Configuring Unicast Overlay Routing

This article describes how to provision unicast overlay routing and the OSPF and BGP routing protocols.

Configure Service-Side Routing

The Viptela overlay network supports BGP and OSPF unicast routing protocols. You can configure these protocols on vEdge routers to provide reachability to networks at their local sites. Provisioning BGP and OSPF in this way enables routing on the service side of the network.

To set up routing on the vEdge router, you provision one VPN or multiple VPNs if segmentation is required. Within each VPN, you configure the interfaces that participate in that VPN and the routing protocols that operate in that VPN.

Because vSmart controllers never participate in a local site network, you never configure BGP or OSPF on these devices.

Set Up Basic OSPF on a vEdge Router

To configure basic service-side OSPF functionality:

1. Configure a VPN for the OSPF network:
   ```
   vEdge(config)# vpn vpn-id
   ```
   `vpn-id` can be any VPN number except VPN 0 and VPN512. VPN 0 is the transport VPN and carries only control traffic, and VPN 512 is the management interface.

2. Configure OSPF area 0 and the interfaces that participate in that area:
   ```
   vEdge(config-vpn)# router ospf
   vEdge(config-ospf)# area 0
   vEdge(config-area-0)# interface interface-name
   vEdge(config-interface)# ip-address address
   vEdge(config-interface)# no shutdown
   vEdge (ospf-if)# exit
   ```

3. Redistribute OMP routes into OSPF:
   ```
   vEdge(config-ospf)# redistribute omp
   ```
   By default, OMP routes are not redistributed into OSPF.

4. Repeat Steps 1 through 3 for any additional VPNs.

5. If desired, configure OMP to advertise to the vSmart controller any BGP and OSPF external routes that the vEdge router has learned:
   ```
   vEdge(config)# omp
   vEdge(config-omp)# advertise bgp
   vEdge(config-omp)# advertise ospf external
   ```

Here is an example of an OSPF routing configuration on the vEdge router. This configuration sets up VPN 10 with two
interfaces, **ge2/0** and **ge3/0**. It enables OSPF routing on those interfaces in area 0, and it redistributes the OMP routes from the vSmart controller into OSPF.

```plaintext
vpn 10
  router
    ospf
      redistribute omp
      area 0
        interface ge2/0
        exit
        interface ge3/0
        exit
        exit!
  interface ge2/0
    ip address 10.0.5.12/24
    no shutdown!
  interface ge3/0
    ip address 10.0.2.12/24
    no shutdown!
```

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### Set Up Basic BGP on a vEdge Router

To configure basic service-side BGP functionality:

1. **Configure a VPN:**
   ```
   vEdge(config)# vpn vpn-id
   
   vpn-id can be any service-side VPN, which is a VPN other than VPN 0 and VPN 512. VPN 0 is the transport VPN and carries only control traffic, and VPN 512 is the management VPN.
   ```

2. **Configure BGP to run in the VPN:**
   1. Configure the local AS number:
      ```
      vEdge(config-vpn)# router bgp local-as-number
      
      You can specify the AS number in 2-byte ASDOT notation (1 through 65535) or in 4-byte ASDOT notation (1.0 through 65535.65535).
      ```
   2. Configure the BGP peer, specifying its address and AS number (the remote AS number), and enable the connection to the peer:
      ```
      vEdge(config-bgp)# neighbor address remote-as remote-as-number
      vEdge(config-bgp)# no shutdown
      ```

3. **Configure a system IP address for the vEdge router:**
   ```
   vEdge(config)# system system-ip address
   ```

Here is an example of a BGP configuration on the vEdge router:

```plaintext
vEdge# show running-config system
system
  system-ip 10.1.2.3
!
vEdge# show running-config vpn 1
vpn 1
  router
    bgp 1
      neighbor 11.1.2.3
        remote-as 2
        no shutdown
        no shutdown
        
```

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https://sdwan-docs.cisco.com/Product_Documentation/Software_Features/Release_18.1/03Routing/03Configuring_Unicast___...
### Redistribute BGP Routes and AS Path Information

By default, routes from other routing protocols are not redistributed into BGP. It can be useful for BGP to learn OMP routes, because OMP learns routes to destinations throughout the overlay network. BGP on the vEdge router then advertises the OMP routes to all the BGP routers in the service-side of the network. To redistribute OMP routes into BGP so that these routes are advertised to all BGP routers in the service side of the network, configure redistribution in any VPN except VPN 0 or VPN 512:

```
vEdge(config)# vpn vpn-id router bgp
vEdge(config-bgp)# address-family ipv4-unicast redistribute omp [route-policy policy-name]
```

You can also redistribute routes learned from other protocols into BGP:

```
vEdge(config-bgp)# address-family ipv4-unicast redistribute (connected | nat | natpool-outside | ospf | static) [route-policy policy-name]
```

You can control redistribution of routes on a per-neighbor basis:

```
vEdge(config-bgp)# neighbor ip-address
vEdge(config-neighbor)# address-family ipv4-unicast redistribute (connected | nat | natpool-outside | ospf | static)
vEdge(config-neighbor)# route-policy policy-name (in | out)
```

In the BGP route redistribution commands, the optional route policy is applied to the routes that are redistributed into BGP or routes that are redistributed out from BGP.

You can configure the vEdge router to advertise BGP routes that it has learned, through OMP, from the vSmart controller. Doing so allows the vSmart controller to advertise these routes to other vEdge routers in the overlay network. You can advertise BGP routes either globally or for a specific VPN:

```
vEdge(config)# omp advertise bgp
vEdge(config)# vpn vpn-id omp advertise bgp
```

By default, when BGP advertises routes into OMP, BGP advertises each prefix's metric. BGP can also advertise the prefix's AS path:

```
vEdge(config)# vpn vpn-id router bgp
vEdge(config-bgp)# propagate-aspath
```

When you configure BGP to propagate AS path information, the router sends AS path information to routers that are behind the vEdge router (in the service-side network) that are running BGP, and it receives AS path information from these routers. If you are redistributing BGP routes into OMP or into another protocol, or if you are advertising BGP routes to OMP, the AS path information is included in the advertised BGP routes. If you configure BGP AS path propagation on some but not all vEdge routers in the overlay network, the routers on which it is not configured receive the AS path information but they do not forward it to the BGP routers in their local service-side network. Propagating AS path information can help to avoid BGP routing loops.

In networks that have both overlay and underlay connectivity—for example, when vEdge routers are interconnected by both a Viptela overlay network and an MPLS underlay network—you can assign as AS number to OMP itself. For vEdge routers running BGP, this overlay AS number is included in the AS path of BGP route updates. To configure the
overlay AS:

```bash
vEdge(config)# omp
vEdge(omp)# overlay-as as-number
```

You can specify the AS number in 2-byte ASDOT notation (1 through 65535) or in 4-byte ASDOT notation (1.0 through 65535.65535). As a best practice, it is recommended that the overlay AS number be a unique AS number within both the overlay and the underlay networks. That use, select an AS number that is not used elsewhere in the network.

If you configure the same overlay AS number on multiple vEdge routers in the overlay network, all these routers are considered to be part of the same AS, and as a result, they do not forward any routes that contain the overlay AS number. This mechanism is an additional technique for preventing BGP routing loops in the network.

Configure Transport-Side Routing

When a vEdge router is not directly connected to the WAN cloud, it cannot communicate with the vSmart controller in the overlay network. To enable communication between the vEdge router and other Viptela devices, you configure OSPF or BGP on a loopback interface in VPN 0. The loopback interface is a virtual transport interface that is the terminus of the DTLS and IPsec tunnel connections required for the vEdge router to participate in the overlay network.

To configure transport-side routing, you configure a loopback interface, the physical interface, and the routing protocol in VPN 0.

Configure BGP Transport-Side Routing

To configure BGP transport-side routing:

1. Configure a physical interface in VPN 0:
   ```bash
   vEdge(config)# vpn 0 interface ge/slot/port ip address address
   vEdge(config)# no shutdown
   ```

2. Configure a loopback interface in VPN 0:
   ```bash
   vEdge(config)# vpn 0 interface loopback number ip address address
   vEdge(config)# no shutdown
   vEdge(config)# tunnel-interface color color
   ```

3. Configure a BGP instance in VPN 0:
   ```bash
   vEdge(config)# vpn 0 router bgp local-as-number
   ```

4. Create a policy for BGP to advertise the loopback interface address to its neighbors:
   ```bash
   vEdge(config)# policy lists prefix-list prefix-list-name ip-prefix prefix
   prefix is the IP address of the loopback interface.
   ```

5. Configure a route policy that affects the loopback interface's prefix:
   ```bash
   vEdge(config)# policy route-policy policy-name sequence number match address prefix-list-name
   vEdge(config)# policy route-policy policy-name sequence number action accept
   vEdge(config)# policy route-policy policy-name default-action reject
   ```
6. Reference the policy in the BGP instance. To apply the policy such that the loopback address is advertised to all BGP neighbors:

```
vEedge(config)# vpn 0 router bgp local-as-number address-family ipv4-unicast redistribute connected route-policy policy-name
```

To apply the policy only to a specific neighbor:

```
vEedge(config)# vpn 0 router bgp local-as-number neighbor neighbor-address address-family ipv4-unicast redistribute connected route-policy policy-name out
```

Specify `out` in the second command so that BGP advertises the loopback prefix out to the neighbor.

Here is an example of a minimal BGP transport-side routing configuration in which the loopback address is advertised to all the vEedge router's BGP neighbors. Note that even though we did not configure any services on the tunnel interface, these services are associated with the tunnel by default and are included in the configuration. Because services affect only physical interfaces, you can ignore them on loopback interfaces.

```
vEdge# show running-config vpn 0
vpn 0
  router
    bgp 2
      router-id 172.16.255.18
timers
    keepalive 1
    holdtime 3
  !
  address-family ipv4-unicast
    redistribute connected route-policy export_loopback
  !
  neighbor 10.20.25.16
    no shutdown
    remote-as 1
timers
    connect-retry 2
    advertisement-interval 1
  !
  !
  interface ge0/1
    ip address 10.20.25.18/24
    no shutdown
  !
  interface loopback
    ip address 172.16.255.118/32
tunnel-interface
color lte
  allow-service dhcp
  allow-service dns
  allow-service icmp
  no allow-service sshd
  no allow-service ntp
  no allow-service stun
  !
  no shutdown
  !
policy
  lists
    prefix-list loopback_prefix
      ip-prefix 172.16.255.118/32
    !
  route-policy export_loopback
    sequence 10
    match
      address loopback_prefix
    !
    action accept
    !
    default-action reject
    !
```
Configure OSPF Transport-Side Routing

To configure OSPF transport-side routing:

1. Configure a physical interface in VPN 0:
   ```
   vEdge(config)# vpn 0 interface ge slot/port ip address address
   vEdge(config-interface)# no shutdown
   ```

2. Configure a loopback interface in VPN 0 as a tunnel interface:
   ```
   vEdge(config)# vpn 0 interface loopback number ip address address
   vEdge(config-interface)# no shutdown
   vEdge(config-interface)# tunnel-interface color color
   ```

3. Configure an OSPF instance in VPN 0:
   ```
   vEdge(config)# vpn 0 router ospf
   ```

4. Add the physical and loopback interfaces to the OSPF area:
   ```
   vEdge(config-ospf)# area number interface ge slot/port
   vEdge(config-area)# interface loopback number
   ```

Here is any example of a minimal OSPF transport-side routing configuration. Note that even though we did not configure any services on the tunnel interface, these services are associated with the tunnel by default and are included in the configuration. Because services affect only physical interfaces, you can ignore them on loopback interfaces.

```
vEdge# show running-config vpn 0
vpn 0
  router
  ospf
    router-id 172.16.255.11
    timers spf 200 1000 10000
    area 0
      interface ge0/1
      exit
      interface loopback1
      exit
      exit
    !
    interface ge0/1
      ip address 10.0.26.11/24
      no shutdown
    !
    interface loopback1
      ip address 10.0.101.1/32
      no allow-service dhcp
      allow-service dns
      allow-service icmp
      no allow-service sshd
      no allow-service ntp
      no allow-service stun
      no allow-service ntp
      no shutdown
    !
  !
```

Additional Information

- **Unicast Overlay Routing Overview**
- **Routing Configuration Example**
show bgp neighbor
show ip mfib summary
show ip routes
show ospf neighbor