interface fe-0/0/1.0;
    interface lo0.0;
  }
}
```

Configuring Router PE1

Step-by-Step Procedure

1. On Router PE1, configure IPv4 addresses on the SONET, Fast Ethernet, and logical loopback interfaces. Specify the **inet** address family on all of the interfaces. Specify the **mpls** address family on the SONET and Fast Ethernet interfaces.

```
[edit interfaces]
so-0/2/0 {
  unit 0 {
    family inet {
      address 19.19.19.1/30;
    }
    family mpls;
  }
}
fe-1/2/3 {
  unit 0 {
```

```
      family inet {
        address 18.18.18.2/30;
      }
      family mpls;
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 2.2.2.2/32;
      }
    }
  }
```

2. On Router PE1, configure the routing instance for VPN2. Specify the **vrf** instance type and specify the customer-facing Fast Ethernet interface. Configure a route distinguisher to create a unique VPN-IPv4 address prefix. Apply the VRF import and export policies to enable the sending and receiving of route targets. Configure the OSPF protocol within the VRF. Specify the customer-facing Fast Ethernet interface and specify the export policy to export BGP routes into OSPF.

```
[edit routing-instances]
vpn2CE1 {
  instance-type vrf;
  interface fe-1/2/3.0;
  route-distinguisher 1:100;
  vrf-import vpnimport;
  vrf-export vpnexport;
  protocols {
    ospf {
      export bgp-to-ospf;
      area 0.0.0.2 {
        interface fe-1/2/3.0;
      }
    }
  }
}
```

3. On Router PE1, configure the RSVP and MPLS protocols to support the label-switched path (LSP). Configure the LSP to Router ASBR1 and specify the IP address of the logical loopback interface on Router ASBR1. Configure a BGP group. Specify the group type as **internal**. Specify the local address as the logical loopback interface on Router PE1. Specify the neighbor address as the logical loopback interface on Router ASBR1. Specify the **inet-vpn** address family and **unicast** traffic type to enable BGP to carry IPv4 network layer reachability information (NLRI) for VPN routes. Configure the OSPF protocol. Specify the core-facing SONET interface and specify the logical loopback interface on Router PE1.

```
[edit protocols]
rsvp {
  interface so-0/2/0.0;
  interface lo0.0;
}
mpls {
  label-switched-path To-ASBR1 {
```

```
        to 4.4.4.4;
      }
      interface so-0/2/0.0;
      interface lo0.0;
    }
    bgp {
      group To_ASBR1 {
        type internal;
        local-address 2.2.2.2;
        neighbor 4.4.4.4 {
          family inet-vpn {
            unicast;
          }
        }
      }
    }
    ospf {
      traffic-engineering;
      area 0.0.0.0 {
        interface so-0/2/0.0;
        interface lo0.0;
      }
    }
```

4. On Router PE1, configure the BGP local autonomous system number.

```
[edit routing-options]
autonomous-system 100;
```

5. On Router PE1, configure a policy to export the BGP routes into OSPF.

```
[edit policy-options]
policy-statement bgp-to-ospf {
  term 1 {
    from protocol bgp;
    then accept;
  }
  term 2 {
    then reject;
  }
}
```

6. On Router PE1, configure a policy to add the VRF route target to the routes being advertised for this VPN.

```
[edit policy-options]
policy-statement vpnexport {
  term 1 {
    from protocol ospf;
    then {
      community add test_comm;
      accept;
    }
  }
  term 2 {
    then reject;
  }
}
```

7. On Router PE1, configure a policy to import routes from BGP that have the **test_comm** community attached.

```
[edit policy-options]
policy-statement vpnimport {
  term 1 {
    from {
      protocol bgp;
      community test_comm;
    }
    then accept;
  }
  term 2 {
    then reject;
  }
}
```

8. On Router PE1, define the **test_comm** BGP community with a route target.

```
[edit policy-options]
community test_comm members target:1:100;
```

Configuring Router P1

Step-by-Step Procedure

1. On Router P1, configure IP addresses for the SONET and Gigabit Ethernet interfaces. Enable the interfaces to process the **inet** and **mpls** address families. Configure the IP address for the **lo0.0** loopback interface and enable the interface to process the **inet** address family.

```
[edit interfaces]
so-0/2/1 {
  unit 0 {
    family inet {
      address 19.19.19.2/30;
    }
    family mpls;
  }
}
ge-1/3/0 {
  unit 0 {
    family inet {
      address 20.20.20.1/30;
    }
    family mpls;
  }
}
lo0 {
  unit 0 {
    family inet {
      address 3.3.3.3/32;
    }
  }
}
```

2. On Router P1, configure the RSVP and MPLS protocols to support the LSP. Specify the SONET and Gigabit Ethernet interfaces.

Configure the OSPF protocol. Specify the SONET and Gigabit Ethernet interfaces and specify the logical loopback interface. Enable OSPF to support traffic engineering extensions.

```
[edit protocols]
rsvp {
   interface so-0/2/1.0;
   interface ge-1/3/0.0;
   interface lo0.0;
}
mpls {
   interface lo0.0;
   interface ge-1/3/0.0;
   interface so-0/2/1.0;
}
ospf {
   traffic-engineering;
   area 0.0.0.0 {
      interface ge-1/3/0.0;
      interface so-0/2/1.0;
      interface lo0.0;
   }
}
```

Configuring Router ASBR1

Step-by-Step Procedure

1. On Router ASBR1, configure IP addresses for the Gigabit Ethernet interfaces. Enable the interfaces to process the **inet** and **mpls** addresses families. Configure the IP addresses for the **lo0.0** loopback interface and enable the interface to process the **inet** address family.

```
[edit interfaces]
ge-0/0/0 {
   unit 0 {
      family inet {
         address 20.20.20.2/30;
      }
      family mpls;
   }
}
ge-0/1/1 {
   unit 0 {
      family inet {
         address 21.21.21.1/30;
      }
      family mpls;
   }
}
lo0 {
   unit 0 {
      family inet {
         address 4.4.4.4/32;
      }
   }
}
```

2. On Router ASBR1, configure the **To_ASBR2** routing instance. Specify the **vrf** instance type and specify the core-facing Gigabit Ethernet interface. Configure a route distinguisher to create a unique VPN-IPv4 address prefix. Configure a route target for the VPN. Configure the BGP peer group within the VRF. Specify AS 200 as the peer AS and specify the IP address of the Gigabit Ethernet interface on Router ASBR2 as the neighbor address.

```
[edit routing instances]
To_ASBR2{
   instance-type vrf;
   interface ge-0/1/1.0;
   route-distinguisher 1:100;
   vrf-target target:1:100;
   protocols {
      bgp {
         group To_ASBR2 {
            type external;
            neighbor 21.21.21.2 {
               peer-as 200;
            }
         }
      }
   }
}
```

3. On Router ASBR1, configure the RSVP and MPLS protocols to support the LSP. Specify the Gigabit Ethernet interfaces.

   Configure the OSPF protocol. Specify the SONET and Gigabit Ethernet interfaces and specify the logical loopback interface. Enable OSPF to support traffic engineering extensions.

```
[edit protocols]
rsvp {
   interface ge-0/0/0.0;
   interface lo0.0;
}
mpls {
   label-switched-path To_PE1 {
      to 2.2.2.2;
   }
   interface lo0.0;
   interface ge-0/0/0.0;
}
ospf {
   traffic-engineering;
   area 0.0.0.0 {
      interface ge-0/0/0.0;
      interface lo0.0;
   }
}
```

4. On Router ASBR1, create the **To-PE1** internal BGP peer group. Specify the local IP peer address as the local **lo0.0** address. Specify the neighbor IP peer address as the **lo0.0** interface address of Router PE1.


```
[edit protocols]
bgp {
  group To-PE1 {
    type internal;
    local-address 4.4.4.4;
    neighbor 2.2.2.2 {
      family inet-vpn {
        unicast;
      }
    }
  }
}
```

5. On Router ASBR1, configure the BGP local autonomous system number.

```
[edit routing-options]
autonomous-system 100;
```

Configuring Router ASBR2

Step-by-Step Procedure

1. On Router ASBR2, configure IP addresses for the Gigabit Ethernet interfaces. Enable the interfaces to process the **inet** and **mpls** address families. Configure the IP address for the **lo0.0** loopback interface and enable the interface to process the **inet** address family.

```
[edit interfaces]
ge-0/1/1 {
  unit 0 {
    family inet {
      address 21.21.21.2/30;
    }
    family mpls;
  }
}
ge-0/2/3 {
  unit 0 {
    family inet {
      address 22.22.22.1/30;
    }
    family mpls;
  }
}
lo0 {
  unit 0 {
    family inet {
      address 5.5.5.5/32;
    }
  }
}
```

2. On Router ASBR2, configure the **To_ASBR1** routing instance. Specify the **vrf** instance type and specify the core-facing Gigabit Ethernet interface. Configure a route distinguisher to create a unique VPN-IPv4 address prefix. Configure a route target for the VPN. Configure the BGP peer group within the VRF. Specify AS 100 as the

peer AS and specify the IP address of the Gigabit Ethernet interface on Router ASBR1 as the neighbor address.

```
[edit routing-instances]
To_ASBR1 {
   instance-type vrf;
   interface ge-0/1/1.0;
   route-distinguisher 1:100;
   vrf-target target:1:100;
   protocols {
      bgp {
         group To_ASBR1 {
            type external;
            neighbor 21.21.21.1 {
               peer-as 100;
            }
         }
      }
   }
}
```

3. On Router ASBR2, configure the RSVP and MPLS protocols to support the LSP. Specify the Gigabit Ethernet interfaces.

   Configure the OSPF protocol. Specify the SONET and Gigabit Ethernet interfaces and specify the logical loopback interface. Enable OSPF to support traffic engineering extensions.

```
[edit protocols]
rsvp {
   interface ge-0/2/3.0;
   interface lo0.0;
}
mpls {
   label-switched-path To_PE2 {
      to 7.7.7.7;
   }
   interface lo0.0;
   interface ge-0/2/3.0;
}
ospf {
   traffic-engineering;
   area 0.0.0.0 {
      interface ge-0/2/3.0;
      interface lo0.0;
   }
}
```

4. On Router ASBR2, create the **To-PE2** internal BGP peer group. Specify the local IP peer address as the local **lo0.0** address. Specify the neighbor IP peer address as the **lo0.0** interface address of Router PE2.

```
[edit protocols]
bgp {
   group To-PE2 {
      type internal;
      local-address 5.5.5.5;
```



```
    neighbor 7.7.7.7 {
      family inet-vpn {
        unicast;
      }
    }
  }
```

5. On Router ASBR2, configure the BGP local autonomous system number.

```
[edit routing-options]
autonomous-system 200;
```

Configuring Router P2

Step-by-Step Procedure

1. On Router P2, configure IP addresses for the SONET and Gigabit Ethernet interfaces. Enable the interfaces to process the **inet** and **mpls** address families. Configure the IP address for the **lo0.0** loopback interface and enable the interface to process the **inet** address family.

```
[edit interfaces]
so-0/0/0 {
  unit 0 {
    family inet {
      address 23.23.23.1/30;
    }
    family mpls;
  }
}
ge-0/2/2 {
  unit 0 {
    family inet {
      address 22.22.22.2/30;
    }
    family mpls;
  }
}
lo0 {
  unit 0 {
    family inet {
      address 6.6.6.6/32;
    }
  }
}
```

2. On Router P2, configure the RSVP and MPLS protocols to support the LSP. Specify the SONET and Gigabit Ethernet interfaces.

   Configure the OSPF protocol. Specify the SONET and Gigabit Ethernet interfaces and specify the logical loopback interface. Enable OSPF to support traffic engineering extensions.

```
[edit protocols]
rsvp {
  interface so-0/0/0.0;
  interface ge-0/2/2.0;
  interface lo0.0;
```

```
}
mpls {
   interface lo0.0;
   interface ge-0/2/2.0;
   interface so-0/0/0.0;
}
ospf {
   traffic-engineering;
   area 0.0.0.0 {
      interface ge-0/2/2.0;
      interface so-0/0/0.0;
      interface lo0.0;
   }
}
```

Configuring Router PE2

Step-by-Step Procedure

1. On Router PE2, configure IPv4 addresses on the SONET, Fast Ethernet, and logical loopback interfaces. Specify the **inet** address family on all of the interfaces. Specify the **mpls** address family on the SONET and Fast Ethernet interfaces.

```
[edit interfaces]
so-0/0/1 {
   unit 0 {
      family inet {
         address 23.23.23.2/30;
      }
      family mpls;
   }
}
fe-0/3/1 {
   unit 0 {
      family inet {
         address 24.24.24.1/30;
      }
      family mpls;
   }
lo0 {
   unit 0 {
      family inet {
         address 7.7.7.7/32;
      }
   }
}
```

2. On Router PE2, configure the routing instance for VPN2. Specify the **vrf** instance type and specify the customer-facing Fast Ethernet interface. Configure a route distinguisher to create a unique VPN-IPv4 address prefix. Apply the VRF import and export policies to enable the sending and receiving of route targets. Configure the BGP peer group within the VRF. Specify AS **20** as the peer AS and specify the IP address of the Fast Ethernet interface on Router CE2 as the neighbor address.

```
[edit routing-instances]
vpn2CE2 {
   instance-type vrf;
```

```
    interface fe-0/3/1.0;
    route-distinguisher 1:100;
    vrf-import vpnimport;
    vrf-export vpnexport;
    protocols {
      bgp {
        group To_CE2 {
          peer-as 20;
          neighbor 24.24.24.2;
        }
      }
    }
  }
```

3. On Router PE2, configure the RSVP and MPLS protocols to support the LSP. Configure the LSP to ASBR2 and specify the IP address of the logical loopback interface on Router ASBR2. Configure a BGP group. Specify the group type as **internal**. Specify the local address as the logical loopback interface on Router PE2. Specify the neighbor address as the logical loopback interface on the Router ASBR2. Specify the **inet-vpn** address family and **unicast** traffic type to enable BGP to carry IPv4 NLRI for VPN routes. Configure the OSPF protocol. Specify the core-facing SONET interface and specify the logical loopback interface on Router PE2.

```
[edit protocols]
rsvp {
  interface so-0/0/1.0;
  interface lo0.0;
}
mpls {
  label-switched-path To-ASBR2 {
    to 5.5.5.5;
  }
  interface so-0/0/1.0;
  interface lo0.0;
}
bgp {
  group To_ASBR2 {
    type internal;
    local-address 7.7.7.7;
    neighbor 5.5.5.5 {
      family inet-vpn {
        unicast;
      }
    }
  }
}
ospf {
  traffic-engineering;
  area 0.0.0.0 {
    interface so-0/0/1.0;
    interface lo0.0;
  }
}
```

4. On Router PE2, configure the BGP local autonomous system number.

```
[edit routing-options]
autonomous-system 200;
```

5. On Router PE2, configure a policy to add the VRF route target to the routes being advertised for this VPN.

```
[edit policy-options]
policy-statement vpnexport {
  term 1 {
    from protocol bgp;
    then {
      community add test_comm;
      accept;
    }
  }
  term 2 {
    then reject;
  }
}
```

6. On Router PE2, configure a policy to import routes from BGP that have the **test_comm** community attached.

```
[edit policy-options]
  policy-statement vpnimport {
    term 1 {
      from {
        protocol bgp;
        community test_comm;
      }
      then accept;
    }
    term 2 {
      then reject;
    }
  }
```

7. On Router PE2, define the **test_comm** BGP community with a route target.

```
[edit policy-options]
community test_comm members target:1:100;
```

Configuring Router CE2

Step-by-Step Procedure

1. On Router CE2, configure the IP address and protocol family on the Fast Ethernet interface for the link between Router CE2 and Router PE2. Specify the **inet** address family type.

```
[edit interfaces]
fe-3/0/0 {
  unit 0 {
    family inet {
      address 24.24.24.2/30;
    }
  }
}
```

2. On Router CE2, configure the IP address and protocol family on the loopback interface. Specify the **inet** address family type.

```
[edit interfaces lo0]
lo0 {
  unit 0 {
    family inet {
      address 8.8.8.8/32;
    }
  }
}
```

3. On Router CE2, configure an IGP. The IGP can be a static route, RIP, OSPF, ISIS, or EBGP. In this example, we configure EBGP. Specify AS **200** as the peer AS and specify the BGP neighbor IP address as the Fast Ethernet interface of Router PE2.

```
[edit protocols]
bgp {
  group To_PE2 {
    neighbor 24.24.24.1 {
      export myroutes;
      peer-as 200;
    }
  }
}
```

Verifying the VPN Operation

Step-by-Step Procedure

1. Commit the configuration on each router.

NOTE: The MPLS labels shown in this example will be different than the labels used in your configuration.

2. On Router PE1, display the routes for the **vpn2CE1** routing instance using the **show ospf route** command. Verify that the **1.1.1.1** route is learned from OSPF.

```
user@PE1> show ospf route instance vpn2CE1

Topology default Route Table:

Prefix             Path   Route       NH   Metric  NextHop       Nexthop
                   Type   Type        Type        Interface     addr/label
1.1.1.1          Intra  Router      IP        1  fe-1/2/3.0    18.18.18.1
1.1.1.1/32       Intra  Network     IP        1  fe-1/2/3.0    18.18.18.1
18.18.18.0/30    Intra  Network     IP        1  fe-1/2/3.0    18.18.18.1
```

3. On Router PE1, use the **show route advertising-protocol** command to verify that Router PE1 advertises the **1.1.1.1** route to Router ASBR1 using MP-BGP with the VPN MPLS label.

```
user@PE1> show route advertising-protocol bgp 4.4.4.4 extensive

vpn2CE1.inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
* 1.1.1.1/32 (1 entry, 1 announced)
```

```
 BGP group To_PE1 type Internal
     Route Distinguisher: 1:100
     VPN Label: 299856
     Nexthop: Self
     Flags: Nexthop Change
     MED: 1
     Localpref: 100
     AS path: [100] I
     Communities: target:1:100 rte-type:0.0.0.2:1:0
```

4. On Router ASBR1, use the **show route receive-protocol** command to verify that the router receives and accepts the **1.1.1.1** route and places it in the **To_ASBR2.inet.0** routing table.

```
user@ASBR1> show route receive-protocol bgp 2.2.2.2 extensive

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

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

To_ASBR2.inet.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
* 1.1.1.1/32 (1 entry, 1 announced)
     Route Distinguisher: 1:100
     VPN Label: 299856
     Nexthop: 2.2.2.2
     MED: 1
     Localpref: 100
     AS path: I
     Communities: target:1:100 rte-type:0.0.0.2:1:0

MPLS.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

BGP.13VPN.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

* 1:100:1.1.1.1/32 (1 entry, 0 announced)
     Route Distinguisher: 1:100
     VPN Label: 299856
     Nexthop: 2.2.2.2
     MED: 1
     Localpref: 100
     AS path: I
     Communities: target:1:100 rte-type:0.0.0.2:1:0
```

5. On Router ASBR1, use the **show route advertising-protocol** command to verify that Router ASBR1 advertises the **1.1.1.1** route to Router ASBR2.

```
user@ASBR1> show route advertising-protocol bgp 21.21.21.2 extensive

To_ASBR2.inet.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
* 1.1.1.1/32 (1 entry, 1 announced)
 BGP group To_ASBR2.inet.0 type External
     Nexthop: Self
     AS path: [100] I
     Communities: target:1:100 rte-type:0.0.0.2:1:0
```

6. On Router ASBR2, use the **show route receive-protocol** command to verify that the router receives and accepts the **1.1.1.1** route and places it in the **To_ASBR1.inet.0** routing table.

```
user@ASBR2> show route receive-protocol bgp 21.21.21.1 extensive
```

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

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

To_ASBR1.inet.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
* 1.1.1.1/32 (1 entry, 1 announced)
     Accepted
     Nexthop: 21.21.21.1
     AS path: 100 I
     Communities: target:1:100 rte-type:0.0.0.2:1:0

MPLS.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

BGP.l3VPN.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

7. On Router ASBR2, use the **show route advertising-protocol** command to verify that Router ASBR2 advertises the **1.1.1.1** route to Router PE2 in the **To-PE2** routing instance.

```
user@ASBR2> show route advertising-protocol bgp 7.7.7.7 extensive

To_ASBR1.inet.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
* 1.1.1.1/32 (1 entry, 1 announced)
 BGP group To-PE2 type Internal
     Route Distinguisher: 1:100
     VPN Label: 299936
     Nexthop: Self
     Flags: Nexthop Change
     Localpref: 100
     AS path: [200] 100 I
     Communities: target:1:100 rte-type:0.0.0.2:1:0
```

8. On Router PE2, use the **show route receive-protocol** command to verify that the router receives and accepts the **1.1.1.1** route and places it in the **To_CE2.inet.0** routing table.

```
user@PE2> show route receive-protocol bgp 5.5.5.5 extensive

inet.0: 12 destinations, 13 routes (12 active, 0 holddown, 0 hidden)

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

__juniper_private1__.inet.0: 14 destinations, 14 routes (8 active, 0
holddown, 6 hidden)

__juniper_private2__.inet.0: 1 destinations, 1 routes (0 active, 0
holddown, 1 hidden)

To_CE2.inet.0: 5 destinations, 6 routes (5 active, 0 holddown, 0 hidden)
* 1.1.1.1/32 (1 entry, 1 announced)
     Accepted
     Route Distinguisher: 1:100
     VPN Label: 299936
     Nexthop: 5.5.5.5
     Localpref: 100
     AS path: 100 I
     AS path: Recorded
     Communities: target:1:100 rte-type:0.0.0.2:1:0
```

9. On Router PE2, use the **show route advertising-protocol** command to verify that Router PE2 advertises the **1.1.1.1** route to Router CE2 through the **To_CE2** peer group.

```
user@PE2> show route advertising-protocol bgp 24.24.24.2 extensive

To_CE2.0: 5 destinations, 6 routes (5 active, 0 holddown, 0 hidden)
* 1.1.1.1/32 (1 entry, 1 announced)
 BGP group To_CE2 type External
     Nexthop: Self
     AS path: [200] 100 I
     Communities: target:1:100 rte-type:0.0.0.2:1:0
```

10. On Router CE2, use the **show route** command to verify that Router CE2 receives the **1.1.1.1** route from Router PE2.

```
user@CE2> show route 1.1.1.1

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

1.1.1.1/32          *[BGP/170] 00:25:36, localpref 100
                       AS path: 200 100 I
                     > to 24.24.24.1 via fe-3/0/0.0
```

11. On Router CE2, use the **ping** command and specify **8.8.8.8** as the source of the ping packets to verify connectivity with Router CE1.

```
user@CE2> ping 1.1.1.1 source 8.8.8.8

PING 1.1.1.1 (1.1.1.1): 56 data bytes
64 bytes from 1.1.1.1: icmp_seq=0 ttl=58 time=4.672 ms
64 bytes from 1.1.1.1: icmp_seq=1 ttl=58 time=10.480 ms
64 bytes from 1.1.1.1: icmp_seq=2 ttl=58 time=10.560 ms
```

12. On Router PE2, use the **show route** command to verify that the traffic is sent with an inner label of **299936** and a top label of **299776**.

```
user@PE2> show route 1.1.1.1 detail


To_CE2.inet.0: 5 destinations, 6 routes (5 active, 0 holddown, 0 hidden)
1.1.1.1/32 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 1:100
                Next hop type: Indirect
                Next-hop reference count: 6
                Source: 5.5.5.5
                Next hop type: Router, Next hop index: 648
                Next hop: via so-0/0/1.0 weight 0x1, selected
                Label-switched-path To-ASBR2
                Label operation: Push 299936, Push 299776(top)
                Protocol next hop: 5.5.5.5
                Push 299984
                Indirect next hop: 8c6109c 262143
                State: <Secondary Active Int Ext>
                Local AS:   200 Peer AS:   200
                Age: 3:37       Metric2: 2
                Task: BGP_200.5.5.5.5+179
                Announcement bits (3): 0-RT 1-KRT 2-BGP RT Background
                AS path: 100 I
                AS path: Recorded
                Communities: target:1:100 rte-type:0.0.0.2:1:0
                Accepted
                VPN Label: 299984
                Localpref: 100
```



```
                    Router ID: 5.5.5.5
                    Primary Routing Table BGP.l3VPN.0
```

13. On Router ASBR2, use the **show route table** command to verify that Router ASBR2 receives the traffic.

```
lab@ASBR2# show route table mpls.0 detail

299936 (1 entry, 1 announced)
        *VPN    Preference: 170
                Next hop type: Router, Next hop index: 649
                Next-hop reference count: 2
                Source: 21.21.21.1
                Next hop: 21.21.21.1 via ge-0/1/1.0, selected
                Label operation: Pop
                State: <Active Int Ext>
                Local AS:   200
                Age: 9:54
                Task: BGP RT Background
                Announcement bits (1): 0-KRT
                AS path: 100 I
                Ref Cnt: 1
                Communities: target:1:100 rte-type:0.0.0.2:1:0
```

14. On Router ASBR2, use the **show route table** command to verify that Router ASBR2 receives the traffic.

```
lab@ASBR2# show route 1.1.1.1 detail

To_ASBR1.inet.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
1.1.1.1/32 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 576
                Next-hop reference count: 3
                Source: 21.21.21.1
                Next hop: 21.21.21.1 via ge-0/1/1.0, selected
                State: <Active Ext>
                Peer AS:   100
                Age: 13:07
                Task: BGP_100.21.21.21.1+53372
                Announcement bits (2): 0-KRT 1-BGP RT Background
                AS path: 100 I
                Communities: target:1:100 rte-type:0.0.0.2:1:0
                Accepted
                Localpref: 100
                Router ID: 21.21.21.1
```

15. On Router ASBR1, use the **show route** command to verify that ASBR1 sends traffic toward PE1 with the top label **299792** and VPN label **299856**.

```
lab@ASBR1# show route 1.1.1.1 detail

To_ASBR2.inet.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
1.1.1.1/32 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 1:100
                Next hop type: Indirect
                Next-hop reference count: 3
                Source: 2.2.2.2
                Next hop type: Router, Next hop index: 669
                Next hop: 20.20.20.1 via ge-0/0/0.0 weight 0x1, selected
```

```
                    Label-switched-path To_PE1
                    Label operation: Push 299856, Push 299792(top)
                    Protocol next hop: 2.2.2.2                Push 299856
                    Indirect next hop: 8af70a0 262143
                    State: <Secondary Active Int Ext>
                    Local AS:   100 Peer AS:   100
                    Age: 12:15      Metric: 1       Metric2: 2
                    Task: BGP_100.2.2.2.2+58065
                    Announcement bits (2): 0-KRT 1-BGP RT Background
                    AS path: I
                    Communities: target:1:100 rte-type:0.0.0.2:1:0
                    VPN Label: 299856
                    Localpref: 100
                    Router ID: 2.2.2.2
                    Primary Routing Table BGP.l3VPN.0
```

16. On Router PE1, use the **show route table** command to verify that Router PE1 receives the traffic with label **299856**, pops the label,l and the traffic is sent toward Router CE1 through interface **fe-1/2/3.0**.

```
lab@PE1# show route table mpls.0 detail

299856 (1 entry, 1 announced)
        *VPN    Preference: 170
                Next hop type: Router, Next hop index: 666
                Next-hop reference count: 2
                Next hop: 18.18.18.1 via fe-1/2/3.0, selected
                Label operation: Pop
                State: <Active Int Ext>
                Local AS:   100
                Age: 17:38
                Task: BGP RT Background
                Announcement bits (1): 0-KRT
                AS path: I
                Ref Cnt: 1
                Communities: rte-type:0.0.0.2:1:0
```

17. On Router PE1, use the **show route** command to verify that PE1 receives the traffic after the top label is popped by Router P and the traffic is sent toward Router CE1 through interface **fe-1/2/3.0**.

```
lab@PE1# show route 1.1.1.1 detail


 vpn2CE1.inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
1.1.1.1/32 (1 entry, 1 announced)
        *OSPF   Preference: 10
                Next hop type: Router, Next hop index: 634
                Next-hop reference count: 3
                Next hop: 18.18.18.1 via fe-1/2/3.0, selected
                State: <Active Int>
                Age: 18:42      Metric: 1
                Area: 0.0.0.2
                Task: VPN2alice-OSPFv2
                Announcement bits (2): 2-KRT 3-BGP RT Background
                AS path: I
                Communities: rte-type:0.0.0.2:1:0
```


Related Documentation

- Interprovider Layer 3 VPN Option A Overview on page 1