

# Network Configuration Example

## Implementing Interprovider Layer 3 VPN Option A

Release  
**13.1**



Published: 2013-02-08

Juniper Networks, Inc.  
1194 North Mathilda Avenue  
Sunnyvale, California 94089  
USA  
408-745-2000  
www.juniper.net

This product includes the Envoy SNMP Engine, developed by Epilogue Technology, an Integrated Systems Company. Copyright © 1986-1997, Epilogue Technology Corporation. All rights reserved. This program and its documentation were developed at private expense, and no part of them is in the public domain.

This product includes memory allocation software developed by Mark Moraes, copyright © 1988, 1989, 1993, University of Toronto.

This product includes FreeBSD software developed by the University of California, Berkeley, and its contributors. All of the documentation and software included in the 4.4BSD and 4.4BSD-Lite Releases is copyrighted by the Regents of the University of California. Copyright © 1979, 1980, 1983, 1986, 1988, 1989, 1991, 1992, 1993, 1994. The Regents of the University of California. All rights reserved.

GateD software copyright © 1995, the Regents of the University. All rights reserved. Gate Daemon was originated and developed through release 3.0 by Cornell University and its collaborators. Gated is based on Kirton's EGP, UC Berkeley's routing daemon (routed), and DCN's HELLO routing protocol. Development of Gated has been supported in part by the National Science Foundation. Portions of the GateD software copyright © 1988, Regents of the University of California. All rights reserved. Portions of the GateD software copyright © 1991, D. L. S. Associates.

This product includes software developed by Maker Communications, Inc., copyright © 1996, 1997, Maker Communications, Inc.

Juniper Networks, Junos, Steel-Belted Radius, NetScreen, and ScreenOS are registered trademarks of Juniper Networks, Inc. in the United States and other countries. The Juniper Networks Logo, the Junos logo, and JunosE are trademarks of Juniper Networks, Inc. All other trademarks, service marks, registered trademarks, or registered service marks are the property of their respective owners.

Juniper Networks assumes no responsibility for any inaccuracies in this document. Juniper Networks reserves the right to change, modify, transfer, or otherwise revise this publication without notice.

Products made or sold by Juniper Networks or components thereof might be covered by one or more of the following patents that are owned by or licensed to Juniper Networks: U.S. Patent Nos. 5,473,599, 5,905,725, 5,909,440, 6,192,051, 6,333,650, 6,359,479, 6,406,312, 6,429,706, 6,459,579, 6,493,347, 6,538,518, 6,538,899, 6,552,918, 6,567,902, 6,578,186, and 6,590,785.

*Network Configuration Example Implementing Interprovider Layer 3 VPN Option A*

Release 13.1

NCE0001

Copyright © 2013, Juniper Networks, Inc.

All rights reserved.

The information in this document is current as of the date on the title page.

## YEAR 2000 NOTICE

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

## END USER LICENSE AGREEMENT

The Juniper Networks product that is the subject of this technical documentation consists of (or is intended for use with) Juniper Networks software. Use of such software is subject to the terms and conditions of the End User License Agreement ("EULA") posted at <http://www.juniper.net/support/eula.html>. By downloading, installing or using such software, you agree to the terms and conditions of that EULA.

# Table of Contents

Interprovider Layer 3 VPN Option A Overview .....	1
Applications .....	1
Implementation .....	2
Example: Configuring Interprovider Layer 3 VPN Option A .....	2



## 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.

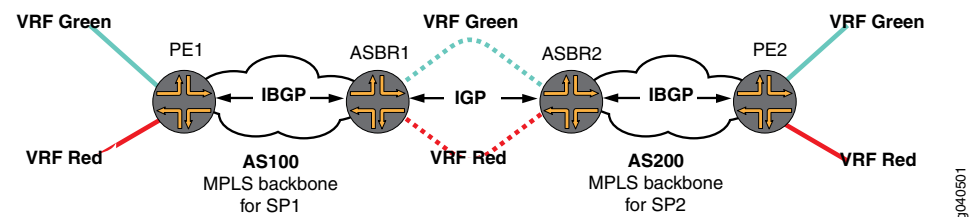
In addition to resolving the initial problem described above, carrier-of-carriers or interprovider VPN solutions may be used to solve other problems such as scalability and merging two service providers.

## 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 2](#)

## Example: Configuring Interprovider Layer 3 VPN Option A

Interprovider Layer 3 VPN Option A provides interprovider VRF-to-VRF connections at the AS boundary routers (ASBRs). Compared to Option B and Option C, Option A is the least scalable solution.

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 on page 2](#)
- [Overview and Topology on page 3](#)
- [Configuration on page 4](#)

## 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.

---

## 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).

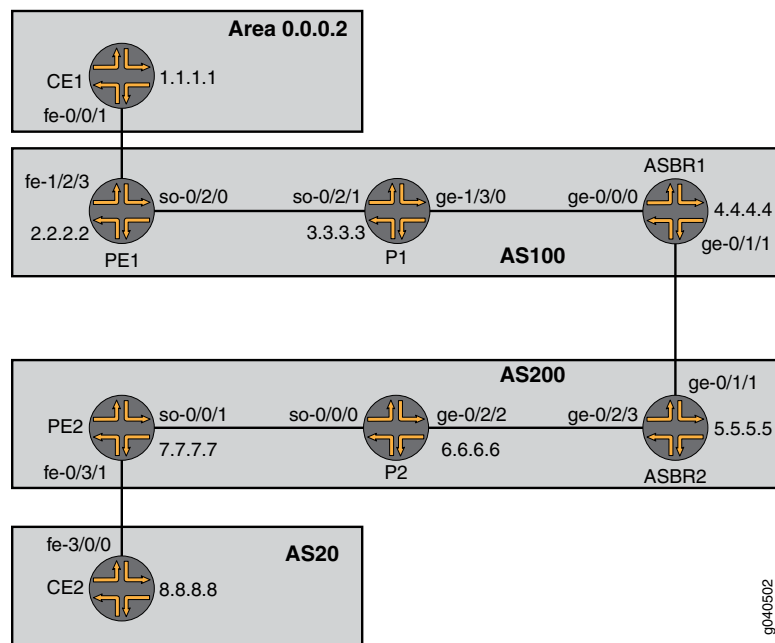
*RFC 4364*, section 10, refers to this method as Interprovider VRF-to-VRF connections at the AS border routers.

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 on page 4](#)
- [Configuring Router PE1 on page 5](#)
- [Configuring Router P1 on page 8](#)
- [Configuring Router ASBR1 on page 9](#)
- [Configuring Router ASBR2 on page 11](#)
- [Configuring Router P2 on page 13](#)
- [Configuring Router PE2 on page 14](#)
- [Configuring Router CE2 on page 16](#)
- [Verifying the VPN Operation on page 17](#)

### 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;  
    }  
  }  
}
```

- 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

- Commit the configuration on each router.



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

- 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

- 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

- 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)
* 1.1.1/32 (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)

```

```

* 1:100:1.1.1/32 (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 bgp** 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)
* 1.1.1/32 (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)
* 1.1.1/32 (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.13VPN.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./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+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.13VPN.0
```

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

```
1ab@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.13VPN.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, 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**.

```
Tab@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](#)