

Open Compute Network Operating System Version 1.1

OcNOS™ Validated Solution Guide

Data Center Solution - EVPN with VXLAN

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Glossary

VXLAN – Virtual extensible LAN

EVPN – Ethernet Virtual Private Network

VM – Virtual Machine

PBB – Provider Backbone bridging

OTV – Overlay Transport Virtualization

NVGRE – Network virtualization using Generic Route Encapsulation

MPLS - Multiprotocol Label Switching

VPLS – Virtual Private LAN Service

STT – Stateless Transport Tunelling

ISIS – Intermediate system – Intermediate system

BGP – Border Gateway Protocol

MP-BGP – Multiprotocol Border Gateway Protocol

CHAPTER 1

Data Center Solution Overview

- Data Center Virtualization
- Virtualization Technologies
- Data Center Virtualization with VXLAN and EVPN

Data Center Virtualization

With the increase of data centers and huge amount of data that they store and manage and the increase in services, virtualization in data centers has been the need of the day. Server virtualization helps in reducing the cost to setup and manage a data center, as not only does it reduces the cost in buying and setting up the hardware, it also reduces the cost for cooling, electricity and maintenance. Also, most enterprise data centers are deployed in a hybrid cloud environment, which require the ability to expand, reduce or move their services/virtual machines.

Redeploying a service or a VM, needs support from the data center network. When new VMs have to be added in a data center or old VMs need to be moved, they should be added based on the compute availability and not because of the network configuration for the customer. This way the compute infrastructure is better utilized. In IP networks this requires reconfiguration of L3 infrastructure or a change in the customer VM IP address. This is not acceptable in a data center deployment. Tenants would want their VMs in the same subnet, wherever they are placed.

An overlay protocol can be used to connect the customer virtual machines (VMs) on servers located at different locations in the network to communicate without affecting the L3 infrastructure. The following sections discuss the technologies that can be used for this purpose.

Virtualization Technologies

An overlay is basically a tunneling protocol where the customer traffic can be tunneled across the network, without reconfiguring the network. Various tunneling technologies are in use in the enterprise and data center network.

802.1Q-in-Q tunneling or provider bridging provides a solution to scale beyond the 4K VLAN limitation, but it does not hide the customer MAC addresses from the core network.

PBB or Mac-in-Mac tunneling provided a solution to hide customer MAC addresses along with scaling, but it has a disadvantage on relying on xSTP protocols.

TRILL and SPB solved the issue of reliance on STP by using ISIS control plane learning. These technologies are deployable at the edge networks.

OTV and LISP are other tunneling technologies which address L2/L3 over L3 networks.

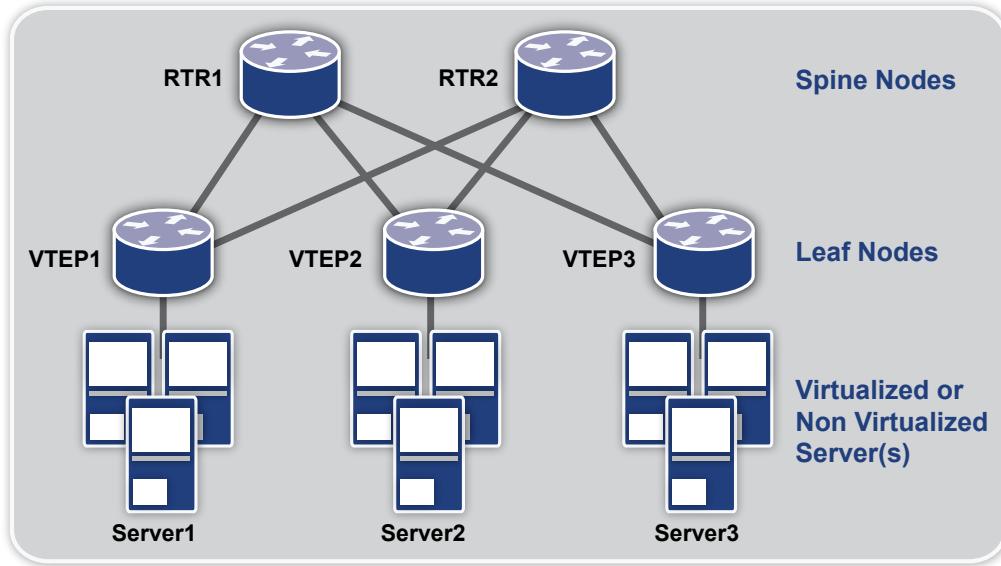
MPLS based VPLS and VPRN services provide VPN services within the data center and data center interconnect.

New host based virtualization technologies focus more on VM/Service mobility and multitenancy.

VXLAN, NVGRE and STT are some of the technologies developed in this area. VXLAN is the most popular among these as it is an UDP-based protocol allowing the network to use multiple paths. In this paper, VXLAN and EVPN will be discussed in details.

Data Center Virtualization with VXLAN and EVPN

VXLAN, NVGRE and STT are some of the technologies developed in this area. VXLAN is the most popular amongst these as it is an UDP based protocol providing the network to use multipaths. In this paper, VXLAN and EVPN will be discussed in details.



The VTEPs (Virtual Tunnel Endpoints) form UDP tunnels among themselves. VTEPs identify a specific tenant's traffic and encapsulate it within the UDP tunnel. If the traffic is broadcast, multicast or unknown, then the traffic is multicasted over UDP to other VTEPs. A VXLAN header is inserted by the VTEP to identify the tenant of the traffic.

OcNOS supports VTEP functionality for VXLAN tunnels.

VXLAN depends on multicast and data plane learning to discover the VTEPs. To overcome this limitation, OcNOS supports EVPN control plane for VXLAN from Release 1.1 as beta quality.

EVPN is a control plane technology using MP-BGP for implementing VPN technologies in a network. EVPN was developed to provide the following improvements over the current VPN technologies.

- Control plane learning
- Multicast optimization
- Multihoming
- Simplicity in provisioning
- Achieving various services
- Better reconvergence

When VXLAN is deployed in DCI, multicast and data plane learning are not preferred. A VXLAN solution with EVPN control plane is preferred in that deployment.

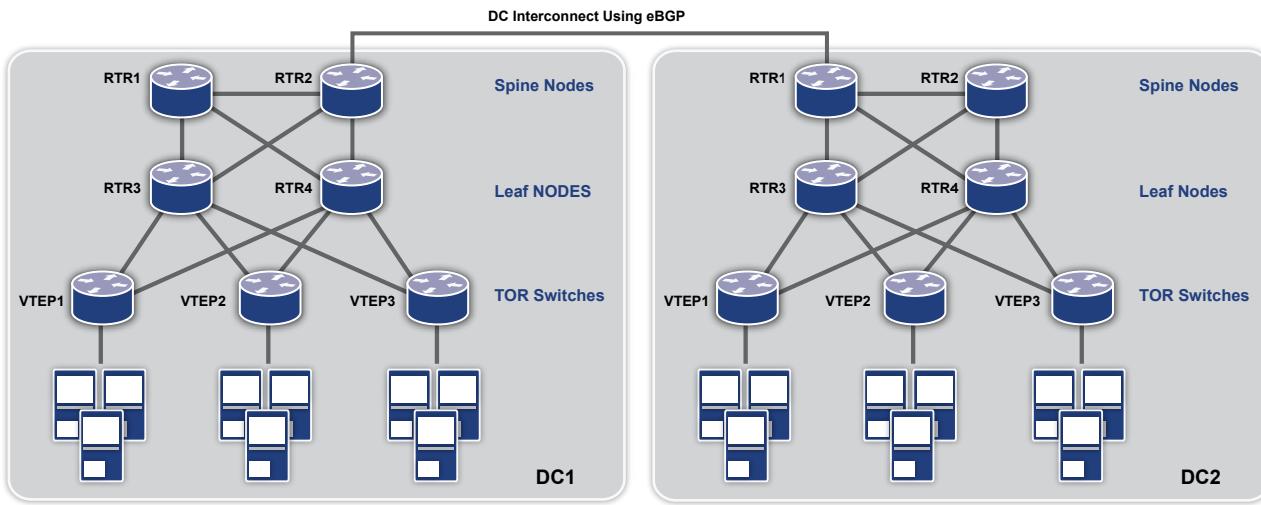
The next chapter describes the VXLAN and EVPN solution in OcNOS.

CHAPTER 2

VXLAN and EVPN Overview

- OcNOS VXLAN EVPN architecture
- VXLAN using unicast and multicast tunnels
- EVPN to learn VTEP topology
- Basic example configurations

OcNOS VXLAN EVPN Architecture



The above topology diagram demonstrates the network architecture which will be used to describe this solution. The access or top-of-rack (TOR) switches implement the VTEP functionality. The Leaf node routers act as Route Reflectors and communicate within the data center. The Spine node routers act as second-level hierarchical Route Reflectors to communicate between different data centers using eBGP on the data center interconnect (DCI). MP-BGP is used at the routers and VTEPs to implement EVPN.

VXLAN using Unicast and Multicast Tunnels

VXLAN technology is defined in RFC 7348. The OcNOS implementation of VXLAN complies with the specification. In addition to providing the option of IP multicast for broadcast, unknown and multicast (BUM) traffic, the OcNOS implementation also provides an option for head-end replication of this kind of traffic.

This configuration shows a unicast-only VXLAN VNID (Tenant), mostly used for ELINE services. Also shown in this configuration is mapping a port to a tenant and a static entry for a remote virtual machine MAC address.

```
OcNOS(config)#nvo vxlan id 2
OcNOS(config-nvo)#vxlan map-network tunnel Tunnel4
OcNOS(config-nvo)#vxlan map-access port xe1
OcNOS(config-nvo)#vxlan static-entry host-mac 0000.0000.bbbb remote-vtep-ip 2.2.2.4
```

This configuration shows a VXLAN VNID with IP multicast tunnels. All broadcast, unknown and multicast traffic will be sent on the tunnel destined to the multicast IP address specified in the configuration.

```
OcNOS(config)#nvo vxlan id 54321 multicast 239.10.10.9
```

```
OcNOS(config-nvo)#vxlan map-network tunnel Tunnel4
```

```
OcNOS(config-nvo)#vxlan map-access port-vlan xe1 2
```

This configuration shows a VXLAN VNID with head-end replication. All broadcast, unknown and multicast traffic will be sent on all the unicast tunnels mapped to this tenant, in this case on both Tunnel4 and Tunnel5.

The tenant traffic can be identified through a port or through a port+VLAN identifier mapped to the tenant.

When a port is mapped to the tenant, all traffic arriving at the port is treated as the tenant traffic and tunneled to remote VTEP(s) using the tenant id (VNID) in the VXLAN header.

When a port+VLAN is mapped to the tenant, all traffic tagged with the specified VLAN arriving at the specified port is treated as the tenant traffic. When tunneled, the packet is encapsulated as shown in the below packet capture.

```
Frame 77: 110 bytes on wire (880 bits), 110 bytes captured (880 bits)
Ethernet II, Src: Dell_d9:22:c5 (34:17:eb:d9:22:c5), Dst: Dell_d5:2e:c5 (34:17:eb:d5:2e:c5)
Internet Protocol Version 4, Src: 2.2.2.2 (2.2.2.2), Dst: 1.1.1.1 (1.1.1.1)
User Datagram Protocol, Src Port: 49152 (49152), Dst Port: 4789 (4789)
Virtual extensible Local Area Network
    Flags: 0x08
    Reserved: 0x000000
    VXLAN Network Identifier (VNI): 100
    Reserved: 0
Ethernet II, Src: 00:00:00_00:bb:bb (00:00:00:00:bb:bb), Dst: 00:00:00_00:aa:aa (00:00:00:00:aa:aa)
802.1Q Virtual LAN, PRI: 0, CFI: 0, ID: 2
    00. .... .... .... = Priority: Best Effort (default) (0)
    ...0 .... .... .... = CFI: Canonical (0)
    .... 0000 0000 0010 = ID: 2
    Type: IP (0x0800)
    Trailer: 00000000000000000000000000000000
```

EVPN Learns VTEP Topology

EVPN was introduced in RFC 7432 for VPLS. EVPN was then extended for overlay technologies like VXLAN in draft-ietf-bess-evpn-overlay-02. The OcNOS EVPN solution complies with these standards. It is implemented only for the VXLAN data plane and is extensible to other data planes.

EVPN defines the use of MP-BGP protocol for learning the MAC/IP of the hosts connected to the VTEPs. The host MAC/IP is learned at the local VTEP through data plane learning. This is then transmitted to the other VTEPs through MP BGP. The remote VTEPs learn these routes at the tunnels connected to these VTEPs. The tunnels are learned automatically through MP-BGP.

In the configuration below, BGP neighbors are configured for the EVPN address family.

```
OcNOS(config)#router bgp 1  
OcNOS(config-router)#bgp router-id 1.1.1.1  
OcNOS(config-router)#neighbor 10.1.1.2 remote-as 1  
OcNOS(config-router)#address-family l2vpn evpn  
OcNOS(config-router-af)#neighbor 10.1.1.2 activate
```

When configuring VXLAN VNIDs, it needs to be specified that EVPN will be used as a control plane. This is shown in the below configuration.

```
OcNOS(config)# nvo vxlan id 100 ingress-replication  
OcNOS(config-nvo)# vxlan host-reachability-protocol evpn-bgp vrfblue  
OcNOS(config-nvo)# vxlan map-access port xe1
```

As can be seen in the above configuration, for VNIDs that will be using EVPN, there is no need to configure a tunnel, it will be automatically configured through BGP EVPN.

When a VNID is configured with EVPN, a BGP update message is sent to the EVPN neighbors with this information. This is the “Inclusive Multicast Ethernet Tag Route”. OcNOS supports only head end replication with EVPN. Once the tunnels are established on receiving this route, the MAC IP advertisements for host MAC and IP are distributed to the remote VTEPs using BGP-MP. This is illustrated in the packet capture below. On receiving this route, the MAC/IP for the remote host is learned at this tunnel, and the packets will no longer be multicasted

```

87 104.953557 10.1.1.2      10.1.1.1      BGP      85 KEEPALIVE Message
104 134.953769 10.1.1.2      10.1.1.1      BGP      85 KEEPALIVE Message
106 134.953969 10.1.1.1      10.1.1.2      BGP      89 KEEPALIVE Message
129 164.953262 10.1.1.2      10.1.1.1      BGP      85 KEEPALIVE Message
130 164.953427 10.1.1.1      10.1.1.2      BGP      89 KEEPALIVE Message
  ...
  Flags: 0x90: Optional, Non-transitive, Complete, Extended Length
    1... .... = Optional: Optional
    .0... .... = Transitive: Non-transitive
    ..0.... = Partial: Complete
    ...1.... = Length: Extended length
  Type Code: MP_REACH_NLRI (14)
  Length: 48
  Address family: Layer-2 VPN (25)
  Subsequent address family identifier: EVPN (70)
  Next hop network address (4 bytes)
  Subnetwork points of attachment: 0
  Network layer reachability information (39 bytes)
    EVPN NLRI: MAC Advertisement Route
      AFI: MAC Advertisement Route (2)
      Length: 37
      Route Distinguisher: 0001020202020001 (2.2.2.2:1)
      ESI: 00000000000000000000
      Ethernet Tag ID: 0
      MAC Address Length: 48
      MAC Address: 00:00:00:00:bb:bb (00:00:00:00:bb:bb)
      IP Address Length: 32
      IPv4 address: 11.11.11.20 (11.11.11.20)
      MPLS Label Stack: 6, (BOGUS: Bottom of Stack NOT set!)
0080 01 02 01 01 01 00 01 03 0c 00 00 00 00 00 09  .....
0090 90 0e 00 30 00 19 46 04 02 02 02 02 00 25 00  ....0..F. ....%.
00a0 01 02 02 02 02 00 01 00 00 00 00 00 00 00 00  .....
00b0 00 00 00 00 00 30 00 00 00 00 bb bb 20 0b 0b 0b  ....0.....d...
00c0 14 00 00 64
  
```

At the route reflectors, the neighbors are configured as RR clients for the EVPN address family. The hierarchical RRs help load balance the intra and inter data center traffic.

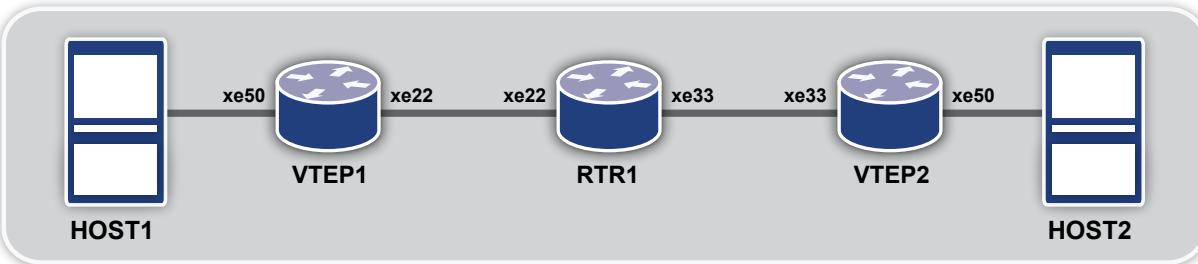
Basic Example Configuration

1. Non-EVPN: VXLAN Unicast Traffic

This configuration has the following features:

- Data plane learning
- ISIS configured as interior gateway protocol
- The loopback interface is used as the VTEP IP

Topology



VTEP1

| | Command | Purpose |
|---------|---|--|
| Step 1 | VTEP1#configure terminal | Entering configuration mode |
| Step 2 | VTEP1(config)#bridge 1 protocol mstp | Creating bridge |
| Step 3 | VTEP1(config)#interface xe50 | Configure xe50 interface. |
| Step 4 | VTEP1(config-if)#switchport | Configure the port as L2 port. |
| Step 5 | VTEP1(config-if)#bridge-group 1 | Add the port to the bridge |
| Step 6 | VTEP1(config-if)#switchport mode access | Set the port as access port |
| Step 7 | VTEP1(config-if)#no shutdown | Set interface state as up |
| Step 8 | VTEP1(config-if)#exit | Exit interface mode |
| Step 9 | VTEP1(config)#interface xe22 | Configure xe22 interface |
| Step 10 | VTEP1(config-if)#no switchport | Configure the port as L3 port. |
| Step 11 | VTEP1(config-if)#ip address 11.11.11.1/24 | Configure IP address on the interface |
| Step 12 | VTEP1(config-if)#no shutdown | Set interface state as up |
| Step 13 | VTEP1(config-if)#exit | Exit interface mode |
| Step 14 | VTEP1(config)#interface lo | Configure loopback interface |
| Step 15 | VTEP1(config-if)#ip address 2.2.2.1/24 | Configure IP address on the interface |
| Step 16 | VTEP1(config-if)#exit | Exit interface mode |
| Step 17 | VTEP1(config)#router isis ipi | Configure ISIS as IGP. |
| Step 18 | VTEP1(config-router)#is-type level-1 | Set the ISIS as Level 1. |
| Step 19 | VTEP1(config-router)#net 49.0001.1111.1111.1111.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 20 | VTEP1(config-if)#exit | Exit router mode |
| Step 21 | VTEP1(config)#interface lo | Configure loopback interface |
| Step 22 | VTEP1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 23 | VTEP1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface lo |
| Step 24 | VTEP1(config-if)#exit | Exit interface mode |
| Step 25 | VTEP1(config)#interface xe22 | Configure xe22 interface |
| Step 26 | VTEP1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 27 | VTEP1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe22 |
| Step 28 | VTEP1(config-if)#exit | Exit interface mode |
| Step 29 | VTEP1(config)#nvo vxlan enable | Enable VXLAN. Configure the node as VTEP. |
| Step 30 | VTEP1(config)#interface tunnel 98 | Configure Tunnel interface |
| Step 31 | VTEP1(config-if)#tunnel mode vxlan | Set the tunnel interface for vxlan |
| Step 32 | VTEP1(config-if)#tunnel source 2.2.2.1 | Set the tunnel source ip |
| Step 33 | VTEP1(config-if)#tunnel destination 3.3.3.1 | Set the tunnel destination ip |
| Step 34 | VTEP1(config-if)#exit | Exit interface mode |
| Step 35 | VTEP1(config)#nvo vxlan id 54321 ingress-replication | Configure a VXLAN VPN with head end replication |
| Step 36 | VTEP1(config-nvo)#vxlan map-access port xe50 | Set xe50 as access port to VPN 54321 |
| Step 37 | VTEP1(config-nvo)#vxlan map-network tunnel Tunnel98 | Set Tunnel98 as network tunnel for VPN 54321 |
| Step 38 | VTEP2(config-nvo)#vxlan static-entry host-mac 0000.0000.bbbb remote-vtep-ip 3.3.3.1 | Add a static entry for remote host |

VTEP2

| | Command | Purpose |
|---------|---|--|
| Step 1 | VTEP2#configure terminal | Entering configuration mode |
| Step 2 | VTEP2(config)#bridge 1 protocol mstp | Creating bridge |
| Step 3 | VTEP2(config)#interface xe50 | Configure xe50 interface. |
| Step 4 | VTEP2(config-if)#switchport | Configure the port as L2 port. |
| Step 5 | VTEP2(config-if)#bridge-group 1 | Add the port to the bridge |
| Step 6 | VTEP2(config-if)#switchport mode access | Set the port as access port |
| Step 7 | VTEP2(config-if)#no shutdown | Set interface state as up |
| Step 8 | VTEP2(config-if)#exit | Exit interface mode |
| Step 9 | VTEP2(config)#interface xe33 | Configure xe33 interface |
| Step 10 | VTEP2(config-if)#no switchport | Configure the port as L3 port. |
| Step 11 | VTEP2(config-if)#ip address 12.12.12.1/24 | Configure IP address on the interface |
| Step 12 | VTEP2(config-if)#no shutdown | Set interface state as up |
| Step 13 | VTEP2(config-if)#exit | Exit interface mode |
| Step 14 | VTEP2(config)#interface lo | Configure loopback interface |
| Step 15 | VTEP2(config-if)#ip address 3.3.3.1/24 | Configure IP address on the interface |
| Step 16 | VTEP2(config-if)#exit | Exit interface mode |
| Step 17 | VTEP2(config)#router isis ipi | Configure ISIS as IGP. |
| Step 18 | VTEP2(config-router)#is-type level-1 | Set the ISIS as Level 1. |
| Step 19 | VTEP2(config-router)#net 49.0001.3333.3333.3333.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 20 | VTEP2(config-if)#exit | Exit router mode |
| Step 21 | VTEP2(config)#interface lo | Configure loopback interface |
| Step 22 | VTEP2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 23 | VTEP2(config-if)#isis circuit-type level-1 | Set the circuit type for the interface lo |
| Step 24 | VTEP2(config-if)#exit | Exit interface mode |
| Step 25 | VTEP2(config)#interface xe33 | Configure xe33 interface |
| Step 26 | VTEP2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 27 | VTEP2(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe33 |
| Step 28 | VTEP2(config-if)#exit | Exit interface mode |
| Step 29 | VTEP2(config)#nvo vxlan enable | Enable VXLAN. Configure the node as VTEP. |
| Step 30 | VTEP2(config)#interface tunnel 98 | Configure Tunnel interface |
| Step 31 | VTEP2(config-if)#tunnel mode vxlan | Set the tunnel interface for vxlan |
| Step 32 | VTEP2(config-if)#tunnel source 3.3.3.1 | Set the tunnel source ip |
| Step 33 | VTEP2(config-if)#tunnel destination 2.2.2.1 | Set the tunnel destination ip |
| Step 34 | VTEP2(config-if)#exit | Exit interface mode |
| Step 35 | VTEP2(config)#nvo vxlan id 54321 ingress-replication | Configure a VXLAN VPN with head end replication |
| Step 36 | VTEP2(config-nvo)#vxlan map-access port xe50 | Set xe50 as access port to VPN 54321 |
| Step 37 | VTEP2(config-nvo)#vxlan map-network tunnel Tunnel98 | Set Tunnel98 as network tunnel for VPN 54321 |
| Step 38 | VTEP2(config-nvo)#vxlan static-entry host-mac 0000.0000.aaaa remote-vtep-ip 2.2.2.1 | Add a static entry for remote host |

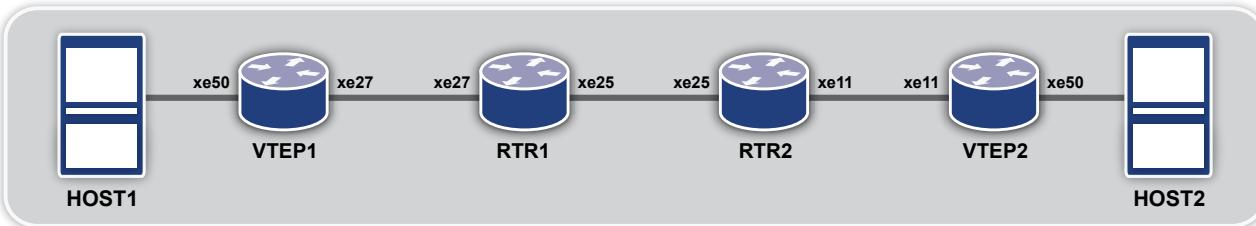
RTR1

| | Command | Purpose |
|---------|--|--|
| Step 1 | RTR1#configure terminal | Entering configuration mode |
| Step 2 | RTR1(config)#interface xe22 | Configure xe22 interface. |
| Step 3 | RTR1(config-if)#no switchport | Configure the port as L3 port. |
| Step 4 | RTR1(config-if)#ip address 11.11.11.2/24 | Configure IP address on the interface |
| Step 5 | RTR1(config-if)#no shutdown | Set interface state as up |
| Step 6 | RTR1(config-if)#exit | Exit interface mode |
| Step 7 | RTR1(config)#interface xe33 | Configure xe33 interface |
| Step 8 | RTR1(config-if)#no switchport | Configure the port as L3 port. |
| Step 9 | RTR1(config-if)#ip address 12.12.12.2/24 | Configure IP address on the interface |
| Step 10 | RTR1(config-if)#no shutdown | Set interface state as up |
| Step 11 | RTR1(config-if)#exit | Exit interface mode |
| Step 12 | RTR1(config)#router isis ipi | Configure ISIS as IGP. |
| Step 13 | RTR1(config-router)#is-type level-1 | Set the ISIS as Level 1. |
| Step 14 | RTR1(config-router)#net 49.0001.2222.2222.2222.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 15 | RTR1(config-if)#exit | Exit router mode |
| Step 16 | RTR1(config)#interface xe22 | Configure xe22 interface |
| Step 17 | RTR1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 18 | RTR1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe22 |
| Step 19 | RTR1(config-if)#exit | Exit interface mode |
| Step 20 | RTR1(config)#interface xe33 | Configure xe33 interface |
| Step 21 | RTR1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 22 | RTR1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe33 |
| Step 23 | RTR1(config-if)#exit | Exit interface mode |

2. EVPN: VXLAN with EVPN Control Plane

In this configuration, the transit BGP routers are Route Reflectors that are EBGP peers.

Topology



VTEP1

| | Command | Purpose |
|---------|--|--|
| Step 1 | VTEP1#configure terminal | Entering configuration mode |
| Step 2 | VTEP1(config)#bridge 1 protocol mstp | Creating bridge |
| Step 3 | VTEP1(config)#interface xe50 | Configure xe50 interface. |
| Step 4 | VTEP1(config-if)#switchport | Configure the port as L2 port. |
| Step 5 | VTEP1(config-if)#bridge-group 1 | Add the port to the bridge |
| Step 6 | VTEP1(config-if)#switchport mode access | Set the port as access port |
| Step 7 | VTEP1(config-if)#no shutdown | Set interface state as up |
| Step 8 | VTEP1(config-if)#exit | Exit interface mode |
| Step 9 | VTEP1(config)#interface xe27 | Configure xe27 interface |
| Step 10 | VTEP1(config-if)#no switchport | Configure the port as L3 port. |
| Step 11 | VTEP1(config-if)#ip address 3.3.3.1/24 | Configure IP address on the interface |
| Step 12 | VTEP1(config-if)#no shutdown | Set interface state as up |
| Step 13 | VTEP1(config-if)#exit | Exit interface mode |
| Step 14 | VTEP1(config)#router isis ipi | Configure ISIS as IGP. |
| Step 15 | VTEP1(config-router)#is-type level-2 only | Set the ISIS as Level 2 |
| Step 16 | VTEP1(config-router)#net 49.0001.1111.1111.1111.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 17 | VTEP1(config-if)#exit | Exit router mode |
| Step 18 | VTEP1(config)#interface xe27 | Configure xe27 interface |
| Step 19 | VTEP1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 20 | VTEP1(config-if)#isis circuit-type level-2 | Set the circuit type for the interface xe27 |
| Step 21 | VTEP1(config-if)#exit | Exit interface mode |
| Step 22 | VTEP1(config)#nvo vxlan enable | Enable VXLAN. Configure the node as VTEP. |
| Step 23 | VTEP1(config)#nvo vxlan vtep-ip-global 3.3.3.1 | Configure the VTEP IP to be used in EVPN. |
| Step 24 | VTEP1(config)#router bgp 1 | Configure BGP Router |
| Step 25 | VTEP1(config-router)#neighbor 3.3.3.2 remote-as 1 | Configure BGP neighbor |
| Step 26 | VTEP1(config-router)#address-family l2vpn evpn | Set the address family to evpn |
| Step 27 | VTEP1(config-router-af)#neighbor 3.3.3.2 activate | Activate the neighbor for evpn address family. |
| Step 28 | VTEP1(config-router-af)#exit | Exit address family mode |
| Step 29 | VTEP1(config-router)#exit | Exit router mode |
| Step 30 | VTEP1(config)#ip vrf vxlan100 | Configure VRF for EVPN |
| Step 31 | VTEP1(config-vrf)#rd 100:1 | Configure Route Distinguisher |
| Step 32 | VTEP1(config-vrf)#route-target both 100:100 | Configure Route Target |
| Step 33 | VTEP1(config-vrf)#exit | Exit VRF mode |
| Step 34 | VTEP1(config)#nvo vxlan id 100 ingress-replication | Configure a VXLAN VPN with head end replication |
| Step 35 | VTEP1(config-nvo)#vxlan host-reachability-protocol evpn-bgp vxlan100 | Set EVPN based learning for VXLAN VPN 100 |
| Step 36 | VTEP1(config-nvo)#vxlan map-access port xe50 | Set xe50 as access port to VPN 100 |
| Step 37 | VTEP1(config-nvo)#exit | Exit NVO mode |

RTR1

| | Command | Purpose |
|---------|--|--|
| Step 1 | RTR1#configure terminal | Entering configuration mode |
| Step 2 | RTR1(config)#interface xe27 | Configure xe27 interface |
| Step 3 | RTR1(config-if)#no switchport | Configure the port as L3 port. |
| Step 4 | RTR1(config-if)#ip address 3.3.3.2/24 | Configure IP address on the interface |
| Step 5 | RTR1(config-if)#no shutdown | Set interface state as up |
| Step 6 | RTR1(config-if)#exit | Exit interface mode |
| Step 7 | RTR1(config)#interface xe25 | Configure xe25 interface |
| Step 8 | RTR1(config-if)#no switchport | Configure the port as L3 port. |
| Step 9 | RTR1(config-if)#ip address 2.2.2.2/24 | Configure IP address on the interface |
| Step 10 | RTR1(config-if)#no shutdown | Set interface state as up |
| Step 11 | RTR1(config-if)#exit | Exit interface mode |
| Step 12 | RTR1(config)#router isis ipi | Configure ISIS as IGP. |
| Step 13 | RTR1(config-router)#is-type level-2 only | Set the ISIS as Level 2 |
| Step 14 | RTR1(config-router)#net 49.0001.2222.2222.2222.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 15 | RTR1(config-if)#exit | Exit router mode |
| Step 16 | RTR1(config)#interface xe27 | Configure xe27 interface |
| Step 17 | RTR1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 18 | RTR1(config-if)#isis circuit-type level-2 | Set the circuit type for the interface xe27 |
| Step 19 | RTR1(config-if)#exit | Exit interface mode |
| Step 20 | RTR1(config)#interface xe25 | Configure xe25 interface |
| Step 21 | RTR1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 22 | RTR1(config-if)#isis circuit-type level-2 | Set the circuit type for the interface xe25 |
| Step 23 | RTR1(config-if)#exit | Exit interface mode |
| Step 24 | RTR1(config)#router bgp 1 | Configure BGP Router |
| Step 25 | RTR1(config-router)#neighbor 2.2.2.1 remote-as 2 | Configure BGP neighbor |
| Step 26 | RTR1(config-router)#neighbor 3.3.3.1 remote-as 1 | Configure BGP neighbor |
| Step 27 | RTR1(config-router)#address-family l2vpn evpn | Set the address family to evpn |
| Step 28 | RTR1(config-router-af)#neighbor 2.2.2.1 activate | Activate the neighbor for evpn address family. |
| Step 29 | RTR1(config-router-af)#neighbor 3.3.3.1 activate | Activate the neighbor for evpn address family. |
| Step 30 | RTR1(config-router-af)#neighbor 3.3.3.1 route-reflector-client | Configure RR client for this RR |
| Step 31 | RTR1(config-router-af)#exit | Exit address family mode |
| Step 32 | RTR1(config-router)#exit | Exit router mode |

RTR2

| | Command | Purpose |
|---------|---|--|
| Step 1 | RTR2#configure terminal | Entering configuration mode |
| Step 2 | RTR2(config)#interface xe25 | Configure xe25 interface |
| Step 3 | RTR2(config-if)#no switchport | Configure the port as L3 port. |
| Step 4 | RTR2(config-if)#ip address 2.2.2.1/24 | Configure IP address on the interface |
| Step 5 | RTR2(config-if)#no shutdown | Set interface state as up |
| Step 6 | RTR2(config-if)#exit | Exit interface mode |
| Step 7 | RTR2(config)#interface xe11 | Configure xe11 interface |
| Step 8 | RTR2(config-if)#no switchport | Configure the port as L3 port. |
| Step 9 | RTR2(config-if)#ip address 4.4.4.1/24 | Configure IP address on the interface |
| Step 10 | RTR2(config-if)#no shutdown | Set interface state as up |
| Step 11 | RTR2(config-if)#exit | Exit interface mode |
| Step 12 | RTR2(config)#router isis ipi | Configure ISIS as IGP. |
| Step 13 | RTR2(config-router)#is-type level-2 only | Set the ISIS as Level 2 |
| Step 14 | RTR2(config-router)#net 49.0001.3333.3333.3333.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 15 | RTR2(config-if)#exit | Exit router mode |
| Step 16 | RTR2(config)#interface xe25 | Configure xe25 interface |
| Step 17 | RTR2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 18 | RTR2(config-if)#isis circuit-type level-2 | Set the circuit type for the interface xe25 |
| Step 19 | RTR2(config-if)#exit | Exit interface mode |
| Step 20 | RTR2(config)#interface xe11 | Configure xe11 interface |
| Step 21 | RTR2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 22 | RTR2(config-if)#isis circuit-type level-2 | Set the circuit type for the interface xe11 |
| Step 23 | RTR2(config-if)#exit | Exit interface mode |
| Step 24 | RTR2(config)#router bgp 2 | Configure BGP Router |
| Step 25 | RTR2(config-router)#neighbor 2.2.2.2 remote-as 1 | Configure BGP neighbor |
| Step 26 | RTR2(config-router)#neighbor 4.4.4.2 remote-as 2 | Configure BGP neighbor |
| Step 27 | RTR2(config-router)#address-family l2vpn evpn | Set the address family to evpn |
| Step 28 | RTR2(config-router-af)#neighbor 2.2.2.2 activate | Activate the neighbor for evpn address family. |
| Step 29 | RTR2(config-router-af)#neighbor 4.4.4.2 activate | Activate the neighbor for evpn address family. |
| Step 30 | RTR2(config-router-af)#neighbor 4.4.4.2 route-reflector-client | Configure RR client for this RR |
| Step 31 | RTR2(config-router-af)#exit | Exit address family mode |
| Step 32 | RTR2(config-router)#exit | Exit router mode |

VTEP2

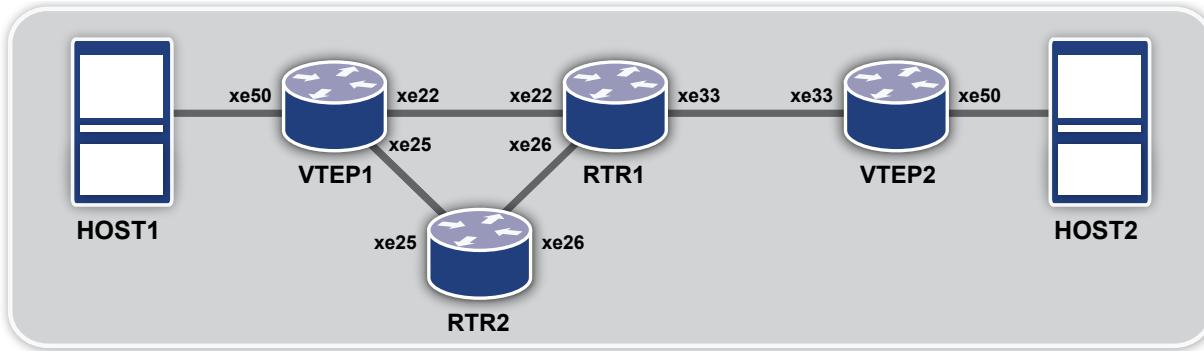
| | Command | Purpose |
|---------|--|--|
| Step 1 | VTEP2#configure terminal | Entering configuration mode |
| Step 2 | VTEP2(config)#bridge 1 protocol mstp | Creating bridge |
| Step 3 | VTEP2(config)#interface xe50 | Configure xe50 interface. |
| Step 4 | VTEP2(config-if)#switchport | Configure the port as L2 port. |
| Step 5 | VTEP2(config-if)#bridge-group 1 | Add the port to the bridge |
| Step 6 | VTEP2(config-if)#switchport mode access | Set the port as access port |
| Step 7 | VTEP2(config-if)#no shutdown | Set interface state as up |
| Step 8 | VTEP2(config-if)#exit | Exit interface mode |
| Step 9 | VTEP2(config)#interface xe11 | Configure xe11 interface |
| Step 10 | VTEP2(config-if)#no switchport | Configure the port as L3 port. |
| Step 11 | VTEP2(config-if)#ip address 4.4.4.2/24 | Configure IP address on the interface |
| Step 12 | VTEP2(config-if)#no shutdown | Set interface state as up |
| Step 13 | VTEP2(config-if)#exit | Exit interface mode |
| Step 14 | VTEP2(config)#router isis ipi | Configure ISIS as IGP. |
| Step 15 | VTEP2(config-router)#is-type level-2 only | Set the ISIS as Level 2 |
| Step 16 | VTEP2(config-router)#net 49.0001.4444.4444.4444.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 17 | VTEP2(config-if)#exit | Exit router mode |
| Step 18 | VTEP2(config)#interface xe11 | Configure xe11 interface |
| Step 19 | VTEP2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 20 | VTEP2(config-if)#isis circuit-type level-2 | Set the circuit type for the interface xe27 |
| Step 21 | VTEP2(config-if)#exit | Exit interface mode |
| Step 22 | VTEP2(config)#nvo vxlan enable | Enable VXLAN. Configure the node as VTEP. |
| Step 23 | VTEP2(config)#nvo vxlan vtep-ip-global 4.4.4.2 | Configure the VTEP IP to be used in EVPN. |
| Step 24 | VTEP2(config)#router bgp 2 | Configure BGP Router |
| Step 25 | VTEP2(config-router)#neighbor 4.4.4.1 remote-as 2 | Configure BGP neighbor |
| Step 26 | VTEP2(config-router)#address-family l2vpn evpn | Set the address family to evpn |
| Step 27 | VTEP2(config-router-af)#neighbor 4.4.4.1 activate | Activate the neighbor for evpn address family. |
| Step 28 | VTEP2(config-router-af)#exit | Exit address family mode |
| Step 29 | VTEP2(config-router)#exit | Exit router mode |
| Step 30 | VTEP2(config)#ip vrf vxlan100 | Configure VRF for EVPN |
| Step 31 | VTEP2(config-vrf)#rd 101:1 | Configure Route Distinguisher |
| Step 32 | VTEP2(config-vrf)#route-target both 100:100 | Configure Route Target |
| Step 33 | VTEP2(config-vrf)#exit | Exit VRF mode |
| Step 34 | VTEP2(config)#nvo vxlan id 100 ingress-replication | Configure a VXLAN VPN with head end replication |
| Step 35 | VTEP2(config-nvo)#vxlan host-reachability-protocol evpn-bgp vxlan100 | Set EVPN based learning for VXLAN VPN 100 |
| Step 36 | VTEP2(config-nvo)#vxlan map-access port xe50 | Set xe50 as access port to VPN 100 |
| Step 37 | VTEP2(config-nvo)#exit | Exit NVO mode |

3. Non-EVPN: VXLAN with Data Plane Learning

This configuration has the following features:

- The VTEP is connected to more than one router
- Link failover happens when one router interface shuts down and then the packets are forwarded using the other router

Topology



VTEP1

| | Command | Purpose |
|---------|---|---------------------------------------|
| Step 1 | VTEP1#configure terminal | Entering configuration mode |
| Step 2 | VTEP1(config)#bridge 1 protocol mstp | Creating bridge |
| Step 3 | VTEP1(config)#interface xe50 | Configure xe50 interface. |
| Step 4 | VTEP1(config-if)#switchport | Configure the port as L2 port. |
| Step 5 | VTEP1(config-if)#bridge-group 1 | Add the port to the bridge |
| Step 6 | VTEP1(config-if)#switchport mode access | Set the port as access port |
| Step 7 | VTEP1(config-if)#no shutdown | Set interface state as up |
| Step 8 | VTEP1(config-if)#exit | Exit interface mode |
| Step 9 | VTEP1(config)#interface xe22 | Configure xe22 interface |
| Step 10 | VTEP1(config-if)#no switchport | Configure the port as L3 port. |
| Step 11 | VTEP1(config-if)#ip address 11.11.11.1/24 | Configure IP address on the interface |
| Step 12 | VTEP1(config-if)#no shutdown | Set interface state as up |
| Step 13 | VTEP1(config-if)#exit | Exit interface mode |
| Step 14 | VTEP1(config)#interface xe25 | Configure xe25 interface |
| Step 15 | VTEP1(config-if)#no switchport | Configure the port as L3 port. |
| Step 16 | VTEP1(config-if)#ip address 21.21.21.1/24 | Configure IP address on the interface |
| Step 17 | VTEP1(config-if)#no shutdown | Set interface state as up |
| Step 18 | VTEP1(config-if)#exit | Exit interface mode |
| Step 19 | VTEP1(config)#interface lo | Configure loopback interface |
| Step 20 | VTEP1(config-if)#ip address 2.2.2.1/24 | Configure IP address on the interface |
| Step 21 | VTEP1(config-if)#exit | Exit interface mode |
| Step 22 | VTEP1(config)#router isis ipi | Configure ISIS as IGP. |

| | Command | Purpose |
|---------|---|--|
| Step 23 | VTEP1(config-router)#is-type level-1 | Set the ISIS as Level 1. |
| Step 24 | VTEP1(config-router)#net 49.0001.1111.1111.1111.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 25 | VTEP1(config-if)#exit | Exit router mode |
| Step 26 | VTEP1(config)#interface lo | Configure loopback interface |
| Step 27 | VTEP1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 28 | VTEP1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface lo |
| Step 29 | VTEP1(config-if)#exit | Exit interface mode |
| Step 30 | VTEP1(config)#interface xe22 | Configure xe22 interface |
| Step 32 | VTEP1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe22 |
| Step 33 | VTEP1(config-if)#exit | Exit interface mode |
| Step 34 | VTEP1(config)#interface xe22 | Configure xe22 interface |
| Step 35 | VTEP1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 36 | VTEP1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe22 |
| Step 37 | VTEP1(config-if)#exit | Exit interface mode |
| Step 38 | VTEP1(config)#nvo vxlan enable | Enable VXLAN. Configure the node as VTEP. |
| Step 39 | VTEP1(config)#interface tunnel 98 | Configure Tunnel interface |
| Step 40 | VTEP1(config-if)#tunnel mode vxlan | Set the tunnel interface for vxlan |
| Step 41 | VTEP1(config-if)#tunnel source 2.2.2.1 | Set the tunnel source ip |
| Step 42 | VTEP1(config-if)#tunnel destination 3.3.3.1 | Set the tunnel destination ip |
| Step 43 | VTEP1(config-if)#exit | Exit interface mode |
| Step 44 | VTEP1(config)#nvo vxlan id 54321 ingress-replication | Configure a VXLAN VPN with head end replication |
| Step 45 | VTEP1(config-nvo)#vxlan map-access port xe50 | Set xe50 as access port to VPN 54321 |
| Step 46 | VTEP1(config-nvo)#vxlan map-network tunnel Tunnel98 | Set Tunnel98 as network tunnel for VPN 54321 |
| Step 47 | VTEP1(config-nvo)#vxlan static-entry host-mac 0000.0000.bbbb remote-vtep-ip 3.3.3.1 | Add a static entry for remote host |

VTEP2

| | Command | Purpose |
|---------|---|--|
| Step 1 | VTEP2#configure terminal | Entering configuration mode |
| Step 2 | VTEP2(config)#bridge 1 protocol mstp | Creating bridge |
| Step 3 | VTEP2(config)#interface xe50 | Configure xe50 interface. |
| Step 4 | VTEP2(config-if)#switchport | Configure the port as L2 port. |
| Step 5 | VTEP2(config-if)#bridge-group 1 | Add the port to the bridge |
| Step 6 | VTEP2(config-if)#switchport mode access | Set the port as access port |
| Step 7 | VTEP2(config-if)#no shutdown | Set interface state as up |
| Step 8 | VTEP2(config-if)#exit | Exit interface mode |
| Step 9 | VTEP2(config)#interface xe33 | Configure xe33 interface |
| Step 10 | VTEP2(config-if)#no switchport | Configure the port as L3 port. |
| Step 11 | VTEP2(config-if)#ip address 12.12.12.1/24 | Configure IP address on the interface |
| Step 12 | VTEP2(config-if)#no shutdown | Set interface state as up |
| Step 13 | VTEP2(config-if)#exit | Exit interface mode |
| Step 14 | VTEP2(config)#interface lo | Configure loopback interface |
| Step 15 | VTEP2(config-if)#ip address 3.3.3.1/24 | Configure IP address on the interface |
| Step 16 | VTEP2(config-if)#exit | Exit interface mode |
| Step 17 | VTEP2(config)#router isis ipi | Configure ISIS as IGP. |
| Step 18 | VTEP2(config-router)#is-type level-1 | Set the ISIS as Level 1. |
| Step 19 | VTEP2(config-router)#net 49.0001.3333.3333.3333.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 20 | VTEP2(config-if)#exit | Exit router mode |
| Step 21 | VTEP2(config)#interface lo | Configure loopback interface |
| Step 22 | VTEP2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 23 | VTEP2(config-if)#isis circuit-type level-1 | Set the circuit type for the interface lo |
| Step 24 | VTEP2(config-if)#exit | Exit interface mode |
| Step 25 | VTEP2(config)#interface xe33 | Configure xe33 interface |
| Step 26 | VTEP2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 27 | VTEP2(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe33 |
| Step 28 | VTEP2(config-if)#exit | Exit interface mode |
| Step 29 | VTEP2(config)#nvo vxlan enable | Enable VXLAN. Configure the node as VTEP. |
| Step 30 | VTEP2(config)#interface tunnel 98 | Configure Tunnel interface |
| Step 31 | VTEP2(config-if)#tunnel mode vxlan | Set the tunnel interface for vxlan |
| Step 32 | VTEP2(config-if)#tunnel source 3.3.3.1 | Set the tunnel source ip |
| Step 33 | VTEP2(config-if)#tunnel destination 2.2.2.1 | Set the tunnel destination ip |
| Step 34 | VTEP2(config-if)#exit | Exit interface mode |
| Step 35 | VTEP2(config)#nvo vxlan id 54321 ingress-replication | Configure a VXLAN VPN with head end replication |
| Step 36 | VTEP2(config-nvo)#vxlan map-access port xe50 | Set xe50 as access port to VPN 54321 |
| Step 37 | VTEP2(config-nvo)#vxlan map-network tunnel Tunnel98 | Set Tunnel98 as network tunnel for VPN 54321 |
| Step 38 | VTEP2(config-nvo)#vxlan static-entry host-mac 0000.0000.aaaa remote-vtep-ip 2.2.2.1 | Add a static entry for remote host |

RTR1

| | Command | Purpose |
|---------|--|--|
| Step 1 | RTR1#configure terminal | Entering configuration mode |
| Step 2 | RTR1(config)#interface xe22 | Configure xe22 interface. |
| Step 3 | RTR1(config-if)#no switchport | Configure the port as L3 port. |
| Step 4 | RTR1(config-if)#ip address 11.11.11.2/24 | Configure IP address on the interface |
| Step 5 | RTR1(config-if)#no shutdown | Set interface state as up |
| Step 6 | RTR1(config-if)#exit | Exit interface mode |
| Step 7 | RTR2(config)#interface xe26 | Configure xe26 interface |
| Step 8 | RTR2(config-if)#no switchport | Configure the port as L3 port. |
| Step 9 | RTR2(config-if)#ip address 22.22.22.1/24 | Configure IP address on the interface |
| Step 10 | RTR2(config-if)#no shutdown | Set interface state as up |
| Step 11 | RTR2(config-if)#exit | Exit interface mode |
| Step 12 | RTR1(config)#interface xe33 | Configure xe33 interface |
| Step 13 | RTR1(config-if)#no switchport | Configure the port as L3 port. |
| Step 14 | RTR1(config-if)#ip address 12.12.12.2/24 | Configure IP address on the interface |
| Step 15 | RTR1(config-if)#no shutdown | Set interface state as up |
| Step 16 | RTR1(config-if)#exit | Exit interface mode |
| Step 17 | RTR1(config)#router isis ipi | Configure ISIS as IGP. |
| Step 18 | RTR1(config-router)#is-type level-1 | Set the ISIS as Level 1. |
| Step 19 | RTR1(config-router)#net 49.0001.2222.2222.2222.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 20 | RTR1(config-if)#exit | Exit router mode |
| Step 21 | RTR1(config)#interface xe22 | Configure xe22 interface |
| Step 22 | RTR1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 23 | RTR1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe22 |
| Step 24 | RTR1(config-if)#exit | Exit interface mode |
| Step 25 | RTR1(config)#interface xe33 | Configure xe33 interface |
| Step 26 | RTR1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 27 | RTR1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe33 |
| Step 28 | RTR1(config-if)#exit | Exit interface mode |
| Step 29 | RTR2(config)#interface xe26 | Configure xe26 interface |
| Step 30 | RTR2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 31 | RTR2(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe26 |
| Step 32 | RTR2(config-if)#exit | Exit interface mode |

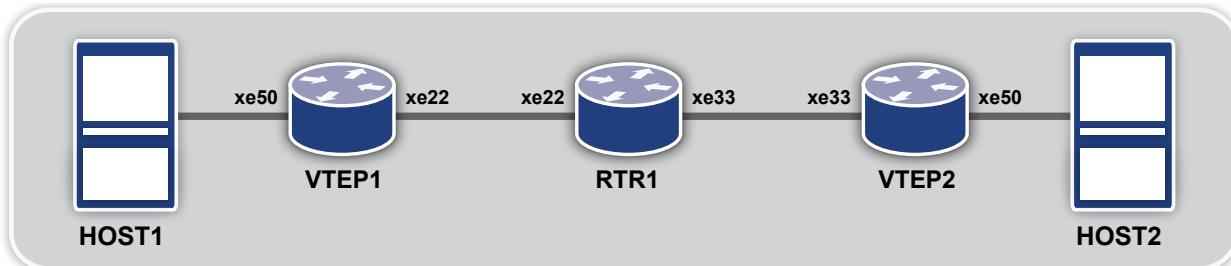
RTR2

| | Command | Purpose |
|---------|--|--|
| Step 1 | RTR2#configure terminal | Entering configuration mode |
| Step 2 | RTR2(config)#interface xe25 | Configure xe25 interface. |
| Step 3 | RTR2(config-if)#no switchport | Configure the port as L3 port. |
| Step 4 | RTR2(config-if)#ip address 21.21.21.2/24 | Configure IP address on the interface |
| Step 5 | RTR2(config-if)#no shutdown | Set interface state as up |
| Step 6 | RTR2(config-if)#exit | Exit interface mode |
| Step 7 | RTR2(config)#interface xe26 | Configure xe26 interface |
| Step 8 | RTR2(config-if)#no switchport | Configure the port as L3 port. |
| Step 9 | RTR2(config-if)#ip address 22.22.22.2/24 | Configure IP address on the interface |
| Step 10 | RTR2(config-if)#no shutdown | Set interface state as up |
| Step 11 | RTR2(config-if)#exit | Exit interface mode |
| Step 12 | RTR2(config)#router isis ipi | Configure ISIS as IGP. |
| Step 13 | RTR2(config-router)#is-type level-1 | Set the ISIS as Level 1. |
| Step 14 | RTR2(config-router)#net 49.0001.4444.4444.4444.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 15 | RTR2(config-if)#exit | Exit router mode |
| Step 16 | RTR2(config)#interface xe25 | Configure xe25 interface |
| Step 17 | RTR2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 18 | RTR2(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe25 |
| Step 19 | RTR2(config-if)#exit | Exit interface mode |
| Step 20 | RTR2(config)#interface xe26 | Configure xe26 interface |
| Step 21 | RTR2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 22 | RTR2(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe26 |
| Step 23 | RTR2(config-if)#exit | Exit interface mode |

4. EVPN: VXLAN Tenant Identification using Port and VLAN

All the other test cases mentioned until have used only the port for identification. In this configuration, the VLAN identifier (2 in this example) is also used along with port to identify the tenant. So, data traffic must be tagged with the configured VLAN (2 in this case).

Topology



VTEP1

| | Command | Purpose |
|---------|--|--|
| Step 1 | VTEP1#configure terminal | Entering configuration mode |
| Step 2 | VTEP1(config)#bridge 1 protocol mstp | Creating bridge |
| Step 3 | VTEP1(config)#vlan 2-10 bridge 1 state enable | Create VLANs for the bridge |
| Step 4 | VTEP1(config)#interface xe50 | Configure xe50 interface. |
| Step 5 | VTEP1(config-if)#switchport | Configure the port as L2 port. |
| Step 6 | VTEP1(config-if)#bridge-group 1 | Add the port to the bridge |
| Step 7 | VTEP1(config-if)#switchport mode hybrid | Set the port as hybrid port |
| Step 8 | VTEP1(config-if)#switchport hybrid allowed vlan add 2 egress-tagged enable | Make the port a member of VLAN 2 |
| Step 9 | VTEP1(config-if)#no shutdown | Set interface state as up |
| Step 10 | VTEP1(config-if)#exit | Exit interface mode |
| Step 11 | VTEP1(config)#interface xe22 | Configure xe22 interface |
| Step 12 | VTEP1(config-if)#no switchport | Configure the port as L3 port. |
| Step 13 | VTEP1(config-if)#ip address 10.1.1.2/24 | Configure IP address on the interface |
| Step 14 | VTEP1(config-if)#no shutdown | Set interface state as up |
| Step 15 | VTEP1(config-if)#exit | Exit interface mode |
| Step 16 | VTEP1(config)#interface lo | Configure lo interface |
| Step 17 | VTEP1(config-if)#ip address 3.3.3.3/32 | Configure IP address on the interface |
| Step 18 | VTEP1(config-if)#exit | Exit interface mode |
| Step 19 | VTEP1(config)#router isis ipi | Configure ISIS as IGP. |
| Step 20 | VTEP1(config-router)#is-type level-1 | Set the ISIS as Level 1 |
| Step 21 | VTEP1(config-router)#net 49.0001.3333.3333.3333.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 22 | VTEP1(config-if)#exit | Exit router mode |
| Step 23 | VTEP1(config)#interface xe22 | Configure xe22 interface |
| Step 24 | VTEP1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 25 | VTEP1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface lo |
| Step 26 | VTEP1(config-if)#exit | Exit interface mode |
| Step 27 | VTEP1(config)#interface lo | Configure lo interface |
| Step 28 | VTEP1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 29 | VTEP1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface lo |
| Step 30 | VTEP1(config-if)#exit | Exit interface mode |
| Step 31 | VTEP1(config)#nvo vxlan enable | Enable VXLAN. Configure the node as VTEP. |
| Step 32 | VTEP1(config)#nvo vxlan vtep-ip-global 3.3.3.3 | Configure the VTEP IP to be used in EVPN. |
| Step 33 | VTEP1(config)#router bgp 1 | Configure BGP Router |
| Step 34 | VTEP1(config-router)#bgp router-id 3.3.3.3 | Configure BGP Router id |
| Step 35 | VTEP1(config-router)#neighbor 10.1.1.1 remote-as 1 | Configure BGP neighbor |
| Step 36 | VTEP1(config-router)#address-family l2vpn evpn | Set the address family to evpn |
| Step 37 | VTEP1(config-router-af)#neighbor 10.1.1.1 activate | Activate the neighbor for evpn address family. |
| Step 38 | VTEP1(config-router-af)#exit | Exit address family mode |

| | Command | Purpose |
|---------|--|---|
| Step 39 | VTEP1(config-router)#exit | Exit router mode |
| Step 40 | VTEP1(config)#ip vrf vxlan100 | Configure VRF for EVPN |
| Step 41 | VTEP1(config-vrf)#rd 3.3.3.3:1 | Configure Route Distinguisher |
| Step 42 | VTEP1(config-vrf)#route-target both 3.3.3.3:1 | Configure Route Target |
| Step 43 | VTEP1(config-vrf)#exit | Exit VRF mode |
| Step 44 | VTEP1(config)#nvo vxlan id 100 ingress-replication | Configure a VXLAN VPN with head end replication |
| Step 45 | VTEP1(config-nvo)#vxlan host-reachability-protocol evpn-bgp vxlan100 | Set EVPN based learning for VXLAN VPN 100 |
| Step 46 | VTEP1(config-nvo)#vxlan map-access port-vlan xe50 2 | Set xe50 and vlan 2 as access port to VPN 100 |
| Step 47 | VTEP1(config-nvo)#exit | Exit NVO mode |

RTR1

| | Command | Purpose |
|---------|---|--|
| Step 1 | RTR1#configure terminal | Entering configuration mode |
| Step 2 | RTR1(config)#interface xe22 | Configure xe22 interface |
| Step 3 | RTR1(config-if)#no switchport | Configure the port as L3 port. |
| Step 4 | RTR1(config-if)#ip address 10.1.1.1/24 | Configure IP address on the interface |
| Step 5 | RTR1(config-if)#no shutdown | Set interface state as up |
| Step 6 | RTR1(config-if)#exit | Exit interface mode |
| Step 7 | RTR1(config)#interface xe33 | Configure xe33 interface |
| Step 8 | RTR1(config-if)#no switchport | Configure the port as L3 port. |
| Step 9 | RTR1(config-if)#ip address 10.2.1.1/24 | Configure IP address on the interface |
| Step 10 | RTR1(config-if)#no shutdown | Set interface state as up |
| Step 11 | RTR1(config-if)#exit | Exit interface mode |
| Step 12 | RTR1(config)#router isis ipi | Configure ISIS as IGP. |
| Step 13 | RTR1(config-router)#is-type level 1 | Set the ISIS as Level 1 |
| Step 14 | RTR1(config-router)#net 49.0001.2222.2222.2222.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 15 | RTR1(config-if)#exit | Exit router mode |
| Step 16 | RTR1(config)#interface xe22 | Configure xe22 interface |
| Step 17 | RTR1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 18 | RTR1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe22 |
| Step 19 | RTR1(config-if)#exit | Exit interface mode |
| Step 20 | RTR1(config)#interface xe33 | Configure xe33 interface |
| Step 21 | RTR1(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 22 | RTR1(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe33 |
| Step 23 | RTR1(config-if)#exit | Exit interface mode |
| Step 24 | RTR1(config)#router bgp 1 | Configure BGP Router |
| Step 25 | RTR1(config-router)#neighbor 10.1.1.2 remote-as 1 | Configure BGP neighbor |

| | Command | Purpose |
|---------|--|--|
| Step 26 | RTR1(config-router)#neighbor 10.2.1.2 remote-as 1 | Configure BGP neighbor |
| Step 27 | RTR1(config-router)#address-family l2vpn evpn | Set the address family to evpn |
| Step 28 | RTR1(config-router-af)#neighbor 10.1.1.2 activate | Activate the neighbor for evpn address family. |
| Step 29 | RTR1(config-router-af)#neighbor 10.2.1.2 activate | Activate the neighbor for evpn address family. |
| Step 30 | RTR1(config-router-af)#neighbor 10.1.1.2 route-reflector-client | Configure RR client for this RR |
| Step 31 | RTR1(config-router-af)#neighbor 10.2.1.2 route-reflector-client | Configure RR client for this RR |
| Step 32 | RTR1(config-router-af)#exit | Exit address family mode |
| Step 33 | RTR1(config-router)#exit | Exit router mode |

VTEP2

| | Command | Purpose |
|---------|---|--|
| Step 1 | VTEP2#configure terminal | Entering configuration mode |
| Step 2 | VTEP2(config)#bridge 1 protocol mstp | Creating bridge |
| Step 3 | VTEP2(config)#vlan 2-10 bridge 1 state enable | Create VLANs for the bridge |
| Step 4 | VTEP2(config)#interface xe50 | Configure xe50 interface. |
| Step 5 | VTEP2(config-if)#switchport | Configure the port as L2 port. |
| Step 6 | VTEP2(config-if)#bridge-group 1 | Add the port to the bridge |
| Step 7 | VTEP2(config-if)#switchport mode hybrid | Set the port as hybrid port |
| Step 8 | VTEP2(config-if)#switchport hybrid allowed vlan add 2 egress-tagged enable | Make the port a member of VLAN 2 |
| Step 9 | VTEP2(config-if)#no shutdown | Set interface state as up |
| Step 10 | VTEP2(config-if)#exit | Exit interface mode |
| Step 11 | VTEP2(config)#interface xe33 | Configure xe33 interface |
| Step 12 | VTEP2(config-if)#no switchport | Configure the port as L3 port. |
| Step 13 | VTEP2(config-if)#ip address 10.2.1.2/24 | Configure IP address on the interface |
| Step 14 | VTEP2(config-if)#no shutdown | Set interface state as up |
| Step 15 | VTEP2(config-if)#exit | Exit interface mode |
| Step 16 | VTEP2(config)#interface lo | Configure lo interface |
| Step 17 | VTEP2(config-if)#ip address 4.4.4.4/32 | Configure IP address on the interface |
| Step 18 | VTEP2(config-if)#exit | Exit interface mode |
| Step 19 | VTEP2(config)#router isis ipi | Configure ISIS as IGP. |
| Step 20 | VTEP2(config-router)#is-type level-1 | Set the ISIS as Level 1 |
| Step 21 | VTEP2(config-router)#net 49.0001.4444.4444.4444.00 | Establish a Network Entity Title for this instance, specifying the area address and the system ID. |
| Step 22 | VTEP2(config-if)#exit | Exit router mode |
| Step 23 | VTEP2(config)#interface xe33 | Configure xe33 interface |

| | Command | Purpose |
|---------|--|---|
| Step 24 | VTEP2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 25 | VTEP2(config-if)#isis circuit-type level-1 | Set the circuit type for the interface xe33 |
| Step 26 | VTEP2(config-if)#exit | Exit interface mode |
| Step 27 | VTEP2(config)#interface lo | Configure lo interface |
| Step 28 | VTEP2(config-if)#ip router isis ipi | Enable IS-IS routing on an interface for area ipi |
| Step 29 | VTEP2(config-if)#isis circuit-type level-1 | Set the circuit type for the interface lo |
| Step 30 | VTEP2(config-if)#exit | Exit interface mode |
| Step 31 | VTEP2(config)#nvo vxlan enable | Enable VXLAN. Configure the node as VTEP. |
| Step 32 | VTEP2(config)#nvo vxlan vtep-ip-global 4.4.4.4 | Configure the VTEP IP to be used in EVPN. |
| Step 33 | VTEP2(config)#router bgp 1 | Configure BGP Router |
| Step 34 | VTEP2(config-router)#bgp router-id 4.4.4.4 | Configure BGP Router id |
| Step 35 | VTEP2(config-router)#neighbor 10.2.1.1 remote-as 1 | Configure BGP neighbor |
| Step 36 | VTEP2(config-router)#address-family l2vpn evpn | Set the address family to evpn |
| Step 37 | VTEP2(config-router-af)#neighbor 10.2.1.1 activate | Activate the neighbor for evpn address family. |
| Step 38 | VTEP2(config-router-af)#exit | Exit address family mode |
| Step 39 | VTEP2(config-router)#exit | Exit router mode |
| Step 40 | VTEP2(config)#ip vrf vxlan100 | Configure VRF for EVPN |
| Step 41 | VTEP2(config-vrf)#rd 4.4.4.4:1 | Configure Route Distinguisher |
| Step 42 | VTEP2(config-vrf)#route-target both 3.3.3.3:1 | Configure Route Target |
| Step 43 | VTEP2(config-vrf)#exit | Exit VRF mode |
| Step 44 | VTEP2(config)#nvo vxlan id 100 ingress-replication | Configure a VXLAN VPN with head end replication |
| Step 45 | VTEP2(config-nvo)#vxlan host-reachability-protocol evpn-bgp vxlan100 | Set EVPN based learning for VXLAN VPN 100 |
| Step 46 | VTEP2(config-nvo)#vxlan map-access port-vlan xe50 2 | Set xe50 and vlan 2 as access port to VPN 100 |
| Step 47 | VTEP2(config-nvo)#exit | Exit NVO mode |

Conclusion

OcNOS is a feature rich solution for data center deployments. VXLAN with EVPN is a perfect solution to provide various services especially in a multi-tenant and hybrid cloud environments. OcNOS is fully standards compliant in both these features.

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About IP Infusion

IP Infusion is a leading provider of intelligent network software for enhanced Ethernet and IP services. Tier one and two OEMs rely on IP Infusion's ZebOS software and global professional services to bring products to market faster, and to differentiate them from competitors with less cost. Products built on IP Infusion technology are deployed in networks with five-9s reliability across five continents—as well as a growing number of enterprises—to improve network performance, decrease network infrastructure costs, and grow revenue. IP Infusion is headquartered in Sunnyvale, Calif., and is a wholly owned and independently operated subsidiary of ACCESS CO., LTD., of Tokyo, Japan.

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