

Chapter 18

Interprovider and Carrier-of-Carriers VPNs Configuration Guidelines

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, you include statements at the `[edit protocols bgp]` hierarchy level:

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

This chapter contains the following sections:

Interprovider VPNs on page 307

Carrier-of-Carriers VPNs on page 312

Interprovider VPNs

You can configure interprovider VPN service in one of the following ways:

Interprovider VPNs Using MP-EBGP on page 308

Interprovider VPNs Using Multihop MP-EBGP on page 310

Interprovider VPNs Using MP-EBGP

To configure interprovider VPN service using multiprotocol external BGP (MP-EBGP), you need to configure the AS border routers of each AS. See Figure 41, “Interprovider VPN Network Topology” on page 301 for an illustration of how the routers interconnect in an interprovider VPN service.

Configure the AS Border Routers

The configuration of the AS border routers in each AS is nearly identical. You need to configure the following on each AS border router:

Configure RSVP on page 308

Configure MPLS on page 308

Configure BGP on page 309

Configure OSPF on page 309

Configure RSVP

Configure an interface for VPN traffic from the other AS to the PE router handling VPN traffic in the current AS at the [edit protocols rsvp] hierarchy level:

```
[edit]
protocols {
  rsvp {
    interface interface-name;
  }
}
```

Configure MPLS

Configure a label-switched path (LSP) to the PE router at the [edit protocols mpls] hierarchy level. Also configure the interfaces handling VPN traffic from the other AS and to the PE router in the current AS:

```
[edit]
protocols {
  mpls {
    label-switched-path path-name {
      to address;
    }
    interface interface-name;
    interface interface-name;
  }
}
```

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.

Configure the MP-EBGP session at the [edit protocols bgp] hierarchy level. Configure a group to handle internal BGP (IBGP) and a group to handle external BGP (EBGP):

```
[edit]
protocols {
  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;
    }
  }
}
}
```

Configure OSPF

Configure Open Shortest Path First (OSPF) on the AS border router at the [edit protocols ospf] hierarchy level as follows:

```
[edit]
protocols {
  ospf {
    traffic engineering;
    area address {
      interface interface-name;
      interface interface-name {
        passive;
      }
    }
  }
}
}
```

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. See Figure 41, "Interprovider VPN Network Topology" on page 301 for an illustration of how the routers interconnect in an interprovider VPN service.

Configure the AS Border Routers

The configuration of the AS border routers in each AS is nearly identical. You need to configure the following on each AS border router:

Configure BGP on page 310

Configure Policy Options on page 311

Configure BGP

Configure BGP on the AS border routers at the [edit protocols bgp] hierarchy level. Configure a group for IBGP and a group for EBGP to the PE router as follows:

```
[edit]
protocols {
  bgp {
    group group-name {
      type internal;
      local-address address;
      family inet {
        labeled-unicast {
          resolve-vpn;
        }
      }
      neighbor address;
    }
    group group-name {
      type external;
      family inet {
        labeled-unicast;
      }
      export internal;
      neighbor address {
        peer-as as-number;
      }
    }
  }
}
```

Configure Policy Options

Configure the policy options on the AS border routers as follows at the [edit policy-options] hierarchy level:

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

Configure the PE Router

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

Include the labeled-unicast statement at the [edit protocols bgp group family inet] hierarchy level to pass labeled IPv4 routes:

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

Configure a group at the [edit protocols bgp] hierarchy level to handle an EBGp multihop session with the remote PE router (to pass VPN-IPv4 routes):

```
[edit]
protocols {
  bgp {
    group group-name {
      multihop {
        ttl 10;
      }
      family inet-vpn {
        unicast;
      }
      neighbor address {
        peer-as as-number;
      }
    }
  }
}
```

Carrier-of-Carriers VPNs

You can configure carrier-of-carriers VPN service in one of the following ways:

Carrier-of-Carriers VPN—Customer Provides Internet Service on page 312

Carrier-of-Carriers VPN—Customer Provides VPN Service on page 317

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 is optional for the carrier service customer. Figure 42, “Carrier-of-Carriers VPN Architecture” on page 304 shows how the routers in this type of service interconnect.

This section describes the following:

Configure the Carrier-of-Carriers VPN Service Customer’s CE Router on page 312

Configure the Carrier-of-Carriers VPN Service Provider’s PE Routers on page 314

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

Configure MPLS at the [edit protocols mpls] hierarchy level as follows on the customer's CE router:

```
[edit]
protocols {
  mpls {
    traffic-engineering bgp-igp;
    interface interface-name;
  }
}
```

Configure BGP

Configure a group at the [edit protocols bgp] hierarchy level to collate the customer's internal routes:

```
[edit]
protocols {
  bgp {
    group group-name {
      type internal;
      local-address address;
      neighbor address;
    }
  }
}
```

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 at the [edit protocols bgp group neighbor family inet] hierarchy level:

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

Configure OSPF

Configure OSPF at the [edit protocols ospf] hierarchy level on the customer's CE router as follows:

```
[edit]
protocols {
  ospf {
    area area-id {
      interface interface-name {
        passive;
      }
      interface interface-name;
    }
  }
}
```

Configure Policy Options

Configure policy options at the [edit policy-options] hierarchy level on the customer's CE router as follows:

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

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

Configure MPLS at the [edit protocols mpls] hierarchy level on the provider's PE routers as follows:

```
[edit]
protocols {
  mpls {
    interface interface-name;
    interface interface-name;
  }
}
```

Configure BGP

Configure a BGP session at the [edit protocols bgp] hierarchy level with the provider PE router at the other end of the provider's network as follows:

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

Configure IS-IS

Configure Intermediate System-to-Intermediate System (IS-IS) at the [edit protocols isis] hierarchy level on the provider's PE routers as follows:

```
[edit]
protocols {
  isis {
    interface interface-name;
    interface interface-name {
      passive;
    }
  }
}
```

Configure LDP

Configure the Label Distribution Protocol (LDP) at the [edit protocols ldp] hierarchy level on the provider's PE routers as follows:

```
[edit]
protocols {
  ldp {
    interface interface-name;
  }
}
```

Configure a Routing Instance

At the [edit routing-instances] hierarchy level, configure layer 3 VPN service with the customer's CE router. You include the labeled-unicast statement within the routing instance so the PE router can send labels to the customer's CE router.

```
[edit]
routing-instances {
  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;
            }
          }
        }
      }
    }
  }
}
```

Configure Policy Options

Configure a policy statement at the [edit policy-options] hierarchy level to import routes from the customer's CE router as follows:

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

Configure a policy statement to export routes to the customer's CE router as follows:

```
[edit]
policy-options {
  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;
}
```

Carrier-of-Carriers VPN—Customer Provides VPN Service

Figure 42, “Carrier-of-Carriers VPN Architecture” on page 304 shows how the routers in this type of service interconnect.

Configure the following routers in the customer's and provider's networks to enable carrier-of-carriers VPN service:

Configure the Carrier-of-Carriers Customer's PE Router on page 317

Configure the Carrier-of-Carriers Customer's CE Router on page 320

Configure the Provider's PE Router on page 321

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

Configure MPLS at the [edit protocols mpls] hierarchy level on the carrier-of-carriers customer's PE router as follows:

```
[edit]
protocols {
  mpls {
    interface interface-name;
    interface interface-name;
  }
}
```

Configure BGP

Configure the labeled-unicast statement at the [edit protocols bgp] hierarchy level on the IBGP session to the carrier-of-carriers customer's CE router (see "Configure the Carrier-of-Carriers Customer's CE Router" on page 320) 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:

```
[edit]
protocols {
  bgp {
    group group-name {
      type internal;
      local-address address;
      neighbor address {
        family inet {
          labeled-unicast;
          resolve-vpn;
        }
      }
    }
    neighbor address {
      family inet-vpn {
        any;
      }
    }
  }
}
```

Configure OSPF

Configure OSPF at the [edit protocols ospf] hierarchy level on the carrier-of-carriers customer's PE router as follows:

```
[edit]
protocols {
  ospf {
    area area-id {
      interface interface-name {
        passive;
      }
      interface interface-name;
    }
  }
}
```

Configure LDP

Configure LDP at the [edit protocols ldp] hierarchy level on the carrier-of-carriers customer's PE router as follows:

```
[edit]
protocols {
  ldp {
    interface interface-name;
  }
}
```

Configure VPN Service in the Routing Instance

Configure VPN service for the end customer's CE router at the [edit routing-instances *routing-instance-name*] hierarchy level on the carrier-of-carriers customer's PE router:

```
[edit]
routing-instances {
  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;
        }
      }
    }
  }
}
```

Configure Policy Options

Configure policy options at the [edit policy-options] hierarchy level to import and export routes to and from the end customer's CE router:

```
[edit]
policy-options {
  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;
}
```

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 provider router in the customer's network:

```
[edit]
protocols {
  mpls {
    traffic-engineering bgp-igp;
    interface interface-name;
    interface interface-name;
  }
}
```

Configure BGP

In the BGP configuration for the carrier-of-carriers customer's CE router at the [edit protocols bgp] hierarchy level, 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:

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

Configure a group to send labeled internal routes to the provider's PE router as follows:

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

Configure OSPF and LDP

Configure OSPF and LDP at the [edit protocols] hierarchy level on the carrier-of-carriers customer's CE router as follows:

```
[edit]
protocols {
  ospf {
    area area-id {
      interface interface-name {
        passive;
      }
      interface interface-name;
    }
  }
  ldp {
    interface interface-name;
  }
}
```

Configure Policy Options

Configure the policy options at the [edit policy-options] hierarchy level on the carrier-of-carriers customer's CE router as follows:

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

Configure the Provider's PE Router

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

Configure MPLS

Configure at least two interfaces at the [edit protocols mpls] hierarchy level—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:

```
[edit]
protocols {
  mpls {
    interface interface-name;
    interface interface-name;
  }
}
```

Configure a PE-Router-to-PE-Router BGP Session

Configure a PE-router-to-PE-router BGP session at the [edit protocols bgp] hierarchy level on the provider's PE routers to allow VPN-IPv4 routes to pass between the PE routers:

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

Configure IS-IS and LDP

Configure IS-IS and LDP at the [edit protocols] hierarchy level on the provider's PE routers as follows:

```
[edit]
protocols {
  isis {
    interface interface-name;
    interface interface-name {
      passive;
    }
  }
  ldp {
    interface interface-name;
  }
}
```

Configure Policy Options

Configure policy statements at the [edit policy-options] hierarchy level on the provider's PE router to export routes to and import routes from the carrier customer's network:

```
[edit]
policy-options {
  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;
}
```

Configure a Routing Instance to Send Labeled Routes to the CE Router

Configure the routing instance at the [edit routing-instances] hierarchy level on the provider's PE router to send labeled routes to the carrier customer's CE router:

```
[edit]
routing-instances {
  routing-instance-name {
    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;
            }
          }
        }
      }
    }
  }
}
```