

Chapter 18

Configure 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:

Configure Interprovider VPNs on page 366

Configure Carrier-of-Carriers VPNs on page 371

Configure BGP to Gather Interprovider and Carrier-of-Carriers VPNs Statistics on page 387

Configure Interprovider VPNs

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

Configure Interprovider VPNs Using MP-EBGP on page 366

Configure Interprovider VPNs Using Multihop MP-EBGP on page 368

Configure 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 43 on page 360.

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

Configure RSVP on page 366

Configure MPLS on page 367

Configure BGP on page 367

Configure OSPF on page 368

Configure 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]
```

Configure 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]

Configure 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]

Configure 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]

Configure Interprovider VPNs Using Multihop MP-EBGP

This section describes how to configure a network to provide interprovider VPN service using multihop MP-EBGP. With this type of configuration, 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 43 on page 360.

Configure the AS Border Routers

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

Configure BGP on page 369

Configure Policy Options on page 370

Configure 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]

Configure 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]
```

Configure 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 under the bgp statement:

```

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

```

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]

Configure 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:

Configure Carrier-of-Carriers VPN—Customer Provides Internet Service on page 371

Configure Carrier-of-Carriers VPN—Customer Provides VPN Service on page 378

Configure 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 44 on page 363 shows how the routers in this type of service interconnect.

To configure a carrier-of-carriers VPN, do the following:

Configure the Carrier-of-Carriers VPN Service Customer's CE Router on page 372

Configure the Carrier-of-Carriers VPN Service Provider's PE Routers on page 374

Configure 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. This section describes how to configure the carrier-of-carriers VPN service customer's CE router.

Configure 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]

Configure 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 `bgp` statement at the following hierarchy levels:

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

[edit protocols]

Configure 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]

Configure 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]

Configure 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.

Configure 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]

Configure 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]

Configure 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]

Configure 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]

Configure 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]

Configure 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]

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

Figure 44 on page 363 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 do the following:

Configure the Carrier-of-Carriers Customer's PE Router on page 378

Configure the Carrier-of-Carriers Customer's CE Router on page 382

Configure the Provider's PE Router on page 384

Configure 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.

Configure 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]

Configure BGP

Configure the `labeled-unicast` statement on the IGBP session to the carrier-of-carriers customer's CE router (see "Configure the Carrier-of-Carriers Customer's CE Router" on page 382), and configure the `family-inet-vpn` statement for the IGBP 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]

Configure 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]

Configure 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]

Configure 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*]

Configure 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]

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

The carrier-of-carriers customer's CE router connects to the provider's PE router.

Configure 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]

Configure 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]

Configure 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]

Configure 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]

Configure the Provider's PE Router

The carrier-of-carriers provider's PE routers connect to the carrier customer's CE routers.

Configure 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]

Configure 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]

Configure 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]

Configure 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]

Configure 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*]

Configure 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
```