

Chapter 19

Configuring Interprovider and Carrier-of-Carriers VPNs

To configure interprovider or carrier-of-carriers virtual private network (VPN) functionality, you typically need to include the `labeled-unicast` statement in the configuration for the Border Gateway Protocol (BGP) on the autonomous system (AS) border routers of an interprovider VPN or the provider edge (PE) and customer edge (CE) routers of a carrier-of-carriers VPN. You must also configure the provider (P) routers in the service provider's and service customer's networks.

To configure interprovider or carrier-of-carriers VPN functionality, include the `bgp` statement:

```
bgp {
    group group-name {
        type internal;
        local-address address;
        family inet {
            labeled-unicast {
                resolve-vpn;
            }
        }
        neighbor address;
    }
}
```

You can include the `bgp` statement at the following hierarchy levels:

- `[edit protocols]`
- `[edit logical-routers logical-router-name protocols]`

This chapter describes how to configure interprovider and carrier-of-carriers VPNs, discussing the following topics:

- Configuring Interprovider VPNs on page 434
- Configuring Carrier-of-Carriers VPNs on page 439
- Configuring BGP to Gather Interprovider and Carrier-of-Carriers VPNs Statistics on page 455

Configuring Interprovider VPNs

You can configure interprovider VPN service using either multiprotocol external BGP (MP-EBGP) or multihop MP-EBGP:

- Configuring Interprovider VPNs Using MP-EBGP on page 434
- Configuring Interprovider VPNs Using Multihop MP-EBGP on page 436

Configuring Interprovider VPNs Using MP-EBGP

To configure interprovider VPN service using MP-EBGP, you need to configure the AS border routers of each AS. For an illustration of how the routers interconnect in an interprovider VPN service, see Figure 46 on page 428.

The configuration of the AS border routers in each AS is nearly identical. To configure each AS border router, you perform the steps in the following sections:

- Configuring RSVP on page 434
- Configuring MPLS on page 435
- Configuring BGP on page 435
- Configuring OSPF on page 436

Configuring RSVP

You need to configure the interprovider VPN interface in Resource Reservation Protocol (RSVP). This interface on the PE router, which handles VPN traffic in the current AS, receives VPN traffic from the other AS.

Configure the interface for RSVP by including the `interface` statement:

```
interface interface-name;
```

You can include the `interface` statement at the following hierarchy levels:

- [edit protocols rsvp]
- [edit logical-routers *logical-router-name* protocols rsvp]

Configuring MPLS

Configure a label-switched path (LSP) to the PE router. Also configure the interfaces handling VPN traffic from the other AS and to the PE router in the current AS.

```
mpls {
  label-switched-path path-name {
    to address;
  }
  interface interface-name;
  interface interface-name;
}
```

You can include the `mpls` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring BGP

Configure an MP-EBGP session on the AS border router. This session exchanges VPN–Internet Protocol version 4 (IPv4) routes with the AS border router in the other AS.

To configure a group to handle internal BGP (IBGP) and a group to handle external BGP (EBGP), include the `bgp` statement:

```
bgp {
  keep all;
  group group-name {
    type internal;
    local-address address;
    family inet-vpn {
      unicast;
    }
    neighbor address;
  }
  group group-name {
    type external;
    family inet-vpn {
      unicast;
    }
    neighbor address {
      peer-as as number;
    }
  }
}
```

You can include include the `bgp` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring OSPF

To configure Open Shortest Path First (OSPF) on the AS border router, include the `ospf` statement:

```
ospf {
  traffic engineering;
  area address {
    interface interface-name;
    interface interface-name {
      passive;
    }
  }
}
```

You can include the `ospf` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring Interprovider VPNs Using Multihop MP-EBGP

To configure a network to provide interprovider VPN service using multihop MP-EBGP, you need to set up the AS border routers and the PE routers connected to the end customer's CE routers. For an illustration of how the routers interconnect in an interprovider VPN service, see Figure 46 on page 428.

The following sections describe how to configure a network to provide interprovider VPN service using multihop MP-EBGP:

- Configuring the AS Border Routers on page 436
- Configuring the PE Router on page 438

Configuring the AS Border Routers

The configuration of the AS border routers in each AS is nearly identical. To configure each AS border router, you perform the steps in the following sections:

- Configuring BGP on page 437
- Configuring Policy Options on page 438

Configuring BGP

Configure BGP on the AS border routers. To configure a group for IBGP to the PE router, include the `bgp` statement:

```
bgp {
  group group-name {
    type internal;
    local-address address;
    family inet {
      labeled-unicast {
        resolve-vpn;
      }
    }
    neighbor address;
  }
}
```

To configure a group for EBGP to the AS border router in the adjacent AS router, include the `bgp` statement:

```
bgp {
  group group-name {
    type external;
    family inet {
      labeled-unicast;
    }
    export internal;
    neighbor address {
      peer-as as-number;
    }
  }
}
```

You can include the `bgp` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring Policy Options

For the policy configuration on the AS border routers, you only need to advertise the loopbacks of the PE routers. If the AS border router is also a PE router, configure from protocol ospf direct at the [edit policy-options policy-statement *policy-name* term *term-name*] hierarchy level.

To configure the policy options on the AS border routers, include the policy-statement statement:

```

policy-statement policy-name {
  term term-name {
    from {
      protocol ospf direct;
      route-filter pe-router-loopback-address exact accept;
    }
    then reject;
  }
}

```

You can include these statements at the following hierarchy levels:

- [edit policy-options]
- [edit logical-routers *logical-router-name* policy-options]

Configuring the PE Router

Configure a multihop MP-EBGP session on the PE router connected to the end customer's CE router.

To pass labeled IPv4 routes, include the labeled-unicast statement:

```

labeled-unicast {
  resolve-vpn;
}

```

You can include the labeled-unicast statement at the following hierarchy levels:

- [edit protocols bgp group *group-name* family inet]
- [edit logical-routers *logical-router-name* protocols bgp group *group-name* family inet]

To configure a group to handle an EBGp multihop session with the remote PE router (that is, to pass VPN-IPv4 routes), include the `bgp` statement:

```

bgp {
  group group-name {
    multihop {
      ttl 10;
    }
    family inet-vpn {
      unicast;
    }
  }
  neighbor address {
    peer-as as-number;
  }
}

```

You can include the `bgp` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring Carrier-of-Carriers VPNs

You can configure a carrier-of-carriers VPN service for customers who want to provide Internet service or for customers who want to provide VPN service:

- Configuring Carrier-of-Carriers VPN—Customer Provides Internet Service on page 439
- Configuring Carrier-of-Carriers VPN—Customer Provides VPN Service on page 446

Configuring Carrier-of-Carriers VPN—Customer Provides Internet Service

In this type of carrier-of-carriers VPN service configuration, the customer provides basic Internet service. The carrier-of-carriers VPN service provider must configure Multiprotocol Label Switching (MPLS) in its network, although this configuration is optional for the carrier service customer. Figure 47 on page 430 shows how the routers in this type of service interconnect.

To configure a carrier-of-carriers VPN, perform the tasks described in the following sections:

- Configuring the Carrier-of-Carriers VPN Service Customer's CE Router on page 440
- Configuring the Carrier-of-Carriers VPN Service Provider's PE Routers on page 442

Configuring the Carrier-of-Carriers VPN Service Customer's CE Router

The carrier-of-carriers VPN service customer's router acts as a CE router with respect to the service provider's PE router. The following sections describe how to configure the carrier-of-carriers VPN service customer's CE router:

- Configuring MPLS on page 440
- Configuring BGP on page 440
- Configuring OSPF on page 441
- Configuring Policy Options on page 442

Configuring MPLS

To configure MPLS on the customer's CE router, include the `mpls` statement:

```
mpls {
  traffic-engineering bgp-igp;
  interface interface-name;
}
```

You can include the `mpls` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring BGP

To configure a group to collate the customer's internal routes, include the `bgp` statement:

```
bgp {
  group group-name {
    type internal;
    local-address address;
    neighbor address;
  }
}
```

You can include the `bgp` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

The customer's CE router must be able to send labels to the VPN service provider's router. Enable this by including the `labeled-unicast` statement under the `bgp` statement:

```

bgp {
  group group-name {
    export internal;
    peer-as as-number;
    neighbor address {
      family inet {
        labeled-unicast;
      }
    }
  }
}

```

You can include the `bgp` statement at the following hierarchy levels:

- [edit logical-routers *logical-router-name* protocols]
- [edit protocols]

Configuring OSPF

To configure OSPF on the customer's CE router, include the `ospf` statement:

```

ospf {
  area area-id {
    interface interface-name {
      passive;
    }
    interface interface-name;
  }
}

```

You can include the `ospf` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring Policy Options

To configure policy options on the customer's CE router, include the `policy-statement` statement:

```
policy-statement statement-name {
  term term-name {
    from protocol [ospf direct ldp];
    then accept;
  }
  term term-name {
    then reject;
  }
}
```

You can include the `policy-statement` statement at the following hierarchy levels:

- [edit policy-options]
- [edit logical-routers *logical-router-name* policy-options]

Configuring the Carrier-of-Carriers VPN Service Provider's PE Routers

The service provider's PE routers connect to the customer's CE routers and forward the customer's VPN traffic across the provider's network.

The following sections describe how to configure the carrier-of-carriers VPN service provider's PE routers:

- Configuring MPLS on page 442
- Configuring BGP on page 443
- Configuring IS-IS on page 443
- Configuring LDP on page 443
- Configuring a Routing Instance on page 444
- Configuring Policy Options on page 445

Configuring MPLS

To configure MPLS on the provider's PE routers, include the `mpls` statement:

```
mpls {
  interface interface-name;
  interface interface-name;
}
```

You can include the `mpls` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring BGP

To configure a BGP session with the provider PE router at the other end of the provider's network, include the `bgp` statement:

```
bgp {
  group group-name {
    type internal;
    local-address address;
    family inet-vpn {
      any;
    }
    neighbor address;
  }
}
```

You can include the `bgp` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring IS-IS

To configure Intermediate System-to-Intermediate System (IS-IS) on the provider's PE routers, include the `isis` statement:

```
isis {
  interface interface-name;
  interface interface-name {
    passive;
  }
}
```

You can include the `isis` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring LDP

To configure the Label Distribution Protocol (LDP) on the provider's PE routers, include the `ldp` statement:

```
ldp {
  interface interface-name;
}
```

You can include the `ldp` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring a Routing Instance

To configure Layer 3 VPN service with the customer's CE router, include the `labeled-unicast` statement within the routing instance so the PE router can send labels to the customer's CE router:

```

routing-instance-name {
  instance-type vrf;
  interface interface-name;
  route-distinguisher address;
  vrf-import policy-name;
  vrf-export policy-name;
  protocols {
    bgp {
      group group-name {
        peer-as as-number;
        neighbor address {
          family inet {
            labeled-unicast;
          }
        }
      }
    }
  }
}

```

You can include these statements at the following hierarchy levels:

- [edit routing-instances]
- [edit logical-routers *logical-router-name* routing-instances]

Configuring Policy Options

To configure a policy statement to import routes from the customer's CE router, include the `policy-statement` statement:

```
policy-statement policy-name {
  term term-name {
    from {
      protocol bgp;
      community community-name;
    }
    then accept;
  }
  term term-name {
    then reject;
  }
}
```

You can include the `policy-statement` statement at the following hierarchy levels:

- [edit `policy-options`]
- [edit `logical-routers logical-router-name policy-options`]

To configure a policy statement to export routes to the customer's CE router, include the `policy-statement` and `community` statements:

```
policy-statement policy-name {
  term term-name {
    from protocol bgp;
    then {
      community add community-name;
      accept;
    }
  }
  term term-name {
    then reject;
  }
}
community community-name members value;
```

You can include these statements at the following hierarchy levels:

- [edit `policy-options`]
- [edit `logical-routers logical-router-name policy-options`]

Configuring Carrier-of-Carriers VPN—Customer Provides VPN Service

Figure 47 on page 430 shows how the routers in this type of service interconnect.

To configure the following routers in the customer's and provider's networks to enable carrier-of-carriers VPN service, you perform the steps in the following sections:

- Configuring the Carrier-of-Carriers Customer's PE Router on page 446
- Configuring the Carrier-of-Carriers Customer's CE Router on page 449
- Configuring the Provider's PE Router on page 452

Configuring the Carrier-of-Carriers Customer's PE Router

The carrier-of-carriers customer's PE router is connected to the end customer's CE router.

The following sections describe how to configure the carrier-of-carriers customer's PE router:

- Configuring MPLS on page 446
- Configuring BGP on page 447
- Configuring OSPF on page 447
- Configuring LDP on page 448
- Configuring VPN Service in the Routing Instance on page 448
- Configuring Policy Options on page 449

Configuring MPLS

To configure MPLS on the carrier-of-carriers customer's PE router, include the `mpls` statement:

```
mpls {
  interface interface-name;
  interface interface-name;
}
```

You can include the `mpls` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring BGP

Configure the `labeled-unicast` statement on the IBGP session to the carrier-of-carriers customer's CE router (see "Configuring the Carrier-of-Carriers Customer's CE Router" on page 449), and configure the `family-inet-vpn` statement for the IBGP session to the carrier-of-carriers PE router on the other side of the network:

```

bgp {
  group group-name {
    type internal;
    local-address address;
    neighbor address {
      family inet {
        labeled-unicast;
        resolve-vpn;
      }
    }
  }
  neighbor address {
    family inet-vpn {
      any;
    }
  }
}

```

You can include these statements at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring OSPF

To configure OSPF on the carrier-of-carriers customer's PE router, include the `ospf` statement:

```

ospf {
  area area-id {
    interface interface-name {
      passive;
    }
    interface interface-name;
  }
}

```

You can include the `ospf` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring LDP

To configure LDP on the carrier-of-carriers customer's PE router, include the `ldp` statement:

```
ldp {
    interface interface-name;
}
```

You can include the `ldp` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring VPN Service in the Routing Instance

To configure VPN service for the end customer's CE router on the carrier-of-carriers customer's PE router, include the following statements:

```
instance-type vrf;
interface interface-name;
route-distinguisher address;
vrf-import policy-name;
vrf-export policy-name;
protocols {
    bgp {
        group group-name {
            peer-as as-number;
            neighbor address;
        }
    }
}
```

You can include these statements at the following hierarchy levels:

- [edit routing-instances *routing-instance-name*]
- [edit logical-routers *logical-router-name* routing-instances *routing-instance-name*]

Configuring Policy Options

To configure policy options to import and export routes to and from the end customer's CE router, include the `policy-statement` and `community` statements:

```

policy-statement policy-name {
  term term-name {
    from {
      protocol bgp;
      community community-name;
    }
    then accept;
  }
  term term-name {
    then reject;
  }
}
policy-statement policy-name {
  term term-name {
    from protocol bgp;
    then {
      community add community-name;
      accept;
    }
  }
  term term-name {
    then reject;
  }
}
community community-name members value;

```

You can include these statements at the following hierarchy levels:

- [edit `policy-options`]
- [edit `logical-routers logical-router-name policy-options`]

Configuring the Carrier-of-Carriers Customer's CE Router

The carrier-of-carriers customer's CE router connects to the provider's PE router. Complete the instructions in the following sections to configure the carrier-of-carriers customers' CE router:

- Configuring MPLS on page 450
- Configuring BGP on page 450
- Configuring OSPF and LDP on page 451
- Configuring Policy Options on page 452

Configuring MPLS

In the MPLS configuration for the carrier-of-carriers customer's CE router, include the interfaces to the provider's PE router and to a P router in the customer's network:

```
mpls {
  traffic-engineering bgp-igp;
  interface interface-name;
  interface interface-name;
}
```

You can include these statements at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring BGP

In the BGP configuration for the carrier-of-carriers customer's CE router, configure a group that includes the `labeled-unicast` statement to extend VPN service to the PE router connected to the end customer's CE router:

```
bgp {
  group group-name {
    type internal;
    local-address address;
    neighbor address {
      family inet {
        labeled-unicast;
      }
    }
  }
}
```

You can include the `bgp` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

To configure a group to send labeled internal routes to the provider's PE router, include the `bgp` statement:

```
bgp {
  group group-name {
    export internal;
    peer-as as-number;
    neighbor address {
      family inet {
        labeled-unicast;
      }
    }
  }
}
```

You can include the `bgp` statement at the following hierarchy levels:

- [edit logical-routers *logical-router-name* protocols]
- [edit protocols]

Configuring OSPF and LDP

To configure OSPF and LDP on the carrier-of-carriers customer's CE router, include the `ospf` and `ldp` statements:

```
ospf {
  area area-id {
    interface interface-name {
      passive;
    }
    interface interface-name;
  }
}
ldp {
  interface interface-name;
}
```

You can include these statements at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring Policy Options

To configure the policy options on the carrier-of-carriers customer's CE router, include the `policy-statement` statement:

```
policy-statement policy-statement-name {
  term term-name {
    from protocol [ ospf direct ldp ];
    then accept;
  }
  term term-name {
    then reject;
  }
}
```

You can include the `policy-statement` statement at the following hierarchy levels:

- [edit policy-options]
- [edit logical-routers *logical-router-name* policy-options]

Configuring the Provider's PE Router

The carrier-of-carriers provider's PE routers connect to the carrier customer's CE routers. Complete the instructions in the following sections to configure the provider's PE router:

- Configuring MPLS on page 452
- Configuring a PE-Router-to-PE-Router BGP Session on page 453
- Configuring IS-IS and LDP on page 453
- Configuring Policy Options on page 454
- Configuring a Routing Instance to Send Routes to the CE Router on page 455

Configuring MPLS

In the MPLS configuration, specify at least two interfaces—one to the customer's CE router and one to connect to the provider's PE router on the other side of the provider's network:

```
interface interface-name;
interface interface-name;
```

You can include these statements at the following hierarchy levels:

- [edit protocols mpls]
- [edit logical-routers *logical-router-name* protocols mpls]

Configuring a PE-Router-to-PE-Router BGP Session

To configure a PE-router-to-PE-router BGP session on the provider's PE routers to allow VPN-IPv4 routes to pass between the PE routers, include the `bgp` statement:

```
bgp {
  group group-name {
    type internal;
    local-address address;
    family inet-vpn {
      any;
    }
    neighbor address;
  }
}
```

You can include the `bgp` statement at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring IS-IS and LDP

To configure IS-IS and LDP on the provider's PE routers, include the `isis` and `ldp` statements:

```
isis {
  interface interface-name;
  interface interface-name {
    passive;
  }
}
ldp {
  interface interface-name;
}
```

You can include these statements at the following hierarchy levels:

- [edit protocols]
- [edit logical-routers *logical-router-name* protocols]

Configuring Policy Options

To configure policy statements on the provider's PE router to export routes to and import routes from the carrier customer's network, include the **policy-statement** and **community** statements:

```

policy-statement statement-name {
  term term-name {
    from {
      protocol bgp;
      community community-name;
    }
    then accept;
  }
  term term-name {
    then reject;
  }
}
policy-statement statement-name {
  term term-name {
    from protocol bgp;
    then {
      community add community-name;
      accept;
    }
  }
  term term-name {
    then reject;
  }
}
community community-name members value;

```

You can include these statements at the following hierarchy levels:

- [edit policy-options]
- [edit logical-routers *logical-router-name* policy-options]

Configuring a Routing Instance to Send Routes to the CE Router

To configure the routing instance on the provider's PE router to send labeled routes to the carrier customer's CE router, include the following statements:

```
instance-type vrf;
interface interface-name;
route-distinguisher value;
vrf-import policy-name;
vrf-export policy-name;
protocols {
  bgp {
    group group-name {
      peer-as as-number;
      neighbor address {
        family inet {
          labeled-unicast;
        }
      }
    }
  }
}
```

You can include these statements at the following hierarchy levels:

- [edit routing-instances *routing-instance-name*]
- [edit logical-routers *logical-router-name* routing-instances *routing-instance-name*]

Configuring BGP to Gather Interprovider and Carrier-of-Carriers VPNs Statistics

You can configure BGP to gather traffic statistics for interprovider and carrier-of-carriers VPNs.

To configure BGP to gather traffic statistics for interprovider and carrier-of-carriers VPNs, include the `traffic-statistics` statement:

```
traffic-statistics {
  file file-name <world-readable | no-world-readable>;
  interval seconds;
}
```

For a list of the hierarchy levels at which you can include the `traffic-statistics` statement, see the summary section for this statement.



NOTE: Traffic statistics for interprovider and carrier-of-carriers VPNs are available only for IPv4. IPv6 is not supported.

If you do not specify a filename, the statistics are not written to a file. However, if you have included the `traffic-statistics` statement in the BGP configuration, the statistics are still available and can be accessed by means of the `show bgp group traffic-statistics group-name` command.

To account for traffic from each customer separately, separate labels must be advertised for the same prefix to the peer routers in different groups. To enable separate traffic accounting, you need to include the `per-group-label` statement in the configuration for each BGP group. By including this statement, statistics are collected and displayed that account for traffic sent by the peers of the specified BGP group.

If you configure the statement at the `[edit protocols bgp family inet]` hierarchy level, rather than configuring it for a specific BGP group, then the traffic statistics are shared with all BGP groups configured with the `traffic-statistics` statement but not configured with the `per-group-label` statement.

To account for traffic from each customer separately, include the `per-group-label` statement in the configuration for each BGP group:

```
per-group-label;
```

For a list of the hierarchy levels at which you can include the `per-group-label` statement, see the summary section for this statement.

The following shows a sample of the output to the traffic statistics file:

```
Dec 19 10:39:54 Statistics for BGP group ext2 (Index 1) NLRI
inet-labeled-unicast
Dec 19 10:39:54 FEC          Packets      Bytes      EgressAS
FECLabel
Dec 19 10:39:54 10.255.245.55          0           0           I
100160
Dec 19 10:39:54 10.255.245.57          0           0           I
100112
Dec 19 10:39:54 100.101.0.0            0           0           25
100080
Dec 19 10:39:54 100.102.0.0            0           0           25
100080
Dec 19 10:39:54 100.103.0.0           109         9592        25
100048
Dec 19 10:39:54 100.104.0.0           109         9592        25
100048
Dec 19 10:39:54 192.168.25.0          0           0           I
100064
Dec 19 10:39:54 Dec 19 10:39:54, read statistics for 5 FECs in 00:00:00
seconds (10 queries) for BGP group ext2 (Index 1) NLRI inet-labeled-unicast
```