Configuring EVPN VXLAN External Connectivity

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Restrictions for EVPN VXLAN External Connectivity

- External connectivity with VPLS networks is supported only when bridging is the mode of interworking between the two domains. Integrated routing and bridging (IRB) is not supported between a BGP EVPN VXLAN fabric and a VPLS network.
- External Connectivity with Layer 3 networks is supported only for IPv4 and IPv6 unicast traffic.
- External connectivity with an MVPN network is not supported for multicast traffic.
- Import of EVPN IP routes, which includes both route type 5 and route type 2 host routes, to global routing table is not supported.

Information About EVPN VXLAN External Connectivity

External connectivity allows the movement of Layer 2 and Layer 3 traffic between an EVPN VXLAN network and an external network. It also enables the EVPN VXLAN network to exchange routes with the externally connected network. Routes within an EVPN VXLAN network are already shared between all the VTEPs or leaf switches. External connectivity uses the VTEPs on the periphery of the network to pass on these routes to an external Layer 2 or Layer 3 network. Similarly, the EVPN VXLAN network imports the reachability routes from the external network. External connectivity extends the Layer 2 or Layer 3 overlay network outside the VXLAN network. The process of extending a Layer 2 or Layer 3 network outside the EVPN VXLAN network is also known as handoff.

Implementation of Border Nodes for EVPN VXLAN External Connectivity

Border nodes or border VTEPs are the devices through which you establish a connection between an EVPN VXLAN network and an external network. The border nodes sit on the periphery of the EVPN VXLAN

network and remain a part of the BGP EVPN VXLAN fabric. To enable external connectivity, you can implement the border nodes of an EVPN VXLAN network as either border leaf or border spine switches.

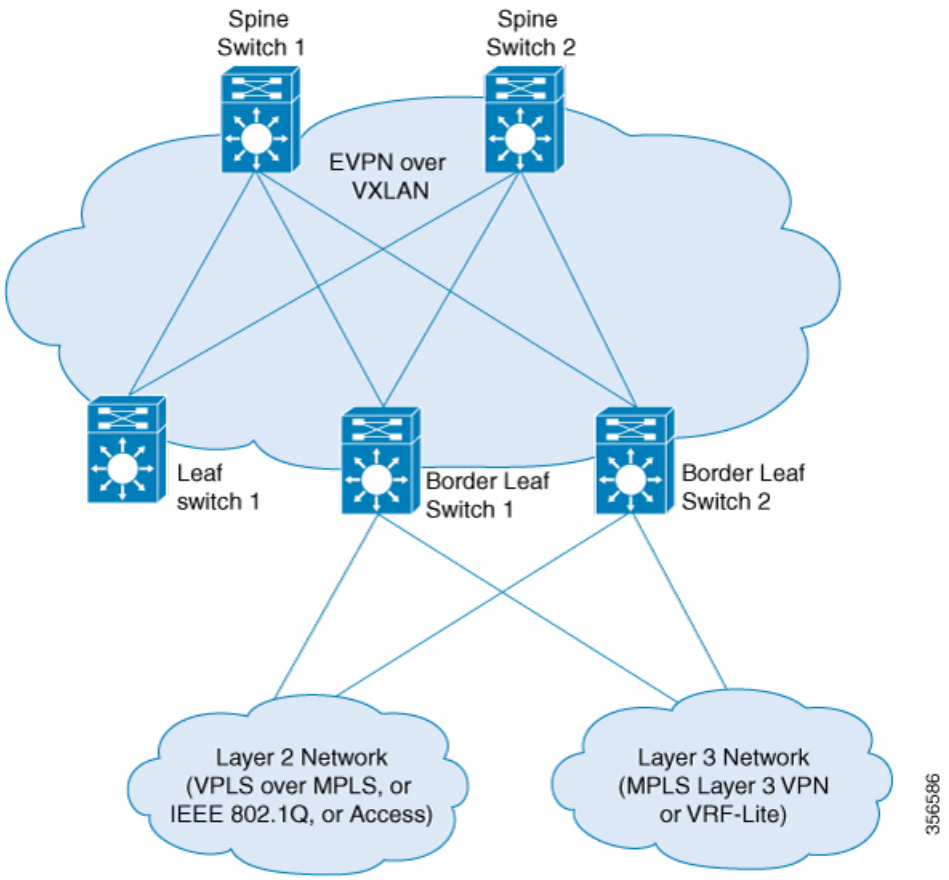
Connectivity Through a Border Leaf Switch

Leaf switches deployed as border nodes support the required control plane and data plane functionalities. Border leaf deployment ensures that the configuration on the spine switches is much simpler. Border leaf switches only allow communication between the external network and the VXLAN network, also known as north-south communication.

Note A border leaf switch can also be multiple switches functioning as a single logical system with Cisco StackWise Virtual configured.

The following figure shows border leaf external connectivity of an EVPN VXLAN network with external Layer 2 and Layer 3 networks.:

Figure 1: EVPN VXLAN External Connectivity Through a Border Leaf Switch

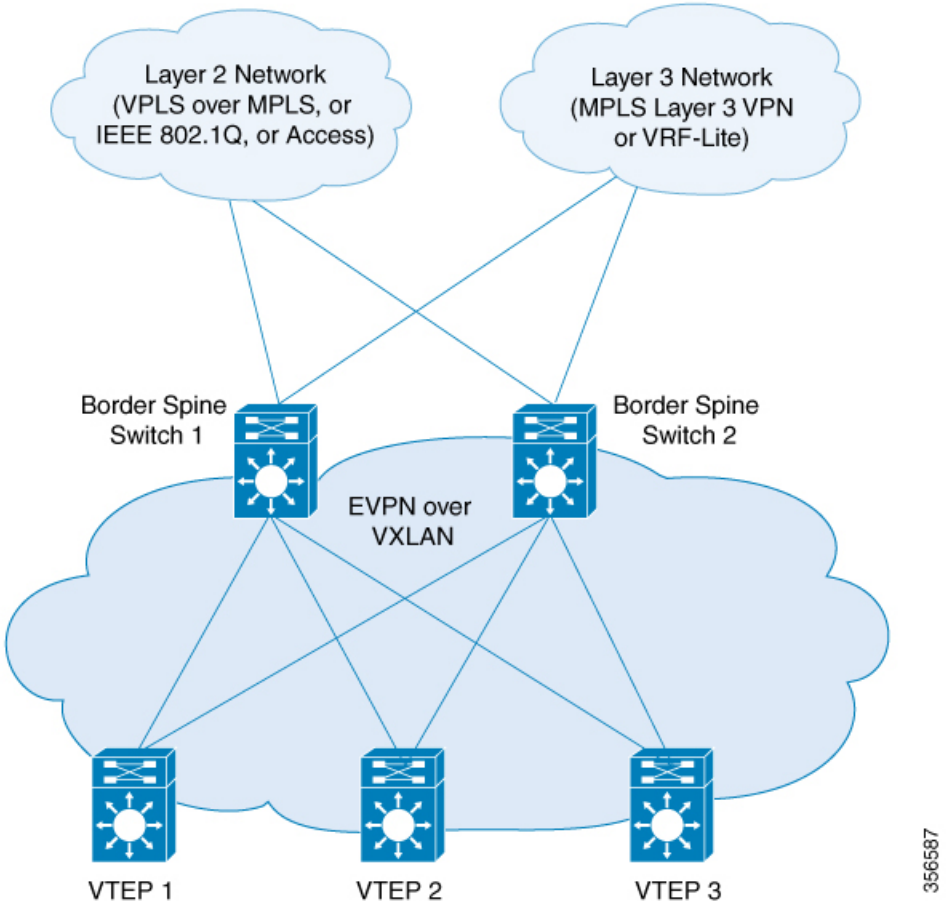


Connectivity Through a Border Spine Switch

Deploying spine switches as border nodes provides the advantage of optimizing the north-south communication with external resources. At the same time, border spine deployment allows the spine switches to support VXLAN control and data plane functionality. Border spine switches allow both north-south communication and east-west communication. East-west communication represents the communication within the nodes of the EVPN VXLAN network.

The following figure shows border spine external connectivity of an EVPN VXLAN network with external Layer 2 and Layer 3 networks.:

Figure 2: EVPN VXLAN External Connectivity Through a Border Spine Switch



External Connectivity with Layer 3 Networks

Layer 3 external connectivity or handoff is established by connecting the border nodes of a BGP EVPN VXLAN fabric with an edge router from the external Layer 3 network. The border node acts as a VTEP to perform VXLAN encapsulation and decapsulation, but it also routes the traffic towards the edge routing device. The VXLAN-facing interface on the external Layer 3 network can be a switch virtual interface (SVI), or a Layer 3 interface, or a Layer 3 subinterface.

You can use Layer 3 external connectivity to achieve any of the following:

- Extend the logical isolation between VRFs or VLANs within the EVPN VXLAN network into the externally routed network. The external routed network can be a traditional non-VXLAN campus network, a datacenter, or a WAN.
- Provide shared access within the EVPN VXLAN network to a common external service such as the internet.

BGP EVPN VXLAN fabric supports Layer 3 external connectivity with VRF-Lite and MPLS Layer 3 VPN networks.

Layer 3 External Connectivity with VRF-Lite

Using VRF allows for the use of multiple routing tables that are independent and isolated. VRF-Lite is a mechanism to extend the tenant Layer 3 VRF information beyond the BGP EVPN VXLAN Fabric. External connectivity with VRF-Lite or VRF handoff involves a two-box approach where the border node and the edge router are physically independent devices. With VRF-Lite handoff, the BGP EVPN VXLAN fabric extends the connectivity for different tenants externally on a hop-by-hop basis.

Once the border node learns external routes from the edge router, it advertises the prefixes inside the BGP EVPN VXLAN fabric as EVPN type 5 routes. This information is distributed to all the other VTEPs in the network. The border node also advertises EVPN routes to the external edge router. It sends the EVPN routes learned from the Layer 2 VPN EVPN address family to the IPv4 or IPv6 unicast address family.

Layer 3 Multicast External Connectivity with MPLS Layer 3 VPN

Layer 3 external connectivity with an MPLS Layer 3 VPN network or MPLS handoff uses a single-box approach. The single-box approach combines the functionalities of an EVPN VXLAN border node and an MPLS PE router into a single physical device. The device is also known as a border PE node. The border PE node reoriginates IP prefixes from the EVPN address family of the BGP EVPN VXLAN fabric to the VPNv4 address family of the MPLS network. Likewise, the border PE node performs the corresponding function in the reverse direction. eBGP peering is necessary between the border PE node and the MPLS PE devices to ensure the connectivity.

MPLS handoff allows scalability for EVPN VXLAN networks that have a large number of tenants or VRFs. Scalability is not possible with VRF-Lite handoff.

In every VRF on a border VTEP, there are two sets of manually configured import and export route targets. The first set of import and export route targets is associated with the BGP neighbor in the BGP EVPN VXLAN fabric. This BGP neighbor uses the EVPN address family to exchange Layer 3 information. The second set of import and export route targets is associated with the BGP neighbor in the Layer 3 VPN network. This BGP neighbor uses either VPNv4 or VPNv6 unicast address families to exchange Layer 3 information. The separation of route targets allows you to configure both sets of route targets independently. In this way, a border VTEP in an EVPN VXLAN network effectively stitches the two sets of route targets. The route targets associated with the BGP neighbor in the Layer 3 VPN network are known as normal route targets. The route targets associated with the BGP neighbor in the BGP EVPN VXLAN fabric are known as stitching route targets.

External Connectivity with Layer 2 Networks

Layer 2 external connectivity or handoff for an EVPN VXLAN network extends the Layer 2 domain outside of the network. BGP EVPN VXLAN fabric supports Layer 2 external connectivity with IEE 802.1Q, access, and VPLS over MPLS networks.

Layer 2 External connectivity with IEEE 802.1Q or Access Networks

Layer 2 handoff to IEEE 802.1Q networks is achieved through a regular IEEE 802.1Q Trunk port configuration on the Switchport interfaces on the border nodes. You can also connect EVPN VXLAN networks to external access networks.

The commonly deployed scenario has EVPN enabled at the distribution layer and has the access layer switches connected with IEEE 802.1Q Trunk encapsulation. The IEEE 802.1Q Layer 2 traffic that comes from the access layer switches is mapped to the corresponding VLAN. The border node then bridges the traffic towards the destination with VXLAN encapsulation. The inner packet does not carry the IEEE 802.1Q tag. Instead, the VXLAN network identifier (VNI), which is the Layer 2 VNI in the VXLAN header, represents the broadcast domain. Similarly, the border nodes decapsulate the traffic from the BGP EVPN VXLAN fabric and bridge it with the corresponding IEEE 802.1Q tag to the access switches. The interface on the border VTEP that faces the external interface can be either an access or a Trunk port. The external interface can belong to either a Layer 2 switch or a firewall.

Note If you connect the network to an external Layer 2 switch through two border VTEPs, it represents a dual connection. In such cases, STP does not propagate over the BGP EVPN VXLAN fabric by default.

Layer 2 External connectivity with VPLS over MPLS Network

External connectivity with VPLS networks or VPLS handoff is achieved when a border VTEP or multiple border VTEPs establish a connection with the VPLS network. The border nodes act as the provider edge (PE) devices in the VPLS network and as VTEPs in the EVPN VXLAN network.

BGP EVPN VXLAN supports VPLS handoff in the form of VPLS stitching through either an access VFI or an access pseudowire on the VLAN on the border VTEP.

The access pseudowires and the pseudowires in the access VFI function as the access ports in the EVPN VXLAN network. The BGP EVPN VXLAN fabric treats the MAC addresses learned on the pseudowires as locally learned MAC addresses. It advertises these MAC addresses within the fabric as EVPN type 2 routes. The pseudowires are in a different split horizon group compared to the EVPN VXLAN network. Therefore, BUM traffic floods between both the EVPN VXLAN and VPLS networks.

How to Configure EVPN VXLAN External Connectivity

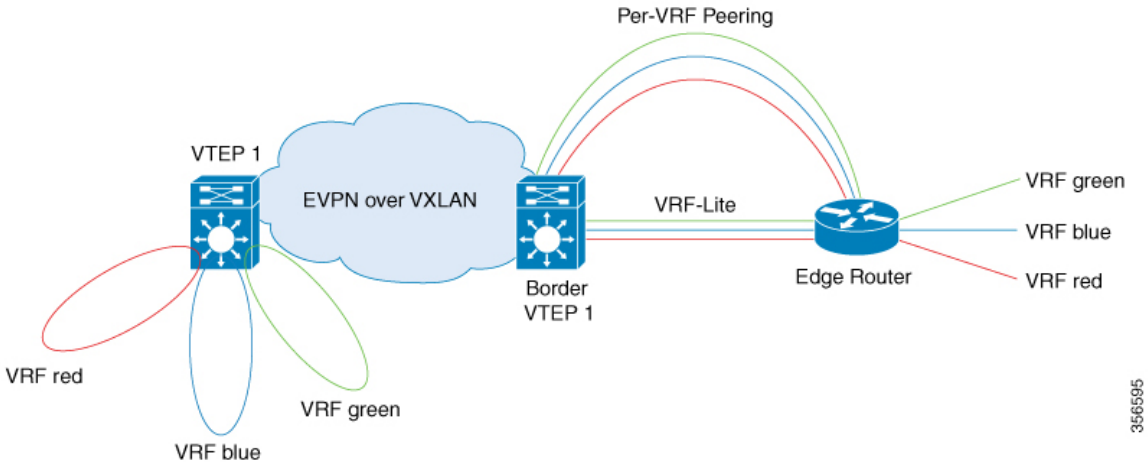
This section provides information about how to configure external connectivity between an EVPN VXLAN network and an external Layer 2 or Layer 3 network.

Note You must configure EVPN VXLAN Layer 2 and Layer 3 overlay networks before you configure external connectivity. See How to Configure EVPN VXLAN Integrated Routing and Bridging for detailed steps.

Enabling Layer 3 External Connectivity with VRF-Lite

The following figure shows a sample topology that illustrates Layer 3 external connectivity with VRF-Lite:

Figure 3: Layer 3 External Connectivity with VRF-Lite



To configure Layer 3 external connectivity with VRF-Lite, perform the following set of procedures:

- Configure the VRF on the border VTEP interface that faces the external router.
- Ensure that Layer 2 VPN EVPN is advertised as part of the BGP VRF configuration. See Configuring BGP with EVPN and VRF Address Families on a VTEP for detailed steps.

Note Redistribution of the respective interior gateway protocol (IGP) is required in the BGP VRF address family to distribute the external prefixes into the BGP EVPN VXLAN fabric.

For more information about VRF-Lite, see *Contents → IP Routing Configuration Guide → Configuring VRF-lite* in the software configuration guide for the applicable release.

Configuring the VRF on the Border VTEP Interface that Faces the External Router

To cnofigure the VRF on the border VTEP interface that faces the external router, perform these steps:

Procedure

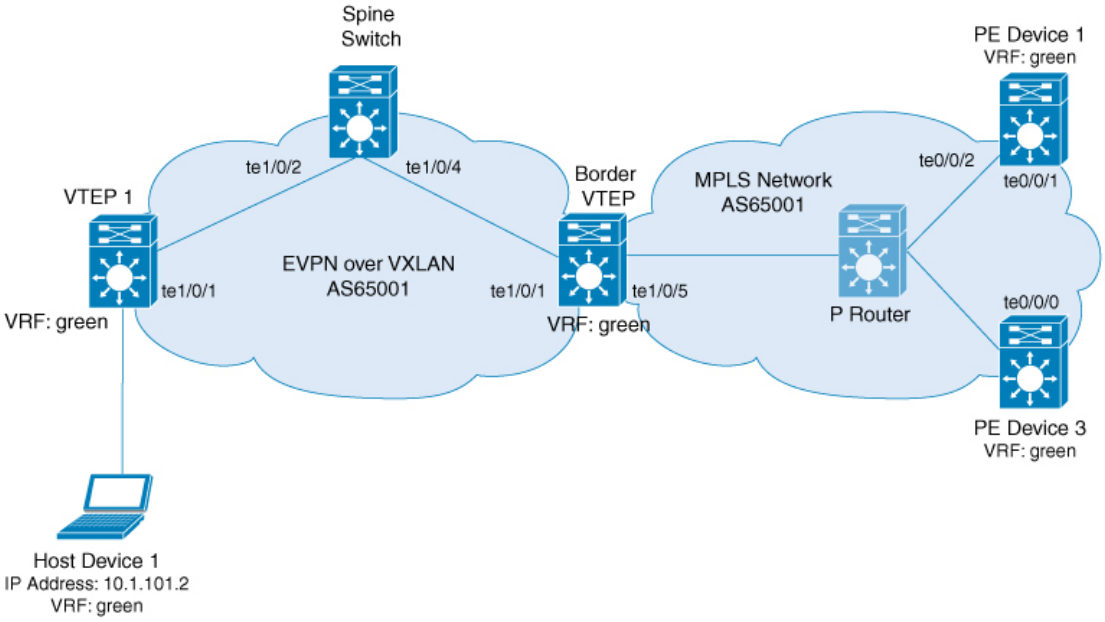
	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**interface** *interface-id* **Example:** `Device(config)# interface GigabitEthernet1/0/30`	Enters the interface configuration mode for the specified interface.
Step 4	**vrf forwarding** *vrf-name* **Example:** `Device(config-if)# vrf forwarding green`	Associates the VRF with the interface. **Note** The interface must be associated with the same VRF for which the Layer 3 VNI has been configured for the EVPN VXLAN network.
Step 5	**ip address** *ip-address* **Example:** `Device(config-if)# ip address 192.168.3.203 255.255.255.0`	Configures the IP address for the interface.
Step 6	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Enabling Layer 3 External Connectivity with MPLS Layer 3 VPN

The following figure shows a sample topology that illustrates Layer 3 external connectivity with an MPLS Layer 3 VPN network:

Figure 4: Layer 3 External Connectivity with MPLS Layer 3 VPN



To enable EVPN VLAN Layer 3 external connectivity with MPLS Layer 3 VPN networks, perform the following set of procedures:

- Run the **mpls label mode all-vrfs protocol all-afs per-vrf** command in global configuration mode on the border VTEP.
- Configure BGP with reorigination of routes with a new route type for Layer 2 VPN, VPNv4, VPNv6 address families on the border VTEP.

Configuring BGP on a Border VTEP for External Connectivity with MPLS Layer 3 VPN

To configure BGP on a border VTEP to establish eternal connectivity with an MPLS Layer 3 VPN network, perform this procedure:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**router bgp** *autonomous-system-number* **Example:** `Device(config)# router bgp 1`	Enables a BGP routing process, assigns it an autonomous system number, and enters router configuration mode.
Step 4	**bgp log-neighbor-changes** **Example:** `Device(config-router)# bgp log-neighbor-changes`	(Optional) Enables the generation of logging messages when the status of a BGP neighbor changes. For more information, see Configuring BGP section of the *IP Routing Configuration Guide*.
Step 5	**bgp update-delay** *time-period* **Example:** `Device(config-router)# bgp update-delay 1`	(Optional) Sets the maximum initial delay period before sending the first update. For more information, see Configuring BGP section of the *IP Routing Configuration Guide*.
Step 6	**bgp graceful-restart** **Example:** `Device(config-router)# bgp graceful-restart`	(Optional) Enables the BGP graceful restart capability for all BGP neighbors. For more information, see Configuring BGP section of the *IP Routing Configuration Guide*.
Step 7	**no bgp default ipv4-unicast** **Example:** `Device(config-router)# no bgp default ipv4-unicast`	(Optional) Disables default IPv4 unicast address family for BGP peering session establishment. For more information, see Configuring BGP section of the *IP Routing Configuration Guide*.
Step 8	**neighbor** *spine-ip-address* **remote-as** *number* **Example:** `Device(config-router)# neighbor 172.16.255.1 remote-as 1`	Defines multiprotocol-BGP neighbors in the EVPN network. Use the IP address of the spine switch as the neighbor IP address. This configures the spine switch as a BGP neighbor.
Step 9	**neighbor** *mpls-peer-ip-address* **remote-as** *number* **Example:** `Device(config-router)# neighbor 172.16.255.103 remote-as 1`	Defines multiprotocol-BGP neighbors in the external MPLS network. Use the IP address of the external MPLS network peer as the neighbor IP address. This configures the external MPLS network peer as a BGP neighbor.
Step 10	**neighbor** {*ip-address* | *group-name*} **update-source** *interface* **Example:** `Device(config-router)# neighbor 172.16.255.1 update-source Loopback0`	Configures update source. Update source can be configured per neighbor or per peer-group. Use the IP address of the spine switch as the neighbor IP address.

	Command or Action	Purpose
Step 11	**address-family l2vpn evpn** **Example:** `Device(config-router)# address-family l2vpn evpn`	Specifies the L2VPN address family and enters address family configuration mode.
Step 12	**import vpnv4 unicast re-originate** **Example:** `Device(config-router-af)# import vpnv4 unicast re-originate`	Reoriginates the VPNv4 routes imported from the external peer into the EVPN address family as EVPN routes, and distributes within the EVPN fabric.
Step 13	**import vpnv6 unicast re-originate** **Example:** `Device(config-router-af)# import vpnv6 unicast re-originate`	Reoriginates the VPNv6 routes imported from the external peer into the EVPN address family as EVPN routes, and distributes within the EVPN fabric.
Step 14	**neighbor** *ip-address* **activate** **Example:** `Device(config-router-af)# neighbor 10.11.11.11 activate`	Enables the exchange information from a BGP neighbor. Use the IP address of the spine switch as the neighbor IP address.
Step 15	**neighbor** *ip-address* **send-community** [**both** | **extended** | **standard**] **Example:** `Device(config-router-af)# neighbor 10.11.11.11 send-community both`	Specifies the communities attribute sent to a BGP neighbor. Use the IP address of the spine switch as the neighbor IP address. **Note** Use either of **extended** or **both** keywords. External connectivity cannot be established when you use the **standard** keyword.
Step 16	**neighbor** {**ip-address** | **peer-group-name**} **next-hop-self** [**all**] **Example:** `Device(config-router-af)# neighbor ip-address next-hop-self all`	Configures the router as the next hop for a BGP-speaking neighbor or peer group. The **all** keyword is mandatory when implementing external connectivity through iBGP, where the EVPN fabric and the MPLS network are in the same BGP autonomous system number. The **all** keyword is optional when implementing external connectivity through eBGP, where the EVPN fabric and the MPLS network are in different BGP autonomous system numbers.
Step 17	**exit-address-family** **Example:** `Device(config-router-af)# exit-address-family`	Exits address family configuration mode and returns to router configuration mode.

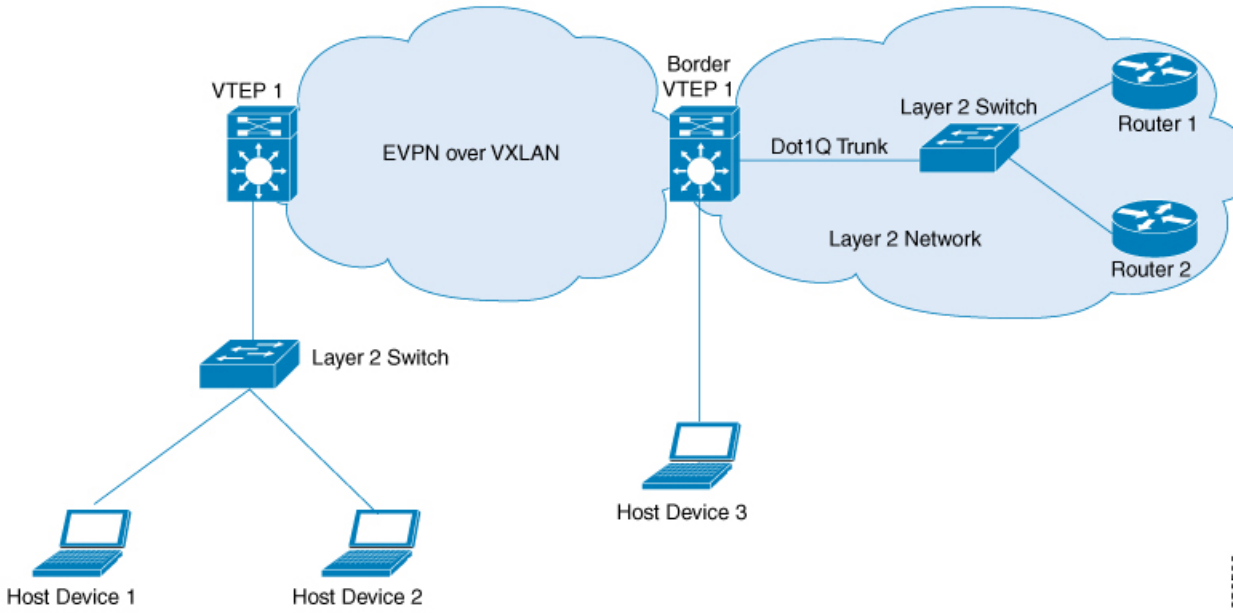
	Command or Action	Purpose
Step 18	**address-family vpnv4** **Example:** `Device(config-router)# address-family vpnv4`	Specifies the VPNv4 address family and enters address family configuration mode.
Step 19	**import l2vpn evpn re-originate** **Example:** `Device(config-router-af)# import l2vpn evpn re-originate`	Reoriginates the EVPN routes imported from the EVPN fabric into the VPNv4 address family as VPNv4 routes and distributes them to the external network.
Step 20	**neighbor** *ip-address* **activate** **Example:** `Device(config-router-af)# neighbor 172.16.255.103 activate`	Enables the exchange information from a BGP neighbor. Use the IP address of the external MPLS network router as the neighbor IP address.
Step 21	**neighbor** *ip-address* **send-community** [**both** | **extended** | **standard**] **Example:** `Device(config-router-af)# neighbor 172.16.255.103 send-community both`	Specifies the communities attribute sent to a BGP neighbor. Use the IP address of the external MPLS network router as the neighbor IP address. **Note** Use either of **extended** or **both** keywords. External connectivity cannot be established when you use the **standard** keyword.
Step 22	**neighbor** {**ip-address** | **peer-group-name**} **next-hop-self** [**all**] **Example:** `Device(config-router-af)# neighbor ip-address next-hop-self all`	Configures the router as the next hop for a BGP-speaking neighbor or peer group. The **all** keyword is mandatory when implementing external connectivity through iBGP, where the EVPN fabric and the MPLS network are in the same BGP autonomous system number. The **all** keyword is optional when implementing external connectivity through eBGP, where the EVPN fabric and the MPLS network are in different BGP autonomous system numbers.
Step 23	**exit-address-family** **Example:** `Device(config-router-af)# exit-address-family`	Exits address family configuration mode and returns to router configuration mode.
Step 24	**address-family vpnv6** **Example:** `Device(config-router)# address-family vpnv6`	Specifies the VPNv6 address family and enters address family configuration mode.

	Command or Action	Purpose
Step 25	**import l2vpn evpn re-originate** **Example:** `Device(config-router-af)# import l2vpn evpn re-originate`	Reoriginates the EVPN routes imported from the EVPN fabric into the VPNv6 address family as VPNv6 routes and distributes them to the external network.
Step 26	**neighbor** *ip-address* **activate** **Example:** `Device(config-router-af)# neighbor 172.16.255.103 activate`	Enables the exchange information from a BGP neighbor. Use the IP address of the spine switch as the neighbor IP address.
Step 27	**neighbor** *ip-address* **send-community** [**both** | **extended** | **standard**] **Example:** `Device(config-router-af)# neighbor 172.16.255.103 send-community both`	Specifies the communities attribute sent to a BGP neighbor. Use the IP address of the spine switch as the neighbor IP address. **Note** Use either of **extended** or **both** keywords. External connectivity cannot be established when you use the **standard** keyword.
Step 28	**neighbor** {**ip-address** | **peer-group-name**} **next-hop-self** [**all**] **Example:** `Device(config-router-af)# neighbor ip-address next-hop-self all`	Configures the router as the next hop for a BGP-speaking neighbor or peer group. The **all** keyword is mandatory when implementing external connectivity through iBGP, where the EVPN fabric and the MPLS network are in the same BGP autonomous system number. The **all** keyword is optional when implementing external connectivity through eBGP, where the EVPN fabric and the MPLS network are in different BGP autonomous system numbers.
Step 29	**exit-address-family** **Example:** `Device(config-router-af)# exit-address-family`	Exits address family configuration mode and returns to router configuration mode.
Step 30	**end** **Example:** `Device(config-router)# end`	Returns to privileged EXEC mode.

Enabling Layer 2 External Connectivity with IEEE 802.1Q Networks

The following image shows a sample topology that illustrates Layer 2 external connectivity with an IEEE 802.1Q network:

Figure 5: Layer 2 External Connectivity with IEEE 802.1Q Networks



You can also connect the EVPN VXLAN network to a firewall in place of the Layer 2 switch in the above image. To configure Layer 2 external connectivity with an IEEE 802.1Q network, perform the following steps on the external Layer 2 switch:

Procedure

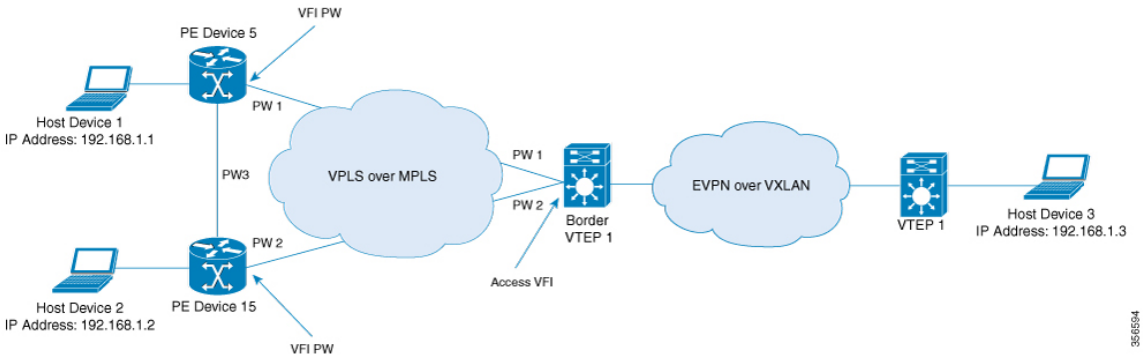
	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-id* **Example:** `Device(config)# interface GigabitEthernet4/0/1`	Enters interface configuration mode for the specified interface. The specified interface must be the interface on the Layer 2 switch through which the EVPN VXLAN network communicates with the IEEE 802.1Q network.
Step 4	**switchport mode trunk** **Example:** `Device(config-if)# switchport mode trunk`	Configures the interface as a trunking VLAN Layer 2 interface.

	Command or Action	Purpose
Step 5	**switchport trunk allowed vlan** *vlan-list* **Example:** `Device(config-if)# switchport trunk allowed vlan 201,202`	Sets the list of VLANs that are allowed to transmit traffic from this interface in tagged format when the interface is in trunking mode.
Step 6	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Enabling Layer 2 External Connectivity with a VPLS Network Through an Access VFI

The following illustration shows a single-homed VXLAN network connected to a VPLS over MPLS network through the access VFIs on the border VTEP:

Figure 6: Layer 2 External Connectivity with a VPLS Network Through an Access VFI



Note We recommend you to use Cisco Catalyst 9500 Series - High Performance switches or Cisco Catalyst 9600 Series switches as border VTEPs when you configure Layer 2 external connectivity with a VPLS network.

We recommend you to configure Cisco Stackwise Virtual on the border VTEPs in order to achieve physical redundancy when you configure Layer 2 external connectivity with a VPLS network.

Perform the following set of procedures to enable Layer 2 external connectivity with VPLS networks through an access VFI interface:

1. Define the access VFI for the VTEPs.
2. Configure the access VFI as a member of the VLAN on the VTEPs.
3. Configure the EVPN instance as a member of the VLAN on the VTEPs.
4. Configure VPLS on the border VTEP.

Defining an Access VFI on a Border VTEP

To configure an access facing VFI on the VLAN of a border VTEP, perform the following steps:

For more information on configuring VFIs, in the software configuration guide for the required release, go to *Contents → Multiprotocol Label Switching (MPLS) Configuration Guide → Configuring Virtual Private LAN Service (VPLS) and VPLS BGP-Based Autodiscovery*.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enters privileged EXEC mode. Enter password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**l2vpn vfi context** *vfi-name* **Example:** `Device(config)# l2vpn vfi context myVFI`	Establishes an Layer 2 VPN VFI between two or more separate networks, and enters VFI configuration mode.
Step 4	**vpn id** *vpn-id* **Example:** `Device(config-vfi)# vpn id 1`	Configures the VPN ID for the VFI.
Step 5	**member** *ip-address* **encapsulation mpls** **Example:** `Device(config-vfi)# member 10.12.12.5 encapsulation mpls`	Specifies the device that forms a point-to-point Layer 2 VPN VFI connection.
Step 6	Repeat step 5 for all devices that form a point-to-point Layer 2 VPN VFI connection.	
Step 7	**end** **Example:** `Device(config-vfi)# end`	Exits VFI configuration mode and enters privileged EXEC mode.

Adding an Access VFI and an EVPN Instance as Members of the VLAN of a Border VTEP

To add an access VFI and an EVPN instance as members of the VLAN of a border VTEP, perform the following steps:

Procedure

	Command or Action	Purpose
Step 1	**enable**	Enters privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	Enter password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**vlan configuration** *vlan-number* **Example:** `Device(config)# vlan configuration 11`	Enters VLAN feature configuration mode for the specified VLAN interface. Enter the VLAN number that is associated with the Layer 2 VNI configured in the EVPN VXLAN network.
Step 4	**member access-vfi** *vfi-name* **Example:** `Device(config-vlan)# member access-vfi myVFI`	Adds the access VFI as a member of the VLAN configuration.
Step 5	**member evpn-instance** *evpn-instance-number* **vni** *l2-vni-number* **Example:** `Device(config-vlan)# member evpn-instance 1 vni 6000`	Adds the EVPN instance as a member of the VLAN configuration.
Step 6	**end** **Example:** `Device(config-vlan)# end`	Exits VLAN configuration mode and enters privileged EXEC mode.

Configuring VPLS on a Border VTEP

To configure VPLS on a border VTEP, in the software configuration guide for the required release, see *Contents → Multiprotocol Label Switching (MPLS) Configuration Guide → Configuring Virtual Private LAN Service (VPLS) and VPLS BGP-Based Autodiscovery*.

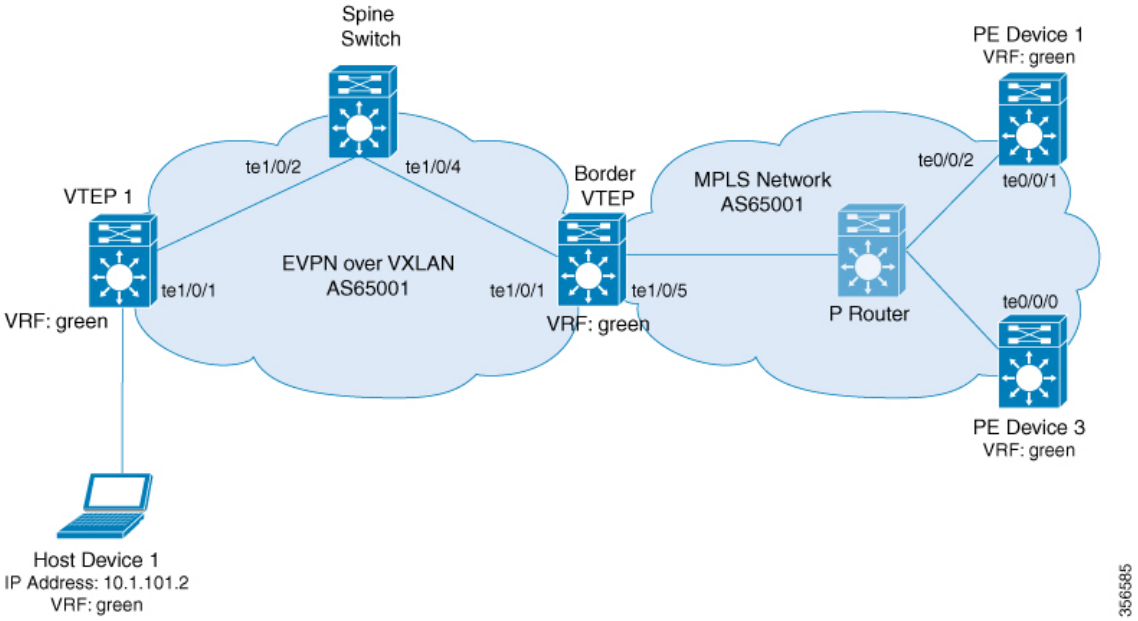
Configuration Examples for EVPN VXLAN External Connectivity

The following section shows the configuration examples for EVPN VXLAN external connectivity to other technologies:

Example: Enabling Layer 3 External Connectivity with MPLS Layer 3 VPN through iBGP

This section provides an example to show how Layer 3 external connectivity with MPLS Layer 3 VPN is enabled for a BGP EVPN VXLAN fabric through iBGP. The example shows how to configure and verify Layer 3 external connectivity with MPLS Layer 3 VPN for the topology shown below:

Figure 7: Layer 3 External Connectivity with MPLS Layer 3 VPN through iBGP



The topology shows an EVPN VXLAN network with two VTEPS, VTEP 1 and border VTEP. Border VTEP is connected to an external PE device that belongs to an MPLS network. The BGP EVPN VXLAN fabric and the MPLS network are in the autonomous system number 65001. All the VTEPs, PE devices and, host devices are part of the VRF green. The following tables provide sample configurations for the devices in the topology above.

Table 1: Configuring Spine Switch, Border VTEP and PE Device 1 for Enabling Layer 3 External Connectivity with MPLS Layer 3 VPN through iBGP

Spine Switch	Border VTEP	PE Device 1
Spine_switch# **show running-config** hostname Spine_switch ! interface Loopback0 ip address 172.16.255.1 255.255.255.255 ip ospf 1 area 0 ip pim sparse-mode ! interface Loopback1 ip address 172.16.254.1 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface Loopback2 ip address 172.16.255.255 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface TenGigabitEthernet1/0/2 no switchport ip address 172.16.14.1 255.255.255.0 ip pim sparse-mode ip ospf network point-to-point ip ospf 1 area 0 ! interface TenGigabitEthernet1/0/4 no switchport ip address 172.16.16.1 255.255.255.0 ip pim sparse-mode ip ospf network point-to-point ip ospf 1 area 0 ! router ospf 1 router-id 172.16.255.1 ! router bgp 65001 template peer-policy RR-PP route-reflector-client send-community both exit-peer-policy ! template peer-session RR-PS remote-as 65001 update-source Loopback0 exit-peer-session ! bgp router-id 172.16.255.1 bgp log-neighbor-changes no bgp default ipv4-unicast neighbor 172.16.255.4 inherit peer-session RR-PS neighbor 172.16.255.6 inherit peer-session RR-PS ! ! !	Border_VTEP# **show running-config** hostname Border_VTEP !vrf definition green rd 1:1 ! address-family ipv4 route-target export 1:1 route-target import 1:1 route-target export 1:1 stitching route-target import 1:1 stitching exit-address-family ! address-family ipv6 route-target export 1:1 route-target import 1:1 route-target export 1:1 stitching route-target import 1:1 stitching exit-address-family ! mpls label mode all-vrfs protocol all-afs per-vrf ! l2vpn evpn replication-type static router-id Loopback1 default-gateway advertise ! l2vpn evpn instance 101 vlan-based encapsulation vxlan ! l2vpn evpn instance 102 vlan-based encapsulation vxlan replication-type ingress ! vlan configuration 101 member evpn-instance 101 vni 10101 vlan configuration 102 member evpn-instance 102 vni 10102 vlan configuration 901 member vni 50901 ! interface Loopback0 ip address 172.16.255.6 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface Loopback1 ip address 172.16.254.6 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface TenGigabitEthernet1/0/1 no switchport ip address 172.16.16.6 255.255.255.0 ip pim sparse-mode ip ospf network point-to-point ip ospf 1 area 0	PE_device_1# **show running-config** hostname PE_device_1 ! vrf definition green rd 1:1 ! address-family ipv4 route-target export 1:1 route-target import 1:1 exit-address-family ! address-family ipv6 route-target export 1:1 route-target import 1:1 exit-address-family ! interface Loopback0 ip address 172.16.255.101 255.255.255.255 ! interface Loopback1 vrf forwarding green ip address 10.1.255.101 255.255.255.255 ! interface TenGigabitEthernet0/0/1 ip address 172.16.111.101 255.255.255.0 ip router isis cdp enable mpls ip isis network point-to-point ! interface TenGigabitEthernet0/0/2 ip address 172.16.106.101 255.255.255.0 ip router isis negotiation auto cdp enable mpls ip isis network point-to-point ! router isis net 49.0001.1720.1625.5101.00 is-type level-2-only metric-style wide passive-interface Loopback0 ! router bgp 65001 bgp log-neighbor-changes no bgp default ipv4-unicast neighbor 172.16.255.103 remote-as 65001 neighbor 172.16.255.103 update-source Loopback0 ! address-family ipv4 exit-address-family !

Spine Switch	Border VTEP	PE Device 1
!	!	
address-family ipv4	interface TenGigabitEthernet1/0/5	address-family vpnv4
exit-address-family	no switchport	neighbor 172.16.255.103 activate
!	ip address 172.16.106.6 255.255.255.0	neighbor 172.16.255.103
address-family l2vpn evpn	ip router isis	send-community both
neighbor 172.16.255.4 activate	duplex full	exit-address-family
neighbor 172.16.255.4 send-community	mpls ip	!
extended	isis network point-to-point	address-family vpnv6
neighbor 172.16.255.4 inherit	!	neighbor 172.16.255.103 activate
peer-policy RR-PP	interface Vlan101	neighbor 172.16.255.103
neighbor 172.16.255.6 activate	vrf forwarding green	send-community both
neighbor 172.16.255.6 send-community	ip address 10.1.101.1 255.255.255.0	exit-address-family
extended	!	!
neighbor 172.16.255.6 inherit	interface Vlan102	address-family ipv4 vrf green
peer-policy RR-PP	vrf forwarding green	redistribute connected
	ip address 10.1.102.1 255.255.255.0	exit-address-family
exit-address-family	!	!
!	interface Vlan901	address-family ipv6 vrf green
ip pim rp-address 172.16.255.255	vrf forwarding green	redistribute connected
!	ip unnumbered Loopback1	exit-address-family
end	ipv6 enable	!
!	no autostate	end
!	!	
!	interface nve1	!
!	no ip address	!
!	source-interface Loopback1	!
!	host-reachability protocol bgp	!
!	member vni 10101 mcast-group	!
!	225.0.0.101	!
!	member vni 50901 vrf green	!
!	member vni 10102 ingress-replication	!
!	!	!
!	router ospf 1	!
!	!	!
!	router isis	!
!	net 49.0001.1720.1625.5006.00	!
!	is-type level-2-only	!
!	metric-style wide	!
!	passive-interface Loopback0	!
!	!	!
!	router bgp 65001	!
!	!	!
!	template peer-session RR-PS	!
!	remote-as 65001	!
!	update-source Loopback0	!
!	exit-peer-session	!
!	!	!
!	bgp log-neighbor-changes	!
!	no bgp default ipv4-unicast	!
!	neighbor 172.16.255.1 inherit	!
!	peer-session RR-PS	!
!	neighbor 172.16.255.103 inherit	!
!	peer-session RR-PS	!
!	!	!
!	address-family ipv4	!
!	exit-address-family	!
!	!	!
!	!	!
!	!	!
!	!	!
!	!	!

Spine Switch	Border VTEP	PE Device 1
!	!	!
!	address-family vpnv4	!
!	import l2vpn evpn re-originate	!
!	neighbor 172.16.255.103 activate	!
!	neighbor 172.16.255.103	!
!	send-community both	!
!	neighbor 172.16.255.103	!
!	route-reflector-client	!
!	neighbor 172.16.255.103 next-hop-self	!
!	all	!
!	exit-address-family	!
!	!	!
!	address-family vpnv6	!
!	import l2vpn evpn re-originate	!
!	neighbor 172.16.255.103 activate	!
!	neighbor 172.16.255.103	!
!	send-community both	!
!	neighbor 172.16.255.103	!
!	route-reflector-client	!
!	neighbor 172.16.255.103 next-hop-self	!
!	all	!
!	exit-address-family	!
!	!	!
!	address-family l2vpn evpn	!
!	import vpnv4 unicast re-originate	!
!	import vpnv6 unicast re-originate	!
!	neighbor 172.16.255.1 activate	!
!	neighbor 172.16.255.1 send-community	!
!	both	!
!	neighbor 172.16.255.1	!
!	route-reflector-client	!
!	neighbor 172.16.255.1 next-hop-self	!
!	all	!
!	exit-address-family	!
!	!	!
!	address-family ipv4 vrf green	!
!	advertise l2vpn evpn	!
!	redistribute connected	!
!	redistribute static	!
!	exit-address-family	!
!	!	!
!	address-family ipv6 vrf green	!
!	advertise l2vpn evpn	!
!	redistribute connected	!
!	redistribute static	!
!	exit-address-family	!
!	!	!
!	ip pim rp-address 172.16.255.255	!
!	!	!
!	end	!
Spine_switch#	Border_VTEP#	PE_device_1#

Table 2: Configuring VTEP 1 and PE Device 3 for Enabling Layer 3 External Connectivity with MPLS Layer 3 VPN through iBGP

VTEP 1	PE Device 3
VTEP_1# **show running-config** hostname VTEP_1 ! vrf definition green rd 1:1 ! address-family ipv4 route-target export 1:1 route-target import 1:1 route-target export 1:1 stitching route-target import 1:1 stitching exit-address-family ! address-family ipv6 route-target export 1:1 route-target import 1:1 route-target export 1:1 stitching route-target import 1:1 stitching exit-address-family ! l2vpn evpn replication-type static router-id Loopback1 default-gateway advertise ! l2vpn evpn instance 101 vlan-based encapsulation vxlan ! l2vpn evpn instance 102 vlan-based encapsulation vxlan replication-type ingress ! vlan configuration 101 member evpn-instance 101 vni 10101 vlan configuration 102 member evpn-instance 102 vni 10102 vlan configuration 901 member vni 50901 ! interface Loopback0 ip address 172.16.255.4 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface Loopback1 ip address 172.16.254.4 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface TenGigabitEthernet1/0/1 no switchport ip address 172.16.14.4 255.255.255.0 ip pim sparse-mode ip ospf network point-to-point ip ospf 1 area 0 ! interface Vlan101 vrf forwarding green ip address 10.1.101.1 255.255.255.0	PE_device_3# **show running-config** hostname PE_device_3 ! vrf definition green rd 1:1 ! address-family ipv4 route-target export 1:1 route-target import 1:1 exit-address-family ! address-family ipv6 route-target export 1:1 route-target import 1:1 exit-address-family ! interface Loopback0 ip address 172.16.255.103 255.255.255.255 ! interface Loopback1 vrf forwarding green ip address 10.1.255.103 255.255.255.255 ! interface TenGigabitEthernet0/0/0 ip address 172.16.111.103 255.255.255.0 ip router isis cdp enable mpls ip isis network point-to-point ! router isis net 49.0001.1720.1625.5103.00 is-type level-2-only metric-style wide passive-interface Loopback0 ! router bgp 65001 template peer-policy RR-PP route-reflector-client send-community both exit-peer-policy ! template peer-session RR-PS remote-as 65001 update-source Loopback0 exit-peer-session ! bgp log-neighbor-changes no bgp default ipv4-unicast neighbor 172.16.255.6 inherit peer-session RR-PS neighbor 172.16.255.101 inherit peer-session RR-PS ! address-family ipv4 exit-address-family ! ! ! ! !

VTEP 1	PE Device 3
!	address-family vpnv4
interface Vlan102	neighbor 172.16.255.6 activate
vrf forwarding green	neighbor 172.16.255.6 send-community extended
ip address 10.1.102.1 255.255.255.0	neighbor 172.16.255.6 inherit peer-policy RR-PP
!	neighbor 172.16.255.101 activate
interface Vlan901	neighbor 172.16.255.101 send-community extended
vrf forwarding green	neighbor 172.16.255.101 inherit peer-policy RR-PP
ip unnumbered Loopback1	exit-address-family
ipv6 enable	!
no autostate	address-family vpnv6
!	neighbor 172.16.255.6 activate
interface nve1	neighbor 172.16.255.6 send-community extended
no ip address	neighbor 172.16.255.6 inherit peer-policy RR-PP
source-interface Loopback1	neighbor 172.16.255.101 activate
host-reachability protocol bgp	neighbor 172.16.255.101 send-community extended
member vni 10101 mcast-group 225.0.0.101	neighbor 172.16.255.101 inherit peer-policy RR-PP
member vni 50901 vrf green	exit-address-family
member vni 10102 ingress-replication	!
!	address-family ipv4 vrf green
router ospf 1	redistribute connected
!	exit-address-family
router bgp 65001	!
!	address-family ipv6 vrf green
template peer-session RR-PS	redistribute connected
remote-as 65001	exit-address-family
update-source Loopback0	!
exit-peer-session	end
!	!
bgp log-neighbor-changes	!
no bgp default ipv4-unicast	!
neighbor 172.16.255.1 inherit peer-session RR-PS	!
!	!
address-family ipv4	!
exit-address-family	!
!	!
address-family l2vpn evpn	!
neighbor 172.16.255.1 activate	!
neighbor 172.16.255.1 send-community both	!
exit-address-family	!
!	!
address-family ipv4 vrf green	!
advertise l2vpn evpn	!
redistribute connected	!
redistribute static	!
exit-address-family	!
!	!
address-family ipv6 vrf green	!
advertise l2vpn evpn	!
redistribute connected	!
redistribute static	!
exit-address-family	!
!	!
ip pim rp-address 172.16.255.255	!
!	!
end	!
!	!
!	!
VTEP_1#	PE_device_3#

The following examples provide sample outputs for **show** commands on VTEP 1 and border VTEP to verify external connectivity for the topology configured above:

VTEP 1

The following example shows the output for the **show bgp l2vpn evpn route-type** command for route type 5 on VTEP 1:

```
VTEP_1# show bgp l2vpn evpn route-type 5 0 10.1.255.103 32
BGP routing table entry for [5][1:1][0][32][10.1.255.103]/17, version 12
Paths: (1 available, best #1, table EVPN-BGP-Table)
  Flag: 0x100
  Not advertised to any peer
  Refresh Epoch 1
  Local
    172.16.254.6 (metric 3) (via default) from 172.16.255.1 (172.16.255.1)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      EVPN ESI: 00000000000000000000, Gateway Address: 0.0.0.0, VNI Label 50901, MPLS VPN
Label 0
      Extended Community: RT:1:1 ENCAP:8 Router MAC:0C75.BD67.EF48
      Originator: 172.16.255.103, Cluster list: 172.16.255.1, 172.16.255.6
      rx pathid: 0, tx pathid: 0x0
      net: 0x7F84B914EF38, path: 0x7F84BAFD0E30, pathext: 0x7F84BB42E698
      flags: net: 0x100, path: 0x3, pathext: 0xA1
      Updated on May 20 2020 19:31:08 UTC
```

The following example shows the output for the **show bgp l2vpn evpn route-type** command for route type 2 on VTEP 1:

```
VTEP_1# show bgp l2vpn evpn route-type 2 0 44d3ca286cc1 10.1.101.2
BGP routing table entry for [2][172.16.254.4:101][0][48][44D3CA286CC1][32][10.1.101.2]/24,
 version 17
Paths: (1 available, best #1, table evi_101)
  Advertised to update-groups:
     1
  Refresh Epoch 1
  Local
    :: (via default) from 0.0.0.0 (172.16.255.4)
      Origin incomplete, localpref 100, weight 32768, valid, sourced, local, best
      EVPN ESI: 00000000000000000000, Label1 10101, Label2 50901
      Extended Community: RT:1:1 RT:65001:101 ENCAP:8
        Router MAC:7C21.0DBD.9548
      Local irb vxlan vtep:
        vrf:green, l3-vni:50901
        local router mac:7C21.0DBD.9548
        core-irb interface:Vlan901
        vtep-ip:172.16.254.4
      rx pathid: 0, tx pathid: 0x0
      net: 0x7F84B914E858, path: 0x7F84BAFD09F8, pathext: 0x7F84BB42E4B8
      flags: net: 0x0, path: 0x4000028000003, pathext: 0x81
      Updated on May 20 2020 19:31:30 UTC
```

The following example shows the output for the **show ip route vrf** command on VTEP 1:

```
VTEP_1# show ip route vrf green

Routing Table: green
```

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C        10.1.101.0/24 is directly connected, Vlan101
L        10.1.101.1/32 is directly connected, Vlan101
C        10.1.102.0/24 is directly connected, Vlan102
L        10.1.102.1/32 is directly connected, Vlan102
B        10.1.255.101/32 [200/0] via 172.16.254.6, 00:21:47, Vlan901
B        10.1.255.103/32 [200/0] via 172.16.254.6, 00:21:47, Vlan901
```

Border VTEP

The following example shows the output for the **show mpls ldp neighbor** command on border VTEP:

```
Border_VTEP# show mpls ldp neighbor
    Peer LDP Ident: 172.16.111.101:0; Local LDP Ident 172.16.106.6:0
        TCP connection: 172.16.111.101.26371 - 172.16.106.6.646
        State: Oper; Msgs sent/rcvd: 86/69; Downstream
        Up time: 00:32:14
        LDP discovery sources:
          TenGigabitEthernet1/0/5, Src IP addr: 172.16.106.101
        Addresses bound to peer LDP Ident:
          172.16.111.101  172.16.106.101  172.16.255.101
```

The following example shows the output for the **show bgp l2vpn evpn route-type** command for route type 5 on border VTEP:

```
Border_VTEP# show bgp l2vpn evpn route-type 5 0 10.1.255.103 32
BGP routing table entry for [5][1:1][0][32][10.1.255.103]/17, version 7
Paths: (1 available, best #1, table EVPN-BGP-Table)
  Flag: 0x100
  Advertised to update-groups:
     1
  Refresh Epoch 1
  Local, (Received from a RR-client), imported path from base
    172.16.255.103 (metric 20) (via default) from 172.16.255.103 (172.16.255.103)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      EVPN ESI: 00000000000000000000, Gateway Address: 0.0.0.0, local vtep: 172.16.254.6,
VNI Label 50901, MPLS VPN Label 23
      Extended Community: RT:1:1 ENCAP:8 Router MAC:0C75.BD67.EF48
      rx pathid: 0, tx pathid: 0x0
      net: 0x7FED6F808948, path: 0x7FED6D7EDA68, pathext: 0x7FED6D80DE40, exp_net:
0x7FED6F9BF070
      flags: net: 0x100, path: 0x7, pathext: 0xA1
      Updated on May 20 2020 19:22:47 UTC
```

The following example shows the output for the **show bgp vpnv4 unicast all** command on border VTEP for the IP address of host device 1:

```
Border_VTEP# show bgp vpnv4 unicast all 10.1.101.2
BGP routing table entry for 1:1:10.1.101.2/32, version 10
Paths: (1 available, best #1, table green)
  Advertised to update-groups:
     3
  Refresh Epoch 1
  Local, (Received from a RR-client), imported path from
[2][172.16.254.4:101][0][48][44D3CA286CC1][32][10.1.101.2]/24 (global)
    172.16.254.4 (metric 3) (via default) from 172.16.255.1 (172.16.255.1)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      Extended Community: RT:1:1 ENCAP:8 Router MAC:7C21.0DBD.9548
      Originator: 172.16.255.4, Cluster list: 172.16.255.1
      Local vxlan vtep:
        vrf:green, vni:50901
        local router mac:0C75.BD67.EF48
        encap:8
        vtep-ip:172.16.254.6
        bdi:Vlan901
      Remote VxLAN:
        Topoid 0x4(vrf green)
        Remote Router MAC:7C21.0DBD.9548
        Encap 8
        Egress VNI 50901
        RTEP 172.16.254.4
      mpls labels in/out IPv4 VRF Aggr:34/nolabel
      rx pathid: 0, tx pathid: 0x0
      Updated on May 20 2020 19:23:11 UTC
```

Spine Switch

The following example shows the output for the **show bgp l2vpn evpn route-type** command for route type 5 on spine switch:

```
Spine_switch# show bgp l2vpn evpn route-type 5 0 10.1.255.103 32
BGP routing table entry for [5][1:1][0][32][10.1.255.103]/17, version 12
Paths: (1 available, best #1, table EVPN-BGP-Table)
  Advertised to update-groups:
     1
  Refresh Epoch 1
  Local, (Received from a RR-client)
    172.16.254.6 (metric 2) (via default) from 172.16.255.6 (172.16.255.6)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      EVPN ESI: 00000000000000000000, Gateway Address: 0.0.0.0, VNI Label 50901, MPLS VPN
Label 0
      Extended Community: RT:1:1 ENCAP:8 Router MAC:0C75.BD67.EF48
      Originator: 172.16.255.103, Cluster list: 172.16.255.6
      rx pathid: 0, tx pathid: 0x0
      net: 0x7F54CC99CEF8, path: 0x7F54CC9AD310, pathext: 0x7F54CC9C6998
      flags: net: 0x0, path: 0x3, pathext: 0x81
      Updated on May 20 2020 19:28:59 UTC
```

The following example shows the output for the **show bgp l2vpn evpn route-type** command for route type 2 on spine switch:

```
Spine_switch# show bgp l2vpn evpn route-type 2 0 44d3ca286cc1 10.1.101.2
BGP routing table entry for [2][172.16.254.4:101][0][48][44D3CA286CC1][32][10.1.101.2]/24,
 version 14
Paths: (1 available, best #1, table EVPN-BGP-Table)
  Advertised to update-groups:
     1
  Refresh Epoch 1
  Local, (Received from a RR-client)
    172.16.254.4 (metric 2) (via default) from 172.16.255.4 (172.16.255.4)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      EVPN ESI: 00000000000000000000, Label1 10101, Label2 50901
      Extended Community: RT:1:1 RT:65001:101 ENCAP:8
        Router MAC:7C21.0DBD.9548
      rx pathid: 0, tx pathid: 0x0
      net: 0x7F54CC99CAD8, path: 0x7F54CC9AD088, pathext: 0x7F54CC9C68D8
      flags: net: 0x0, path: 0x3, pathext: 0x81
      Updated on May 20 2020 19:29:22 UTC
```

PE Device 3

The following example shows the output for the **show bgp vpnv4 unicast all** command on PE device 3 for the IP address of host device 1:

```
PE_device_3# show bgp vpnv4 unicast all 10.1.101.2
BGP routing table entry for 1:1:10.1.101.2/32, version 14
Paths: (1 available, best #1, table green)
  Advertised to update-groups:
     3
  Refresh Epoch 1
  Local, (Received from a RR-client)
    172.16.255.6 (metric 20) (via default) from 172.16.255.6 (172.16.255.6)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      Extended Community: RT:1:1 ENCAP:8 Router MAC:7C21.0DBD.9548
      Originator: 172.16.255.4, Cluster list: 172.16.255.6, 172.16.255.1
      mpls labels in/out nolabel/34
      rx pathid: 0, tx pathid: 0x0
      Updated on May 20 2020 11:27:25 UTC
```

The following example shows the output for the **show ip route vrf green** command on PE device 3:

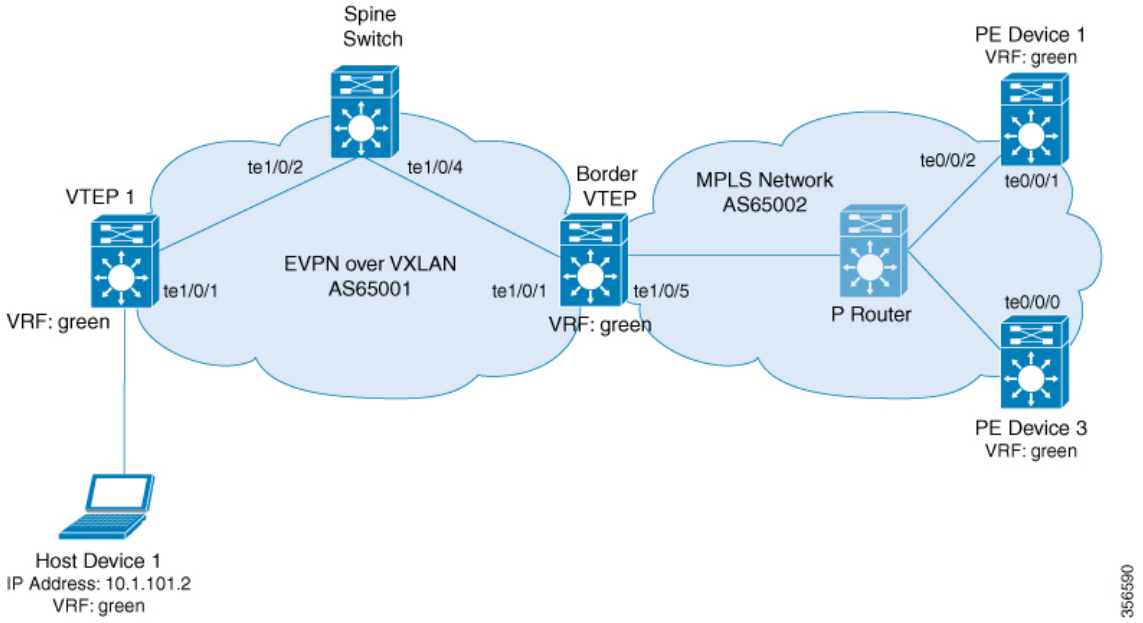
```
PE_device_3# show ip route vrf green

Routing Table: green
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
```

```
B        10.1.101.0/24 [200/0] via 172.16.255.6, 00:28:12
B        10.1.101.1/32 [200/0] via 172.16.255.6, 00:28:10
B        10.1.101.2/32 [200/0] via 172.16.255.6, 00:27:48
B        10.1.102.0/24 [200/0] via 172.16.255.6, 00:28:12
B        10.1.102.1/32 [200/0] via 172.16.255.6, 00:28:10
B        10.1.255.101/32 [200/0] via 172.16.255.101, 00:28:09
C        10.1.255.103/32 is directly connected, Loopback1
```

Example: Enabling Layer 3 External Connectivity with MPLS Layer 3 VPN through eBGP

This section provides an example to show how Layer 3 external connectivity with MPLS Layer 3 VPN is enabled for a BGP EVPN VXLAN fabric through eBGP. The example shows how to configure and verify Layer 3 external connectivity with MPLS Layer 3 VPN for the topology shown below:

Figure 8: Layer 3 External Connectivity with MPLS Layer 3 VPN through eBGP



The topology shows an EVPN VXLAN network with two VTEPS, VTEP 1 and border VTEP. Border VTEP is connected to an external PE device that belongs to an MPLS network. The BGP EVPN VXLAN fabric is in the autonomous system number 65001. The MPLS network is in the autonomous system number 65002. All the VTEPs, PE devices, and host devices are part of the VRF green. The following tables provide sample configurations for the devices in the topology above.

Table 3: Configuring Spine Switch, Border VTEP and PE Device 1 for Enabling Layer 3 External Connectivity with MPLS Layer 3 VPN through eBGP

Spine Switch	Border VTEP	PE Device 1
Spine_switch# **show running-config** hostname Spine_switch ! interface Loopback0 ip address 172.16.255.1 255.255.255.255 ip ospf 1 area 0 ip pim sparse-mode ! interface Loopback1 ip address 172.16.254.1 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface Loopback2 ip address 172.16.255.255 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface TenGigabitEthernet1/0/2 no switchport ip address 172.16.14.1 255.255.255.0 ip pim sparse-mode ip ospf network point-to-point ip ospf 1 area 0 ! interface TenGigabitEthernet1/0/4 no switchport ip address 172.16.16.1 255.255.255.0 ip pim sparse-mode ip ospf network point-to-point ip ospf 1 area 0 ! router ospf 1 router-id 172.16.255.1 ! router bgp 65001 template peer-policy RR-PP route-reflector-client send-community both exit-peer-policy ! template peer-session RR-PS remote-as 65001 update-source Loopback0 exit-peer-session ! bgp router-id 172.16.255.1 bgp log-neighbor-changes no bgp default ipv4-unicast neighbor 172.16.255.4 inherit peer-session RR-PS neighbor 172.16.255.6 inherit peer-session RR-PS ! address-family ipv4 exit-address-family !	Border_VTEP# **show running-config** hostname Border_VTEP ! vrf definition green rd 1:1 ! address-family ipv4 route-target export 1:1 route-target import 1:1 route-target export 1:1 stitching route-target import 1:1 stitching exit-address-family ! address-family ipv6 route-target export 1:1 route-target import 1:1 route-target export 1:1 stitching route-target import 1:1 stitching exit-address-family ! mpls label mode all-vrfs protocol all-afs per-vrf ! l2vpn evpn replication-type static router-id Loopback1 default-gateway advertise ! l2vpn evpn instance 101 vlan-based encapsulation vxlan ! l2vpn evpn instance 102 vlan-based encapsulation vxlan replication-type ingress ! vlan configuration 101 member evpn-instance 101 vni 10101 vlan configuration 102 member evpn-instance 102 vni 10102 vlan configuration 901 member vni 50901 ! interface Loopback0 ip address 172.16.255.6 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface Loopback1 ip address 172.16.254.6 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface TenGigabitEthernet1/0/1 no switchport ip address 172.16.16.6 255.255.255.0 ip pim sparse-mode ip ospf network point-to-point ip ospf 1 area 0	PE_device_1# **show running-config** hostname PE_device_1 ! vrf definition green rd 1:1 ! address-family ipv4 route-target export 1:1 route-target import 1:1 exit-address-family ! address-family ipv6 route-target export 1:1 route-target import 1:1 exit-address-family ! interface Loopback0 ip address 172.16.255.101 255.255.255.255 ! interface Loopback1 vrf forwarding green ip address 10.1.255.101 255.255.255.255 ! interface TenGigabitEthernet0/0/1 ip address 172.16.111.101 255.255.255.0 ip router isis cdp enable mpls ip isis network point-to-point ! interface TenGigabitEthernet0/0/2 ip address 172.16.106.101 255.255.255.0 negotiation auto cdp enable mpls bgp forwarding ! router isis net 49.0001.1720.1625.5101.00 is-type level-2-only metric-style wide passive-interface Loopback0 ! router bgp 65002 bgp log-neighbor-changes no bgp default ipv4-unicas no bgp default route-target filter neighbor 172.16.106.6 remote-as 65001 neighbor 172.16.255.6 remote-as 65001 neighbor 172.16.255.6 ebgp-multihop 255 neighbor 172.16.255.6 update-source Loopback0 neighbor 172.16.255.103 remote-as 65002 neighbor 172.16.255.103 update-source Loopback0

Spine Switch	Border VTEP	PE Device 1
!	!	address-family ipv4
address-family l2vpn evpn	interface TenGigabitEthernet1/0/5	network 172.16.255.101 mask
neighbor 172.16.255.4 activate	no switchport	255.255.255.255
neighbor 172.16.255.4 send-community	ip address 172.16.106.6 255.255.255.0	neighbor 172.16.106.6 activate
extended	speed 1000	neighbor 172.16.106.6 send-label
neighbor 172.16.255.4 inherit	duplex full	exit-address-family
peer-policy RR-PP	mpls bgp forwarding	!
neighbor 172.16.255.6 activate	!	address-family vpnv4
neighbor 172.16.255.6 send-community	interface Vlan101	neighbor 172.16.255.6 activate
extended	vrf forwarding green	neighbor 172.16.255.6 send-community
neighbor 172.16.255.6 inherit	ip address 10.1.101.1 255.255.255.0	both
peer-policy RR-PP	!	neighbor 172.16.255.103 activate
	interface Vlan102	neighbor 172.16.255.103
exit-address-family	vrf forwarding green	send-community both
!	ip address 10.1.102.1 255.255.255.0	neighbor 172.16.255.103 next-hop-self
ip pim rp-address 172.16.255.255	!	exit-address-family
!	interface Vlan901	!
end	vrf forwarding green	address-family vpnv6
!	ip unnumbered Loopback1	neighbor 172.16.255.6 activate
!	ipv6 enable	neighbor 172.16.255.6 send-community
!	no autostate	both
!	!	neighbor 172.16.255.103 activate
!	interface nve1	neighbor 172.16.255.103
!	no ip address	send-community both
!	source-interface Loopback1	neighbor 172.16.255.103 next-hop-self
!	host-reachability protocol bgp	exit-address-family
!	member vni 10101 mcast-group	!
!	225.0.0.101	address-family ipv4 vrf green
!	member vni 50901 vrf green	redistribute connected
!	member vni 10102 ingress-replication	exit-address-family
!	!	!
!	router ospf 1	address-family ipv6 vrf green
!	!	redistribute connected
!	router bgp 65001	exit-address-family
!	template peer-policy RR-PP	!
!	send-community both	end
!	exit-peer-policy	
!	!	!
!	template peer-session RR-PS	!
!	remote-as 65001	!
!	update-source Loopback0	!
!	exit-peer-session	!
!	!	!
!	bgp log-neighbor-changes	!
!	no bgp default ipv4-unicast	!
!	no bgp default route-target filter	!
!	neighbor 172.16.106.101 remote-as	!
!	65002	!
!	neighbor 172.16.255.1 inherit	!
!	peer-session RR-PS	!
!	neighbor 172.16.255.101 remote-as	!
!	65002	!
!	neighbor 172.16.255.101 ebgp-multihop	!
!	255	!
!	neighbor 172.16.255.101 update-source	!
!	Loopback0	!
!	!	!

Spine Switch	Border VTEP	PE Device 1
!		!
!	address-family ipv4	!
!	network 172.16.255.6 mask	!
!!	255.255.255.255	!
!	neighbor 172.16.106.101 activate	!
!	neighbor 172.16.106.101 send-label	!
!	exit-address-family	!
!	!	!
!	address-family vpnv4	!
!	import l2vpn evpn re-originate	!
!	neighbor 172.16.255.101 activate	!
!	neighbor 172.16.255.101	!
!	send-community both	!
!	exit-address-family	!
!	!	!
!	address-family vpnv6	!
!	import l2vpn evpn re-originate	!
!	neighbor 172.16.255.101 activate	!
!	neighbor 172.16.255.101	!
!	send-community both	!
!	exit-address-family	!
!	!	!
!	address-family l2vpn evpn	!
!	import vpnv4 unicast re-originate	!
!	import vpnv6 unicast re-originate	!
!	neighbor 172.16.255.1 activate	!
!	neighbor 172.16.255.1 send-community	!
!	both	!
!	neighbor 172.16.255.1 next-hop-self	!
!	exit-address-family	!
!	!	!
!	address-family ipv4 vrf green	!
!	advertise l2vpn	!
!	redistribute connected	!
!	redistribute static	!
!	exit-address-family	!
!	!	!
!	address-family ipv6 vrf green	!
!	advertise l2vpn evpn	!
!	redistribute connected	!
!	redistribute static	!
!	exit-address-family	!
!	!	!
!	ip pim rp-address 172.16.255.255	!
!	!	!
!	end	!
Spine_switch#	Border_VTEP#	PE_device_1#

Table 4: Configuring VTEP 1 and PE Device 3 for Enabling Layer 3 External Connectivity with MPLS Layer 3 VPN through eBGP

VTEP 1	PE Device 3
VTEP_1# **show running-config** hostname VTEP_1! ! vrf definition green rd 1:1 ! address-family ipv4 route-target export 1:1 route-target import 1:1 route-target export 1:1 stitching route-target import 1:1 stitching exit-address-family ! address-family ipv6 route-target export 1:1 route-target import 1:1 route-target export 1:1 stitching route-target import 1:1 stitching exit-address-family ! l2vpn evpn replication-type static router-id Loopback1 default-gateway advertise ! l2vpn evpn instance 101 vlan-based encapsulation vxlan ! l2vpn evpn instance 102 vlan-based encapsulation vxlan replication-type ingress ! vlan configuration 101 member evpn-instance 101 vni 10101 vlan configuration 102 member evpn-instance 102 vni 10102 vlan configuration 901 member vni 50901 ! interface Loopback0 ip address 172.16.255.4 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface Loopback1 ip address 172.16.254.4 255.255.255.255 ip pim sparse-mode ip ospf 1 area 0 ! interface TenGigabitEthernet1/0/1 no switchport ip address 172.16.14.4 255.255.255.0 ip pim sparse-mode ip ospf network point-to-point ip ospf 1 area 0 !	PE_device_3# **show running-config** hostname PE_device_3 ! vrf definition green rd 1:1 ! address-family ipv4 route-target export 1:1 route-target import 1:1 exit-address-family ! address-family ipv6 route-target export 1:1 route-target import 1:1 exit-address-family ! interface Loopback0 ip address 172.16.255.103 255.255.255.255 ! interface Loopback1 vrf forwarding green ip address 10.1.255.103 255.255.255.255 ! interface TenGigabitEthernet0/0/0 ip address 172.16.111.103 255.255.255.0 ip router isis cdp enable mpls ip isis network point-to-point ! router isis net 49.0001.1720.1625.5103.00 is-type level-2-only metric-style wide passive-interface Loopback0 ! router bgp 65002 template peer-policy RR-PP route-reflector-client send-community both exit-peer-policy ! template peer-session RR-PS remote-as 65002 update-source Loopback0 exit-peer-session ! bgp log-neighbor-changes no bgp default ipv4-unicast neighbor 172.16.255.101 inherit peer-session RR-PS ! address-family ipv4 exit-address-family ! ! !

VTEP 1	PE Device 3
!	
interface Vlan101	address-family vpnv4
vrf forwarding green	neighbor 172.16.255.101 activate
ip address 10.1.101.1 255.255.255.0	neighbor 172.16.255.101 send-community extended
!	neighbor 172.16.255.101 route-reflector-client
interface Vlan102	exit-address-family
vrf forwarding green	!
ip address 10.1.102.1 255.255.255.0	address-family vpnv6
!	neighbor 172.16.255.101 activate
interface Vlan901	neighbor 172.16.255.101 send-community extended
vrf forwarding green	neighbor 172.16.255.101 route-reflector-client
ip unnumbered Loopback1	exit-address-family
ipv6 enable	!
no autostate	address-family ipv4 vrf green
!	redistribute connected
interface nve1	exit-address-family
no ip address	!
source-interface Loopback1	address-family ipv6 vrf green
host-reachability protocol bgp	redistribute connected
member vni 10101 mcast-group 225.0.0.101	exit-address-family
member vni 50901 vrf green	!
member vni 10102 ingress-replication	end
!	!
router ospf 1	!
!	!
router bgp 65001	!
!	!
template peer-session RR-PS	!
remote-as 65001	!
update-source Loopback0	!
exit-peer-session	!
!	!
bgp log-neighbor-changes	!
no bgp default ipv4-unicast	!
neighbor 172.16.255.1 inherit peer-session RR-PS	!
!	!
address-family ipv4	!
exit-address-family	!
!	!
address-family l2vpn evpn	!
neighbor 172.16.255.1 activate	!
neighbor 172.16.255.1 send-community both	!
exit-address-family	!
!	!
address-family ipv4 vrf green	!
advertise l2vpn evpn	!
redistribute connected	!
redistribute static	!
exit-address-family	!
!	!
address-family ipv6 vrf green	!
advertise l2vpn evpn	!
redistribute connected	!
redistribute static	!
exit-address-family	!
!	!
ip pim rp-address 172.16.255.255	!
!	!
end	!
VTEP_1#	PE_device_3#

The following examples provide sample outputs for **show** commands on the devices to verify external connectivity for the topology configured above:

VTEP 1

The following example shows the output for the **show bgp l2vpn evpn route-type** command for route type 5 on VTEP 1:

```
VTEP_1# show bgp l2vpn evpn route-type 5 0 10.1.255.103 32
BGP routing table entry for [5][1:1][0][32][10.1.255.103]/17, version 36
Paths: (1 available, best #1, table EVPN-BGP-Table)
  Not advertised to any peer
  Refresh Epoch 1
  65002
    172.16.254.6 (metric 3) (via default) from 172.16.255.1 (172.16.255.1)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      EVPN ESI: 00000000000000000000, Gateway Address: 0.0.0.0, VNI Label 50901, MPLS VPN
Label 0
      Extended Community: RT:1:1 ENCAP:8 Router MAC:0C75.BD67.EF48
      Originator: 172.16.255.6, Cluster list: 172.16.255.1
      rx pathid: 0, tx pathid: 0x0
      net: 0x7F84BB35A5C8, path: 0x7F84B913E010, pathext: 0x7F84BB54A8A8
      flags: net: 0x0, path: 0x3, pathext: 0x81
      Updated on May 21 2020 13:56:28 UTC
```

The following example shows the output for the **show bgp l2vpn evpn route-type** command for route type 2 on VTEP 1:

```
VTEP_1# show bgp l2vpn evpn route-type 2 0 44d3ca286cc1 10.1.101.2
BGP routing table entry for [2][172.16.254.4:101][0][48][44D3CA286CC1][32][10.1.101.2]/24,
 version 37
Paths: (1 available, best #1, table evi_101)
  Advertised to update-groups:
     1
  Refresh Epoch 1
  Local
    :: (via default) from 0.0.0.0 (172.16.255.4)
      Origin incomplete, localpref 100, weight 32768, valid, sourced, local, best
      EVPN ESI: 00000000000000000000, Label1 10101, Label2 50901
      Extended Community: RT:1:1 RT:65001:101 ENCAP:8
        Router MAC:7C21.0DBD.9548
      Local irb vxlan vtep:
        vrf:green, l3-vni:50901
        local router mac:7C21.0DBD.9548
        core-irb interface:Vlan901
        vtep-ip:172.16.254.4
      rx pathid: 0, tx pathid: 0x0
      net: 0x7F84BB35A468, path: 0x7F84B913DF38, pathext: 0x7F84BB54A848
      flags: net: 0x0, path: 0x4000028000003, pathext: 0x81
      Updated on May 21 2020 14:00:49 UTC
```

The following example shows the output for the **show ip route vrf** command on VTEP 1:

```
VTEP_1# show ip route vrf green

Routing Table: green
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
```

```
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C        10.1.101.0/24 is directly connected, Vlan101
L        10.1.101.1/32 is directly connected, Vlan101
C        10.1.102.0/24 is directly connected, Vlan102
L        10.1.102.1/32 is directly connected, Vlan102
B        10.1.255.101/32 [200/0] via 172.16.254.6, 00:06:25, Vlan901
B        10.1.255.103/32 [200/0] via 172.16.254.6, 00:05:54, Vlan901
```

Border VTEP

The following example shows the output for the **show bgp vpnv4 unicast all** command on border VTEP for the IP address of the external device:

```
Border_VTEP# show bgp vpnv4 uni all 10.1.255.103/32
BGP routing table entry for 1:1:10.1.255.103/32, version 9
Paths: (1 available, best #1, table green)
  Not advertised to any peer
  Refresh Epoch 1
  65002
    172.16.255.101 (via default) from 172.16.255.101 (172.16.255.101)
      Origin incomplete, localpref 100, valid, external, best
      Extended Community: RT:1:1
      Local vxlan vtep:
        vrf:green, vni:50901
        local router mac:0C75.BD67.EF48
        encap:8
        vtep-ip:172.16.254.6
        bdi:Vlan901
      mpls labels in/out nolabel/16
      rx pathid: 0, tx pathid: 0x0
      Updated on May 21 2020 13:48:09 UTC
```

The following example shows the output for the **show bgp l2vpn evpn route-type** command for route type 5 on border VTEP:

```
Border_VTEP# show bgp l2vpn evpn route-type 5 0 10.1.255.103 32
BGP routing table entry for [5][1:1][0][32][10.1.255.103]/17, version 32
Paths: (1 available, best #1, table EVPN-BGP-Table)
  Advertised to update-groups:
     1
  Refresh Epoch 1
  65002, imported path from base
    172.16.255.101 (via default) from 172.16.255.101 (172.16.255.101)
      Origin incomplete, localpref 100, valid, external, best
      EVPN ESI: 00000000000000000000, Gateway Address: 0.0.0.0, local vtep: 172.16.254.6,
VNI Label 50901, MPLS VPN Label 16
      Extended Community: RT:1:1 ENCAP:8 Router MAC:0C75.BD67.EF48
      rx pathid: 0, tx pathid: 0x0
      net: 0x7FED704944D0, path: 0x7FED704A4CA0, pathext: 0x7FED6DA6E250, exp_net:
0x7FED6F812678
```

```
      flags: net: 0x0, path: 0x7, pathext: 0x81
      Updated on May 21 2020 13:48:09 UTC
```

The following example shows the output for the **show mpls forwarding-table** command on border VTEP:

```
Border_VTEP# show mpls forwarding-table
Local      Outgoing   Prefix           Bytes Label   Outgoing   Next Hop
Label      Label      or Tunnel Id     Switched      interface
16         No Label   IPv4 VRF[V]      156           aggregate/green
17         Pop Label  172.16.106.101/32   \
                                       228           Te1/0/5    172.16.106.101
18         Pop Label  172.16.255.101/32   \
                                       0             Te1/0/5    172.16.106.101
```

The following example shows the output for the **show bgp vpnv4 unicast all** command on border VTEP for the IP address of host device 1:

```
Border_VTEP# show bgp vpnv4 uni all 10.1.101.2/32
BGP routing table entry for 1:1:10.1.101.2/32, version 10
Paths: (1 available, best #1, table green)
  Advertised to update-groups:
     1
  Refresh Epoch 4
  Local, imported path from [2][172.16.254.4:101][0][48][44D3CA286CC1][32][10.1.101.2]/24
(global)
    172.16.254.4 (metric 3) (via default) from 172.16.255.1 (172.16.255.1)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      Extended Community: RT:1:1 ENCAP:8 Router MAC:7C21.0DBD.9548
      Originator: 172.16.255.4, Cluster list: 172.16.255.1
      Local vxlan vtep:
        vrf:green, vni:50901
        local router mac:0C75.BD67.EF48
        encap:8
        vtep-ip:172.16.254.6
        bdi:Vlan901
      Remote VxLAN:
        Topoid 0x9(vrf green)
        Remote Router MAC:7C21.0DBD.9548
        Encap 8
        Egress VNI 50901
        RTEP 172.16.254.4
      mpls labels in/out IPv4 VRF Aggr:16/nolabel
      rx pathid: 0, tx pathid: 0x0
      Updated on May 21 2020 13:52:30 UTC
```

Spine Switch

The following example shows the output for the **show bgp l2vpn evpn route-type** command for route type 5 on spine switch:

```
Spine_switch# show bgp l2vpn evpn route-type 5 0 10.1.255.103 32
BGP routing table entry for [5][1:1][0][32][10.1.255.103]/17, version 23
Paths: (1 available, best #1, table EVPN-BGP-Table)
  Advertised to update-groups:
     1
  Refresh Epoch 1
  65002, (Received from a RR-client)
    172.16.254.6 (metric 2) (via default) from 172.16.255.6 (172.16.255.6)
```

```
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      EVPN ESI: 0000000000000000000, Gateway Address: 0.0.0.0, VNI Label 50901, MPLS VPN
Label 0
      Extended Community: RT:1:1 ENCAP:8 Router MAC:0C75.BD67.EF48
      rx pathid: 0, tx pathid: 0x0
      net: 0x7F54CC95FAB8, path: 0x7F54CCA542F8, pathext: 0x7F54CC9707B0
      flags: net: 0x0, path: 0x3, pathext: 0x81
      Updated on May 21 2020 13:54:20 UTC
```

The following example shows the output for the **show bgp l2vpn evpn route-type** command for route type 2 on spine switch:

```
Spine_switch# show bgp l2vpn evpn route-type 2 0 44d3ca286cc1 10.1.101.2
BGP routing table entry for [2][172.16.254.4:101][0][48][44D3CA286CC1][32][10.1.101.2]/24,
 version 24
Paths: (1 available, best #1, table EVPN-BGP-Table)
  Advertised to update-groups:
     1
  Refresh Epoch 1
  Local, (Received from a RR-client)
    172.16.254.4 (metric 2) (via default) from 172.16.255.4 (172.16.255.4)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      EVPN ESI: 0000000000000000000, Label1 10101, Label2 50901
      Extended Community: RT:1:1 RT:65001:101 ENCAP:8
        Router MAC:7C21.0DBD.9548
      rx pathid: 0, tx pathid: 0x0
      net: 0x7F54CC95F958, path: 0x7F54CCA54220, pathext: 0x7F54CC970750
      flags: net: 0x0, path: 0x3, pathext: 0x81
      Updated on May 21 2020 13:58:41 UTC
```

PE Device 1

The following example shows the output for the **show bgp vpnv4 unicast all** command on PE device 1 for the IP address of host device 1:

```
PE_device_1# show bgp vpnv4 unicast all 10.1.255.103/32
BGP routing table entry for 1:1:10.1.101.2/32, version 14
Paths: (1 available, best #1, table green)
  Advertised to update-groups:
     1
  Refresh Epoch 1
  65001
    172.16.255.6 (via default) from 172.16.255.6 (172.16.255.6)
      Origin incomplete, localpref 100, valid, external, best
      Extended Community: RT:1:1 ENCAP:8 Router MAC:7C21.0DBD.9548
      mpls labels in/out 22/16
      rx pathid: 0, tx pathid: 0x0
      Updated on May 21 2020 05:57:06 UTC
```

The following example shows the output for the **show ip route vrf** command on PE device 1:

```
PE_device_1# show ip route vrf green

Routing Table: green
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
```

```
       E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
B        10.1.101.0/24 [20/0] via 172.16.255.6, 00:28:09
B        10.1.101.1/32 [20/0] via 172.16.255.6, 00:28:09
B        10.1.101.2/32 [20/0] via 172.16.255.6, 00:23:17
B        10.1.102.0/24 [20/0] via 172.16.255.6, 00:28:09
B        10.1.102.1/32 [20/0] via 172.16.255.6, 00:28:09
C        10.1.255.101/32 is directly connected, Loopback1
B        10.1.255.103/32 [200/0] via 172.16.255.103, 00:28:09
```

PE Device 3

The following example shows the output for the **show bgp vpnv4 unicast all** command on PE device 3 for the IP address of host device 1:

```
PE_device_3# show bgp vpnv4 unicast all 10.1.101.2/32
BGP routing table entry for 1:1:10.1.101.2/32, version 14
Paths: (1 available, best #1, table green)
  Not advertised to any peer
  Refresh Epoch 1
  65001, (Received from a RR-client)
    172.16.255.101 (metric 10) (via default) from 172.16.255.101 (172.16.255.101)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
      Extended Community: RT:1:1 ENCAP:8 Router MAC:7C21.0DBD.9548
      mpls labels in/out nolabel/22
      rx pathid: 0, tx pathid: 0x0
      Updated on May 21 2020 05:56:46 UTC
```

The following example shows the output for the **show ip route vrf** command on PE device 3:

```
PE_device_3# show ip route vrf green

Routing Table: green
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
```

```
B        10.1.101.0/24 [200/0] via 172.16.255.101, 00:29:09
B        10.1.101.1/32 [200/0] via 172.16.255.101, 00:29:09
B        10.1.101.2/32 [200/0] via 172.16.255.101, 00:24:17
B        10.1.102.0/24 [200/0] via 172.16.255.101, 00:29:09
B        10.1.102.1/32 [200/0] via 172.16.255.101, 00:29:09
B        10.1.255.101/32 [200/0] via 172.16.255.101, 00:29:09
C        10.1.255.103/32 is directly connected, Loopback1
```