# Nexus 9000でのMPLS/SRハンドオフへのVxLAN/EVPNの実装

## 内容

## 概要

このドキュメントでは、Cisco Nexus 9000シリーズスイッチでVxLAN EVPN over Segment Routing(VPN)MPLSハンドオフを設定する方法について説明します。

## 前提条件

### 要件

次の項目に関する知識があることが推奨されます。

- MPLSレイヤ3 VPN
- MP-BGP
- セグメントルーティング

### 使用するコンポーネント

このドキュメントの情報は、次のソフトウェアとハードウェアのバージョンに基づいています。

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

このドキュメントの情報は、特定のラボ環境にあるデバイスに基づいて作成されました。このドキュメントで使用するすべてのデバイスは、初期（デフォルト）設定の状態から起動しています

。本稼働中のネットワークでは、各コマンドによって起こる可能性がある影響を十分確認してください。

## 背景説明

データセンター(DC)の導入では、EVPNコントロールプレーン学習、マルチテナント、シームレスなモビリティ、冗長性、および簡単なPODの追加などの利点のために、VXLAN EVPNが採用されています。同様に、COREは、Label Distribution Protocol(LDP)ベースのMPLS L3VPNネットワークか、従来のMPLS L3VPN LDPベースのアンダーレイから、セグメントルーティング(SR)などのより高度なソリューションへの移行のいずれかです。

セグメントルーティングは、ソースルーティングパラダイムに基づいてネットワーク上でパケットを転送する方法です。送信元はパスを選択し、セグメントの順序付きリストとしてパケットヘッダーにエンコードします。セグメントは、任意の種類の命令の識別子です。

### SRの利点

セグメントルーティングは、次のような利点のために採用されています。

- Unified IGP MPLSコントロールプレーン。

- SDNに対応：セグメントルーティングはSDN用に構築され、Application Engineered Routing(AER)の基盤となります。SRは、アプリケーションがネットワークの動作を誘導できるビジネスモデル用にネットワークを準備します。SRは、分散インテリジェンスと中央集中型の最適化およびプログラミングの間の適切なバランスを提供します。

- 最小限の設定：TEのセグメントルーティングには、送信元ルータでの最小限の設定が必要です。

- ロードバランシング：RSVP-TEとは異なり、セグメントルーティングのロードバランシングは、等コストマルチパス(ECMP)の存在で行われます。

- 高速再ルーティング(FRR)をサポート：高速再ルーティングにより、パス障害から50ミリ秒以内に事前設定されたバックアップパスをアクティブ化できます。

- プラグアンドプレイ導入：セグメントルーティングポリシーは、既存のMPLSコントロールプレーンおよびデータプレーンと相互運用でき、既存の展開に実装できます。

## EVPNとL3VPN(MPLS SR)のシームレスな統合を設定するためのガイドラインと制限事項

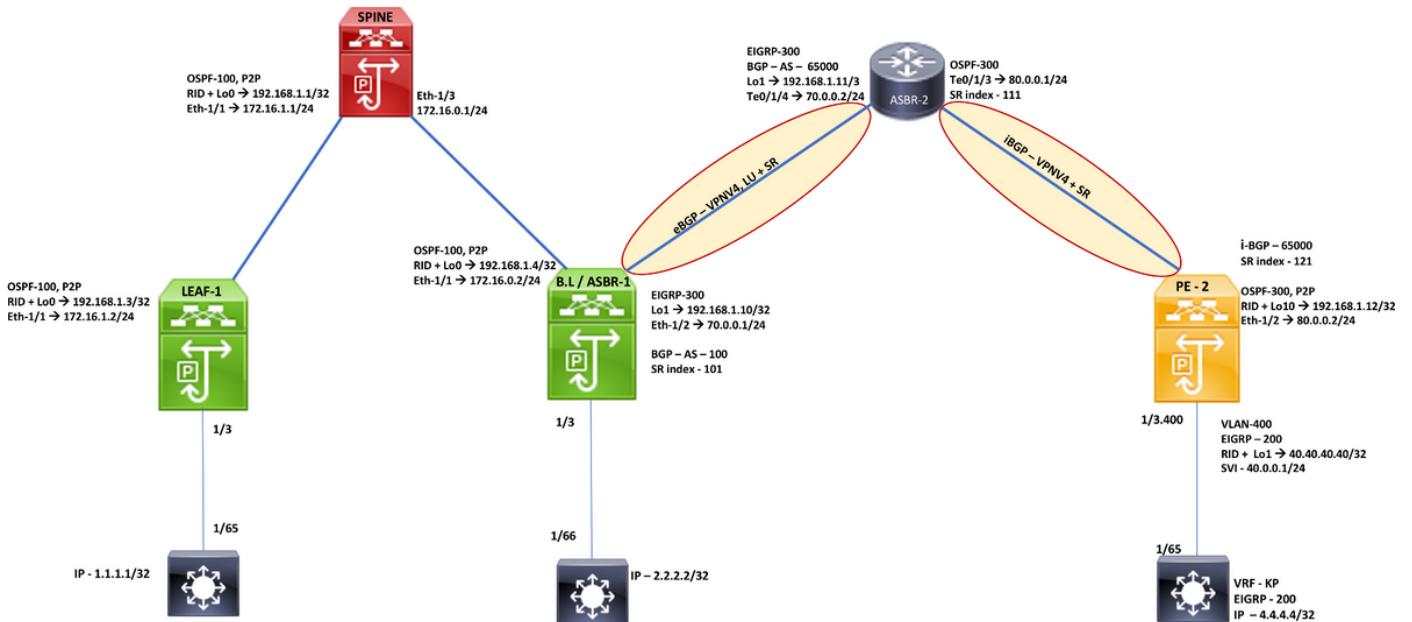| 機能 | Cisco Nexus 9300-FX2スイッチ | Cisco Nexus 9504および9508スイッチ（Rラインカード搭載） | 注 |
|---|---|---|---|
| VXLAN EVPNからSR-L3VPN | Yes | Yes | SR拡張を使用して、異なるDCポッド間のヤ3接続のアンダーレイIGP/BGPを拡張し。 |
| VXLAN EVPNからSR-L3VPN | Yes | Yes | VXLANを実行するDC PODと、SRを実行ドメイン（DCまたはコア）との間でレイ |

| VXLAN EVPN to MPLS L3VPN(LDP) | No | Yes | 続を拡張します。<br><br>アンダーレイはLDPです。 |
| --- | --- | --- | --- |

# 設定

## ネットワーク図



ネットワーク図:

- **SPINE**
  OSPF-100, P2P
  RID + Lo0 → 192.168.1.1/32
  Eth-1/1 → 172.16.1.1/24
  Eth-1/3
  172.16.0.1/24

- **LEAF-1**
  OSPF-100, P2P
  RID + Lo0 → 192.168.1.3/32
  Eth-1/1 → 172.16.1.2/24
  1/3
  1/65
  IP - 1.1.1.1/32

- **B.L / ASBR-1**
  OSPF-100, P2P
  RID + Lo0 → 192.168.1.4/32
  Eth-1/1 → 172.16.0.2/24
  EIGRP-300
  Lo1 → 192.168.1.10/32
  Eth-1/2 → 70.0.0.1/24
  BGP – AS – 100
  SR index - 101
  1/3
  1/66
  IP – 2.2.2.2/32

- **ASBR-2**
  EIGRP-300
  BGP – AS – 65000
  Lo1 → 192.168.1.11/3
  Te0/1/4 → 70.0.0.2/24
  OSPF-300
  Te0/1/3 → 80.0.0.1/24
  SR index - 111

- eBGP – VPNV4, LU + SR
- iBGP – VPNV4 + SR

- **PE - 2**
  i-BGP – 65000
  SR index - 121
  OSPF-300, P2P
  RID + Lo10 → 192.168.1.12/32
  Eth-1/2 → 80.0.0.2/24
  1/3.400
  VLAN-400
  EIGRP – 200
  RID + Lo1 → 40.40.40.40/32
  SVI - 40.0.0.1/24
  1/65
  VRF - KP
  EIGRP - 200
  IP – 4.4.4.4/32

## コンフィギュレーション

### 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 adveig 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 adveig
route-map ibgpout 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 ibgpout
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 1,400
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 eigrp 200
  router-id 40.40.40.40
  address-family ipv4 unicast
  vrf KP
   address-family ipv4 unicast
    redistribute bgp 65000 route-map ibgpout
```

```
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
```

確認

## Host-1 & Leaf-1 Verification

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, I-injected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

| Network | Next Hop | Metric | LocPrf | Weight Path |
|---|---|---|---|---|
| Route Distinguisher: 192.168.1.4:3 | | | | |
| *>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) | | | | |
| *>l[5]:[0]:[0]:[24]:[20.0.0.0]/224 | | | | |
| | 192.168.1.3 | 0 | 100 | 32768 ? |
| *>l[5]:[0]:[0]:[24]:[30.0.0.0]/224 | | | | |
| | 192.168.1.4 | 0 | 100 | 0 ? |
| *>l[5]:[0]:[0]:[24]:[40.0.0.0]/224 | | | | |
| | 192.168.1.4 | | 100 | 0 65000 ? |
| *>l[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#

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 |

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#

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## Border Leaf Verification

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, I-injected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

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

BL#

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, I-injected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

| Network | Next Hop | Metric | LocPrf | Weight Path |
|---|---|---|---|---|
| Route Distinguisher: 192.168.1.4:3 (VRF KP) | | | | |
| *>i1.1.1.1/32 | 192.168.1.3 | 130816 | 100 | 0 ? |
| *>r2.2.2.2/32 | 0.0.0.0 | 130816 | 100 | 32768 ? |
| *>e4.4.4.4/32 | 192.168.1.11 | | | 0 65000 ? |
| *>i20.0.0.0/24 | 192.168.1.3 | 0 | 100 | 0 ? |
| *>i20.20.20.20/32 | 192.168.1.3 | 0 | 100 | 0 ? |
| *>r30.0.0.0/24 | 0.0.0.0 | 0 | 100 | 32768 ? |
| *>r30.30.30.30/32 | 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#

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#

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#

BL# show segment-routing mpls detail
    Segment-Routing Mpls Global info
Service Name: segment-routing
State: Enabled
Process Id: 2605
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#

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 Verification

**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, i - 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 ?
 *>  20.20.20.20/32 192.168.1.10              0 100 ?
 *>  30.0.0.0/24    192.168.1.10        0     0 100 ?
 *>  30.30.30.30/32 192.168.1.10        0     0 100 ?
Route Distinguisher: 192.168.1.12:3
 *>i 4.4.4.4/32     192.168.1.12      130816 100   0 ?
 *>i 40.0.0.0/24    192.168.1.12        0    100   0 ?
 *>i 40.40.40.40/32 192.168.1.12       0    100   0 ?
P-Router#
```

**P-Router#show segment-routing mpls state**

```
 Segment Routing MPLS State : ENABLED

P-Router#
```

**P-Router#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    192.168.1.4:3:30.30.30.30/32 \
                                  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    192.168.1.12:3:40.40.40.40/32 \
                                  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    192.168.1.4:3:20.20.20.20/32 \

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

SRHandle: 3 ClientType: BGP ClientHandle: 7FB45A5DF9A8
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

        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

[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

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

[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-redist, I-injected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

   Network        Next Hop        Metric LocPrf Weight Path
Route Distinguisher: 192.168.1.4:3
*>i1.1.1.1/32       192.168.1.11      0    100   0 100 ?
*>i2.2.2.2/32       192.168.1.11   130816  100   0 100 ?
*>i20.0.0.0/24      192.168.1.11      0    100   0 100 ?
*>i20.20.20.20/32   192.168.1.11      0    100   0 100 ?
*>i30.0.0.0/24      192.168.1.11      0    100   0 100 ?
*>i30.30.30.30/32   192.168.1.11      0    100   0 100 ?

Route Distinguisher: 192.168.1.12:3  (VRF KP)
*>i1.1.1.1/32       192.168.1.11      0    100   0 100 ?
*>i2.2.2.2/32       192.168.1.11   130816  100   0 100 ?
*>r4.4.4.4/32       0.0.0.0       130816  100  32768 ?
*>i20.0.0.0/24      192.168.1.11      0    100   0 100 ?
*>i20.20.20.20/32   192.168.1.11      0    100   0 100 ?
*>i30.0.0.0/24      192.168.1.11      0    100   0 100 ?
*>i30.30.30.30/32   192.168.1.11      0    100   0 100 ?
*>r40.0.0.0/24      0.0.0.0          0    100  32768 ?
*>r40.40.40.40/32   0.0.0.0          0    100  32768 ?
```

**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# 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 |        |          |          |        |Pop Label
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

ADJ_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

ADJ 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#
```

# 関連情報

- [EVPNとL3VPN(MPLS SR)のシームレスな統合の設定に関する情報](#)
- [テクニカル サポートとドキュメント – Cisco Systems](#)