Implementing Nexus L2 EVPN over Segment Routing MPLS

Contents

Introduction

This document describes how to deploy/configure Layer2 EVPN over Segment Routing MPLS on Cisco Nexus 9000 series switches.

Prerequisites

Requirements

Required to have knowledge on BGP, OSPF, MPLS, LDP, RSVP, EVPN, Segment Routing(SR)

Components Used

Cisco Nexus switch 93360YC-FX2 running with 9.3.(3)

Cisco Nexus switch 93240YC-FX2 running with 9.3.(3)

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

Background

Define Layer 2 VPN, VPLS/L2-EVPN is a Multipoint-to-Multipoint Layer 2 VPN Service that connects multiple branches of a Customer, in a single logical switched architecture over an IP/MPLS network.

Layer2 EVPN-MPLS SR:

- EVPN (RFC 7432) is BGP MPLS-based solution which has been used for next generation

Ethernet services in virtualized data center network

- EVPN uses several building blocks such as 'RD', 'RT' and 'VRF' from existing MPLS technologies
- EVPN operates in contrast to the existing VPLS by enabling control-plane based MAC learning in the core
- In EVPN, PEs participating in the EVPN instances learn customer MAC routes in control-plane using MP-BGP protocol
- Control-plane MAC learning provides a number of benefits that allow EVPN to address the VPLS shortcomings, including support for multihoming with per-flow load balancing
- SR L2 EVPN is new feature available in NXOS 9.3(1) and it's supported on Nexus 9300 FX2 series platform

Limitations for L2 EVPN over SR MPLS:

- Segment routing Layer 2 EVPN flooding is based on the ingress replication mechanism
- It uses EVPN Type 3 Route for BUM Traffic
- MPLS core does not support multicast
- ARP suppression is not supported
- Consistency checking on VPC is not supported
- The same L2 EVI and L3 EVI cannot be configured together

Configure

Network Diagram
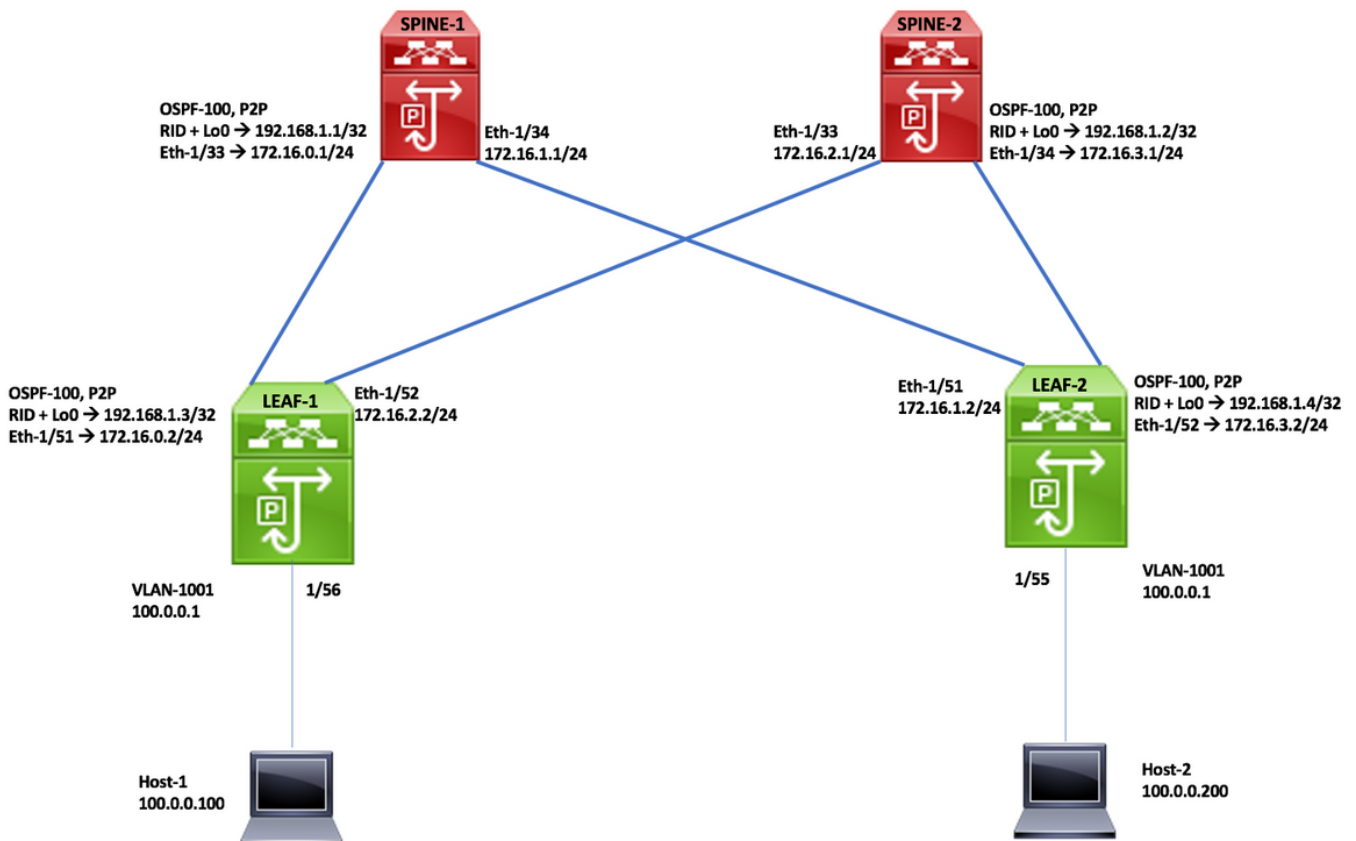
High Level Configuration Steps:

- Install Features
- Configure Ip address -Underlay
- Configure IGP -OSPF
- Configure MP-BGP
- Configure VLAN and EVPN Overlay
- Configure End Host for Layer 2

SPINE -1 Configuration		
Enabling Features, Label-Range, Route-map, Label-Index	**OSPF Configuration**	**BGP/EVPN Configuration**
install feature-set mpls	interface Ethernet1/33	router bgp 65001
feature-set mpls	ip address 172.16.0.1/24	router-id 192.168.1.1
feature ospf	ip ospf network point-to-point	address-family ipv4 unicast
feature bgp	ip router ospf 100 area 0.0.0.0	network 192.168.1.1/32 route-map label-index-spine1
feature mpls segment-routing	mpls ip forwarding	allocate-label all
feature mpls evpn	no shutdown	address-family ipv4 labeled-unicast
feature interface-vlan		address-family l2vpn evpn
feature mpls oam	interface Ethernet1/34	template peer EVPN
	ip address 172.16.1.1/24	remote-as 65001
mpls label range 5000 450000	ip ospf network point-to-point	update-source loopback0
	ip router ospf 100 area 0.0.0.0	address-family l2vpn evpn
segment-routing	mpls ip forwarding	send-community extended
mpls	no shutdown	route-reflector-client
global-block 16000 25000		encapsulation mpls
connected-prefix-sid-map	interface loopback0	template peer Labeled-unicast
address-family ipv4	ip address 192.168.1.1/32	remote-as 65001
192.168.1.1/32 index 211	ip router ospf 100 area 0.0.0.0	address-family ipv4 labeled-unicast
		send-community extended
route-map label-index-spine1 permit 10		route-reflector-client
set label-index 211	router ospf 100	next-hop-self
	segment-routing mpls	soft-reconfiguration inbound always
	router-id 192.168.1.1	neighbor 172.16.0.2
		inherit peer Labeled-unicast
		neighbor 172.16.1.2
		inherit peer Labeled-unicast
		neighbor 192.168.1.3
		inherit peer EVPN
		neighbor 192.168.1.4
		inherit peer EVPN

SPINE -2 Configuration		
Enabling Features, Label-Range, Route-map, Label-Index	**OSPF Configuration**	**BGP/EVPN Configuration**
install feature-set mpls	interface Ethernet1/33	router bgp 65001
feature-set mpls	ip address 172.16.2.1/24	router-id 192.168.1.2
feature ospf	ip ospf network point-to-point	address-family ipv4 unicast
feature bgp	ip router ospf 100 area 0.0.0.0	network 192.168.1.2/32 route-map label-index-spine2
feature mpls segment-routing	mpls ip forwarding	allocate-label all
feature mpls evpn	no shutdown	address-family ipv4 labeled-unicast
feature interface-vlan		address-family l2vpn evpn
feature mpls oam	interface Ethernet1/34	template peer EVPN
	ip address 172.16.3.1/24	remote-as 65001
mpls label range 5000 450000	ip ospf network point-to-point	update-source loopback0
	ip router ospf 100 area 0.0.0.0	address-family l2vpn evpn
segment-routing	mpls ip forwarding	send-community extended
mpls	no shutdown	route-reflector-client
global-block 16000 25000		encapsulation mpls
connected-prefix-sid-map	interface loopback0	template peer Labeled-unicast
address-family ipv4	ip address 192.168.1.2/32	remote-as 65001
192.168.1.2/32 index 221	ip router ospf 100 area 0.0.0.0	address-family ipv4 labeled-unicast
		send-community extended
route-map label-index-spine2 permit 10		route-reflector-client
set label-index 221	router ospf 100	next-hop-self
	segment-routing mpls	soft-reconfiguration inbound always
	router-id 192.168.1.2	neighbor 172.16.2.2
		inherit peer Labeled-unicast
		neighbor 172.16.3.2
		inherit peer Labeled-unicast
		neighbor 192.168.1.3
		inherit peer EVPN
		neighbor 192.168.1.4
		inherit peer EVPN

Leaf-1 Configuration

Enabling Features, Label-Range, Route-map, Label-Index	OSPF Configuration	BGP/EVPN Configuration
install feature-set mpls	interface Ethernet1/51	router bgp 65001
nv overlay evpn	ip address 172.16.0.2/24	router-id 192.168.1.3
feature ospf	ip ospf network point-to-point	address-family ipv4 unicast
feature bgp	ip router ospf 100 area 0.0.0.0	network 192.168.1.3/32 route-map label-index-leaf-1
feature mpls segment-routing	mpls ip forwarding	allocate-label all
feature mpls evpn	no shutdown	address-family ipv4 labeled-unicast
feature interface-vlan		address-family l2vpn evpn
feature mpls oam	interface Ethernet1/52	template peer EVPN
feature nv overlay	ip address 172.16.2.2/24	remote-as 65001
	ip ospf network point-to-point	update-source loopback0
fabric forwarding anycast-gateway-mac 0000.0000.1111	ip router ospf 100 area 0.0.0.0	address-family l2vpn evpn
mpls label range 5000 450000	mpls ip forwarding	send-community extended
	no shutdown	encapsulation mpls
vlan 1,1001		template peer Labeled-unicast
segment-routing	interface Ethernet1/56	remote-as 65001
mpls	switchport	address-family ipv4 labeled-unicast
global-block 16000 25000	switchport mode trunk	send-community extended
connected-prefix-sid-map	switchport trunk allowed vlan 1001	soft-reconfiguration inbound always
address-family ipv4	no shutdown	
192.168.1.3/32 index 311		neighbor 172.16.0.1
vlan 1001	interface loopback0	inherit peer Labeled-unicast
evi auto	ip address 192.168.1.3/32	neighbor 172.16.2.1
	ip router ospf 100 area 0.0.0.0	inherit peer Labeled-unicast
route-map label-index-leaf-1 permit 10		neighbor 192.168.1.1
set label-index 311		inherit peer EVPN
vrf context Tenant-A	router ospf 100	neighbor 192.168.1.2
evi 30001	segment-routing mpls	inherit peer EVPN
	router-id 192.168.1.3	vrf Tenant-A
interface Vlan1001		
no shutdown		evpn
vrf member Tenant-A		encapsulation mpls
ip address 100.0.0.1/24		source-interface loopback0
fabric forwarding mode anycast-gateway		

Leaf-2 Configuration

Enabling Features, Label-Range, Route-map, Label-Index	OSPF Configuration	BGP/EVPN Configuration
install feature-set mpls	interface Ethernet1/51	router bgp 65001
nv overlay evpn	ip address 172.16.1.2/24	router-id 192.168.1.4
feature ospf	ip ospf network point-to-point	address-family ipv4 unicast
feature bgp	ip router ospf 100 area 0.0.0.0	network 192.168.1.4/32 route-map label-index-Leaf2
feature mpls segment-routing	mpls ip forwarding	allocate-label all
feature mpls evpn	no shutdown	address-family ipv4 labeled-unicast
feature interface-vlan		address-family l2vpn evpn
feature mpls oam	interface Ethernet1/52	template peer EVPN
feature nv overlay	ip address 172.16.3.2/24	remote-as 65001
	ip ospf network point-to-point	update-source loopback0
fabric forwarding anycast-gateway-mac 0000.0000.1111	ip router ospf 100 area 0.0.0.0	address-family l2vpn evpn
mpls label range 5000 450000	mpls ip forwarding	send-community extended
	no shutdown	encapsulation mpls
vlan 1,1001		template peer Labeled-unicast
segment-routing	interface Ethernet1/55	remote-as 65001
mpls	switchport	address-family ipv4 labeled-unicast
global-block 16000 25000	switchport mode trunk	send-community extended
connected-prefix-sid-map	switchport trunk allowed vlan 1001	soft-reconfiguration inbound always
address-family ipv4	no shutdown	
192.168.1.4/32 index 321		neighbor 172.16.1.1
vlan 1001	interface loopback0	inherit peer Labeled-unicast
evi auto	ip address 192.168.1.4/32	neighbor 172.16.3.1
	ip router ospf 100 area 0.0.0.0	inherit peer Labeled-unicast
route-map label-index-Leaf2 permit 10		neighbor 192.168.1.1
set label-index 321		inherit peer EVPN
vrf context Tenant-A	router ospf 100	neighbor 192.168.1.2
evi 30001	segment-routing mpls	inherit peer EVPN
	router-id 192.168.1.4	vrf Tenant-A
interface Vlan1001		
no shutdown		evpn
vrf member Tenant-A		encapsulation mpls
ip address 100.0.0.1/24		source-interface loopback0
fabric forwarding mode anycast-gateway		

Verification

Host1# show ip int brief

IP Interface Status for VRF "default"(1)

Interface	IP Address	Interface Status
Vlan1001	100.0.0.200	protocol-up/link-up/admin-up

Mhost1# ping 100.0.0.100

PING 100.0.0.100 (100.0.0.100): 56 data bytes
64 bytes from 100.0.0.100: icmp_seq=0 ttl=253 time=0.84 ms
64 bytes from 100.0.0.100: icmp_seq=1 ttl=253 time=0.45 ms
64 bytes from 100.0.0.100: icmp_seq=2 ttl=253 time=0.443 ms
64 bytes from 100.0.0.100: icmp_seq=3 ttl=253 time=0.438 ms
64 bytes from 100.0.0.100: icmp_seq=4 ttl=253 time=0.431 ms

--- 100.0.0.100 ping statistics ---
5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 0.431/0.52/0.84 ms

Host2# show ip int brief

IP Interface Status for VRF "default"(1)

Interface	IP Address	Interface Status
Vlan1001	100.0.0.100	protocol-up/link-up/admin-up

Mhost2# ping 100.0.0.200

PING 100.0.0.200 (100.0.0.200): 56 data bytes
64 bytes from 100.0.0.200: icmp_seq=0 ttl=253 time=0.854 ms
64 bytes from 100.0.0.200: icmp_seq=1 ttl=253 time=0.46 ms
64 bytes from 100.0.0.200: icmp_seq=2 ttl=253 time=0.451 ms
64 bytes from 100.0.0.200: icmp_seq=3 ttl=253 time=0.427 ms
64 bytes from 100.0.0.200: icmp_seq=4 ttl=253 time=0.418 ms

--- 100.0.0.200 ping statistics ---
5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 0.418/0.522/0.854 ms
Mhost2#

Leaf1# show bgp l2vpn evpn

BGP routing table information for VRF default, address family L2VPN EVPN
BGP table version is 57, Local Router ID is 192.168.1.3
Status: s-suppressed, x-deleted, S-stale, d-dampened, h-history, *-valid, >-best
Path type: i-internal, e-external, c-confed, l-local, a-aggregate, r-redist, I-injected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 192.168.1.3:37864 (L2VNI 1001)					
*>i[2]:[0]:[0]:[48]:[00ee.ab39.fafd]:[0]:[0.0.0.0]/216					
	192.168.1.4	100		0	i
*>i[2]:[0]:[0]:[48]:[00ee.ab39.fb4b]:[0]:[0.0.0.0]/216					
	192.168.1.3	100		32768	i
*>i[2]:[0]:[0]:[48]:[00ee.ab39.fafd]:[32]:[100.0.0.100]/248					
	192.168.1.4	100		0	i
*>l[2]:[0]:[0]:[48]:[00ee.ab39.fb4b]:[32]:[100.0.0.200]/272					
	192.168.1.3	100		32768	i
*>i[3]:[0]:[32]:[192.168.1.3]/88					
	192.168.1.3	100		32768	i
*>i[3]:[0]:[32]:[192.168.1.4]/88					
	192.168.1.4	100		0	i
Route Distinguisher: 192.168.1.4:37864					
* i[2]:[0]:[0]:[48]:[00ee.ab39.fafd]:[0]:[0.0.0.0]/216					
	192.168.1.4	100		0	i
*>i	192.168.1.4	100		0	i
*>i[2]:[0]:[0]:[48]:[00ee.ab39.fafd]:[32]:[100.0.0.100]/248					
	192.168.1.4	100		0	i
* i	192.168.1.4	100		0	i
*>i[3]:[0]:[32]:[192.168.1.4]/88					
	192.168.1.4	100		0	i
* i	192.168.1.4	100		0	i

Leaf2# show bgp l2vpn evpn

BGP routing table information for VRF default, address family L2VPN EVPN
BGP table version is 40, Local Router ID is 192.168.1.4
Status: s-suppressed, x-deleted, S-stale, d-dampened, h-history, *-valid, >-best
Path type: i-internal, e-external, c-confed, l-local, a-aggregate, r-redist, I-injected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 192.168.1.3:37864					
*>i[2]:[0]:[0]:[48]:[00ee.ab39.fb4b]:[0]:[0.0.0.0]/216					
	192.168.1.3	100		0	i
* i	192.168.1.3	100		0	i
*>i[2]:[0]:[0]:[48]:[00ee.ab39.fb4b]:[32]:[100.0.0.200]/272					
	192.168.1.3	100		0	i
* i	192.168.1.3	100		0	i
*>i[3]:[0]:[32]:[192.168.1.3]/88					
	192.168.1.3	100		0	i
* i	192.168.1.3	100		0	i
Route Distinguisher: 192.168.1.4:37864 (L2VNI 1001)					
*>i[2]:[0]:[0]:[48]:[00ee.ab39.fafd]:[0]:[0.0.0.0]/216					
	192.168.1.4	100		0	i
*>i[2]:[0]:[0]:[48]:[00ee.ab39.fb4b]:[0]:[0.0.0.0]/216					
	192.168.1.3	100		0	i
*>i[2]:[0]:[0]:[48]:[00ee.ab39.fafd]:[32]:[100.0.0.100]/248					
	192.168.1.4	100		32768	i
*>i[2]:[0]:[0]:[48]:[00ee.ab39.fb4b]:[32]:[100.0.0.200]/272					
	192.168.1.3	100		0	i
*>i[3]:[0]:[32]:[192.168.1.3]/88					
	192.168.1.3	100		0	i
*>i[3]:[0]:[32]:[192.168.1.4]/88					
	192.168.1.4	100		32768	i

References

[Segment Routing on Cisco Nexus 9500, 9300, 9200, 3200, and 3100 Platform Switches White paper](#)

[Configuring Layer2 EVPN over Segment Routing MPLS](#)