

# Nexus 9000에서 VxLAN/EVPN을 MPLS/SR 핸드 오프 구현

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## 소개

이 문서에서는 Cisco Nexus 9000 Series 스위치에서 VxLAN EVPN over Segment Routing MPLS 핸드오프를 구성하는 방법에 대해 설명합니다.

## 사전 요구 사항

### 요구 사항

다음 주제에 대한 지식을 보유하고 있으면 유용합니다.

- MPLS 레이어 3 VPN
- MP-BGP
- 세그먼트 라우팅

### 사용되는 구성 요소

이 문서의 정보는 다음 소프트웨어 및 하드웨어 버전을 기반으로 합니다.

- BL // N9K-C93240YC-FX2 // 9.3(3)
- ASR1K // 16.12.02
- 스파인-1 // N9K-C92160YC-X // 9.2(3)
- PE // N9K-C93240YC-FX2 // 9.3(3)

이 문서의 정보는 특정 랩 환경의 디바이스를 토대로 작성되었습니다. 이 문서에 사용된 모든 디바이스는 초기화된(기본) 컨피그레이션으로 시작되었습니다. 네트워크가 작동 중인 경우 모든 명령의

잠재적인 영향을 이해해야 합니다.

## 배경 정보

DC(Data Center) 구축에서는 EVPN 컨트롤 플레인 학습, 멀티테넌시, 원활한 모빌리티, 리던던시, 더 쉬운 POD 추가 등의 혜택을 위해 VXLAN EVPN을 채택했습니다. 마찬가지로, CORE는 LDP(Label Distribution Protocol) 기반 MPLS L3VPN 네트워크이거나 기존의 MPLS L3VPN LDP 기반 언더레이에서 SR(Segment Routing)과 같은 보다 정교한 솔루션으로 전환하고 있습니다.

세그먼트 라우팅은 소스 라우팅 패러다임에 따라 네트워크에서 패킷을 전달하는 방법입니다. 소스가 경로를 선택하고 패킷 헤더에 정렬된 세그먼트 목록으로 인코딩합니다. 세그먼트는 모든 유형의 명령에 대한 식별자입니다.

## SR의 장점

세그먼트 라우팅은 다음과 같은 혜택을 위해 채택됩니다.

- Unified IGP MPLS 컨트롤 플레인입니다.
- SDN 준비: 세그먼트 라우팅은 SDN을 위해 구축되었으며 AER(Application Engineering Routing)의 기반입니다. SR은 애플리케이션이 네트워크 행동을 지시할 수 있는 비즈니스 모델에 맞게 네트워크를 준비합니다. SR은 분산 인텔리전스와 중앙 집중식 최적화 및 프로그래밍 간의 적절한 균형을 제공합니다.
- 최소 구성: TE에 대한 세그먼트 라우팅에는 소스 라우터에 대한 최소 컨피그레이션이 필요합니다.
- 로드 밸런싱: RSVP-TE와 달리 세그먼트 라우팅에 대한 로드 밸런싱은 ECMP(Equal Cost Multiple Paths)가 있는 상태에서 발생할 수 있습니다.
- FRR(Fast Reroute) 지원: 빠른 경로 재지정은 경로 장애 발생 후 50밀리초 이내에 사전 구성된 백업 경로를 활성화할 수 있습니다.
- 플러그 앤 플레이 구축: 세그먼트 라우팅 정책은 기존 MPLS 컨트롤 및 데이터 플레인과 상호 운용되며 기존 구축에서 구현할 수 있습니다.

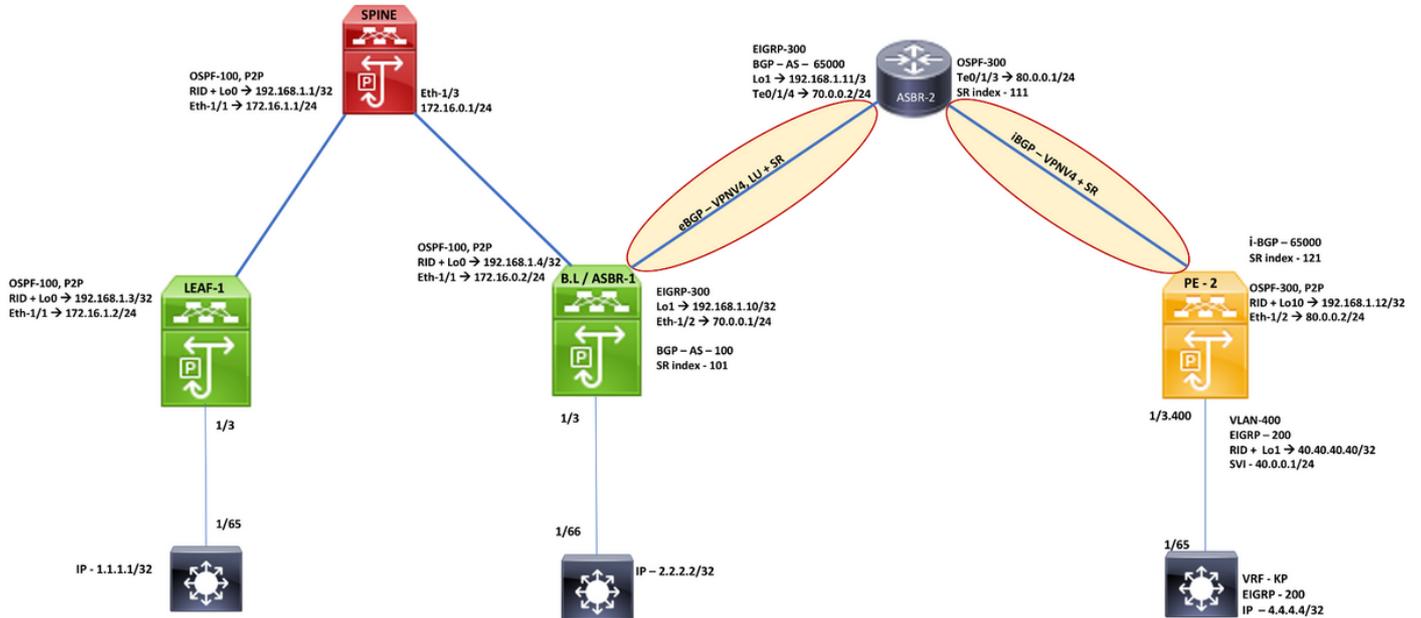
## EVPN과 L3VPN(MPLS SR)의 원활한 통합을 구성하기 위한 지침 및 제한 사항

기능	Cisco Nexus 9300-FX2 Switch	Cisco Nexus 9504 및 9508 스위치와 -R 라인 카드	설명
VXLAN EVPN에서 SR-L3VPN으로	예	예	서로 다른 DC 포드 간 레이어 3 연결 확장을 사용하는 언더레이 IGP/BGP
VXLAN EVPN에서 SR-L3VPN으로	예	예	VXLAN을 실행하는 DC POD와 SR을 실행하는 모든 도메인(DC 또는 CORE) 간에 레이어 3 연결을 확장합니다.
VXLAN EVPN-	아니요	예	언더레이는 자민당입니다.

# MPLS L3VPN(LDP)

## 구성

### 네트워크 다이어그램



## 구성

### Border Leaf - ASBR1 Configuration

```
hostname BL
install feature-set mpls
allow feature-set mpls
feature-set mpls
nv overlay evpn
feature ospf
feature bgp
feature pim
feature eigrp
feature mpls l3vpn
feature mpls segment-routing
feature interface-vlan
feature vn-segment-vlan-based
feature lldp
feature mpls oam
feature nv overlay

ip pim rp-address 192.168.1.1 group-list 224.0.0.0/4
ip pim ssm range 232.0.0.0/8
mpls label range 5000 450000

segment-routing
mpls
  global-block 16000 25000
  connected-prefix-sid-map
  address-family ipv4
    192.168.1.10/32 index 100

ip prefix-list adweig seq 5 permit 2.2.2.2/32
ip prefix-list localsub seq 5 permit 30.0.0.0/24
ip prefix-list localsub seq 10 permit 30.30.30.30/32
ip prefix-list localsub seq 15 permit 192.168.1.10/32
ip prefix-list localsub seq 20 permit 70.0.0.0/24

route-map direct permit 10
match ip address prefix-list localsub
route-map eig permit 10
match ip address prefix-list adweig
route-map lbgpout permit 10
match route-type external internal
route-map label-index-Leaf2 permit 10
set label-index 101
```

```
vlan 1,200,300
vlan 200
  vn-segment 201
vlan 300
  vn-segment 5000

interface Vlan200
no shutdown
vrf member KP
ip address 30.0.0.1/24
ip router eigrp 200

interface Vlan201

interface Vlan300
no shutdown
vrf member KP
ip forward

vrf context KP
vni 5000
ip pim rp-address 192.168.1.1 group-list 224.0.0.0/4
rd auto
address-family ipv4 unicast
route-target import 65000:1
route-target export 65000:1
route-target both auto
route-target both auto evpn

interface nve1
no shutdown
host-reachability-protocol bgp
suppress mac-route
source-interface loopback0
member vni 201
mcast-group 239.0.0.1
member vni 5000 associate-vrf
```

```
interface loopback0
ip address 192.168.1.4/32
ip router ospf 100 area 0.0.0.0
ip pim sparse-mode

interface loopback1
ip address 192.168.1.10/32
ip router eigrp 300

interface loopback10
vrf member KP
ip address 30.30.30.30/32
ip router eigrp 200

interface Ethernet1/1
ip address 172.16.0.2/24
ip ospf network point-to-point
ip router ospf 100 area 0.0.0.0
ip pim sparse-mode
no shutdown

interface Ethernet1/2
mtu 9216
ip address 70.0.0.1/24
ip router eigrp 300
mpls ip forwarding
no shutdown

interface Ethernet1/3
switchport
switchport mode trunk
switchport trunk allowed vlan 200-201,300
no shutdown

router eigrp 200
router-id 30.30.30.30
vrf KP
address-family ipv4 unicast
redistribute bgp 100 route-map lbgpout
router eigrp 300
router-id 192.168.1.10
router ospf 100
router-id 192.168.1.4
```

```
router bgp 100
router-id 192.168.1.4
address-family ipv4 unicast
network 192.168.1.10/32 route-map label-index-Leaf2
redistribute direct route-map direct
allocate-label all
address-family ipv6 unicast
address-family vpnv4 unicast
address-family ipv4 labeled-unicast
address-family l2vpn evpn
neighbor 70.0.0.2
remote-as 65000
ebgp-multihop 10
address-family ipv4 labeled-unicast
send-community
send-community extended
neighbor 192.168.1.1
remote-as 100
update-source loopback0
address-family ipv4 unicast
send-community extended
address-family l2vpn evpn
send-community extended
import vpn unicast reoriginate

neighbor 192.168.1.11
remote-as 65000
update-source loopback1
disable-connected-check
ebgp-multihop 10
address-family vpnv4 unicast
send-community extended
import l2vpn evpn reoriginate
address-family l2vpn evpn
send-community extended
rewrite-evpn-rt-asn

vrf KP
address-family ipv4 unicast
redistribute direct route-map direct
redistribute eigrp 200 route-map eig
```

## ASR1K - ASBR2 Configuration

```
hostname P-Router
interface Loopback0
ip address 192.168.1.11 255.255.255.255
!
!
segment-routing mpls
global-block 16000 25000
!
connected-prefix-sid-map
address-family ipv4
192.168.1.11/32 index 111 range 1
exit-address-family
!
```

```
!
interface TenGigabitEthernet0/1/3
ip address 80.0.0.1 255.255.255.0
ip ospf network point-to-point
cdp enable
mpls ip
!
router ospf 300
router-id 192.168.1.11
segment-routing area 0 mpls
segment-routing mpls
segment-routing prefix-sid-map advertise-local
redistribute connected
redistribute static
redistribute bgp 65000
network 80.0.0.0 0.0.0.255 area 0
network 192.168.1.11 0.0.0.0 area 0
!
!
router eigrp 300
network 70.0.0.0 0.0.0.255
network 192.168.1.11 0.0.0.0
eigrp router-id 192.168.1.11
!
!
interface TenGigabitEthernet0/1/4
mtu 9216
ip address 70.0.0.2 255.255.255.0
ip ospf network point-to-point
cdp enable
mpls ip
mpls bgp forwarding
!
```

```
!
router bgp 65000
bgp router-id 192.168.1.11
no bgp transport path-mtu-discovery
bgp log-neighbor-changes
no bgp default route-target filter
neighbor 70.0.0.1 remote-as 100
neighbor 70.0.0.1 ebgp-multihop 10
neighbor 192.168.1.10 remote-as 100
neighbor 192.168.1.10 ebgp-multihop 10
neighbor 192.168.1.10 disable-connected-check
neighbor 192.168.1.10 update-source Loopback0
neighbor 192.168.1.12 remote-as 65000
neighbor 192.168.1.12 update-source Loopback0
!
address-family ipv4
redistribute connected
redistribute ospf 300
segment-routing mpls
neighbor 70.0.0.1 activate
neighbor 70.0.0.1 send-community both
neighbor 70.0.0.1 send-label
neighbor 192.168.1.10 activate
neighbor 192.168.1.10 send-community both
neighbor 192.168.1.10 soft-reconfiguration inbound
neighbor 192.168.1.10 send-label
no neighbor 192.168.1.12 activate
exit-address-family
!
address-family vpnv4
neighbor 192.168.1.10 activate
neighbor 192.168.1.10 send-community both
neighbor 192.168.1.12 activate
neighbor 192.168.1.12 send-community both
neighbor 192.168.1.12 next-hop-self
exit-address-family
!
address-family l2vpn evpn
exit-address-family
!
```

## Far-End PE2 Configuration

```
hostname PE2
install feature-set mpls
allow feature-set mpls
feature-set mpls
feature ospf
feature bgp
feature eigrp
feature mpls l3vpn
feature mpls segment-routing
feature interface-vlan
feature lldp
feature mpls oam

vlan 1400
segment-routing
mpls
global-block 16000 25000
connected-prefix-sid-map
address-family ipv4
192.168.1.12/32 index 121

ip prefix-list adveig seq 5 permit 4.4.4.4/32
ip prefix-list localsub seq 5 permit 40.0.0.0/24
ip prefix-list localsub seq 10 permit 40.40.40.40/32
route-map direct permit 10
match ip address prefix-list localsub
route-map eig permit 10
match ip address prefix-list adveig
route-map ibgpout permit 10
match tag 100
match route-type internal

route-map label-index-Leaf2 permit 10
set label-index 121

vrf context KP
rd auto
address-family ipv4 unicast
route-target import 100:5000
route-target import 65000:1
route-target export 100:5000
route-target export 65000:1
```

```
interface Ethernet1/2
ip address 80.0.0.2/24
ip ospf network point-to-point
ip router ospf 300 area 0.0.0.0
mpls ip forwarding
no shutdown

interface loopback10
ip address 192.168.1.12/32
ip router ospf 300 area 0.0.0.0

router ospf 300
segment-routing mpls
router-id 192.168.1.12
distance 115

interface Ethernet1/3
switchport
switchport mode trunk
switchport trunk allowed vlan 400
no shutdown

interface Vlan400
no shutdown
vrf member KP
ip address 40.0.0.1/24
ip router eigrp 200

interface loopback1
vrf member KP
ip address 40.40.40.40/32
ip router eigrp 200
```

```
router bgp 65000
router-id 192.168.1.12
address-family ipv4 unicast
network 192.168.1.12/32 route-map label-index-Leaf2
redistribute direct route-map direct
redistribute eigrp 200 route-map eig
allocate-label all
address-family vpnv4 unicast
address-family ipv4 labeled-unicast
neighbor 192.168.1.11
remote-as 65000
update-source loopback10
address-family vpnv4 unicast
send-community extended
vrf KP
address-family ipv4 unicast
redistribute direct route-map direct
redistribute eigrp 200 route-map eig
```

다음을 확인합니다.

## Host-1 & Leaf-1 Verification

### host1# sh ip int br | ex down

```
IP Interface Status for VRF "default"(1)
Interface IP Address Interface Status
Vlan201 20.0.0.2 protocol-up/link-up/admin-up
Lo0 1.1.1.1 protocol-up/link-up/admin-up
```

### host1# traceroute 4.4.4.4 source 1.1.1.1

```
traceroute to 4.4.4.4 (4.4.4.4) from 1.1.1.1 (1.1.1.1), 30 hops max, 40 byte packets
 1 20.0.0.1 (20.0.0.1) 0.92 ms 0.531 ms 0.513 ms
 2 30.0.0.1 (30.0.0.1) 1.043 ms 0.819 ms 0.733 ms
 3 40.0.0.1 (40.0.0.1) 0.912 ms 0.673 ms 0.624 ms
 [Label=492287 E=0 TTL=253 S=1]
 4 4.4.4.4 (4.4.4.4) 0.882 ms 0.825 ms 0.561 ms
host1#
```

### Leaf1\_N3k# show bgp l2vpn evpn

BGP routing table information for VRF default, address family L2VPN EVPN  
 BGP table version is 42, 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, l-injected  
 Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 192.168.1.4:3					
*>i[5]:[0]:[0]:[24]:[30.0.0.0]/224	192.168.1.4	0	100	0	?
*>i[5]:[0]:[0]:[24]:[40.0.0.0]/224	192.168.1.4	100	0	65000	?
*>i[5]:[0]:[0]:[32]:[2.2.2.2]/224	192.168.1.4	130816	100	0	?
*>i[5]:[0]:[0]:[32]:[4.4.4.4]/224	192.168.1.4	100	0	65000	?
*>i[5]:[0]:[0]:[32]:[30.30.30.30]/224	192.168.1.4	0	100	0	?
*>i[5]:[0]:[0]:[32]:[40.40.40.40]/224	192.168.1.4	100	0	65000	?
Route Distinguisher: 192.168.1.3:3 (L3VNI 5000)					
*>i[5]:[0]:[0]:[24]:[20.0.0.0]/224	192.168.1.3	0	100	32768	?
*>i[5]:[0]:[0]:[24]:[30.0.0.0]/224	192.168.1.4	0	100	0	?
*>i[5]:[0]:[0]:[24]:[40.0.0.0]/224	192.168.1.4	100	0	65000	?
*>i[5]:[0]:[0]:[32]:[1.1.1.1]/224	192.168.1.3	130816	100	32768	?
*>i[5]:[0]:[0]:[32]:[2.2.2.2]/224	192.168.1.4	130816	100	0	?
*>i[5]:[0]:[0]:[32]:[4.4.4.4]/224	192.168.1.4	100	0	65000	?
*>i[5]:[0]:[0]:[32]:[20.20.20.20]/224	192.168.1.3	0	100	32768	?
*>i[5]:[0]:[0]:[32]:[30.30.30.30]/224	192.168.1.4	0	100	0	?
*>i[5]:[0]:[0]:[32]:[40.40.40.40]/224	192.168.1.4	100	0	65000	?

Leaf1\_N3k#

## Border Leaf Verification

### BL# sh bgp l2vpn evpn

BGP routing table information for VRF default, address family L2VPN EVPN  
 BGP table version is 30, 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, l-injected  
 Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 192.168.1.3:3					
*>i[5]:[0]:[0]:[24]:[20.0.0.0]/224	192.168.1.3	0	100	0	?
*>i[5]:[0]:[0]:[32]:[1.1.1.1]/224	192.168.1.3	130816	100	0	?
*>i[5]:[0]:[0]:[32]:[20.20.20.20]/224	192.168.1.3	0	100	0	?
Route Distinguisher: 192.168.1.4:3 (L3VNI 5000)					
*>i[5]:[0]:[0]:[24]:[20.0.0.0]/224	192.168.1.3	0	100	0	?
*>i[5]:[0]:[0]:[24]:[30.0.0.0]/224	192.168.1.4	0	100	32768	?
*>i[5]:[0]:[0]:[24]:[40.0.0.0]/224	192.168.1.4	0	65000	?	?
*>i[5]:[0]:[0]:[32]:[1.1.1.1]/224	192.168.1.3	130816	100	0	?
*>i[5]:[0]:[0]:[32]:[2.2.2.2]/224	192.168.1.4	130816	100	32768	?
*>i[5]:[0]:[0]:[32]:[4.4.4.4]/224	192.168.1.4	0	65000	?	?
*>i[5]:[0]:[0]:[32]:[20.20.20.20]/224	192.168.1.3	0	100	0	?
*>i[5]:[0]:[0]:[32]:[30.30.30.30]/224	192.168.1.4	0	100	32768	?
*>i[5]:[0]:[0]:[32]:[40.40.40.40]/224	192.168.1.4	0	65000	?	?

BL#

### BL# show bgp vpnv4 unicast

BGP routing table information for VRF default, address family VPNv4 Unicast  
 BGP table version is 81, 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, l-injected  
 Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 192.168.1.4:3 (VRF KP)					
*>i1.1.1.1/32	192.168.1.3	130816	100	0	?
*>2.2.2.2/32	0.0.0.0	130816	100	32768	?
*>e4.4.4.4/32	192.168.1.11	0	65000	?	?
*>20.0.0.0/24	192.168.1.3	0	100	0	?
*>30.0.0.0/24	192.168.1.3	0	100	0	?
*>30.0.0.0/24	0.0.0.0	0	100	32768	?
*>30.30.30.30/32	0.0.0.0	0	100	32768	?
*>e40.0.0.0/24	192.168.1.11	0	65000	?	?
*>e40.40.40.40/32	192.168.1.11	0	65000	?	?
Route Distinguisher: 192.168.1.12:3					
*>e4.4.4.4/32	192.168.1.11	0	65000	?	?
*>e40.0.0.0/24	192.168.1.11	0	65000	?	?
*>e40.40.40.40/32	192.168.1.11	0	65000	?	?

BL#

### BL# show segment-routing mpls clients

Segment-Routing Mpls Client Info

Client: bgp-100  
 PIB Index: 1 UUID: 0x11b PID: 4611 MTS SAP: 7255  
 TIBs registered:  
 VRF: default Table: base

Total Clients: 1

BL# show segment-routing mpls ipv4 connected-prefix-sid-map

Segment-Routing Mpls Prefix-SID Mappings

Prefix-SID mappings for VRF default Table base

Prefix	SID	Type	Range	SRGB
192.168.1.10/32	100	Indx	1	Y

\*SRGB - Indicates whether Prefix-Sid is within configured SRGB

BL# show segment-routing mpls detail

Segment-Routing Mpls Global Info

Service Name: segment-routing

State: Enabled

Process ID: 2505

Configured SRGB: 16000 - 25000

SRGB Allocation status: Alloc-Successful

Current SRGB: 16000 - 25000

Cleanup Interval: 60

Retry Interval: 180

SRGB ULIB handle: 4096002

ULib RegStatus: Done

ULIB PIB handle: 0x2

BL#

### BL# show mpls switching

Legend:  
 (P)=Protected, (F)=FRR active, (\*)=more labels in stack

IPv4:

In-Label	Out-Label	FEC name	Out-Interface	Next-Hop
VRF default				
5000	Pop Label	80.0.0.0/24	Eth1/2	70.0.0.2
16111	Pop Label	192.168.1.11/32	Eth1/2	70.0.0.2
16121	16121	192.168.1.12/32	Eth1/2	70.0.0.2

In-Label VRF

492288 default

492287 KP

Local	Out-Label	Out-Interface	Next-Hop
FEC: 4.4.4.4/32, 192.168.1.12:3			
5001	22	192.168.1.11	
FEC: 40.0.0.0/24, 192.168.1.12:3			
5002	23	192.168.1.11	
FEC: 40.40.40.40/32, 192.168.1.12:3			
5003	24	192.168.1.11	

Block	Label-Range
1	16000 - 25000

BL#

```

P-Router#sh ip inter bri | ex down
Interface IP-Address OK? Method Status Protocol
Te0/1/2 unassigned YES NVRAM up up
Te0/1/3 80.0.0.1 YES NVRAM up up
Te0/1/4 70.0.0.2 YES NVRAM up up
GigabitEthernet0 10.82.139.101 YES manual up up
Loopback0 192.168.1.11 YES NVRAM up up

```

```

P-Router#show ip ospf neighbor
Neighbor ID Pri State Dead Time Address Interface
192.168.1.12 0 FULL/ - 00:00:35 80.0.0.2 TenGigabitEthernet0/1/3
P-Router#

```

```

P-Router#show bgp vpnv4 unicast all
BGP table version is 28, local router ID is 192.168.1.11
Status codes: s - suppressed, d - damped, h - history, * - valid, > - best, ! - internal,
r - RIB-failure, S - Stale, m - multipath, b - backup-path, f - RT-Filter,
x - best-external, a - additional-path, c - RIB-compressed,
t - secondary path, L - long-lived-stale,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V - valid, I - invalid, N - Not found

```

```

Network Next Hop Metric LocPrf Weight Path
Route Distinguisher: 192.168.1.4:3
*> 1.1.1.1/32 192.168.1.10 0 100 ?
*> 2.2.2.2/32 192.168.1.10 130816 0 100 ?
*> 20.0.0.0/24 192.168.1.10 0 100 ?
*> 20.20.20.0/32 192.168.1.10 0 100 ?
*> 30.0.0.0/24 192.168.1.10 0 0 100 ?
*> 30.30.30.0/32 192.168.1.10 0 0 100 ?
Route Distinguisher: 192.168.1.12:3
*> 4.4.4.4/32 192.168.1.12 130816 100 0 ?
*> 40.0.0.0/24 192.168.1.12 0 100 0 ?
*> 40.40.40.0/32 192.168.1.12 0 100 0 ?
P-Router#

```

```

P-Router#show segment-routing mpls state
Segment Routing MPLS State : ENABLED
P-Router#

```

### P-Router Verification

```

P-Router#show mpls forwarding-table
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or Tunnel Id Switched interface
16 Pop Label 80.0.0.2-A 0 Te0/1/3 80.0.0.2
17 [M] Pop Label 192.168.1.12/32 0 Te0/1/3 80.0.0.2
18 Pop Label 192.168.1.10/32 0 Te0/1/4 70.0.0.1
19 492287 192.168.1.4:3:2.2.2.2/32 \
0 Te0/1/4 70.0.0.1
20 492287 192.168.1.4:3:30.0.0.0/24 \
510 Te0/1/4 70.0.0.1
21 492287 192.168.1.4:3:30.30.30.0/32 \
0 Te0/1/4 70.0.0.1
22 492287 192.168.1.12:3:4.4.4.4/32 \
2828 Te0/1/3 80.0.0.2
23 492287 192.168.1.12:3:40.0.0.0/24 \
9774 Te0/1/3 80.0.0.2
24 492287 192.168.1.12:3:40.40.40.0/32 \
1848 Te0/1/3 80.0.0.2
25 492287 192.168.1.4:3:1.1.1.1/32 \
5082 Te0/1/4 70.0.0.1
26 492287 192.168.1.4:3:20.0.0.0/24 \
780 Te0/1/4 70.0.0.1
27 492287 192.168.1.4:3:20.20.20.0/32 \
P-Router#

```

```

P-Router#show segment-routing client all
SRHandle: 1 ClientType: SR INTERNAL ClientHandle: 0
SRHandle: 2 ClientType: OSPF ClientHandle: 7FB45A5B94C8
Registered Notifications:
Handle: 0x0 topoid(0) sidmap_bitmask(1) algo(0)
Handle: 0x1 topoid(0) sidmap_bitmask(1) algo(1)
Handle: 0x2 topoid(0) sidmap_bitmask(2) algo(0)
Handle: 0x3 topoid(0) sidmap_bitmask(2) algo(1)
Handle: 0x4 topoid(0) sidmap_bitmask(E) algo(0) Expanded
Handle: 0x5 topoid(0) sidmap_bitmask(E) algo(1) Expanded
P-Router#

```

```

SRHandle: 3 ClientType: BGP ClientHandle: 7FB45ADF9A8
Registered Notifications:
Handle: 0x6 topoid(0) sidmap_bitmask(8) algo(0)
Handle: 0x7 topoid(0) sidmap_bitmask(1) algo(0)
P-Router#

```

```

P-Router#show segment-routing mpls connected-prefix-sid-map protocol ipv4

```

```

PREFIX_SID_PROTOCOL_ADV_MAP_ALGO_0
Prefix/masklen SID Type Range Flags SRGB Source
192.168.1.10/32 100 Indx 1 Y BGP 192.168.1.4
192.168.1.11/32 111 Indx 1 Y OSPF Area 0 192.168.1.11
192.168.1.12/32 121 Indx 1 Y OSPF Area 0 192.168.1.12
P-Router#

```

```

PREFIX_SID_PROTOCOL_ADV_MAP_ALGO_1
Prefix/masklen SID Type Range Flags SRGB Source
P-Router#sh mpls forwarding-table 192.168.1.12 32
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or Tunnel Id Switched interface
17 [M] Pop Label 192.168.1.12/32 0 Te0/1/3 80.0.0.2
16121 [M] Pop Label 192.168.1.12/32 0 Te0/1/3 80.0.0.2
P-Router#

```

```

[M] - Merged
P-Router#sh mpls forwarding-table 192.168.1.10 32
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or Tunnel Id Switched interface
18 Pop Label 192.168.1.10/32 0 Te0/1/4 70.0.0.1
16100 Pop Label 192.168.1.10/32 0 Te0/1/4 70.0.0.1
P-Router#show mpls forwarding-table labels 16
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or Tunnel Id Switched interface
16 Pop Label 80.0.0.2-A 0 Te0/1/3 80.0.0.2
P-Router#

```

```

A - Adjacency SID
P-Router#show mpls forwarding-table labels 17
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or Tunnel Id Switched interface
17 [M] Pop Label 192.168.1.12/32 0 Te0/1/3 80.0.0.2
P-Router#

```

```

[M] - Merged
P-Router#show mpls forwarding-table labels 18
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or Tunnel Id Switched interface
18 Pop Label 192.168.1.10/32 0 Te0/1/4 70.0.0.1
P-Router#show mpls forwarding-table labels 22
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or Tunnel Id Switched interface
22 492287 192.168.1.12:3:4.4.4.4/32 \
2828 Te0/1/3 80.0.0.2
P-Router#

```

### Far-End PE Verification

```

PE2# show bgp vpnv4 unicast
BGP routing table information for VRF default, address family VPNv4 Unicast
BGP table version is 79, Local Router ID is 192.168.1.12
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 - redistrib, i - injected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

```

```

PE2# show ip interface brief | ex down
IP Interface Status for VRF "default"(1)
Interface IP Address Interface Status
Lo10 192.168.1.12 protocol-up/link-up/admin-up
Eth1/2 80.0.0.2 protocol-up/link-up/admin-up
PE2#

```

```

PE2# sh ip interface brief vrf KP | ex down
IP Interface Status for VRF "KP"(3)
Interface IP Address Interface Status
Vlan400 40.0.0.1 protocol-up/link-up/admin-up
Lo1 40.40.40.40 protocol-up/link-up/admin-up
PE2#
PE2# show ip ospf neighbors
OSPF Process ID 300 VRF default
Total number of neighbors: 1
Neighbor ID Pri State Up Time Address Interface
192.168.1.11 1 FULL/ - 06:48:03 80.0.0.1 Eth1/2
PE2#

```

```

PE2# show segment-routing mpls detail
Segment-Routing MPLS Global Info
Service Name: segment-routing
State: Enabled
Process ID: 2257
Configured SRGB: 16000 - 25000
SRGB Allocation status: Alloc-Successful
Current SRGB: 16000 - 25000
Cleanup Interval: 60
Retry Interval: 180
SRGB ULIB handle: 4096002
ULIB RegStatus: Done
ULIB PIB handle: 0x2
PE2#
PE2# show segment-routing mpls clients
Segment-Routing MPLS Client Info
Client: ospf-300
PIB Index: 1 UUID: 0x41000119 PID: 4281 MTS SAP: 320
TIBs registered:
VRF: default Table: base
Client: bgp-65000
PIB Index: 2 UUID: 0x11b PID: 4302 MTS SAP: 6825
TIBs registered:
VRF: default Table: base
Total Clients: 2
PE2#

```

```

PE2# show segment-routing mpls ipv4 connected-prefix-sid-map
Segment-Routing MPLS Prefix SID Mappings
Prefix-SID mappings for VRF default Table base
Prefix SID Type Range SRGB
192.168.1.12/32 121 Indx 1 Y
*SRGB - Indicates whether Prefix-Sid is within configured SRGB
PE2# sho forwarding mpls
slot 1
=====
Local |Prefix|FEC|Next-Hop|Interface|Out
Label|Table Id|(Prefix/Tunnel Id)||Label
-----|-----|-----|-----|-----|-----
16 |N/A|N/A||80.0.0.1|Eth1/2|Pop Label
16111 |0x1||192.168.1.11/32||80.0.0.1|Eth1/2|0 SWAP
492288 |||||Eth1/2|0 SWAP
PE2#

```

```

PE2# show mpls switching
Legend:
(P)=Protected, (F)=FRR active, (*)=more labels in stack
IPv4:
In-Label Out-Label FEC name Out-Interface Next-Hop
VRF default:
16111 Pop Label 192.168.1.11/32 Eth1/2 80.0.0.1
In-Label VRF
492288 default
492287 KP
ADI_SID:
In-Label Out-Label FEC name Out-Interface Next-Hop
16 3 80.0.0.1 Eth1/2 80.0.0.1
Block Label-Range
1 16000 - 25000
PE2#

```

```

PE2# show mpls switching detail
VRF default
IPv4 FEC
In-Label : 16111
Out-Label stack : Pop Label
FEC : 192.168.1.11/32
Out interface : Eth1/2
Next hop : 80.0.0.1
Input traffic statistics : 0 packets, 0 bytes
Output statistics per label : label Pop Label, 0 packets, 0 bytes
Deaggregation FEC type
In-Label : 492288
VRF : default
Address-Family : IPv4
Flags : RFC3107
Input traffic statistics : 0 packets 0 bytes
Deaggregation FEC type
In-Label : 492287
VRF : KP
Address-Family : IPv4
Input traffic statistics : 132 packets 15540 bytes
ADI_SID
In-Label : 16
Out-Label stack : 3
FEC : 80.0.0.1
Out interface : Eth1/2
Next hop : 80.0.0.1
Input traffic statistics : 0 packets, 0 bytes
Output statistics per label : label 3, 0 packets, 0 bytes
*Label statistics accurate as of 117 seconds ago
Block Label-Range
1 16000 - 25000
PE2#

```

## 관련 정보

- [EVPN과 L3VPN\(MPLS SR\)의 원활한 통합 구성 정보](#)
- [기술 지원 및 문서 - Cisco Systems](#)