VXLAN EVPN and TRM with IPv6 Multicast Underlay

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This chapter contains the following sections:

Information About Configuring VXLAN EVPN and TRM with IPv6 Multicast Underlay

Cisco NX-OS Release 10.3(99x)F supports VXLAN with IPv6 Multicast in the Underlay. Hosts in the overlay can be IPv4 or IPv6. This requires IPv6 versions of the unicast routing protocols and utilizing IPv6 multicast in the underlay (PIMv6). Any multi-destination overlay traffic (such as TRM, BUM) can use the IPv6 multicast underlay.

Figure 1. **Topology - VXLAN EVPN with IPv6 Multicast Underlay**
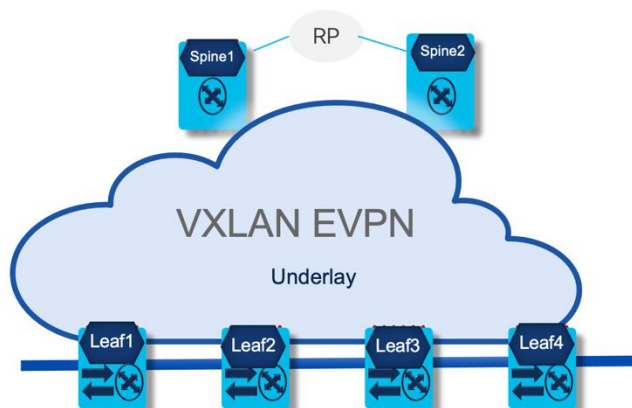
The above topology shows four leafs and two spines in a VXLAN EVPN fabric. The underlay is IPv6 Multicast running PIMv6. RP is positioned in the spine with anycast RP.

Guidelines and Limitations for VXLAN EVPN and TRM with IPv6 Multicast Underlay

VXLAN EVPN and TRM with IPv6 Multicast Underlay has the following guidelines and limitations:

- The upgrade from nxos64-cs.10.3.99w.F.bin to nxos64-cs.10.3.99x.F.bin will be a disruptive upgrade.

- Spine-based static RP is supported in underlay.

- Cisco Nexus 9300-FX, FX2 and FX3 switches are supported as the leaf VTEP.

- N9K-X9716D-GX and N9K-X9736C-FX line cards are supported on the spine (EoR) and N9K-C9332D-GX2B is supported on the super spine.
  Note: EoR requires configuring a non-default template using one of the following commands in global configuration mode:

- ○ **system routing template-multicast-heavy**
  - ○ **system routing template-multicast-ext-heavy**
- OSPFv3, eBGP underlay is supported.
- PIMv6 ASM (sparse mode) is supported in underlay.
- PIMv6 Anycast RP is supported in underlay as RP redundancy.
- Underlay IPv6 Multicast is supported.
- For overlay traffic, each Cisco Nexus 9000 leaf is an RP. External RP is also supported.

Configuring VXLAN EVPN and TRM with IPv6 Multicast Underlay

Configuring IPv6 multicast underlay in the VXLAN fabric involves the following:

- Configuring L2-VNI based multicast group in underlay.
- Configuring L3-VNI based multicast group in underlay.
- Enabling PIMv6 for underlay.

Configuring L2-VNI based multicast group in underlay:

Under NVE configuration on a leaf, IPv6 multicast group (IPv6) is configured for each L2-VNI (VLAN).

SUMMARY STEPS

1. configure terminal
2. interface nve1
3. member vni *<vni>*
4. mcast-group ipv6-prefix
5. exit

DETAILED STEPS
Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** switch# **configure terminal**	Enter configuration mode.
Step 2	**interface nve1** **Example:** switch(config)# **interface nve 1**	Configure the NVE interface.
Step 3	**member vni** *<vni>* **Example:** switch(config-if-nve)# **member vni 10501**	Configure the Layer 2 virtual network identifier.
Step 4	**mcast-group** *ipv6-prefix* **Example:** switch(config-if-nve-vni)# **mcast-group** **ff10::1**	Builds the default multicast distribution tree for the Layer 2 VNI.
Step 5	**exit**	Exits the command mode.

	Command or Action	Purpose
	Example: `switch(config-if-nve-vni)# exit`	

Configuring L3-VNI based multicast group in underlay:

IPv6 multicast group (IPv6) is configured for each L3-VNI (VRF).

SUMMARY STEPS

1. configure terminal
2. interface nve1
3. member vni *<vni>* associate-vrf
4. mcast-group *<ipv6-prefix>*
5. exit

DETAILED STEPS
Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `switch# configure terminal`	Enter configuration mode.
Step 2	**interface nve1** **Example:** `switch(config)# interface nve 1`	Configure the NVE interface.

Step 3	**member vni** *vni* **associate-vrf**
	Example:
	`switch(config-if-nve)# member vni 50001`
	`associate-vrf`
		Associates L3VNI to VRF.

Step 4	**mcast-group** *ipv6-prefix*
	Example:
	`switch(config-if-nve-vni)# mcast-group`
	`ff10:0:0:1::1`
		Builds the default multicast distribution tree for the VRF VNI (Layer 3 VNI used for TRM).

Step 5	**exit** **Example:** `switch(config-if-nve-vni)# exit`	Exits command mode.

Enabling PIMv6 for underlay:

PIMv6 in underlay is configured as follows:

SUMMARY STEPS

1. configure terminal
2. interface loopback *<number>*
3. ipv6 address *<ipv6-prefix>*

4. ipv6 pim sparse-mode

5. interface nve1

6. source-interface loopback *<number>*

7. exit

DETAILED STEPS
Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** switch# **configure terminal**	Enters global configuration mode.
Step 2	**interface loopback** *number* **Example:** switch(config)# **interface loopback 1**	Configures an interface loopback. This example configures interface loopback 1.
Step 3	**ipv6 address** *ipv6-prefix* **Example:** switch(config-if)# **ipv6 address 11:0:0:1::1/128**	Configures an IP address for this interface. It should be a unique IP address that helps to identify this router.
Step 4	**ipv6 pim sparse-mode** Example: switch(config-if)# **ipv6 pim sparse-mode**	Enable PIM6 sparse mode.
Step 5	**interface nve1** **Example:** switch(config-if-nve)# **interface nve 1**	Configure the NVE interface.
Step 6	**source-interface loopback** *number* **Example:** switch(config-if-nve)# **source-interface loopback 1**	Configures an source interface loopback.
Step 7	**exit** **Example:** switch(config-if-nve)# **exit**	Exits command mode.

Note:
For the PIMv6 configuration see the *Cisco Nexus 9000 Series NX-OS Multicast Routing Configuration Guide, Release 10.3(x)*.

For the TRM configuration see the *Cisco Nexus 9000 Series NX-OS VXLAN Configuration Guide, Release 10.3(x)*.

Example Configuration for VXLAN EVPN and TRM with IPv6 Multicast Underlay

In the following section, the sample configuration for the leaf, spine and RP are shown.

Leaf - sample configuration of IPv6 multicast underlay:

NVE Configuration

```
interface nve1
  no shutdown
  host-reachability protocol bgp
  source-interface loopback1
  member vni 10501
    mcast-group ff10::1
  member vni 50001 associate-vrf
    mcast-group ff10:0:0:1::1
```

PIMv6 Configuration

```
feature pim6

ipv6 pim rp-address 101:101:101:101::101 group-list ff00::/8

interface loopback1
  ipv6 address 172:172:16:1::1/128
  ipv6 pim sparse-mode

interface Ethernet1/27
  ipv6 address 27:50:1:1::1/64
  ospfv3 hello-interval 1
  ipv6 router ospfv3 v6u area 0.0.0.0
  ipv6 pim sparse-mode
  no shutdown
```

BGP Configuration

```
router bgp 100
    router-id 172.16.1.1
    address-family ipv4 unicast
      maximum-paths 64
      maximum-paths ibgp 64
    address-family ipv6 unicast
      maximum-paths 64
      maximum-paths ibgp 64
    address-family ipv4 mvpn
    address-family l2vpn evpn
    neighbor 172:17:1:1::1
      remote-as 100
      update-source loopback0
      address-family ipv4 mvpn
        send-community
        send-community extended
      address-family ipv6 mvpn
        send-community
        send-community extended
      address-family l2vpn evpn
        send-community
```

```
    neighbor 172:17:2:2::1
      remote-as 100
      update-source loopback0
      address-family ipv4 mvpn
        send-community
        send-community extended
      address-family ipv6 mvpn
        send-community
        send-community extended
      address-family l2vpn evpn
        send-community
        send-community extended
    vrf VRF1
      reconnect-interval 1
      address-family ipv4 unicast
        network 150.1.1.1/32
        advertise l2vpn evpn
        redistribute hmm route-map hmmAdv

evpn
  vni 10501 l2
    rd auto
    route-target import auto
    route-target export auto
vrf context VRF1
  vni 50001
rd auto
address-family ipv4 unicast
    route-target both auto
    route-target both auto mvpn
    route-target both auto evpn
address-family ipv6 unicast
    route-target both auto
    route-target both auto mvpn
    route-target both auto evpn
```

Spine - sample configuration of IPv6 multicast underlay:

NVE Configuration

```
nv overlay evpn
```

PIMv6 Configuration

```
feature pim6

ipv6 pim rp-address 101:101:101:101::101 group-list ff00::/8
ipv6 pim anycast-rp 101:101:101:101::101 102:102:102:102::102
ipv6 pim anycast-rp 101:101:101:101::101 103:103:103:103::103

interface loopback101
  ipv6 address 101:101:101:101::101/128
  ipv6 router ospfv3 v6u area 0.0.0.0
  ipv6 pim sparse-mode

interface loopback102
  ipv6 address 102:102:102:102::102/128
  ipv6 router ospfv3 v6u area 0.0.0.0
  ipv6 pim sparse-mode
```

```
interface Ethernet1/50/1
  ipv6 address 27:50:1:1::2/64
  ipv6 pim sparse-mode
  no shutdown
```

BGP Configuration

```
feature bgp

router bgp 100
  router-id 172.16.40.1
   address-family ipv4 mvpn
  address-family ipv6 mvpn
  address-family l2vpn evpn
  neighbor 172:16:1:1::1
    remote-as 100
    update-source loopback0
    address-family ipv4 mvpn
      send-community
      send-community extended
       route-reflector-client
    address-family ipv6 mvpn
     send-community
      send-community extended
       route-reflector-client
    address-family l2vpn evpn
    send-community
      send-community extended
       route-reflector-client
```

Verifying VXLAN EVPN and TRM with IPv6 Multicast Underlay

The following example is used to verify the status of the IPv6 Multicast Underlay configuration.

```
switch(config)# show run interface nve 1

!Command: show running-config interface nve1
!Running configuration last done at: Wed Jul  5 10:03:58 2023
!Time: Wed Jul  5 10:04:01 2023
version 10.3(99x) Bios:version 01.08

interface nve1
  no shutdown
  host-reachability protocol bgp
  source-interface loopback1
  member vni 10501
    mcast-group ff10::1
  member vni 50001 associate-vrf
    mcast-group ff10:0:0:1::1
```

Use the following command for verifying PIMv6 ASM configuration:

```
switch(config)# show ipv6 mroute
IPv6 Multicast Routing Table for VRF "default"

(*, ff10::1/128), uptime: 05:20:19, nve pim6 ipv6
  Incoming interface: Ethernet1/36, RPF nbr: fe80::23a:9cff:fe23:8367
  Outgoing interface list: (count: 1)
    nve1, uptime: 05:20:19, nve
```

```
(172:172:16:1::1/128, ff10::1/128), uptime: 05:20:19, nve m6rib pim6 ipv6
  Incoming interface: loopback1, RPF nbr: 172:172:16:1::1
  Outgoing interface list: (count: 2)
    Ethernet1/36, uptime: 01:47:03, pim6
    Ethernet1/27, uptime: 04:14:20, pim6


(*, ff10:0:0:1::10/128), uptime: 05:20:18, nve ipv6 pim6
  Incoming interface: Ethernet1/36, RPF nbr: fe80::23a:9cff:fe23:8367
  Outgoing interface list: (count: 1)
    nve1, uptime: 05:20:18, nve


(172:172:16:1::1/128, ff10:0:0:1::10/128), uptime: 05:20:18, nve m6rib ipv6
pim6
  Incoming interface: loopback1, RPF nbr: 172:172:16:1::1
  Outgoing interface list: (count: 2)
    Ethernet1/36, uptime: 04:04:35, pim6
    Ethernet1/27, uptime: 04:13:35, pim6

switch(config)# show ipv6 pim neighbor
PIM Neighbor Status for VRF "default"
Neighbor                      Interface            Uptime    Expires   DR
Bidir- BFD    ECMP Redirect
                                                                       Priority
Capable State   Capable
fe80::23a:9cff:fe28:5e07      Ethernet1/27         20:23:38  00:01:44 1
yes     n/a     no
  Secondary addresses:
    27:50:1:1::2


switch(config)# show ipv6 pim rp
PIM RP Status Information for VRF "default"
BSR disabled
BSR RP Candidate policy: None
BSR RP policy: None

RP: 101:101:101:101::101, (0),
 uptime: 21:30:43   priority: 255,
 RP-source: (local),
 group ranges:
 ff00::/8
```

The following example provides the output for leaf BGP neighbor-1.

```
switch(config-if)# show ipv6 bgp neighbors

BGP neighbor is 33:52:1:1::2, remote AS 200, ebgp link, Peer index 3
  BGP version 4, remote router ID 172.17.1.1
  Neighbor previous state = OpenConfirm
  BGP state = Established, up for 00:00:16
  Neighbor vrf: default
  Peer is directly attached, interface Ethernet1/33
  Enable logging neighbor events
  Last read 0.926823, hold time = 3, keepalive interval is 1 seconds
  Last written 0.926319, keepalive timer expiry due 0.073338
  Received 23 messages, 0 notifications, 0 bytes in queue
```

```
Sent 67 messages, 0 notifications, 0(0) bytes in queue
Enhanced error processing: On
  0 discarded attributes
Connections established 1, dropped 0
Last update recd 00:00:15, Last update sent  = 00:00:15
 Last reset by us 00:08:45, due to session closed
Last error length sent: 0
Reset error value sent: 0
Reset error sent major: 104 minor: 0
Notification data sent:
Last reset by peer never, due to No error
Last error length received: 0
Reset error value received 0
Reset error received major: 0 minor: 0
Notification data received:

Neighbor capabilities:
Dynamic capability: advertised (mp, refresh, gr) received (mp, refresh, gr)
Dynamic capability (old): advertised received
Route refresh capability (new): advertised received
Route refresh capability (old): advertised received
4-Byte AS capability: advertised received
Address family IPv6 Unicast: advertised received
Graceful Restart capability: advertised received

Graceful Restart Parameters:
Address families advertised to peer:
  IPv6 Unicast
Address families received from peer:
  IPv6 Unicast
Forwarding state preserved by peer for:
Restart time advertised to peer: 400 seconds
Stale time for routes advertised by peer: 300 seconds
Restart time advertised by peer: 120 seconds
Extended Next Hop Encoding Capability: advertised received
Receive IPv6 next hop encoding Capability for AF:
  IPv4 Unicast  VPNv4 Unicast

Message statistics:
                          Sent               Rcvd
Opens:                      46                  1
Notifications:               0                  0
Updates:                     2                  2
Keepalives:                 18                 18
Route Refresh:               0                  0
Capability:                  2                  2
Total:                      67                 23
Total bytes:               521                538
Bytes in queue:              0                  0

For address family: IPv6 Unicast
BGP table version 10, neighbor version 10
3 accepted prefixes (3 paths), consuming 864 bytes of memory
0 received prefixes treated as withdrawn
2 sent prefixes (2 paths)
Inbound soft reconfiguration allowed(always)
Allow my ASN 3 times
Last End-of-RIB received 00:00:01 after session start
Last End-of-RIB sent 00:00:01 after session start
First convergence 00:00:01 after session start with 2 routes sent
```

```
    Local host: 33:52:1:1::1, Local port: 179
    Foreign host: 33:52:1:1::2, Foreign port: 17226
    fd = 112
```

The following example provides the output for leaf BGP neighbor-2.

```
 switch(config-if)# show bgp l2vpn evpn neighbors 172:17:1:1::1

 BGP neighbor is 172:17:1:1::1, remote AS 200, ebgp link, Peer index 5
    BGP version 4, remote router ID 172.17.1.1
    Neighbor previous state = OpenConfirm
    BGP state = Established, up for 00:01:33
    Neighbor vrf: default
    Using loopback0 as update source for this peer
    Using iod 65 (loopback0) as update source
    Enable logging neighbor events
    External BGP peer might be up to 5 hops away
    Last read 0.933565, hold time = 3, keepalive interval is 1 seconds
    Last written 0.915927, keepalive timer expiry due 0.083742
    Received 105 messages, 0 notifications, 0 bytes in queue
    Sent 105 messages, 0 notifications, 0(0) bytes in queue
    Enhanced error processing: On
      0 discarded attributes
    Connections established 1, dropped 0
    Last update recd 00:01:32, Last update sent  = 00:01:32
     Last reset by us never, due to No error
    Last error length sent: 0
    Reset error value sent: 0
    Reset error sent major: 0 minor: 0
    Notification data sent:
    Last reset by peer never, due to No error
    Last error length received: 0
    Reset error value received 0
    Reset error received major: 0 minor: 0
    Notification data received:

    Neighbor capabilities:
    Dynamic capability: advertised (mp, refresh, gr) received (mp, refresh, gr)
    Dynamic capability (old): advertised received
    Route refresh capability (new): advertised received
    Route refresh capability (old): advertised received
    4-Byte AS capability: advertised received
    Address family IPv4 MVPN: advertised received
    Address family IPv6 MVPN: advertised received
    Address family L2VPN EVPN: advertised received
    Graceful Restart capability: advertised received

    Graceful Restart Parameters:
    Address families advertised to peer:
      IPv4 MVPN  IPv6 MVPN  L2VPN EVPN
    Address families received from peer:
      IPv4 MVPN  IPv6 MVPN  L2VPN EVPN
    Forwarding state preserved by peer for:
    Restart time advertised to peer: 400 seconds
    Stale time for routes advertised by peer: 300 seconds
    Restart time advertised by peer: 120 seconds
    Extended Next Hop Encoding Capability: advertised received
    Receive IPv6 next hop encoding Capability for AF:
      IPv4 Unicast  VPNv4 Unicast
```

```
Message statistics:
                                Sent                Rcvd
Opens:                             1                   1
Notifications:                     0                   0
Updates:                           6                   3
Keepalives:                       95                  95
Route Refresh:                     0                   0
Capability:                        6                   6
Total:                           105                 105
Total bytes:                    2551                2047
Bytes in queue:                    0                   0


For address family: IPv4 MVPN
BGP table version 3, neighbor version 3
0 accepted prefixes (0 paths), consuming 0 bytes of memory
0 received prefixes treated as withdrawn
0 sent prefixes (0 paths)
Community attribute sent to this neighbor
Extended community attribute sent to this neighbor
Allow my ASN 3 times
Outbound route-map configured is RN_NextHop_Unchanged, handle obtained
Last End-of-RIB received 00:00:01 after session start
Last End-of-RIB sent 00:00:01 after session start
First convergence 00:00:01 after session start with 0 routes sent


For address family: IPv6 MVPN
BGP table version 3, neighbor version 3
0 accepted prefixes (0 paths), consuming 0 bytes of memory
0 received prefixes treated as withdrawn
0 sent prefixes (0 paths)
Community attribute sent to this neighbor
Extended community attribute sent to this neighbor
Allow my ASN 3 times
Outbound route-map configured is RN_NextHop_Unchanged, handle obtained
Last End-of-RIB received 00:00:01 after session start
Last End-of-RIB sent 00:00:01 after session start
First convergence 00:00:01 after session start with 0 routes sent


For address family: L2VPN EVPN
BGP table version 7, neighbor version 7
0 accepted prefixes (0 paths), consuming 0 bytes of memory
0 received prefixes treated as withdrawn
4 sent prefixes (4 paths)
Community attribute sent to this neighbor
Extended community attribute sent to this neighbor
Allow my ASN 3 times
Advertise GW IP is enabled
Outbound route-map configured is RN_NextHop_Unchanged, handle obtained
Last End-of-RIB received 00:00:01 after session start
Last End-of-RIB sent 00:00:01 after session start
First convergence 00:00:01 after session start with 4 routes sent


Local host: 172:16:1:2::1, Local port: 21132
Foreign host: 172:17:1:1::1, Foreign port: 179
fd = 113
```