Configuring VXLAN

This chapter contains these sections:

Guidelines and Limitations for VXLAN

VXLAN has the following guidelines and limitations:

Switch or port restrictions

- FEX ports do not support IGMP snooping on VXLAN VLANs.
- The VXLAN UDP port number is used for VXLAN encapsulation. For Cisco Nexus NX-OS, the UDP port number is 4789. It complies with IETF standards and is not configurable.
- Cisco Nexus 9300 Series switches with 100G uplinks only support VXLAN switching/bridging.

  Cisco Nexus 9200, Cisco Nexus 9300-EX, and Cisco Nexus 9300-FX, and Cisco Nexus 9300-FX2 platform switches do not have this restriction.

Note For VXLAN routing support, a 40G uplink module is required.

- When SVI is enabled on a VTEP (flood and learn, or EVPN), make sure that ARP-ETHER TCAM is carved using the **hardware access-list tcam region arp-ether 256** command. This requirement does not apply to Cisco Nexus 9200, 9300-EX, 9300-FX/FX2/FX3, and 9300-GX/GX2 platform switches and Cisco 9500 Series switches with 9700-EX/FX/GX line cards.

- Beginning with Cisco NX-OS Release 10.2(3)F, VXLAN can coexist with the GRE tunnel feature or the MPLS (static or segment-routing) feature.
- Native VLANs are supported as transit traffic over a VXLAN fabric on Cisco Nexus 9300-EX/FX/FX2/FX3/GX/GX2 Series switches.
- A FEX HIF (FEX host interface port) is supported for a VLAN that is extended with VXLAN.
- Bind NVE to a loopback address that is separate from other loopback addresses that are required by Layer 3 protocols. A best practice is to use a dedicated loopback address for VXLAN. This best practice should be applied not only for the vPC VXLAN deployment, but for all VXLAN deployments.
- Tenant VRF (VRF with VNI on it) cannot be used on an SVI that has no VNI binding into it (underlay infra VRF).
- For traceroute through a VXLAN fabric when using L3VNI, the following scenario is the expected behavior:

  If L3VNI is associated with a VRF and an SVI, the associated SVI does not have an L3 address that is configured but instead has the "ip forward" configuration command. Due to this interface setup it cannot respond back to the traceroute with its own SVI address. Instead, when a traceroute involving the L3VNI is run through the fabric, the IP address reported will be the lowest IP address of an SVI that belongs to the corresponding tenant VRF.
- In an ingress replication vPC setup, Layer 3 connectivity is needed between vPC peer devices.

VXLAN configuration restrictions

- **show** commands with the **internal** keyword are not supported.
- The **lacp vpc-convergence** command can be configured in VXLAN and non-VXLAN environments that have vPC port channels to hosts that support LACP.
- For scale environments, the VLAN IDs related to the VRF and Layer-3 VNI (L3VNI) must be reserved with the **system vlan nve-overlay id** command.
- The **load-share** keyword has been added to the Configuring a Route Policy procedure for the PBR over VXLAN feature.

  For information regarding the **load-share** keyword usage for PBR with VXLAN, see the Guidelines and Limitations for Policy-Based Routing section of the Cisco Nexus 9000 Series NX_OS Unicast Routing Configuration Guide, Release 9.x.
- The **lacp vpc-convergence** command is added for better convergence of Layer 2 EVPN VXLAN:

```
interface port-channel10
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 1001-1200
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  lacp vpc-convergence
  vpc 10

interface Ethernet1/34  <- The port-channel member-port is configured with LACP-active
 mode (for example, no changes are done at the member-port level.)
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 1001-1200
```

```
channel-group 10 mode active
no shutdown
```

- The **system nve ipmc** command is not applicable to the Cisco Nexus 9200 and 9300-EX platform switches and Cisco Nexus 9500 platform switches with 9700-EX line cards.
- The VXLAN network identifier (VNID) 16777215 is reserved and should not be configured explicitly.
- To refresh the frozen duplicate host during fabric forwarding, use only **fabric forwarding dup-host-recovery-timer** command and do not use **fabric forwarding dup-host-unfreeze-timer** command, as it is deprecated.

ISSU restrictions

- VXLAN supports In-Service Software Upgrades (ISSUs). However, VXLAN ISSU is not supported for Cisco Nexus 9300-GX platform switches.
- To remove configurations from an NVE interface, we recommend manually removing each configuration rather than using the **default interface nve** command.
- Rollback is not supported on VXLAN VLANs that are configured with the port VLAN mapping feature.

Feature support and restrictions

- **ACL**
  - ACL Options for VXLAN Traffic on Cisco Nexus 92300YC, 92160YC-X, 93120TX, 9332PQ, and 9348GC-FXP Switches.

ACL Direction	ACL Type	VTEP Type	Port Type	Flow Direction	Traffic Type	Supported
Ingress	PACL	Ingress VTEP	L2 port	Access to Network [GROUP:encap direction]	Native L2 traffic [GROUP:inner]	YES
	VACL	Ingress VTEP	VLAN	Access to Network [GROUP:encap direction]	Native L2 traffic [GROUP:inner]	YES
Ingress	RACL	Ingress VTEP	Tenant L3 SVI	Access to Network [GROUP:encap direction]	Native L3 traffic [GROUP:inner]	YES
Egress	RACL	Ingress VTEP	Uplink L3/L3-PO/SVI	Access to Network [GROUP:encap direction]	VXLAN encap [GROUP:outer]	NO

ACL Direction	ACL Type	VTEP Type	Port Type	Flow Direction	Traffic Type	Supported
Ingress	RACL	Egress VTEP	Uplink L3/L3-PO/SVI	Network to Access [GROUP:decap direction]	VXLAN encap [GROUP:outer]	NO
Egress	PACL	Egress VTEP	L2 port	Network to Access [GROUP:decap direction]	Native L2 traffic [GROUP:inner]	NO
	VACL	Egress VTEP	VLAN	Network to Access [GROUP:decap direction]	Native L2 traffic [GROUP:inner]	NO
Egress	RACL	Egress VTEP	Tenant L3 SVI	Network to Access [GROUP:decap direction]	Post-decap L3 traffic [GROUP:inner]	YES

- ACL Options for VXLAN traffic on Cisco Nexus 92160YC-X, 93108TC-EX, 93180LC-EX, and 93180YC-EX switches, Release 7.0(3)I6(1).
- Support added for MultiAuth Change of Authorization (CoA). For more information, see the Cisco Nexus 9000 Series NX-OS Security Configuration Guide, Release 9.3(x).

- **Multicast**
  -
  - NLB in the unicast, multicast, and IGMP multicast modes is not supported on Cisco Nexus 9000 switch VXLAN VTEPs. The work-around is to move the NLB cluster behind the intermediary device (which supports NLB in the respective mode) and inject the cluster IP address as an external prefix into the VXLAN fabric.
  - On Cisco Nexus 9500 Series switches, if **feature nv overlay** is enabled, ensure that the interface NVE is configured and in UP state. Otherwise, multicast traffic may be silently dropped in Fabric Modules when it needs to be forwarded out of sub-interfaces.
  - If multiple VTEPs use the same multicast group address for underlay multicast but have different VNIs, the VTEPs should have at least one VNI in common. Doing so ensures that NVE peer discovery occurs and underlay multicast traffic is forwarded correctly.

    For example, leafs L1 and L4 could have VNI 10 and leafs L2 and L3 or border spine could have VNI 20, and both VNIs could share the same group address. When leaf L1 sends traffic to leaf L4, the traffic could pass through leaf L2 or L3 or border spine. Because NVE peer L1 is not learned on leaf L2 or L3 or border spine , the traffic is dropped. Therefore, VTEPs that share a group address need to have at least one VNI in common so that peer learning occurs and traffic is not dropped. This requirement applies to VXLAN bud-node topologies and border spine cases.

- **PIM BiDir**

- PIM BiDir for VXLAN underlay with and without vPC is supported.

  The following features are not supported when PIM BiDir for VXLAN underlay is configured:

  - Flood and Learn VXLAN
  - Tenant Routed Multicast (TRM)
  - VXLAN EVPN Multi-Site
  - VXLAN EVPN Multihoming
  - vPC attached VTEPs

  For redundant RPs, use Phantom RP.

  For transitioning from PIM ASM to PIM BiDir or from PIM BiDir to PIM ASM underlay, we recommend that you use the following example procedure:

  ```
  no ip pim rp-address 192.0.2.100 group-list 230.1.1.0/8
  clear ip mroute *
  clear ip mroute date-created *
  clear ip pim route *
  clear ip igmp groups *
  clear ip igmp snooping groups * vlan all
  ```

  Wait for all tables to clean up.

  ```
  ip pim rp-address 192.0.2.100 group-list 230.1.1.0/8 bidir
  ```

- When entering the **no feature pim** command, NVE ownership on the route is not removed so the route stays and traffic continues to flow. Aging is done by PIM. PIM does not age out entries having a VXLAN encap flag.

- **ARP suppression**

  - Beginning with Cisco NX-OS Release 9.3(3), ARP suppression is supported for Cisco Nexus 9300-GX platform switches.
  - Beginning with Cisco NX-OS Release 9.3(5), ARP suppression is supported with reflective relay for Cisco Nexus 9364C, 9300-EX, 9300-FX/FX2/FXP, and 9300-GX platform switches. For information on reflective relay, see the *Cisco Nexus 9000 Series NX-OS Layer 2 Switching Configuration Guide*.
  - ARP suppression is supported for a VNI only if the VTEP hosts the First-Hop Gateway (Distributed Anycast Gateway) for this VNI. The VTEP and SVI for this VLAN must be properly configured for the Distributed Anycast Gateway operation (for example, global anycast gateway MAC address configured and anycast gateway with the virtual IP address on the SVI).
  - ARP suppression is a per-L2VNI fabric-wide setting in the VXLAN fabric. Enable or disable this feature consistently across all VTEPs in the fabric. Inconsistent ARP suppression configuration across VTEPs is not supported.

- **FCoE/NPV**

  Fibre Channel over Ethernet (FCoE) N-port Virtualization (NPV) can coexist with VXLAN on different fabric uplinks but on the same or different front-panel ports on Cisco Nexus 93180YC-EX and 93180YC-FX switches.

Fibre Channel N-port Virtualization (NPV) can coexist with VXLAN on different fabric uplinks but on the same or different front-panel ports on Cisco Nexus 93180YC-FX switches. VXLAN can exist only on the Ethernet front-panel ports and not on the FC front-panel ports.

- **Subinterfaces**
  - Beginning with Cisco NX-OS Release 9.3(5), the subinterfaces on VXLAN uplinks has the ability to carry non-VXLAN L3 IP traffic for Cisco Nexus 9332C, 9364C, 9300-EX, 9300-FX/FX2/FXP, and 9300-GX platform switches and Cisco Nexus 9500 platform switches with -EX/FX line cards. This feature is supported for VXLAN flood and learn and VXLAN EVPN, VXLAN EVPN Multi-Site, and DCI.
  - Beginning with Cisco NX-OS Release 10.1(1), VXLAN-encapsulated traffic over Parent Interface that Carries Subinterfaces is supported on Cisco Nexus 9300-FX3 platform switches.
  - Beginning with Cisco NX-OS Release 9.3(5), VTEPs support VXLAN-encapsulated traffic over parent interfaces if subinterfaces are configured. This feature is supported for VXLAN flood and learn, VXLAN EVPN, VXLAN EVPN Multi-Site, and DCI. As shown in the following configuration example, VXLAN traffic is forwarded on the parent interface (eth1/1) in the default VRF, and L3 IP (non-VXLAN) traffic is forwarded on subinterfaces (eth1/1.10) in the tenant VRF.

```
interface ethernet 1/1
 description VXLAN carrying interface
 no switchport
 ip address 10.1.1.1/30

interface ethernet 1/1.10
 description NO VXLAN
 no switchport
 vrf member Tenant10
 encapsulation dot1q 10
  ip address 10.10.1.1/30
```

Restrictions of Cisco Nexus 9504 and 9508 switches with -R line cards

- For the Cisco Nexus 9504 and 9508 switches with -R line cards, VXLAN Layer 2 Gateway is supported on the 9636C-RX line card. VXLAN and MPLS cannot be enabled on the Cisco Nexus 9508 switch at the same time.
- For the Cisco Nexus 9504 and 9508 switches with -R line cards, if VXLAN is enabled, the Layer 2 Gateway cannot be enabled when there is any line card other than the 9636C-RX.
- For the Cisco Nexus 9504 and 9508 switches with -R line cards, PIM/ASM is supported in the underlay ports. PIM/Bidir is not supported. For more information, see the *Cisco Nexus 9000 Series NX_OS Multicast Routing Configuration Guide, Release 9.3(x)*.
- For the Cisco Nexus 9504 and 9508 switches with -R line cards, IPv6 hosts routing in the overlay is supported.
- For the Cisco Nexus 9504 and 9508 switches with -R line cards, ARP suppression is supported.
- For the Cisco Nexus 9504 and 9508 switches with -R line cards, VXLAN with ingress replication is not supported.
- VXLAN does not support coexistence with MVR and MPLS for Cisco Nexus 9504 and 9508 with -R line cards.

- For Cisco Nexus 9504 and 9508 switches with -R line cards, the L3VNI's VLAN must be added on the vPC peer-link trunk's allowed VLAN list.

Not supported features

- VXLAN is not supported on the Cisco Nexus N9K-C92348GC-X switches.
- MDP is not supported for VXLAN configurations.
- Consistency checkers are not supported for VXLAN tables.
- VTEP connected to FEX host interface ports is not supported.
- Resilient hashing (port-channel load-balancing resiliency) and VXLAN configurations are not compatible with VTEPs using ALE uplink ports.

Note Resilient hashing is disabled by default.

- Routing protocol adjacencies using Anycast Gateway SVIs is not supported.
- RACLs are not supported on Layer 3 uplinks for VXLAN traffic. Egress VACLs support is not available for de-capsulated packets in the network to access direction on the inner payload.

  As a best practice, use PACLs/VACLs for the access to the network direction.
- The QoS buffer-boost feature is not applicable for VXLAN traffic.
- The following limitations apply to releases prior to Cisco NX-OS Release 9.3(5):
  - VTEPs do not support VXLAN-encapsulated traffic over subinterfaces, regardless of VRF participation or IEEE 802.1Q encapsulation.
  - VTEPs do not support VXLAN-encapsulated traffic over parent interfaces if subinterfaces are configured, regardless of VRF participation.
  - Mixing subinterfaces for VXLAN and non-VXLAN VLANs is not supported.
- Point-to-multipoint Layer 3 and SVI uplinks are not supported.
- SVI and subinterfaces as uplinks are not supported.

Supported Features of CloudScale switches

Table 1: Supported Features of CloudScale switches

Features	Release	Platforms	Limitations
VXLAN	7.0(3)I7(3)	Cisco Nexus 9348GC-FXP switch	—
	—	Cisco Nexus 9300-EX platform switches Cisco Nexus 9500 platform switches with 9500-R and 9700-EX, FX line cards	—
	10.2(3)F and later	Cisco Nexus 9500 platform switches with 9700-GX line cards	—
	10.4(1)F and later	Cisco Nexus 9348GC-FX3, 9348GC-FX3PH and 9332D-H2R switches	
	10.4(2)F and later	Cisco Nexus 93400LD-H1 switches	—
	10.4(3)F and later	Cisco Nexus 9364C-H1 switches	—
	10.5(2)F and later	Cisco Nexus 9500 Series switches with N9K-X9736C-FX3	• VXLAN with vPC • DHCP snooping, ACL, and QoS policies on VXLAN VLANs. • IGMP snooping on VXLAN enabled VLANs. • Nested VXLAN (Host Overlay over Network Overlay) • PBR with IPv4 underlay • NVE source-interface hold-down timer for non-VPC VTEPs
DHCP snooping	—	—	—

Features	Release	Platforms	Limitations
Port-VLAN with VXLAN		Cisco Nexus 9300-EX and 9500 Series switches with 9700-EX line cards	• Only Layer 2 (no routing) is supported with port-VLAN with VXLAN on these switches. • No inner VLAN mapping is supported.
ARP suppression	9.3(3) and later	Cisco Nexus 9300-GX platform switches	—
	9.3(5) and later	Cisco Nexus 9364C, 9300-EX, 9300-FX/FX2/FXP, and 9300-GX platform switches	supported with reflective relay. For information on reflective relay, see the *Cisco Nexus 9000 Series NX-OS Layer 2 Switching Configuration Guide*.
ITD and ePBR over VXLAN	10.1(1) and later	N9K-X9716D-GX TOR and N9K-C93180YC-FX3S platform switches.	—
PBR over VXLAN	10.1(1) and later	N9K-C9316D-GX, N9K-C93600CD-GX, and N9K-C9364C-GX	—
VXLAN flood and learn mode	9.3(6) and later	Cisco Nexus 9300-GX platform switches	—
	10.1(1) and later	N9K-C9316D-GX, N9K-C93600CD-GX, and N9K-C9364C-GX TOR switches.	—
BFD multihop over VXLAN with L3VNI interfaces	10.4(1)F and later		—
Border Spine	10.4(3)F and later	Cisco Nexus 9800 switches	For more information on the supported and not supported features, see Guidelines and Limitations for VXLAN EVPN Multi-Site and Guidelines and Limitations for TRM with Multi-Site.

Features	Release	Platforms	Limitations
Dynamic Load Balancing (DLB)	10.5(1)F and later	Cisco Nexus 9300-FX3, GX, GX2, H2R, and H1 Series switches	Feature can be enabled on the underlay for VXLAN tunnels, allowing for ECMP routing on Layer 3 interfaces.

Table 2: Supported and Unsupported Features of DLB with Limitations

Features	Supported/Unsupported	Limitations
VXLAN standalone or vPC VTEP	Supported	—
Fabric peering	Supported	DLB is not supported when fabric peering with the local link is down, and traffic is rerouted over the PIP tunnel.
VXLAN Anycast and vPC BGWs	Supported	-
Layer 3 uplinks	Supported	Port channel, sub interfaces or SVIs are not supported.
VXLAN Traffic Engineering	Supported	VXLAN Traffic Engineering can coexist with DLB. However, DLB is not utilized for Traffic Engineering ECMP.
IPv4 and IPv6 underlay	Supported	—
VXLAN PBR	Unsupported	—

Considerations for VXLAN Deployment

- For scale environments, the VLAN IDs related to the VRF and Layer-3 VNI (L3VNI) must be reserved with the **system vlan nve-overlay id** command.

  This is required to optimize the VXLAN resource allocation to scale the following platforms:

  - Cisco Nexus 9300 platform switches
  - Cisco Nexus 9500 platform switches with 9500 line cards

  The following example shows how to reserve the VLAN IDs related to the VRF and the Layer-3 VNI:

```
system vlan nve-overlay id 2000

        vlan 2000
          vn-segment 50000

        interface Vlan2000
          vrf member MYVRF_50000
          ip forward
```

```
  ipv6 forward

vrf context MYVRF_50000
  vni 50000
```

Note The **system vlan nve-overlay id** command should be used for a VRF or a Layer-3 VNI (L3VNI) only. Do not use this command for regular VLANs or Layer-2 VNIs (L2VNI).

- When configuring VXLAN BGP EVPN, the "System Routing Mode: Default" is applicable for the following hardware platforms:
  - Cisco Nexus 9200 platform switches
  - Cisco Nexus 9300 platform switches
  - Cisco Nexus 9300-EX platform switches
  - Cisco Nexus 9300-FX/FX2/FX3 platform switches
  - Cisco Nexus 9300-GX platform switches
  - Cisco Nexus 9500 platform switches with X9500 line cards
  - Cisco Nexus 9500 platform switches with X9700-EX/FX line cards
- The “System Routing Mode: template-vxlan-scale” is not applicable.
- When using VXLAN BGP EVPN in combination with Cisco NX-OS Release 7.0(3)I4(x) or NX-OS Release 7.0(3)I5(1), the “System Routing Mode: template-vxlan-scale” is required on the following hardware platforms:
  - Cisco Nexus 9300-EX Switches
  - Cisco Nexus 9500 Switches with X9700-EX line cards
- Changing the “System Routing Mode” requires a reload of the switch.
- A loopback address is required when using the **source-interface config** command. The loopback address represents the local VTEP IP.
- During boot-up of a switch, you can use the **source-interface hold-down-time** *hold-down-time* command to suppress advertisement of the NVE loopback address until the overlay has converged. The range for the *hold-down-time* is 0 - 2147483647 seconds. The default is 300 seconds.

Note Though the loopback is still down, the traffic is encapsulated and sent to fabric.

- To establish IP multicast routing in the core, IP multicast configuration, PIM configuration, and RP configuration is required.
- VTEP to VTEP unicast reachability can be configured through any IGP protocol.

- In VXLAN flood and learn mode, the default gateway for VXLAN VLAN is recommended to be a centralized gateway on a pair of vPC devices with FHRP (First Hop Redundancy Protocol) running between them.
- While running VXLAN EVPN, with
  - any SVI for a VLAN extended over VXLAN is configured with anycast gateway and
  - any other mode of operation is not supported.

  If one VTEP is configured with an L2VNI and associated (with anycast gateway enabled), then every other VTEP where that L2VNI is locally defined has the SVI with anycast gateway configured.
- For flood and learn mode, only a centralized Layer 3 gateway is supported. Anycast gateway is not supported. The recommended Layer 3 gateway design would be a pair of switches in vPC to be the Layer 3 centralized gateway with FHRP protocol running on the SVIs. The same SVI's cannot span across multiple VTEPs even with different IP addresses used in the same subnet.

Note When configuring SVI with flood and learn mode on the central gateway leaf, it is mandatory to configure **hardware access-list tcam region arp-ether** *size* **double-wide**. (You must decrease the size of an existing TCAM region before using this command.)

For example:

```
hardware access-list tcam region arp-ether 256 double-wide
```

Note Configuring the **hardware access-list tcam region arp-ether** *size* **double-wide** is not required on Cisco Nexus 9200 Series switches.

- When configuring ARP suppression with BGP-EVPN, use the **hardware access-list tcam region arp-ether** *size* **double-wide** command to accommodate ARP in this region. (You must decrease the size of an existing TCAM region before using this command.)

Note This step is required for Cisco Nexus 9300 switches (NFE/ALE) and Cisco Nexus 9500 switches with N9K-X9564PX, N9K-X9564TX, and N9K-X9536PQ line cards. This step is not needed with Cisco Nexus 9200 switches, Cisco Nexus 9300-EX switches, or Cisco Nexus 9500 switches with N9K-X9732C-EX line cards.

- VXLAN tunnels cannot have more than one underlay next hop on a given underlay port. For example, on a given output underlay port, only one destination MAC address can be derived as the outer MAC on a given output port.

  This is a per-port limitation, not a per-tunnel limitation. This means that two tunnels that are reachable through the same underlay port cannot drive two different outer MAC addresses.
- When changing the IP address of a VTEP device, you must shut the NVE interface before changing the IP address.

- As a best practice, when migrating any sets of VTEP to a multisite BGW, NVE interface must be shut on all the VTEPs where this migration is being performed. NVE interface should be brought back up once the migration is complete and all necessary configurations for multisite are applied to the VTEPs.
- As a best practice, the RP for the multicast group should be configured only on the spine layer. Use the anycast RP for RP load balancing and redundancy.

  The following is an example of an anycast RP configuration on spines:

```
ip pim rp-address 1.1.1.10 group-list 224.0.0.0/4
ip pim anycast-rp 1.1.1.10 1.1.1.1
ip pim anycast-rp 1.1.1.10 1.1.1.2
```

Note

- 1.1.1.10 is the anycast RP IP address that is configured on all RPs participating in the anycast RP set.
- 1.1.1.1 is the local RP IP.
- 1.1.1.2 is the peer RP IP.

- Static ingress replication and BGP EVPN ingress replication do not require any IP Multicast routing in the underlay.

vPC Considerations for VXLAN Deployment

- As a best practice, when **feature vpc** is enabled or disabled on a VTEP, the NVE interfaces on both the vPC primary and the vPC secondary must be shut down before the change is made. Enabling **feature vpc** without the vPC domain being properly configured will result in the NVE loopback being held administratively down until the configuration is completed and the vPC peer-link is brought up.
- Bind NVE to a loopback address that is separate from other loopback addresses that are required by Layer 3 protocols. A best practice is to use a dedicated loopback address for VXLAN.
- On vPC VXLAN, it is recommended to increase the **delay restore interface-vlan** timer under the vPC configuration, if the number of SVIs are scaled up. For example, if there are 1000 VNIs with 1000 SVIs, we recommend to increase the **delay restore interface-vlan** timer to 45 seconds.
- If a ping is initiated to the attached hosts on VXLAN VLAN from a vPC VTEP node, the source IP address used by default is the anycast IP that is configured on the SVI. This ping can fail to get a response from the host in case the response is hashed to the vPC peer node. This issue can happen when a ping is initiated from a VXLAN vPC node to the attached hosts without using a unique source IP address. As a workaround for this situation, use VXLAN OAM or create a unique loopback on each vPC VTEP and route the unique address via a backdoor path.
- The loopback address used by NVE needs to be configured to have a primary IP address and a secondary IP address.

  The secondary IP address is used for all VXLAN traffic that includes multicast and unicast encapsulated traffic.

- vPC peers must have identical configurations.
  - Consistent VLAN to vn-segment mapping.
  - Consistent NVE1 binding to the same loopback interface
    - Using the same secondary IP address.
    - Using different primary IP addresses.
  - Consistent VNI to group mapping.
- For multicast, the vPC node that receives the (S, G) join from the RP (rendezvous point) becomes the DF (designated forwarder). On the DF node, encap routes are installed for multicast.

  Decap routes are installed based on the election of a decapper from between the vPC primary node and the vPC secondary node. The winner of the decap election is the node with the least cost to the RP. However, if the cost to the RP is the same for both nodes, the vPC primary node is elected.

  The winner of the decap election has the decap mroute installed. The other node does not have a decap route installed.
- On a vPC device, BUM traffic (broadcast, unknown-unicast, and multicast traffic) from hosts is replicated on the peer-link. A copy is made of every native packet and each native packet is sent across the peer-link to service orphan-ports connected to the peer vPC switch.

  To prevent traffic loops in VXLAN networks, native packets ingressing the peer-link cannot be sent to an uplink. However, if the peer switch is the encapper, the copied packet traverses the peer-link and is sent to the uplink.

Note Each copied packet is sent on a special internal VLAN (VLAN 4041 or VLAN 4046).

- When the peer-link is shut, the loopback interface used by NVE on the vPC secondary is brought down and the status is **Admin Shut**. This is done so that the route to the loopback is withdrawn on the upstream and that the upstream can divert all traffic to the vPC primary.

Note Orphans connected to the vPC secondary will experience loss of traffic for the period that the peer-link is shut. This is similar to Layer 2 orphans in a vPC secondary of a traditional vPC setup.

- When the vPC domain is shut, the loopback interface used by NVE on the VTEP with shutdown vPC domain is brought down and the status is Admin Shut. This is done so that the route to the loopback is withdrawn on the upstream and that the upstream can divert all traffic to the other vPC VTEP.
- When peer-link is no-shut, the NVE loopback address is brought up again and the route is advertised upstream, attracting traffic.
- For vPC, the loopback interface has two IP addresses: the primary IP address and the secondary IP address.

  The primary IP address is unique and is used by Layer 3 protocols.

The secondary IP address on loopback is necessary because the interface NVE uses it for the VTEP IP address. The secondary IP address must be same on both vPC peers.

- The vPC peer-gateway feature must be enabled on both peers to facilitate NVE RMAC/VMAC programming on both peers. For peer-gateway functionality, at least one backup routing SVI is required to be enabled across peer-link and also configured with PIM. This provides a backup routing path in the case when VTEP loses complete connectivity to the spine. Remote peer reachability is re-routed over peer-link in his case. In BUD node topologies, the backup SVI needs to be added as a static OIF for each underlay multicast group.

```
switch# sh ru int vlan 2

interface Vlan2
 description backupl_svi_over_peer-link
 no shutdown
 ip address 30.2.1.1/30
 ip router ospf 1 area 0.0.0.0
 ip pim sparse-mode
 ip igmp static-oif route-map match-mcast-groups

 route-map match-mcast-groups permit 1
  match ip multicast group 225.1.1.1/32
```

Note In BUD node topologies, the backup SVI needs to be added as a static OIF for each underlay multicast group.

The SVI must be configured on both vPC peers and requires PIM to be enabled.

- When the NVE or loopback is shut in vPC configurations:
  - If the NVE or loopback is shut only on the primary vPC switch, the global VXLAN vPC consistency checker fails. Then the NVE, loopback, and vPCs are taken down on the secondary vPC switch.
  - If the NVE or loopback is shut only on the secondary vPC switch, the global VXLAN vPC consistency checker fails. Then, the NVE, loopback, and secondary vPC are brought down on the secondary. Traffic continues to flow through the primary vPC switch.
  - As a best practice, you should keep both the NVE and loopback up on both the primary and secondary vPC switches.
- Redundant anycast RPs configured in the network for multicast load-balancing and RP redundancy are supported on vPC VTEP topologies.
- As a best practice, when changing the secondary IP address of an anycast vPC VTEP, the NVE interfaces on both the vPC primary and the vPC secondary must be shut before the IP changes are made.
- When SVI is enabled on a VTEP (flood and learn, or EVPN) regardless of ARP suppression, make sure that ARP-ETHER TCAM is carved using the **hardware access-list tcam region arp-ether 256 double-wide** command. This requirement does not apply to Cisco Nexus 9200, 9300-EX, and 9300-FX/FX2/FX3 and 9300-GX/GX2 platform switches and Cisco Nexus 9500 platform switches with 9700-EX line cards.
- The **show** commands with the **internal** keyword are not supported.
- DHCP snooping (Dynamic Host Configuration Protocol snooping) is not supported on VXLAN VLANs.

- RACLs are not supported on Layer 3 uplinks for VXLAN traffic. Egress VACLs support is not available for de-capsulated packets in the network to access direction on the inner payload.

  As a best practice, use PACLs/VACLs for the access to the network direction.

  See the Cisco Nexus 9000 Series NX-OS Security Configuration Guide, Release 9.3(x) for other guidelines and limitations for the VXLAN ACL feature.

- QoS classification is not supported for VXLAN traffic in the network to access direction on the Layer 3 uplink interface.

  See the Cisco Nexus 9000 Series NX-OS Quality of Service Configuration Guide, Release 9.3(x) for other guidelines and limitations for the VXLAN QoS feature.

- The QoS buffer-boost feature is not applicable for VXLAN traffic.
- Beginning with Cisco NX-OS Release 9.3(5), VTEPs support VXLAN-encapsulated traffic over parent interfaces if subinterfaces are configured.
- VTEPs do not support VXLAN encapsulated traffic over subinterfaces. This is regardless of VRF participation or IEEE802.1Q encapsulation.
- Mixing subinterfaces for VXLAN and non-VXLAN VLANs is not supported.
- Point-to-multipoint Layer 3 and SVI uplinks are not supported.
- Using the **ip forward** command enables the VTEP to forward the VXLAN de-capsulated packet destined to its router IP to the SUP/CPU.
- Before configuring it as an SVI, the backup VLAN needs to be configured on Cisco Nexus 9200, 9300-EX, and 9300-FX/FX2/FX3 and 9300-GX platform switches as an infra-VLAN with the **system nve infra-vlans** command.
- VXLAN is supported on Cisco Nexus 9500 platform switches with the following line cards:
  - 9700-EX
  - 9700-FX
  - 9700-GX
- When Cisco Nexus 9500 platform switches are used as VTEPs, 100G line cards are not supported on Cisco Nexus 9500 platform switches. This limitation does not apply to a Cisco Nexus 9500 switch with 9700-EX or -FX line cards.
- Cisco Nexus 9300 platform switches with 100G uplinks only support VXLAN switching/bridging. Cisco Nexus 9200 and Cisco Nexus 9300-EX/FX/FX2 platform switches do not have this restriction.

Note For VXLAN routing support, a 40 G uplink module is required.

- The VXLAN UDP port number is used for VXLAN encapsulation. For Cisco Nexus NX-OS, the UDP port number is 4789. It complies with IETF standards and is not configurable.
- For Cisco Nexus 9200 platform switches that have the Application Spine Engine (ASE2). There exists a Layer 3 VXLAN (SVI) throughput issue. There is a data loss for packets of sizes 99 - 122.

- The VXLAN network identifier (VNID) 16777215 is reserved and should not be configured explicitly.
- VXLAN supports In Service Software Upgrade (ISSU).
- VXLAN ISSU is not supported on the Cisco Nexus 9300-GX platform switches.
- VXLAN does not support coexistence with the GRE tunnel feature or the MPLS (static or segment routing) feature.
- VTEP connected to FEX host interface ports is not supported.
- Resilient hashing (port-channel load-balancing resiliency) and VXLAN configurations are not compatible with VTEPs using ALE uplink ports.

Note Resilient hashing is disabled by default.

- When ARP suppression is enabled or disabled in a vPC setup, a down time is required because the global VXLAN vPC consistency checker will fail and the VLANs will be suspended if ARP suppression is disabled or enabled on only one side.

Note For information about VXLAN BGP EVPN scalability, see the Cisco Nexus 9000 Series NX-OS Verified Scalability Guide, Release 9.3(x).

Network Considerations for VXLAN Deployments

- MTU Size in the Transport Network

  Due to the MAC-to-UDP encapsulation, VXLAN introduces 50-byte overhead to the original frames. Therefore, the maximum transmission unit (MTU) in the transport network needs to be increased by 50 bytes. If the overlays use a 1500-byte MTU, the transport network needs to be configured to accommodate 1550-byte packets at a minimum. Jumbo-frame support in the transport network is required if the overlay applications tend to use larger frame sizes than 1500 bytes.

- ECMP and LACP Hashing Algorithms in the Transport Network

  As described in a previous section, Cisco Nexus 9000 Series Switches introduce a level of entropy in the source UDP port for ECMP and LACP hashing in the transport network. As a way to augment this implementation, the transport network uses an ECMP or LACP hashing algorithm that takes the UDP source port as an input for hashing, which achieves the best load-sharing results for VXLAN encapsulated traffic.

- Multicast Group Scaling

  The VXLAN implementation on Cisco Nexus 9000 Series Switches uses multicast tunnels for broadcast, unknown unicast, and multicast traffic forwarding. Ideally, one VXLAN segment mapping to one IP multicast group is the way to provide the optimal multicast forwarding. It is possible, however, to have multiple VXLAN segments share a single IP multicast group in the core network. VXLAN can support up to 16 million logical Layer 2 segments, using the 24-bit VNID field in the header. With one-to-one mapping between VXLAN segments and IP multicast groups, an increase in the number of VXLAN

segments causes a parallel increase in the required multicast address space and the amount of forwarding states on the core network devices. At some point, multicast scalability in the transport network can become a concern. In this case, mapping multiple VXLAN segments to a single multicast group can help conserve multicast control plane resources on the core devices and achieve the desired VXLAN scalability. However, this mapping comes at the cost of suboptimal multicast forwarding. Packets forwarded to the multicast group for one tenant are now sent to the VTEPs of other tenants that are sharing the same multicast group. This causes inefficient utilization of multicast data plane resources. Therefore, this solution is a trade-off between control plane scalability and data plane efficiency.

Despite the suboptimal multicast replication and forwarding, having multiple-tenant VXLAN networks to share a multicast group does not bring any implications to the Layer 2 isolation between the tenant networks. After receiving an encapsulated packet from the multicast group, a VTEP checks and validates the VNID in the VXLAN header of the packet. The VTEP discards the packet if the VNID is unknown to it. Only when the VNID matches one of the VTEP's local VXLAN VNIDs, does it forward the packet to that VXLAN segment. Other tenant networks will not receive the packet. Thus, the segregation between VXLAN segments is not compromised.

Considerations for the Transport Network

The following are considerations for the configuration of the transport network:

- On the VTEP device:
  - Enable and configure IP multicast.*
  - Create and configure a loopback interface with a /32 IP address.

    (For vPC VTEPs, you must configure primary and secondary /32 IP addresses.)
  - Enable IP multicast on the loopback interface.*
  - Advertise the loopback interface /32 addresses through the routing protocol (static route) that runs in the transport network.
  - Enable IP multicast on the uplink outgoing physical interface.*
- Throughout the transport network:
  - Enable and configure IP multicast.*

For Cisco Nexus 9200, 9300-EX, and 9300-FX/FX2/FX3 and 9300-GX platform switches, the use of the **system nve infra-vlans** command is required. Otherwise, VXLAN traffic (IP/UDP 4789) is actively treated by the switch. The following scenarios are a non-exhaustive list but most commonly seen, where the need for a **system nve infra-vlans** definition is required.

Every VLAN that is not associated with a VNI (vn-segment) is required to be configured as a **system nve infra-vlans** in the following cases:

In the case of VXLAN flood and learn as well as VXLAN EVPN, the presence of non-VXLAN VLANs could be related to:

- An SVI related to a non-VXLAN VLAN is used for backup underlay routing between vPC peers via a vPC peer-link (backup routing).

- An SVI related to a non-VXLAN VLAN is required for connecting downstream routers (external connectivity, dynamic routing over vPC).
- An SVI related to a non-VXLAN VLAN is required for per Tenant-VRF peering (L3 route sync and traffic between vPC VTEPs in a Tenant VRF).
- An SVI related to a non-VXLAN VLAN is used for first-hop routing toward endpoints (Bud-Node).

In the case of VXLAN flood and learn, the presence of non-VXLAN VLANs could be related to:

- An SVI related to a non-VXLAN VLAN is used for an underlay uplink toward the spine (Core port).

The rule of defining VLANs as **system nve infra-vlans** can be relaxed for special cases such as:

- An SVI related to a non-VXLAN VLAN that does not transport VXLAN traffic (IP/UDP 4789).
- Non-VXLAN VLANs that are not associated with an SVI or not transporting VXLAN traffic (IP/UDP 4789).

Note You must not configure certain combinations of infra-VLANs. For example, 2 and 514, 10 and 522, which are 512 apart. This is specifically but not exclusive to the "Core port" scenario that is described for VXLAN flood and learn.

Note * Not required for static ingress replication or BGP EVPN ingress replication.

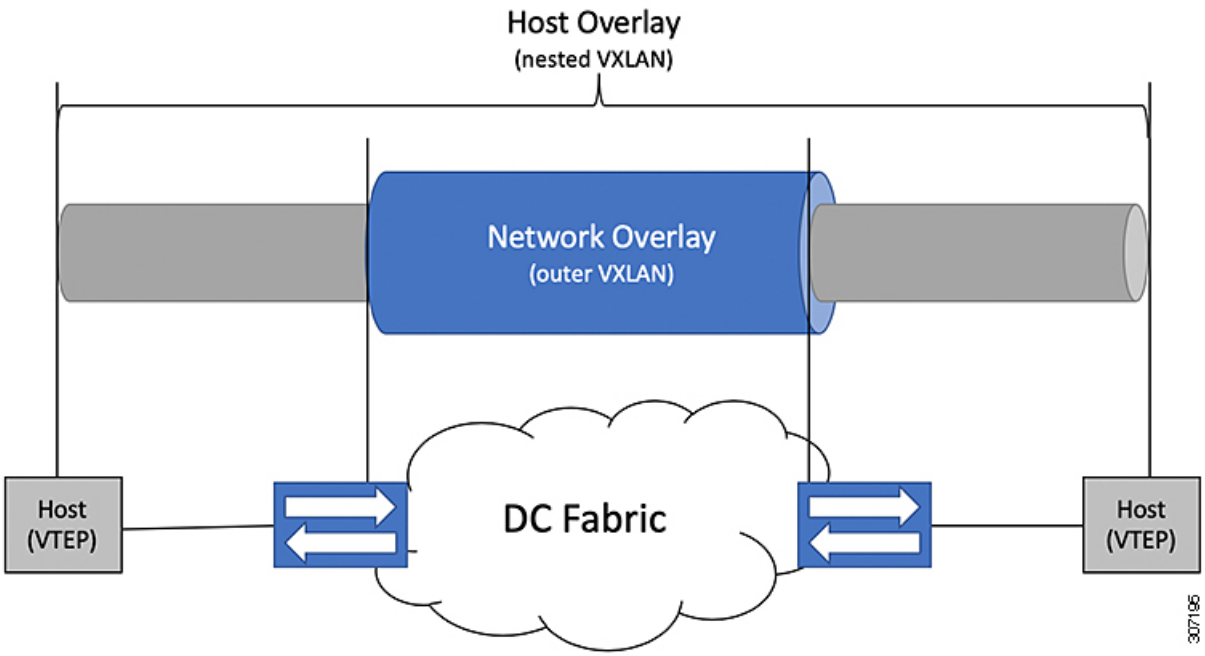
Considerations for Tunneling VXLAN

DC Fabrics with VXLAN BGP EVPN are becoming the transport infrastructure for overlays. These overlays, often originated on the server (Host Overlay), require integration or transport over the top of the existing transport infrastructure (Network Overlay).

Nested VXLAN (Host Overlay over Network Overlay) support has been added starting with Cisco NX-OS Release 7.0(3)I7(4) and Cisco NX-OS Release 9.2(2) on the Cisco Nexus 9200, 9300-EX, 9300-FX, 9300-FX2, 9500-EX, 9500-FX platform switches. It is also supported for Cisco Nexus 9300-FX3 platform switches starting with Cisco NX-OS Release 9.3(5).

Nested VXLAN is not supported on a Layer 3 interface or a Layer 3 port-channel interface in Cisco NX-OS Release 9.3(4) and prior releases. It is supported on a Layer 3 interface or a Layer 3 port-channel interface from Cisco NX-OS Release 9.3(5) onwards.

Figure 1: Host Overlay



To provide Nested VXLAN support, the switch hardware and software must differentiate between two different VXLAN profiles:

- VXLAN originated behind the Hardware VTEP for transport over VXLAN BGP EVPN (nested VXLAN)
- VXLAN originated behind the Hardware VTEP to integrated with VXLAN BGP EVPN (BUD Node)

The detection of the two different VXLAN profiles is automatic and no specific configuration is needed for nested VXLAN. As soon as VXLAN encapsulated traffic arrives in a VXLAN enabled VLAN, the traffic is transported over the VXLAN BGP EVPN enabled DC Fabric.

The following attachment modes are supported for Nested VXLAN:

- Untagged traffic (in native VLAN on a trunk port or on an access port)
- Tagged traffic Layer 2 ports (tagged VLAN on a IEEE 802.1Q trunk port)
- Untagged and tagged traffic that is attached to a vPC domain
- Untagged traffic on a Layer 3 interface or a Layer 3 port-channel interface
- Tagged traffic on Layer 3 interface or a Layer 3 port-channel interface

Configuring VXLAN

Enabling VXLANs

SUMMARY STEPS

1. **configure terminal**
2. [**no**] **feature nv overlay**
3. [**no**] **feature vn-segment-vlan-based**
4. (Optional) **copy running-config startup-config**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	[**no**] **feature nv overlay**	Enables the VXLAN feature.
Step 3	[**no**] **feature vn-segment-vlan-based**	Configures the global mode for all VXLAN bridge domains.
Step 4	(Optional) **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Mapping VLAN to VXLAN VNI

SUMMARY STEPS

1. **configure terminal**
2. **vlan** *vlan-id*
3. **vn-segment** *vnid*
4. **exit**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**vlan** *vlan-id*	Specifies VLAN.

	Command or Action	Purpose
Step 3	**vn-segment** *vnid*	Specifies VXLAN VNID (Virtual Network Identifier)
Step 4	**exit**	Exit configuration mode.

Creating and Configuring an NVE Interface and Associate VNIs

An NVE interface is the overlay interface that terminates VXLAN tunnels.

You can create and configure an NVE (overlay) interface with the following:

SUMMARY STEPS

1. **configure terminal**
2. **interface nve** *x*
3. **source-interface** *src-if*
4. **member vni** *vni*
5. **mcast-group** *start-address* [*end-address*]

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface nve** *x*	Creates a VXLAN overlay interface that terminates VXLAN tunnels. **Note** Only 1 NVE interface is allowed on the switch.
Step 3	**source-interface** *src-if*	The source interface must be a loopback interface that is configured on the switch with a valid /32 IP address. This /32 IP address must be known by the transient devices in the transport network and the remote VTEPs. This is accomplished by advertising it through a dynamic routing protocol in the transport network.
Step 4	**member vni** *vni*	Associate VXLAN VNIs (Virtual Network Identifiers) with the NVE interface.
Step 5	**mcast-group** *start-address* [*end-address*]	Assign a multicast group to the VNIs. **Note** Used only for BUM traffic

Configuring a VXLAN VTEP in vPC

You can configure a VXLAN VTEP in a vPC.

SUMMARY STEPS

1. Enter global configuration mode.
2. Enable the vPC feature on the device.
3. Enable the interface VLAN feature on the device.
4. Enable the LACP feature on the device.
5. Enable the PIM feature on the device.
6. Enables the OSPF feature on the device.
7. Define a PIM RP address for the underlay multicast group range.
8. Define a non-VXLAN enabled VLAN as a backup routed path.
9. Create the VLAN to be used as an infra-VLAN.
10. Create the SVI used for the backup routed path over the vPC peer-link.
11. Create primary and secondary IP addresses.
12. Create a primary IP address for the data plane loopback interface.
13. Create a vPC domain.
14. Configure the IPv4 address for the remote end of the vPC peer-keepalive link.
15. Enable Peer-Gateway on the vPC domain.
16. Enable Peer-switch on the vPC domain.
17. Enable IP ARP synchronize under the vPC domain to facilitate faster ARP table population following device reload.
18. (Optional) Enable IPv6 nd synchronization under the vPC domain to facilitate faster nd table population following device reload.
19. Create the vPC peer-link port-channel interface and add two member interfaces.
20. Modify the STP hello-time, forward-time, and max-age time.
21. (Optional) Enable the delay restore timer for SVI's.

DETAILED STEPS

Procedure

Step 1 Enter global configuration mode.

```
switch# configure terminal
```

Step 2 Enable the vPC feature on the device.

```
switch(config)# feature vpc
```

Step 3 Enable the interface VLAN feature on the device.

```
switch(config)# feature interface-vlan
```

Step 4 Enable the LACP feature on the device.

```
switch(config)# feature lacp
```

Step 5 Enable the PIM feature on the device.

```
switch(config)# feature pim
```

Step 6 Enables the OSPF feature on the device.

```
switch(config)# feature ospf
```

Step 7 Define a PIM RP address for the underlay multicast group range.

```
switch(config)# ip pim rp-address 192.168.100.1 group-list 224.0.0/4
```

Step 8 Define a non-VXLAN enabled VLAN as a backup routed path.

```
switch(config)# system nve infra-vlans 10
```

Step 9 Create the VLAN to be used as an infra-VLAN.

```
switch(config)# vlan 10
```

Step 10 Create the SVI used for the backup routed path over the vPC peer-link.

```
switch(config)# interface vlan 10
switch(config-if)# ip address 10.10.10.1/30
switch(config-if)# ip router ospf UNDERLAY area 0
switch(config-if)# ip pim sparse-mode
switch(config-if)# no ip redirects
switch(config-if)# mtu 9216
(Optional)switch(config-if)# ip igmp static-oif route-map match-mcast-groups
switch(config-if)# no shutdown
(Optional)switch(config)# route-map match-mcast-gropus permit 10
(Optional)switch(config-route-map)# match ip multicast group 225.1.1.1/32
```

Step 11 Create primary and secondary IP addresses.

```
switch(config)# interface loopback 0
switch(config-if)# description Control_plane_Loopback
switch(config-if)# ip address x.x.x.x/32
switch(config-if)# ip router ospf process tag area area id
switch(config-if)# ip pim sparse-mode
switch(config-if)# no shutdown
```

Step 12 Create a primary IP address for the data plane loopback interface.

```
switch(config)# interface loopback 1
switch(config-if)# description Data_Plane_loopback
switch(config-if)# ip address z.z.z.z/32
switch(config-if)# ip address y.y.y.y/32 secondary
switch(config-if)# ip router ospf process tag area area id
switch(config-if)# ip pim sparse-mode
switch(config-if)# no shutdown
```

Step 13 Create a vPC domain.

```
switch(config)# vpc domain 5
```

Step 14 Configure the IPv4 address for the remote end of the vPC peer-keepalive link.

```
switch(config-vpc-domain)# peer-keepalive destination 172.28.230.85
```

Note
The system does not form the vPC peer link until you configure a vPC peer-keepalive link

The management ports and VRF are the defaults.

Note
We recommend that you configure a separate VRF and use a Layer 3 port from each vPC peer device in that VRF for the vPC peer-keepalive link. For more information about creating and configuring VRFs, see the Cisco Nexus 9000 Series NX-OS Unicast Routing Configuration Guide.

Step 15 Enable Peer-Gateway on the vPC domain.

```
switch(config-vpc-domain)# peer-gateway
```

Note
Disable IP redirects on all interface-vlans of this vPC domain for correct operation of this feature.

Step 16 Enable Peer-switch on the vPC domain.

```
switch(config-vpc-domain)# peer-switch
```

Note
Disable IP redirects on all interface-vlans of this vPC domain for correct operation of this feature.

Step 17 Enable IP ARP synchronize under the vPC domain to facilitate faster ARP table population following device reload.

```
switch(config-vpc-domain)# ip arp synchronize
```

Step 18 (Optional) Enable IPv6 nd synchronization under the vPC domain to facilitate faster nd table population following device reload.

```
switch(config-vpc-domain)# ipv6 nd synchronize
```

Step 19 Create the vPC peer-link port-channel interface and add two member interfaces.

```
switch(config)# interface port-channel 1
switch(config-if)# switchport
switch(config-if)# switchport mode trunk
switch(config-if)# switchport trunk allowed vlan 1,10,100-200
switch(config-if)# mtu 9216
switch(config-if)# vpc peer-link
switch(config-if)# no shutdown
switch(config-if)# interface Ethernet 1/1 , 1/21
switch(config-if)# switchport
switch(config-if)# mtu 9216
switch(config-if)# channel-group 1 mode active
switch(config-if)# no shutdown
```

Step 20 Modify the STP hello-time, forward-time, and max-age time.

As a best practice, we recommend changing the **hello-time** to four seconds to avoid unnecessary TCN generation when the vPC role change occurs. As a result of changing the **hello-time**, it is also recommended to change the **max-age** and **forward-time** accordingly.

```
switch(config)# spanning-tree vlan 1-3967 hello-time 4
switch(config)# spanning-tree vlan 1-3967 forward-time 30
switch(config)# spanning-tree vlan 1-3967 max-age 40
```

Step 21 (Optional) Enable the delay restore timer for SVI's.

We recommend that you tune this value when the SVI or VNI scale is high. For example, when the SVI count is 1000, we recommended setting the delay restore for interface-vlan to 45 seconds.

```
switch(config-vpc-domain)# delay restore interface-vlan 45
```

Configuring Static MAC for VXLAN VTEP

Static MAC for VXLAN VTEP is supported on Cisco Nexus 9300 Series switches with flood and learn. This feature enables the configuration of static MAC addresses behind a peer VTEP.

Note Static MAC cannot be configured for a control plane with a BGP EVPN-enabled VNI.

SUMMARY STEPS

1. **configure terminal**
2. **mac address-table static** *mac-address* **vni** *vni-id* **interface nve** *x* **peer-ip** *ip-address*
3. **exit**
4. (Optional) **copy running-config startup-config**
5. (Optional) **show mac address-table static interface nve** *x*

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**mac address-table static** *mac-address* **vni** *vni-id* **interface nve** *x* **peer-ip** *ip-address*	Specifies the MAC address pointing to the remote VTEP.
Step 3	**exit**	Exits global configuration mode.
Step 4	(Optional) **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.
Step 5	(Optional) **show mac address-table static interface nve** *x*	Displays the static MAC addresses pointing to the remote VTEP.

Example

The following example shows the output for a static MAC address configured for VXLAN VTEP:

```
switch# show mac address-table static interface nve 1

Legend:
        * - primary entry, G - Gateway MAC, (R) - Routed MAC, O - Overlay MAC
        age - seconds since last seen,+ - primary entry using vPC Peer-Link,
        (T) - True, (F) - False
   VLAN     MAC Address      Type      age     Secure NTFY Ports
---------+-----------------+--------+---------+------+----+------------------
*  501     0047.1200.0000   static   -         F      F    nve1(33.1.1.3)
*  601     0049.1200.0000   static   -         F      F    nve1(33.1.1.4)
```

Disabling VXLANs

SUMMARY STEPS

1. **configure terminal**
2. **no feature vn-segment-vlan-based**
3. **no feature nv overlay**
4. (Optional) **copy running-config startup-config**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**no feature vn-segment-vlan-based**	Disables the global mode for all VXLAN bridge domains
Step 3	**no feature nv overlay**	Disables the VXLAN feature.
Step 4	(Optional) **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Configuring BGP EVPN Ingress Replication

The following enables BGP EVPN with ingress replication for peers.

SUMMARY STEPS

1. **configure terminal**
2. **interface nve** *x*
3. **source-interface** *src-if*
4. **member vni** *vni*
5. **ingress-replication protocol bgp**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface nve** *x*	Creates a VXLAN overlay interface that terminates VXLAN tunnels. **Note**

	Command or Action	Purpose
		Only 1 NVE interface is allowed on the switch.
Step 3	**source-interface** *src-if*	The source interface must be a loopback interface that is configured on the switch with a valid /32 IP address. This /32 IP address must be known by the transient devices in the transport network and the remote VTEPs. This is accomplished by advertising it through a dynamic routing protocol in the transport network.
Step 4	**member vni** *vni*	Associate VXLAN VNIs (Virtual Network Identifiers) with the NVE interface.
Step 5	**ingress-replication protocol bgp**	Enables BGP EVPN with ingress replication for the VNI.

Configuring Static Ingress Replication

The following enables static ingress replication for peers.

SUMMARY STEPS

1. **configuration terminal**
2. **interface nve** *x*
3. **member vni** [*vni-id* | *vni-range*]
4. **ingress-replication protocol static**
5. **peer-ip** *n.n.n.n*

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configuration terminal**	Enters global configuration mode.
Step 2	**interface nve** *x*	Creates a VXLAN overlay interface that terminates VXLAN tunnels. **Note** Only 1 NVE interface is allowed on the switch.
Step 3	**member vni** [*vni-id*	*vni-range*]	Maps VXLAN VNIs to the NVE interface.
Step 4	**ingress-replication protocol static**	Enables static ingress replication for the VNI.
Step 5	**peer-ip** *n.n.n.n*	Enables peer IP.

VXLAN and IP-in-IP Tunneling

Cisco NX-OS Release 9.3(6) and later releases support the coexistence of VXLAN and IP-in-IP tunneling.

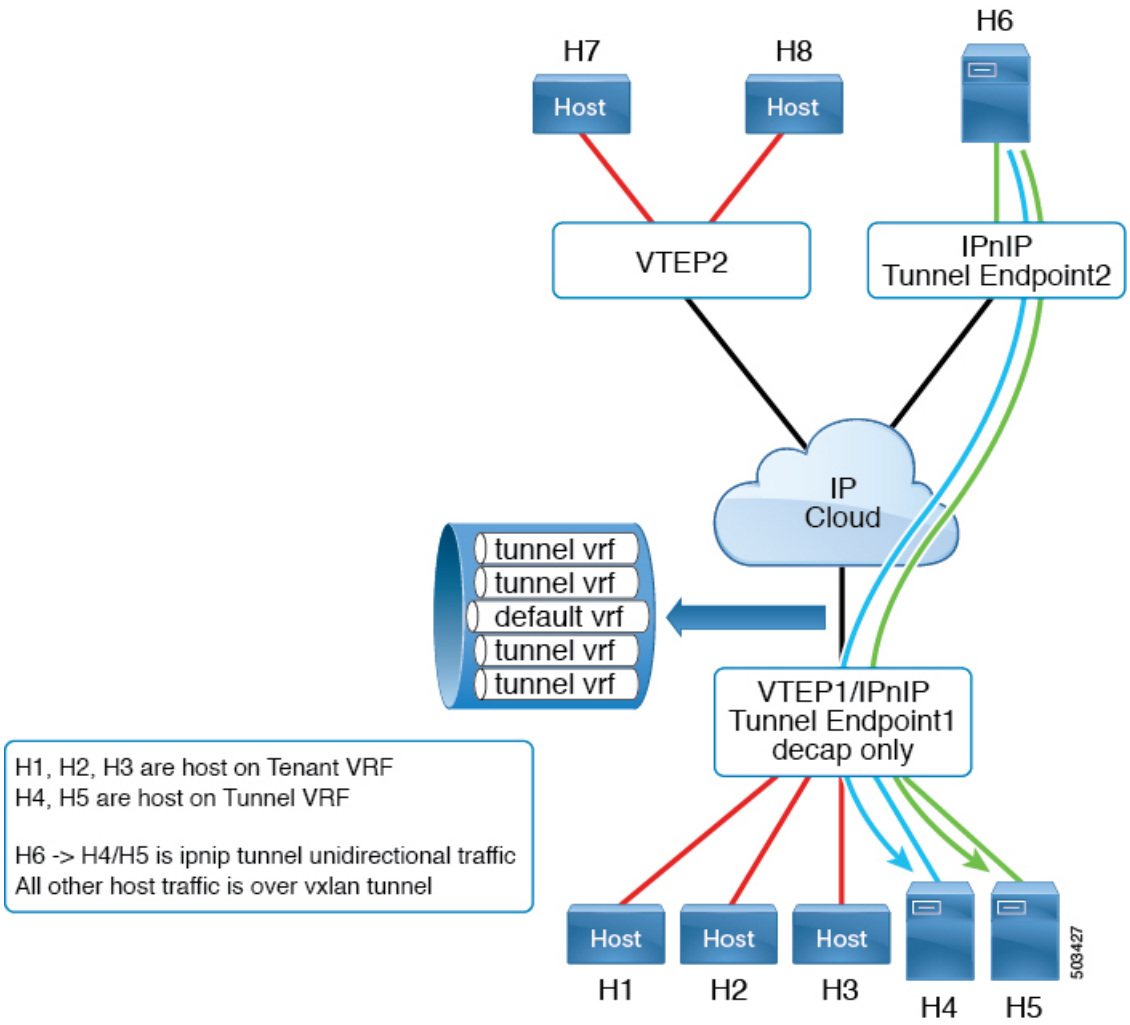
Coexistence of these features requires isolating IP-in-IP tunnels and VXLAN within their own VRFs. By isolating the VRFs, both VXLAN and the tunnels operate independently. VXLAN tunnel termination isn't reencapsulated as an IP-in-IP tunnel (or conversely) on the same or different VRFs.

By configuring subinterfaces under the interface to isolate VRFs, the same uplinks can be used to carry both VXLAN and IP-in-IP tunnel traffic. The parent port can be on the default VRF and subinterfaces on the non-default VRFs.

To terminate IP-in-IP encapsulated packets received on port-channel sub-interfaces, these sub-interfaces must be configured under the same non-default VRF as the tunnel interface, and can only be member of ***one*** non-default VRF.

Multiple port-channel sub interfaces from a different parent PC can still be configured under the same non-default VRF to terminate IP-in-IP encapsulation. The limitation only applies for sub-interfaces under one port-channel. This limitation is not applicable for L3 ports.

As the following example shows, VXLAN traffic is forwarded on the parent interface (eth1/1) in the default VRF, and IP-in-IP (non-VXLAN) traffic is forwarded on subinterfaces (eth1/1.10) in the tunnel VRF.



Cisco Nexus 9300-FX2 platform switches support the coexistence of VXLAN and IP-in-IP tunneling with the following limitations:

- VXLAN must be configured in the default VRF.
- Coexistence is supported on VXLAN with the EVPN control plane.
- IP-in-IP tunneling must be configured in the non-default VRF and is supported only in decapsulate-any mode.

Note If you try to enable VXLAN when a decapsulate-any tunnel is configured in the default VRF, an error message appears. It states that VXLAN and IP-in-IP tunneling can coexist only for a decapsulate-any tunnel in the non-default VRF and to remove the configuration.

- Point-to-point GRE tunnels are not supported. If you try to configure point-to-point tunnels, an error message appears indicating that VXLAN and IP-in-IP tunneling can coexist only for a decapsulate-any tunnel.

- Typically to configure a tunnel, you need to provide the two endpoints. However, decapsulate-any is a receive-only tunnel, so you need to provide only the source IP address or source interface name. The tunnel terminates on any IP interface in the same VRF.
- Tunnel statistics don't support egress counters.
- VXLAN and IP-in-IP tunnels can't share the same source loopback interface. Each tunnel must have its own source loopback interface.

The following example shows a sample configuration:

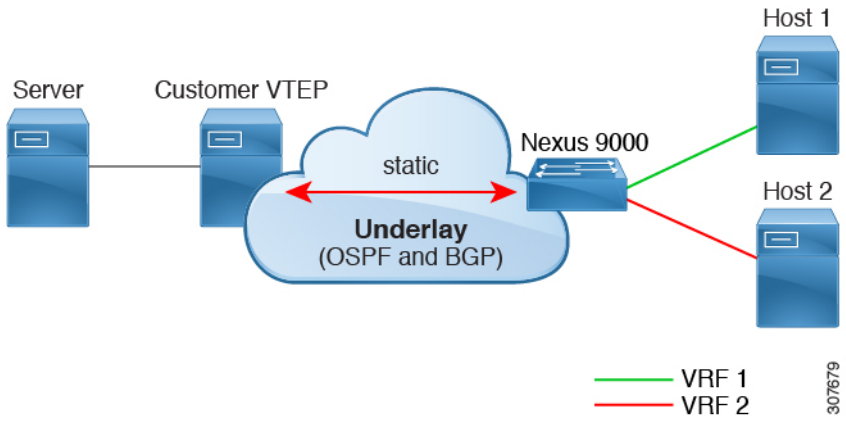
```
feature vn-segment-vlan-based
feature nv overlay
feature tunnel
nv overlay evpn

interface ethernet 1/1
    description VXLAN carrying interface
    no switchport
    ip address 10.1.1.1/30

interface ethernet 1/1.10
    description IPinIP carrying interface
    no switchport
    vrf member tunnel
    encapsulation dot1q 100
    ip address 10.10.1.1/30

interface loopback 0
    description VXLAN-loopback
    ip address 125.125.125.125/32

interface loopback 100
    description Tunnel_loopback
    vrf member tunnel
    ip address 5.5.5.5/32

interface Tunnel1
    vrf member tunnel
    ip address 55.55.55.1/24
    tunnel mode ipip decapsulate-any ip
    tunnel source loopback100
    tunnel use-vrf tunnel
    no shutdown

interface nve1
    host-reachability protocol bgp
    source-interface loopback0
    global mcast-group 224.1.1.1 L2
    global mcast-group 225.3.3.3 L3
    member vni 10000
    suppress-arp
    ingress-replication protocol bgp
    member vni 55500 associate-vrf
```

Configuring VXLAN Static Tunnels

About VXLAN Static Tunnels

Beginning with Cisco NX-OS Release 9.3(3), some Cisco Nexus switches can connect to a customer-provided software VTEP over static tunnels. Static tunnels are customer defined and support VXLAN-encapsulated traffic between hosts without requiring a control plane protocol such as BGP EVPN. You can configure static tunnels manually from the Nexus switch or programmatically, such as through a NETCONF client in the underlay.

Figure 2: VXLAN Static Tunnel Connecting Software VTEP



Static tunnels are supported per VRF. Each VRF can have a dedicated L3VNI to transport a packet with proper encapsulation and decapsulation on the switch and the software VTEP, the static peer. Typically, the static peer is a Cisco Nexus 1000V or bare-metal server with one or more VMs terminating one or more VNIs. However, a static peer can be any customer-developed device that complies with RFC 7348, *Virtual eXtensible Local Area Network (VXLAN): A Framework for Overlaying Virtualized Layer 2 Networks over Layer 3 Networks*. Because the customer provides the static peer and a control plane protocol is not present, you must ensure that the static peer forwards the VXLAN-related configuration and routes to the correct hosts.

Beginning with Cisco NX-OS Release 9.3(5), this feature supports the handling of packets coming in and going out of the tunnel. Specifically, it allows the Nexus switch to send packets to the hosts or other switches over the tunnel. In Cisco NX-OS Releases 9.3(3) and 9.3(4), VXLAN static tunnels support communication only from the local host to the remote host.

Guidelines and Limitations for VXLAN Static Tunnels

The VXLAN static tunnels feature has the following guidelines and limitations:

- The Cisco Nexus 9332C, 9364C, 9300-EX, and 9300-FX/FX2/FX3, 9300-GX and 9300-FX3platform switches support VXLAN static tunnels.
- Beginning with Cisco NX-OS Release 10.1(1), VXLAN Static Tunnels are supported on Cisco Nexus 9300-FX3 platform switches.
- Beginning with Cisco NX-OS Release 10.2(3)F, the VXLAN Static Tunnels are supported on Cisco Nexus 9300-GX2 platform switches.

- The following guidelines apply to software VTEPs:
  - The software VTEP must be configured as needed to determine how to forward traffic from the VNI.
  - The software VTEP must be compliant with RFC 7348.
- The underlay can be OSPFv2, BGP, IS-IS, or IPv4.
- The overlay can be IPv4 only.
- Additional VXLAN features (such as TRM, Multi-Site, OAM, Cross Connect, and VXLAN QoS), IGMP snooping, MPLS handoff, static MPLS, SR, and SRv6 are not supported.
- Pings across the overlay from local tenant VRF loopback to a host behind the software VTEP is not supported.
- Static tunnels do not support ECMP configuration.
- Static tunnels cannot be configured in the same fabric as traditional flood and learn or BGP EVPN fabrics.
- Local hosts are not supported for VNI-enabled VLANs. Therefore, you cannot have a host in the same VLAN where you configured the VNI.
- Fabric forwarding is supported with static tunnels. When fabric forwarding is enabled, be aware that it affects how SVIs and MAC addresses are used. Consider the following example configuration.

```
feature fabric forwarding
fabric forwarding anycast-gateway-mac 0000.0a0a.0a0a

interface Vlan802
no shutdown
vrf member vrfvxlan5201
ip address 103.33.1.1/16
fabric forwarding mode anycast-gateway
```

  When fabric forwarding is enabled:
  - all SVIs where **fabric forwarding mode anycast-gateway** is configured (for example, Vlan802) are used.
  - the MAC address configured with **fabric forwarding anycast-gateway-mac anycast-mac-address** (0000.0a0a.0a0a) is used.

Enabling VXLAN Static Tunnels

Enable the following features to enable VXLAN Static Tunnels.

SUMMARY STEPS

1. **config terminal**
2. **feature vn-segment**
3. **feature ofm**

DETAILED STEPS

Procedure

	Command or Action	Purpose

Step 1	**config terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enter configuration mode.

Step 2	**feature vn-segment**
	Example:
	`switch(config)# feature vn-segment`
	`switch(config)#`
		Enable VLAN-based VXLAN.

Step 3	**feature ofm**
	Example:
	`switch(config)# feature ofm`
	`switch(config)#`
		Enable static VXLAN tunnels.

What to do next

Configure the VRF overlay VLAN for VXLAN routing over Static Tunnels.

Configuring VRF Overlay for Static Tunnels

A VRF overlay must be configured for the VXLAN Static Tunnels.

SUMMARY STEPS

1. **vlan** *number*
2. **vn-segment** *number*

DETAILED STEPS

Procedure

	Command or Action	Purpose

Step 1	**vlan** *number*
	Example:
	`switch(config)# vlan 2001`
	`switch(config-vlan)#`
		Specify the VLAN.

Step 2	**vn-segment** *number* **Example:**	Specify the VN segment.

	Command or Action	Purpose
	`switch(config-vlan)# vn-segment 20001` `switch(config-vlan)#`	

What to do next

Configure the VRF for VXLAN Routing over the Static Tunnel.

Configuring a VRF for VXLAN Routing

Configure the tenant VRF.

SUMMARY STEPS

1. **vrf context** *vrf-name*
2. **vni** *number*

DETAILED STEPS

Procedure

	Command or Action	Purpose

Step 1	**vrf context** *vrf-name*
	Example:
	`switch(config-vlan)# vrf context cust1`
	`switch(config-vrf)#`
		Configure the tenant VRF.

Step 2	**vni** *number*
	Example:
	`switch(config-vrf)# vni 20001`
	`switch(config-vrf)#`
		Specify the VNI for the tenant VRF.

What to do next

Configure the L3 VNI for the host.

Configuring the L3 VNI for Static Tunnels

Configure the L3 VNI for the VTEPs.

Before you begin

The VLAN interface feature must be enabled. Use **feature interface-vlan** if needed.

SUMMARY STEPS

1. **vlan** *number*
2. **interface** *vlan-number*

3. **vrf member** *vrf-name*
4. **ip forward**
5. **no shutdown**

DETAILED STEPS

Procedure

	Command or Action	Purpose

Step 1	**vlan** *number*
	Example:
	`switch(config-vrf)# vlan 2001`
	`switch(config-vlan)#`
		Specify the VLAN number

Step 2	**interface** *vlan-number*
	Example:
	`switch(config)# interface vlan2001`
	`switch(config-if)#`
		Specify the VLAN interface.

Step 3	**vrf member** *vrf-name*
	Example:
	`switch(config-if)# vrf member cust1`
	`Warning: Deleted all L3 config on interface Vlan2001`
	`switch(config-if)#`
		Assign the VLAN interface to the tenant VRF.

Step 4	**ip forward**
	Example:
	`switch(config-if)# ip forward`
	`switch(config-if)#`
		Enable IPv4 traffic on the interface.

Step 5	**no shutdown**
	Example:
	`switch(config-if)# no shutdown`
	`switch(config-if)#`
		Enables the interface.

What to do next

Configure the tunnel profile.

Configuring the Tunnel Profile

To configure static tunnels, you create a tunnel profile that specifies the interface on the Nexus switch, the MAC address of the static peer, and the interface on the static peer.

Before you begin

To configure VXLAN static tunnels, the underlay must be completely configured and operating correctly.

SUMMARY STEPS

1. **tunnel-profile** *profile-name*
2. **encapsulation {***VXLAN* | *VXLAN-GPE* | *SRv6***}**
3. **source-interface loopback** *virtual-interface-number*
4. **route vrf** *tenant-vrf destination-host-prefix destination-vtep-ip-address* **next-hop-vrf** *destination-vtep-vrf* **vni** *vni-number* **dest-vtep-mac** *destination-vtep-mac-address*

DETAILED STEPS

Procedure

	Command or Action	Purpose

Step 1	**tunnel-profile** *profile-name*
	Example:
	`switch(config)# tunnel-profile test`
	`switch(config-tnl-profile)#`
		Create and name the tunnel profile.

Step 2	**encapsulation {***VXLAN* | *VXLAN-GPE* | *SRv6***}**
	Example:
	`switch(config-tnl-profile)# encapsulation vxlan`
	`switch(config-tnl-profile)#`
		Set the appropriate encapsulation type for the tunnel profile.
		Note
		In NX-OS release 9.3(3), only encapsulation type **vxlan** is supported.

Step 3	**source-interface loopback** *virtual-interface-number*
	Example:
	`switch(config-tnl-profile)# source-interface loopback 1`
	`switch(config-tnl-profile)#`
		Configure the loopback interface as the source interface for the tunnel profile, where the virtual interface number is from 0 to 1023.

Step 4	**route vrf** *tenant-vrf destination-host-prefix destination-vtep-ip-address* **next-hop-vrf** *destination-vtep-vrf* **vni** *vni-number* **dest-vtep-mac** *destination-vtep-mac-address*
	Example:
	`switch(tunnel-profile)# route vrf cust1 101.1.1.2/32 7.7.7.1 next-hop-vrf default vni 20001 dest-vtep-mac f80f.6f43.036c`
	`switch(tunnel-profile)#`
		Create the tunnel route by specifying the destination software VTEP and entering the route information for the VNI and destination VTEP MAC address.
		Note
		The **route vrf** command accepts one *destination-vtep-mac-address* per *destination-vtep-ip-address* across all the routes. If you configure additional routes, they are cached as errored routes and a error syslog is generated for each.

Verifying VXLAN Static Tunnels

VXLAN static tunnels remain configured if one end of the tunnel goes down. While one end of the tunnel is down, packets are dropped because that VTEP is unreachable. When the down VTEP comes back online, traffic can resume across the tunnel after the underlay relearns connectivity.

You can use **show** commands to check the state of the tunnel profile and tunnel route.

Before you begin

SUMMARY STEPS

1. **show tunnel-profile**
2. **show ip route** *tenant-vrf-name*
3. **show running-config ofm**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**show tunnel-profile**	Shows information about the tunnel profile for the software.
Step 2	**show ip route** *tenant-vrf-name*	Shows route information for the VRF connecting to the software VTEP. For example, you can use this command when a `route unreachable` error occurs to verify that a route exists for a VRF's tunnel.
Step 3	**show running-config ofm**	Shows the running config for the OFM feature and static tunnels. You can use this command when a `route unreachable` error occurs to check whether the route information for the destination VTEP is present.

What to do next

In addition to VXLAN verification, you can use SPAN to check the ports and source VLANs for packets traversing the switch.

Example Configurations for VXLAN Static Tunnels

The following configuration examples shows VXLAN static tunnel configurations through the supported methods.

NX-OS CLI

```
vlan 2001
vlan 2001
  vn-segment 20001

interface Vlan2001
  no shutdown
  vrf member cust1
  ip forward

vrf context cust1
  vni 20001


feature ofm

tunnel-profile test
```

```
  encapsulation vxlan
  source-interface loopback1
  route vrf cust1 101.1.1.2/32 7.7.7.1 next-hop-vrf default vni 20001 dest-vtep-mac
f80f.6f43.036c
```