



LAB DOCUMENT

Segment Routing with IS-IS Multi Level Design

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INTRODUCTION:

In this lab we will demonstrate segment routing on a multi-level IS-IS topology. We will also demonstrate SR-LDP interaction.

TOPOLOGY

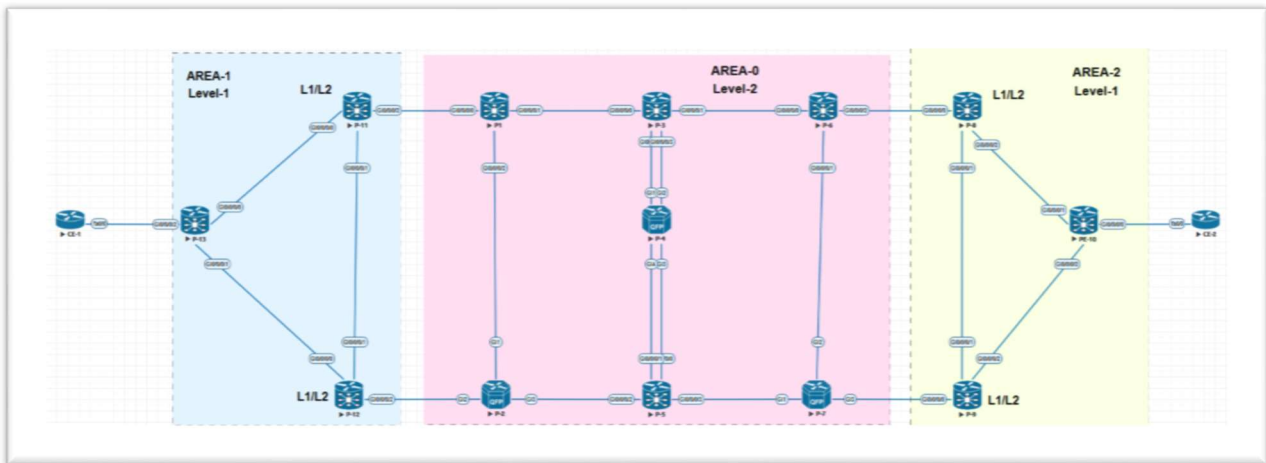


Figure 1: Lab Topology

All routers in Area 0 are Level-2 router and all links are Level-2.

Area1 and Area2 routers are Level-1 routers, except P-11,P-12,P-8 and P-10 which are ABR are configured as Level-1-2 router with link towards area zero configured as Level-2

IP address for loopback are R.R.R.R/32, where R is the router number

Link IP Addresses are 10.R1.R2.R/24. R1<R2,

CE1 and CE2 are customer router in VRF A with RD 100:1 and route-target both 100:1

LAB STEPS

1. IS-IS configuration:

a) Configuration on PE-13 (Area 1 Level 1 Router)

```
router IS-IS 1
  is-type level-1
  net 49.0001.0000.0000.0013.00
  address-family ipv4 unicast
  !
  interface Loopback0
    address-family ipv4 unicast
  !
  !
  interface GigabitEthernet0/0/0/0
    circuit-type level-1
```

```

address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/1
circuit-type level-1
address-family ipv4 unicast
!
!
!
!
!
!

```

Note: in net 49.0001.0000.0000.0013.00, 0001 → Area ID and 0013 → router identifier

b) Configuration in ABR P-11(ABR)

```

router IS-IS 1
net 49.0001.0000.0000.0011.00
address-family ipv4 unicast
!
interface Loopback0
address-family ipv4 unicast
!
interface GigabitEthernet0/0/0/0
circuit-type level-1
address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/1
circuit-type level-1
address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/2
circuit-type level-2-only
address-family ipv4 unicast
!
!
!
!
!
!

```

c) Configuration in L2 backbone routers

```

router IS-IS 1
is-type level-2-only
net 49.0000.0000.0000.0003.00
address-family ipv4 unicast
!
interface Loopback0
address-family ipv4 unicast
!
interface GigabitEthernet0/0/0/0
circuit-type level-2-only
address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/1
circuit-type level-2-only
address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/2
circuit-type level-2-only
address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/3
circuit-type level-2-only
address-family ipv4 unicast
!
!
!
!
!
!

```

2. IS-IS route-leaking is required for end to end LSP

Area 1 area 2 level-1 routers are currently receiving default-routes only to reach other area routers. In order to build PE to PE LSP, loopback IP of remote IP should be learned by the local PE as specific route. To achieve this we need to leak Level 2 route into level 1. Before route leaking the routing table on PE13 looks like following.

```
RP/0/0/CPU0:PE-13#show ip route
```

```

<..... Output omitted .....>

Gateway of last resort is 10.11.13.11 to network 0.0.0.0

i*L1 0.0.0.0/0 [115/10] via 10.11.13.11, 01:09:05, GigabitEthernet0/0/0/0
[115/10] via 10.12.13.12, 01:09:05, GigabitEthernet0/0/0/1
i L1 10.11.12.0/24 [115/20] via 10.11.13.11, 05:21:08, GigabitEthernet0/0/0/0
[115/20] via 10.12.13.12, 05:21:08, GigabitEthernet0/0/0/1
C 10.11.13.0/24 is directly connected, 20:34:10, GigabitEthernet0/0/0/0
L 10.11.13.13/32 is directly connected, 20:34:10, GigabitEthernet0/0/0/0
C 10.12.13.0/24 is directly connected, 20:34:10, GigabitEthernet0/0/0/1
L 10.12.13.13/32 is directly connected, 20:34:10, GigabitEthernet0/0/0/1
i L1 11.11.11.11/32 [115/20] via 10.11.13.11, 02:55:11, GigabitEthernet0/0/0/0
i L1 12.12.12.12/32 [115/20] via 10.12.13.12, 05:20:52, GigabitEthernet0/0/0/1
L 13.13.13.13/32 is directly connected, 20:34:11, Loopback0
RP/0/0/CPU0:PE-13#

```

a) Configuring route-leaking on ABRs

Configuration on P-11 and P-12:

```

route-policy LEAK
  if destination in (10.10.10.10/32) then
    done
  else
    drop
  endif
end-policy
!

router IS-IS 1
  address-family ipv4 unicast
    propagate level 2 into level 1 route-policy LEAK
  !

```

Configuration on P-8 and P-9

```

route-policy LEAK
  if destination in (13.13.13.13/32) then
    done
  else
    drop
  endif
end-policy
!

router IS-IS 1
  address-family ipv4 unicast
    propagate level 2 into level 1 route-policy LEAK
  !

```

Now we are receiving specific route of remote end PE.

```

RP/0/0/CPU0:PE-13#show route
< .... Output omitted .....>

Gateway of last resort is 10.11.13.11 to network 0.0.0.0

i*L1 0.0.0.0/0 [115/10] via 10.11.13.11, 01:40:06, GigabitEthernet0/0/0/0
[115/10] via 10.12.13.12, 01:40:06, GigabitEthernet0/0/0/1
i ia 10.10.10.10/32 [115/70] via 10.11.13.11, 00:09:47, GigabitEthernet0/0/0/0
[115/70] via 10.12.13.12, 00:09:47, GigabitEthernet0/0/0/1
i L1 10.11.12.0/24 [115/20] via 10.11.13.11, 05:52:09, GigabitEthernet0/0/0/0
[115/20] via 10.12.13.12, 05:52:09, GigabitEthernet0/0/0/1
C 10.11.13.0/24 is directly connected, 21:05:11, GigabitEthernet0/0/0/0
L 10.11.13.13/32 is directly connected, 21:05:11, GigabitEthernet0/0/0/0
C 10.12.13.0/24 is directly connected, 21:05:11, GigabitEthernet0/0/0/1
L 10.12.13.13/32 is directly connected, 21:05:11, GigabitEthernet0/0/0/1
i L1 11.11.11.11/32 [115/20] via 10.11.13.11, 03:26:12, GigabitEthernet0/0/0/0
i L1 12.12.12.12/32 [115/20] via 10.12.13.12, 05:51:53, GigabitEthernet0/0/0/1
L 13.13.13.13/32 is directly connected, 21:05:12, Loopback0
RP/0/0/CPU0:PE-13#

```

3. Configuring LDP on Area 2

In our topology all area 2 routers are not capable of segment routing. This area will use LDP for label propagation.

a) Configuring LDP on area 2 routers

```
mpls ldp
interface GigabitEthernet0/0/0/0
!
interface GigabitEthernet0/0/0/1
!
interface GigabitEthernet0/0/0/2
!
!
```

b) Configuring LDP on ABR links on P6 and P7

```
RP/0/0/CPU0:P-6#show run mpls
Fri Jan 25 23:46:43.153 UTC
mpls ldp
interface GigabitEthernet0/0/0/2
!
!
```

```
P-7#show run int gi3
interface GigabitEthernet3
mpls ip
```

c) Verification on P-8

```
RP/0/0/CPU0:P-8#show mpls interfaces

Interface                LDP      Tunnel  Static  Enabled
-----
GigabitEthernet0/0/0/0  Yes      No      No      Yes
GigabitEthernet0/0/0/1  Yes      No      No      Yes
GigabitEthernet0/0/0/2  Yes      No      No      Yes

RP/0/0/CPU0:P-8#show mpls ldp neighbor brief

Peer                    GR  NSR  Up Time   Discovery  Addresses  Labels
                    ipv4  ipv6  ipv4  ipv6  ipv4  ipv6  ipv4  ipv6
-----
9.9.9.9:0                N   N    15:20:48  1   0    4   0    33   0
6.6.6.6:0                N   N    15:20:47  1   0    4   0    33   0
10.10.10.10:0           N   N     04:13:54  1   0    3   0    8    0
```

4. Configuring segment routing on Area 0 and Area 1

Area 0 and Area 1 router are segment routing capable. We will enable segment routing and assign prefix-sid to loopback 0. IS-IS metric-style should be made wide before using segment routing. We will be using default segment routing global block (SRGB) 16000 to 23999.

a) Enabling segment routing on IOS XR router

```
router IS-IS 1
address-family ipv4 unicast
metric-style wide
segment-routing mpls
!
interface Loopback0
address-family ipv4 unicast
prefix-sid index 1          !!!..... index value is different in different router. Here we are using router no as index no
!
```

b) Enabling Segment routing on IOS XE

```
P-4#
segment-routing mpls
!
connected-prefix-sid-map
address-family ipv4
4.4.4.4/32 index 2 range 4    !! loopback 0 Ip address of this router is advertised as Prefix-sid ! enable wide metric in ISIS
exit-address-family
!
router IS-IS
metric-style wide
segment-routing mpls
```

5. SR-Domain to LDP domain continuity

Let's check the LSP status from P-1 to PE-10.

```
RP/0/0/CPU0:P-1#traceroute 10.10.10.10
Sat Jan 26 01:11:52.847 UTC

Type escape sequence to abort.
Tracing the route to 10.10.10.10

 1 10.1.3.3 29 msec 0 msec 0 msec
 2 10.3.6.6 19 msec 9 msec 0 msec
 3 10.6.8.8 [MPLS: Label 24028 Exp 0] 59 msec 9 msec 0 msec
 4 10.8.10.10 19 msec * 9 msec
```

Till the SR-Domain boundary P-6 packet is travelling without label then P-6 is assigning LDP label and forwarding it to P-8. Normal thing as P-10 does not have any prefix-sid information about 10.10.10.10/32 which belongs to LDP domain.

Let's check the status of SR-Labeling

```
RP/0/0/CPU0:P-1#traceroute 7.7.7.7
Sat Jan 26 01:12:47.223 UTC

Type escape sequence to abort.
Tracing the route to 7.7.7.7

 1 10.1.3.3 [MPLS: Label 16007 Exp 0] 9 msec 0 msec 0 msec
 2 10.3.6.6 [MPLS: Label 16007 Exp 0] 9 msec 0 msec 0 msec
 3 10.6.7.7 9 msec * 0 msec
```

We can see that packet is labelled if it is for destination within SR-Domain. Also remember that SR-Label will be used only for those prefix where prefix-sid is assigned. Let's ping one P2P ip ...

```
RP/0/0/CPU0:P-1#traceroute 10.5.7.7
Sat Jan 26 01:23:34.639 UTC

Type escape sequence to abort.
Tracing the route to 10.5.7.7

 1 10.1.2.2 9 msec 0 msec 0 msec
 2 10.2.5.5 49 msec 9 msec 0 msec
 3 10.5.7.7 9 msec * 0 msec
RP/0/0/CPU0:P-1#
```

Note that packet is not labelled even though it is in SR-Domain, because prefix-sid was not assigned for this prefix.

In order to assign prefix-sid for nodes which are not belongs SR-domain we need to configure mapping server (SRMS), which will assign prefix-sid for non-SR prefixes and advertised to other router via IGP. It is not required the SRMS has to be in traffic path. It can be anywhere but IGP filtering (at area boarder/level border) may stop propagation of prefix-sid mapping. Let's 1st configure PE-13 as SRMS and generates Prefix-sid for 10.10.10.10/32

a) Configuring PE-13(Level-1) as SRMS

```
segment-routing
mapping-server
prefix-sid-map
address-family ipv4
 10.10.10.10/32 2000 range 1          !!!!! 2000 is the starting label; Default SRGB is 16000 to 23999, so is label will be 18000
!
!
!
!
router IS-IS 1
address-family ipv4 unicast
segment-routing prefix-sid-map advertise-local
!
```

Let's check on other L1 router, whether it is receiving the map or not!


```

RP/0/0/CPU0:P-12#show mpls forwarding
Sat Jan 26 01:39:09.289 UTC
Local Outgoing Prefix      Outgoing   Next Hop    Bytes
Label Label      or ID      Interface  Hop         Switched
-----
<...output omitted ...>
16013 Pop          SR Pfx (idx 13)  Gi0/0/0/0  10.12.13.13  10128688
18000 18000 SR Pfx (idx 2000) Gi0/0/0/2  10.2.12.2    6256
24000 Pop          SR Adj (idx 0)   Gi0/0/0/1  10.11.12.11  0
24001 Pop          SR Adj (idx 2)   Gi0/0/0/1  10.11.12.11  0
<...output omitted ...>

```

P-12 getting the level 18000 what we mapped in PE-13. How it is getting it ?

```

RP/0/0/CPU0:P-12#show IS-IS database verbose PE-13.00-00
Sat Jan 26 01:41:14.810 UTC

IS-IS 1 (Level-1) Link State Database
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
PE-13.00-00    0x00000089   0xb616        538            0/0/0
Area Address: 49.0001
NLPID:         0xcc
Hostname:      PE-13
IP Address:    13.13.13.13
Router Cap:    13.13.13.13, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10     IS-Extended PE-13.01
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24002 System ID:P-11
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24003 System ID:P-11
Metric: 10     IS-Extended PE-13.03
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24000 System ID:P-12
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24001 System ID:P-12
Metric: 10     IP-Extended 10.11.13.0/24
Metric: 10     IP-Extended 10.12.13.0/24
Metric: 10     IP-Extended 13.13.13.13/32
Prefix-SID Index: 13, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
SID Binding: 10.10.10.10/32 F:0 M:0 S:0 D:0 A:0 Weight:0 Range:1
SID: Start:2000, Algorithm:0, R:0 N:0 P:0 E:0 V:0 L:0

IS-IS 1 (Level-2) Link State Database
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
The requested LSP PE-13.00-00 was not found in the IS-IS 1 Level-2 LSP Database
RP/0/0/CPU0:P-12#

```

PE-13 advertising in by a special TLV (SID Binding)

Now other router's having prefix-sid regarding 10.10.10.10, so let's check the LSP.

```

RP/0/0/CPU0:PE-13#ping 10.10.10.10
Sat Jan 26 01:46:30.579 UTC
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.10.10.10, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)

RP/0/0/CPU0:PE-13#show cef 10.10.10.10
Sat Jan 26 01:47:33.964 UTC
10.10.10.10/32, version 1054, internal 0x1000001 0x81 (ptr 0xa142e374) [1], 0x0 (0xa14136a4), 0xa28 (0xa16cb050)
Updated Jan 26 01:30:22.005
local adjacency 10.11.13.11
Prefix Len 32, traffic index 0, precedence n/a, priority 1
via 10.11.13.11/32, GigabitEthernet0/0/0/0, 7 dependencies, weight 0, class 0 [flags 0x0]
path-idx 0 NHID 0x0 [0xa10cb3f4 0x0]
next hop 10.11.13.11/32
local adjacency
local label 18000 labels imposed {18000}
via 10.12.13.12/32, GigabitEthernet0/0/0/1, 7 dependencies, weight 0, class 0 [flags 0x0]
path-idx 1 NHID 0x0 [0xa10cb49c 0x0]
next hop 10.12.13.12/32
local adjacency
local label 18000 labels imposed {18000}
RP/0/0/CPU0:PE-13#

```

OH! Lost reachability, but it is forwarding towards PE11 and PE12 using SR Label

Let's see what PE12 is doing after receiving the packet with label 18000.

```
RP/0/0/CPU0:P-12#show mpls forwarding | in 18000
Sat Jan 26 01:52:41.653 UTC
18000 18000 SR Pfx (idx 2000) Gi0/0/0/2 10.2.12.2 1376
RP/0/0/CPU0:P-12#
```

Looks fine P-12 forwarding it towards P-2 with label 18000. Now let's check it on P-2.

```
P-2#show mpls forwarding-table | in 18000
P-2#
```

OK! P-2 does not have any idea about label 18000, but it is receiving packet with label 18000. So it will drop those packet. IS-IS probably not forwarding mapping information to level-2.

```
P-2#show isis database verbose P-12.00-00

IS-IS Level-2 LSP P-12.00-00
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime/Rcvd  ATT/P/OL
P-12.00-00     0x000000C0   0x218F        1026/1199          0/0/0
Area Address: 49.0001
NLPID:         0xCC
Hostname: P-12
IP Address:    12.12.12.12
Router CAP:    12.12.12.12, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10     IS-Extended P-2.02
Lan Adjacency SID:
  SID Value:24004, P-2, F:0 B:1 V:1 L:1 S:0 Weight:0
  SID Value:24005, P-2, F:0 B:0 V:1 L:1 S:0 Weight:0
Metric: 10     IP 10.2.12.0/24
Metric: 10     IP 10.11.12.0/24
Metric: 20     IP 10.11.13.0/24
Metric: 10     IP 10.12.13.0/24
Metric: 20     IP 11.11.11.11/32
Prefix-SID Index: 11, Algorithm:SPF, R:1 N:1 P:1 E:0 V:0 L:0
Metric: 10     IP 12.12.12.12/32
Prefix-SID Index: 12, Algorithm:SPF, R:0 N:1 P:0 E:0 V:0 L:0
Metric: 20     IP 13.13.13.13/32
Prefix-SID Index: 13, Algorithm:SPF, R:1 N:1 P:1 E:0 V:0 L:0
P-2#
```

Yah! It is the case that ABR P-12/P-13 not propagating the sid-mapping to level-2 from Level-1.



sid-prefix-map can not be propagated from Level-1 to Level-2.

Let's try to make P-3 (Level-2) as segment routing mapping server (SRMS)

b) Removing mapping server configuration from PE-13

```
RP/0/0/CPU0:PE-13(config)#segment-routing
RP/0/0/CPU0:PE-13(config-sr)# mapping-server
RP/0/0/CPU0:PE-13(config-sr-ms)# no prefix-sid-map
RP/0/0/CPU0:PE-13(config-sr-ms)#router isis 1
RP/0/0/CPU0:PE-13(config-isis)# address-family ipv4 unicast
RP/0/0/CPU0:PE-13(config-isis-af)# no segment-routing prefix-sid-map adverti$
RP/0/0/CPU0:PE-13(config-isis-af)#commit
Sat Jan 26 02:37:01.731 UTC
RP/0/0/CPU0:PE-13(config-isis-af)#
Configuring P-3 as SRMS
```

c) Configuring P-3 as Mapping Server

```
RP/0/0/CPU0:P-3(config)#segment-routing
RP/0/0/CPU0:P-3(config-sr)# mapping-server
RP/0/0/CPU0:P-3(config-sr-ms)# prefix-sid-map
RP/0/0/CPU0:P-3(config-sr-ms-map)# address-family ipv4
RP/0/0/CPU0:P-3(config-sr-ms-map-af)# 10.10.10.10/32 2000 range 1
RP/0/0/CPU0:P-3(config-sr-ms-map-af)# !
RP/0/0/CPU0:P-3(config-sr-ms-map-af)# !
RP/0/0/CPU0:P-3(config-sr-ms-map-af)#
RP/0/0/CPU0:P-3(config-sr-ms-map-af)# router isis 1
RP/0/0/CPU0:P-3(config-isis)# address-family ipv4 unicast
RP/0/0/CPU0:P-3(config-isis-af)# segment-routing prefix-sid-map advertise-lo$
RP/0/0/CPU0:P-3(config-isis-af)# !
RP/0/0/CPU0:P-3(config-isis-af)#
```

```
RP/0/0/CPU0:P-3(config-isis-af)#commit
Sat Jan 26 02:39:04.625 UTC
```

Let's check it in P2 first

```
P-2#show isis database verbose P-3.00-00 | section SID Binding
SID Binding 10.10.10.10/32 F:0 M:0 S:0 D:0 A:0 Weight:0 Range:1
SID: Start:2000, Algorithm:SPF, R:0 N:0 P:0 E:0 V:0 L:0

P-2#show mpls forwarding-table | in 18000
18000      18000      10.10.10.10/32  548          Gi3          10.2.5.5
P-2#
P-2#traceroute 10.10.10.10
Type escape sequence to abort.
Tracing the route to 10.10.10.10
VRF info: (vrf in name/id, vrf out name/id)
 0 10.2.5.5 [MPLS: Label 18000 Exp 0] 53 msec 31 msec 10 msec
 1 10.5.7.7 [MPLS: Label 18000 Exp 0] 15 msec 85 msec 10 msec
 2 10.7.9.9 [MPLS: Label 24028 Exp 0] 22 msec 27 msec 8 msec
 3 10.9.10.10 26 msec 32 msec *
P-2#
```

We have now continuous LSP till PE-10 from P-2. Let's check it from level-1 PE-13.

```
RP/0/0/CPU0:PE-13#traceroute 10.10.10.10
Sat Jan 26 02:49:12.741 UTC

Type escape sequence to abort.
Tracing the route to 10.10.10.10
 0 10.12.13.12 19 msec 0 msec 0 msec
 1 10.2.12.2 [MPLS: Label 18000 Exp 0] 29 msec 19 msec 19 msec
 2 10.2.5.5 [MPLS: Label 18000 Exp 0] 29 msec 9 msec 9 msec
 3 10.5.7.7 [MPLS: Label 18000 Exp 0] 19 msec 9 msec 9 msec
 4 10.7.9.9 [MPLS: Label 24028 Exp 0] 19 msec 9 msec 9 msec
 5 10.9.10.10 9 msec * 9 msec
RP/0/0/CPU0:PE-13#

RP/0/0/CPU0:PE-13#show isis database verbose P-12.00-00
Sat Jan 26 02:50:43.225 UTC

IS-IS 1 (Level-1) Link State Database
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
P-12.00-00     0x000000fe  0xea78        455           1/0/0
Area Address: 49.0001
NLPID:         0xcc
Hostname:      P-12
IP Address:    12.12.12.12
Router Cap:    12.12.12.12, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10     IS-Extended P-12.03
LAN-ADJ-SID:  F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24000 System ID:P-1
1
LAN-ADJ-SID:  F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24001 System ID:P-1
1
Metric: 10     IS-Extended PE-13.03
LAN-ADJ-SID:  F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24002 System ID:PE-
13
LAN-ADJ-SID:  F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24003 System ID:PE-
13
Metric: 60     IP-Extended-Interarea 10.10.10.10/32
Metric: 10     IP-Extended 10.11.12.0/24
Metric: 10     IP-Extended 10.12.13.0/24
Metric: 10     IP-Extended 12.12.12.12/32
Prefix-SID Index: 12, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
RP/0/0/CPU0:PE-13#
```

ABR leaking the Level-2 route 10.10.10.10/32 into area 1 by converting it into Level-1, but it is not forwarding the 'SID Binding' TLV. Till the ABR packet is unlabeled after that it is labelled till PE-10.



sid-prefix-map can not be propagated from Level-2 to Level-1 by route-leaking.

Let's configure the ABR P-11 as mapping server so that mapping can be propagated to both levels.

d) Removing mapping server configuration from P-3

```
RP/0/0/CPU0:P-3(config)#segment-routing
RP/0/0/CPU0:P-3(config-sr)# mapping-server
```

```

RP/0/0/CPU0:P-3(config-sr-ms)# no prefix-sid-map
RP/0/0/CPU0:P-3(config-sr-ms)#router isis 1
RP/0/0/CPU0:P-3(config-isis)# address-family ipv4 unicast
RP/0/0/CPU0:P-3(config-isis-af)# no segment-routing prefix-sid-map advertise$
RP/0/0/CPU0:P-3(config-isis-af)#commit
Sat Jan 26 02:57:40.809 UTC
RP/0/0/CPU0:P-3(config-isis-af)#

Configuring P-11 as mapping server.
RP/0/0/CPU0:P-11(config)#segment-routing
RP/0/0/CPU0:P-11(config-sr)# mapping-server
RP/0/0/CPU0:P-11(config-sr-ms)# prefix-sid-map
RP/0/0/CPU0:P-11(config-sr-ms-map)# address-family ipv4
RP/0/0/CPU0:P-11(config-sr-ms-map-af)# 10.10.10.10/32 2000 range 1
RP/0/0/CPU0:P-11(config-sr-ms-map-af)# !
RP/0/0/CPU0:P-11(config-sr-ms-map-af)# !
RP/0/0/CPU0:P-11(config-sr-ms-map-af)#
RP/0/0/CPU0:P-11(config-sr-ms-map-af)# router isis 1
RP/0/0/CPU0:P-11(config-isis)# address-family ipv4 unicast
RP/0/0/CPU0:P-11(config-isis-af)# segment-routing prefix-sid-map advertise-1$
RP/0/0/CPU0:P-11(config-isis-af)# !
RP/0/0/CPU0:P-11(config-isis-af)#commit
Sat Jan 26 02:59:08.660 UTC
RP/0/0/CPU0:P-11(config-isis-af)#

```

Let's check it in PE-13 now

```

P-2#show isis database verbose P-11.00-00

IS-IS Level-2 LSP P-11.00-00
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime/Rcvd  ATT/P/OL
P-11.00-00     0x00000092  0x918A        1003/1198          0/0/0
Area Address: 49.0001
NLPID:         0xCC
Hostname:      P-11
IP Address:    11.11.11.11
Router CAP:    11.11.11.11, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10     IS-Extended P-1.03
Lan Adjacency SID:
  SID Value:24004, P-1, F:0 B:1 V:1 L:1 S:0 Weight:0
  SID Value:24005, P-1, F:0 B:0 V:1 L:1 S:0 Weight:0
Metric: 10     IP 10.1.11.0/24
Metric: 10     IP 10.11.12.0/24
Metric: 10     IP 10.11.13.0/24
Metric: 20     IP 10.12.13.0/24
Metric: 10     IP 11.11.11.11/32
Prefix-SID Index: 11, Algorithm:SPF, R:0 N:1 P:0 E:0 V:0 L:0
Metric: 20     IP 12.12.12.12/32
Prefix-SID Index: 12, Algorithm:SPF, R:1 N:1 P:1 E:0 V:0 L:0
Metric: 20     IP 13.13.13.13/32
Prefix-SID Index: 13, Algorithm:SPF, R:1 N:1 P:1 E:0 V:0 L:0
SID Binding 10.10.10.10/32 F:0 M:0 S:0 D:0 A:0 Weight:0 Range:1
SID: Start:2000, Algorithm:SPF, R:0 N:0 P:0 E:0 V:0 L:0
=====

RP/0/0/CPU0:PE-13#show isis database verbose P-11.00-00

IS-IS 1 (Level-1) Link State Database
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
P-11.00-00     0x000000b1  0x846b        1116           1/0/0
Area Address: 49.0001
NLPID:         0xcc
Hostname:      P-11
IP Address:    11.11.11.11
Router Cap:    11.11.11.11, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10     IS-Extended P-12.03
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24000 System ID:P-12
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24001 System ID:P-12
Metric: 10     IS-Extended PE-13.01
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24002 System ID:PE-13
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24003 System ID:PE-13
Metric: 60     IP-Extended-Interarea 10.10.10.10/32
Metric: 10     IP-Extended 10.11.12.0/24
Metric: 10     IP-Extended 10.11.13.0/24
Metric: 10     IP-Extended 11.11.11.11/32
Prefix-SID Index: 11, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
SID Binding: 10.10.10.10/32 F:0 M:0 S:0 D:0 A:0 Weight:0 Range:1
SID: Start:2000, Algorithm:0, R:0 N:0 P:0 E:0 V:0 L:0
RP/0/0/CPU0:PE-13#

RP/0/0/CPU0:PE-13#traceroute 10.10.10.10
Type escape sequence to abort.
Tracing the route to 10.10.10.10

 1 10.12.13.12 [MPLS: Label 18000 Exp 0] 89 msec 19 msec 9 msec
 2 10.2.12.2 [MPLS: Label 18000 Exp 0] 19 msec 9 msec 9 msec
 3 10.2.5.5 [MPLS: Label 18000 Exp 0] 9 msec 9 msec 89 msec
 4 10.5.7.7 [MPLS: Label 18000 Exp 0] 19 msec 9 msec 9 msec
 5 10.7.9.9 [MPLS: Label 24028 Exp 0] 19 msec 19 msec 9 msec
 6 10.9.10.10 19 msec * 9 msec

```

Now we have end to end LSP between PEs

Let's check CE1 to CE2 connectivity

```
CE-1#traceroute 200.0.1.1 source lo 0
Type escape sequence to abort.
Tracing the route to 200.0.1.1
 0 100.0.0.1 16 msec 4 msec 8 msec
 1 10.11.13.11 [MPLS: Labels 18000/24005 Exp 0] 100 msec 68 msec 36 msec
 2 10.1.11.1 [MPLS: Labels 18000/24005 Exp 0] 48 msec 40 msec 28 msec
 3 10.1.3.3 [MPLS: Labels 18000/24005 Exp 0] 44 msec 40 msec 28 msec
 4 10.3.6.6 [MPLS: Labels 18000/24005 Exp 0] 68 msec 36 msec 28 msec
 5 10.6.8.8 [MPLS: Labels 24028/24005 Exp 0] 40 msec 52 msec 32 msec
 6 10.8.10.10 [MPLS: Label 24005 Exp 0] 72 msec 40 msec 28 msec
 7 200.0.0.2 28 msec 36 msec *
CE-1#
```

Let's check the label forwarding at SR – LDP boundary

```
RP/0/0/CPU0:P-6#show mpls forwarding | in 18000
Sat Jan 26 03:12:54.305 UTC
18000 24028 SR Pfx (idx 2000) Gi0/0/0/2 10.6.8.8 2646
RP/0/0/CPU0:P-6#

P-7#show mpls forwarding-table | in 18000
18000 [M] 24028 10.10.10.10/32 4089 Gi3 10.7.9.9
P-7#
```

ALL FINAL CONFIGURATIONS

a) PE-13

```
RP/0/0/CPU0:PE-13#show run
Sat Jan 26 03:19:44.915 UTC
Building configuration...
!! IOS XR Configuration 6.0.1
!! Last configuration change at Sat Jan 26 02:37:01 2019 by cisco
!
hostname PE-13
vrf A
  address-family ipv4 unicast
    import route-target
      100:1
    !
    export route-target
      100:1
    !
  !
!
interface Loopback0
  ipv4 address 13.13.13.13 255.255.255.255
!
interface Loopback1234
!
interface MgmtEth0/0/CPU0/0
  shutdown
!
interface GigabitEthernet0/0/0/0
  ipv4 address 10.11.13.13 255.255.255.0
!
interface GigabitEthernet0/0/0/1
  ipv4 address 10.12.13.13 255.255.255.0
!
interface GigabitEthernet0/0/0/2
  vrf A
  ipv4 address 100.0.0.1 255.255.255.0
!
interface GigabitEthernet0/0/0/3
  shutdown
!
interface GigabitEthernet0/0/0/4
  shutdown
!
router isis 1
  is-type level-1
  net 49.0001.0000.0000.0013.00
  address-family ipv4 unicast
  metric-style wide
  segment-routing mpls
!
interface Loopback0
  address-family ipv4 unicast
  prefix-sid index 13
!
!
interface GigabitEthernet0/0/0/0
  circuit-type level-1
  address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/1
  circuit-type level-1
  address-family ipv4 unicast
!
!
!
router bgp 100
  address-family vpnv4 unicast
!
  neighbor 10.10.10.10
  remote-as 100
  update-source Loopback0
  address-family vpnv4 unicast
!
!
  vrf A
  rd 100:1
  address-family ipv4 unicast
  redistribute eigrp 111
!
!
!
router eigrp CUS
  address-family ipv4
!
  vrf A
  address-family ipv4
  default-metric 100 20 255 1 1500
  autonomous-system 111
```

```

redistribute bgp 100
interface GigabitEthernet0/0/0/2
!
!
!
!
segment-routing
!
end

```

b) PE-10

```

RP/0/0/CPU0:PE-10#show run
Sat Jan 26 03:21:54.463 UTC
Building configuration...
!! IOS XR Configuration 6.0.1
!! Last configuration change at Fri Jan 25 22:45:54 2019 by cisco
!
hostname PE-10
vrf A
address-family ipv4 unicast
import route-target
100:1
!
export route-target
100:1
!
!
!
interface Loopback0
ipv4 address 10.10.10.10 255.255.255.255
!
interface Loopback1234
!
interface MgmtEth0/0/CPU0/0
shutdown
!
interface GigabitEthernet0/0/0/0
vrf A
ipv4 address 200.0.0.1 255.255.255.0
!
interface GigabitEthernet0/0/0/1
ipv4 address 10.8.10.10 255.255.255.0
!
interface GigabitEthernet0/0/0/2
ipv4 address 10.9.10.10 255.255.255.0
!
interface GigabitEthernet0/0/0/3
shutdown
!
interface GigabitEthernet0/0/0/4
shutdown
!
router isis 1
is-type level-1
net 49.0002.0000.0000.0010.00
address-family ipv4 unicast
metric-style wide
!
interface Loopback0
address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/0
!
interface GigabitEthernet0/0/0/1
circuit-type level-1
address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/2
circuit-type level-1
address-family ipv4 unicast
!
!
!
router bgp 100
address-family vpv4 unicast
!
neighbor 13.13.13.13
remote-as 100
update-source Loopback0
address-family vpv4 unicast
!
!
vrf A
rd 100:1
address-family ipv4 unicast
redistribute eigrp 111
!
!
!
mpls ldp
interface GigabitEthernet0/0/0/1
!
interface GigabitEthernet0/0/0/2

```

```

!
!
router eigrp CUS
 address-family ipv4
!
 vrf A
  address-family ipv4
  default-metric 100 20 255 1 1500
  autonomous-system 111
  redistribute bgp 100
  interface GigabitEthernet0/0/0/0
!
!
!
end
RP/0/0/CPU0:PE-10#

```

c) P-11

```

RP/0/0/CPU0:P-11#show run
Sat Jan 26 03:23:00.602 UTC
Building configuration...
!! IOS XR Configuration 6.0.1
!! Last configuration change at Sat Jan 26 02:59:08 2019 by cisco
!
hostname P-11
interface Loopback0
 ipv4 address 11.11.11.11 255.255.255.255
!
interface MgmtEth0/0/CPU0/0
 shutdown
!
interface GigabitEthernet0/0/0/0
 ipv4 address 10.11.13.11 255.255.255.0
!
interface GigabitEthernet0/0/0/1
 ipv4 address 10.11.12.11 255.255.255.0
!
interface GigabitEthernet0/0/0/2
 ipv4 address 10.1.11.11 255.255.255.0
!
interface GigabitEthernet0/0/0/3
 shutdown
!
interface GigabitEthernet0/0/0/4
 shutdown
!
route-policy LEAK
 if destination in (10.10.10.10/32) then
  done
 else
  drop
 endif
end-policy
!
router isis 1
 net 49.0001.0000.0000.0011.00
 address-family ipv4 unicast
 metric-style wide
 propagate level 2 into level 1 route-policy LEAK
 segment-routing mpls
 segment-routing prefix-sid-map advertise-local
!
interface Loopback0
 address-family ipv4 unicast
 prefix-sid index 11
!
!
interface GigabitEthernet0/0/0/0
 circuit-type level-1
 address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/1
 circuit-type level-1
 address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/2
 circuit-type level-2-only
 address-family ipv4 unicast
!
!
!
segment-routing
 mapping-server
 prefix-sid-map
 address-family ipv4
 10.10.10.10/32 2000 range 1
!
!
!
end

```


d) P-12

```

RP/0/0/CPU0:P-12#show run
Sat Jan 26 03:23:56.258 UTC
Building configuration...
!! IOS XR Configuration 6.0.1
!! Last configuration change at Fri Jan 25 23:10:50 2019 by cisco
!
hostname P-12
interface Loopback0
  ipv4 address 12.12.12.12 255.255.255.255
!
interface MgmtEth0/0/CPU0/0
  shutdown
!
interface GigabitEthernet0/0/0/0
  ipv4 address 10.12.13.12 255.255.255.0
!
interface GigabitEthernet0/0/0/1
  ipv4 address 10.11.12.12 255.255.255.0
!
interface GigabitEthernet0/0/0/2
  ipv4 address 10.2.12.12 255.255.255.0
!
interface GigabitEthernet0/0/0/3
  shutdown
!
interface GigabitEthernet0/0/0/4
  shutdown
!
route-policy LEAK
  if destination in (10.10.10.10/32) then
    done
  else
    drop
  endif
end-policy
!
router isis 1
  net 49.0001.0000.0000.0012.00
  address-family ipv4 unicast
  metric-style wide
  propagate level 2 into level 1 route-policy LEAK
  segment-routing mpls
  segment-routing prefix-sid-map receive
  segment-routing prefix-sid-map advertise-local
!
interface Loopback0
  address-family ipv4 unicast
  prefix-sid index 12
!
!
interface GigabitEthernet0/0/0/0
  circuit-type level-1
  address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/1
  circuit-type level-1
  address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/2
  circuit-type level-2-only
  address-family ipv4 unicast
!
!
!
segment-routing
!
end
RP/0/0/CPU0:P-12#

```

e) P-1

```

RP/0/0/CPU0:P-1#show run
Sat Jan 26 03:24:52.510 UTC
Building configuration...
!! IOS XR Configuration 6.0.1
!! Last configuration change at Fri Jan 25 22:42:46 2019 by cisco
!
hostname P-1
interface Loopback0
  ipv4 address 1.1.1.1 255.255.255.255
!
interface Loopback1234
!
interface MgmtEth0/0/CPU0/0
  shutdown
!
interface GigabitEthernet0/0/0/0
  ipv4 address 10.1.11.1 255.255.255.0

```



```

!
hostname P-5
interface Loopback0
  ipv4 address 5.5.5.5 255.255.255.255
!
interface Loopback1234
!
interface MgmtEth0/0/CPU0/0
  shutdown
!
interface GigabitEthernet0/0/0/0
  ipv4 address 10.4.5.5 255.255.255.0
!
interface GigabitEthernet0/0/0/1
  ipv4 address 11.4.5.5 255.255.255.0
!
interface GigabitEthernet0/0/0/2
  ipv4 address 10.2.5.5 255.255.255.0
!
interface GigabitEthernet0/0/0/3
  ipv4 address 10.5.7.5 255.255.255.0
!
interface GigabitEthernet0/0/0/4
  shutdown
!
router isis 1
  net 49.0000.0000.0000.0005.00
  address-family ipv4 unicast
  metric-style wide
  mpls traffic-eng level-1-2
  mpls traffic-eng router-id Loopback0
  segment-routing mpls
  segment-routing prefix-sid-map receive
!
interface Loopback0
  address-family ipv4 unicast
  prefix-sid index 5
!
!
interface GigabitEthernet0/0/0/0
  circuit-type level-2-only
  address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/1
  circuit-type level-2-only
  address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/2
  circuit-type level-2-only
  address-family ipv4 unicast
!
!
interface GigabitEthernet0/0/0/3
  circuit-type level-2-only
  address-family ipv4 unicast
!
!
!
mpls traffic-eng
interface GigabitEthernet0/0/0/0
!
interface GigabitEthernet0/0/0/1
!
interface GigabitEthernet0/0/0/2
!
interface GigabitEthernet0/0/0/3
!
!
end
RP/0/0/CPU0:P-5#

```

j) P-6

```

RP/0/0/CPU0:P-6#show run
Sat Jan 26 03:31:39.368 UTC
Building configuration...
!! IOS XR Configuration 6.0.1
!! Last configuration change at Fri Jan 25 22:44:14 2019 by cisco
!
hostname P-6
interface Loopback0
  ipv4 address 6.6.6.6 255.255.255.255
!
interface Loopback1234
!
interface MgmtEth0/0/CPU0/0
  shutdown
!
interface GigabitEthernet0/0/0/0
  ipv4 address 10.3.6.6 255.255.255.0
!
interface GigabitEthernet0/0/0/1
  ipv4 address 10.6.7.6 255.255.255.0
!

```



```

interface GigabitEthernet0/0/0/0
  ipv4 address 10.6.8.8 255.255.255.0
  !
interface GigabitEthernet0/0/0/1
  ipv4 address 10.8.9.8 255.255.255.0
  !
interface GigabitEthernet0/0/0/2
  ipv4 address 10.8.10.8 255.255.255.0
  !
interface GigabitEthernet0/0/0/3
  shutdown
  !
interface GigabitEthernet0/0/0/4
  shutdown
  !
route-policy LEAK
  if destination in (13.13.13.13/32) then
    done
  else
    drop
  endif
end-policy
!
router isis 1
  net 49.0002.0000.0000.0008.00
  address-family ipv4 unicast
  metric-style wide
  propagate level 2 into level 1 route-policy LEAK
  !
interface Loopback0
  address-family ipv4 unicast
  !
  !
interface GigabitEthernet0/0/0/0
  circuit-type level-2-only
  address-family ipv4 unicast
  !
  !
interface GigabitEthernet0/0/0/1
  circuit-type level-1
  address-family ipv4 unicast
  !
  !
interface GigabitEthernet0/0/0/2
  circuit-type level-1
  address-family ipv4 unicast
  !
  !
mpls ldp
  interface GigabitEthernet0/0/0/0
  !
  interface GigabitEthernet0/0/0/1
  !
  interface GigabitEthernet0/0/0/2
  !
  !
end
RP/0/0/CPU0:P-8#

```

m) P-9

```

RP/0/0/CPU0:P-9#show run
Sat Jan 26 03:34:41.026 UTC
Building configuration...
!! IOS XR Configuration 6.0.1
!! Last configuration change at Fri Jan 25 22:45:26 2019 by cisco
!
hostname P-9
interface Loopback0
  ipv4 address 9.9.9.9 255.255.255.255
  !
interface Loopback1234
  !
interface MgmtEth0/0/CPU0/0
  shutdown
  !
interface GigabitEthernet0/0/0/0
  ipv4 address 10.7.9.9 255.255.255.0
  !
interface GigabitEthernet0/0/0/1
  ipv4 address 10.8.9.9 255.255.255.0
  !
interface GigabitEthernet0/0/0/2
  ipv4 address 10.9.10.9 255.255.255.0
  !
interface GigabitEthernet0/0/0/3
  shutdown
  !
interface GigabitEthernet0/0/0/4
  shutdown
  !
route-policy LEAK
  if destination in (13.13.13.13/32) then
    done
  else

```



```

interface FastEthernet3/0
  no ip address
  shutdown
  duplex half
  !
interface FastEthernet4/0
  no ip address
  shutdown
  duplex half
  !
  !
router eigrp 111
  network 0.0.0.0
  !
  !
  !
no ip http server
no ip http secure-server
  !
  !
  !
control-plane
  !
  !
line con 0
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  login
  !
end
CE-1#

```

o) CE-2

```

CE-2#show run
Building configuration...

Current configuration : 851 bytes
!
version 12.2
service timestamps debug datetime msec
service timestamps log datetime msec
!
hostname CE-2
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
ip source-route
!
!
!
!
ip cef
no ipv6 cef
!
!
multilink bundle-name authenticated
!
!
!
!
!
!
!
!
!
!
interface Loopback0
  ip address 200.0.1.1 255.255.255.0
!
interface FastEthernet0/0
  ip address 200.0.0.2 255.255.255.0
  duplex half
!
interface FastEthernet1/0
  no ip address
  shutdown
  duplex half
!
interface FastEthernet2/0
  no ip address
  shutdown
  duplex half
!
interface FastEthernet3/0
  no ip address
  shutdown
  duplex half
!
interface FastEthernet4/0

```

```

no ip address
shutdown
duplex half
!
!
router eigrp 111
network 0.0.0.0
!
!
!
no ip http server
no ip http secure-server
!
!
!
!
control-plane
!
!
!
line con 0
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  login
!
end
CE-2#

```

OTHER VERIFICATION OUTPUT

a) Area 0 isis database

```

RP/0/0/CPU0:P-3#show isis database verbose
Sat Jan 26 03:42:58.313 UTC

IS-IS 1 (Level-2) Link State Database
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
P-1.00-00      0x000000c4   0x7c91        595           0/0/0
  Area Address: 49.0000
  NLPID:        0xcc
  Hostname:     P-1
  IP Address:   1.1.1.1
  Router Cap:   1.1.1.1, D:0, S:0
  Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
  Metric: 10    IS-Extended P-1.03
  LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24002 System ID:P-11
  LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24003 System ID:P-11
  Metric: 10    IS-Extended P-2.01
  LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24000 System ID:P-2
  LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24001 System ID:P-2
  Metric: 10    IS-Extended P-3.05
  LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24004 System ID:P-3
  LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24005 System ID:P-3
  Metric: 10    IP-Extended 1.1.1.1/32
  Prefix-SID Index: 1, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
  Metric: 10    IP-Extended 10.1.2.0/24
  Metric: 10    IP-Extended 10.1.3.0/24
  Metric: 10    IP-Extended 10.1.11.0/24
P-1.03-00      0x00000073   0xc868        738           0/0/0
  Metric: 0     IS-Extended P-1.00
  Metric: 0     IS-Extended P-11.00
P-2.00-00      0x000000b3   0x587d        598           0/0/0
  Area Address: 49.0000
  NLPID:        0xcc
  Router Cap:   2.2.2.2, D:0, S:0
  Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
  SubTLV 19: Length: 2
  Hostname:     P-2
  Metric: 10    IS-Extended P-2.03
  LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 18 System ID:P-5
  Metric: 10    IS-Extended P-2.02
  LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 17 System ID:P-12
  Metric: 10    IS-Extended P-2.01
  LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 16 System ID:P-1
  IP Address:   2.2.2.2
  Metric: 10    IP-Extended 2.2.2.2/32
  SubTLV 4: Length: 1
  Prefix-SID Index: 2, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
  Metric: 10    IP-Extended 10.1.2.0/24
  SubTLV 4: Length: 1
  Metric: 10    IP-Extended 10.2.12.0/24
  SubTLV 4: Length: 1
  Metric: 10    IP-Extended 10.2.5.0/24
  SubTLV 4: Length: 1
P-2.01-00      0x0000008e   0x63d8        595           0/0/0
  Metric: 0     IS-Extended P-2.00
  Metric: 0     IS-Extended P-1.00
P-2.02-00      0x0000008e   0xb178        594           0/0/0
  Metric: 0     IS-Extended P-2.00
  Metric: 0     IS-Extended P-12.00
P-2.03-00      0x0000008e   0xa590        595           0/0/0
  Metric: 0     IS-Extended P-2.00

```

```

Metric: 0          IS-Extended P-5.00
P-3.00-00          * 0x000000b1 0x86a0      894      0/0/0
Area Address: 49.0000
NLPID:             0xcc
Hostname:          P-3
IP Address:        3.3.3.3
Router Cap:        3.3.3.3, D:0, S:0
Segment Routing:  I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10         IS-Extended P-3.05
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24004 System ID:P-1
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24005 System ID:P-1
Metric: 10         IS-Extended P-3.07
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24006 System ID:P-6
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24007 System ID:P-6
Metric: 10         IS-Extended P-3.01
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24000 System ID:P-4
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24001 System ID:P-4
Metric: 10         IS-Extended P-3.03
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24002 System ID:P-4
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24003 System ID:P-4
Metric: 10         IP-Extended 3.3.3.3/32
Prefix-SID Index: 3, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
Metric: 10         IP-Extended 10.1.3.0/24
Metric: 10         IP-Extended 10.3.4.0/24
Metric: 10         IP-Extended 10.3.6.0/24
Metric: 10         IP-Extended 11.3.4.0/24
P-3.01-00          0x0000007a 0xab89      592      0/0/0
Metric: 0          IS-Extended P-3.00
Metric: 0          IS-Extended P-4.00
P-3.03-00          0x0000007b 0x9b96      701      0/0/0
Metric: 0          IS-Extended P-3.00
Metric: 0          IS-Extended P-4.00
P-3.05-00          0x00000075 0x57e1      1040     0/0/0
Metric: 0          IS-Extended P-3.00
Metric: 0          IS-Extended P-1.00
P-3.07-00          0x00000075 0xb77a      1184     0/0/0
Metric: 0          IS-Extended P-3.00
Metric: 0          IS-Extended P-6.00
P-4.00-00          0x0000008d 0xecc6      609      0/0/0
Area Address: 49.0000
NLPID:             0xcc
Router Cap:        4.4.4.4, D:0, S:0
Segment Routing:  I:1 V:0, SRGB Base: 16000 Range: 8000
SubTLV 19: Length: 2
Hostname:          P-4
Metric: 10         IS-Extended P-5.03
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 16 System ID:P-5
Metric: 10         IS-Extended P-3.03
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 19 System ID:P-3
Metric: 10         IS-Extended P-5.01
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 17 System ID:P-5
Metric: 10         IS-Extended P-3.01
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 18 System ID:P-3
IP Address:        4.4.4.4
Metric: 10         IP-Extended 4.4.4.4/32
SubTLV 4: Length: 1
Prefix-SID Index: 2, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
Metric: 10         IP-Extended 10.3.4.0/24
SubTLV 4: Length: 1
Metric: 10         IP-Extended 11.3.4.0/24
SubTLV 4: Length: 1
Metric: 10         IP-Extended 10.4.5.0/24
SubTLV 4: Length: 1
Metric: 10         IP-Extended 11.4.5.0/24
SubTLV 4: Length: 1
P-5.00-00          0x00000109 0x1b2f      594      0/0/0
Area Address: 49.0000
NLPID:             0xcc
Hostname:          P-5
IP Address:        5.5.5.5
Router Cap:        5.5.5.5, D:0, S:0
Segment Routing:  I:1 V:0, SRGB Base: 16000 Range: 8000
Router ID:         5.5.5.5
Metric: 10         IS-Extended P-5.01
Affinity: 0x00000000
Interface IP Address: 10.4.5.5
Neighbor IP Address: 10.4.5.5
Physical BW: 1000000 kbits/sec
Reservable Global pool BW: 0 kbits/sec
Global Pool BW Unreserved:
[0]: 0 kbits/sec [1]: 0 kbits/sec
[2]: 0 kbits/sec [3]: 0 kbits/sec
[4]: 0 kbits/sec [5]: 0 kbits/sec
[6]: 0 kbits/sec [7]: 0 kbits/sec
Admin. Weight: 10
Ext Admin Group: Length: 32
0x00000000 0x00000000
0x00000000 0x00000000
0x00000000 0x00000000
0x00000000 0x00000000
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24002 System ID:P-4
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24003 System ID:P-4
Metric: 10         IS-Extended P-5.03
Affinity: 0x00000000
Interface IP Address: 11.4.5.5
Neighbor IP Address: 11.4.5.5
Physical BW: 1000000 kbits/sec
Reservable Global pool BW: 0 kbits/sec
Global Pool BW Unreserved:

```



```

[0]: 0 kbits/sec [1]: 0 kbits/sec
[2]: 0 kbits/sec [3]: 0 kbits/sec
[4]: 0 kbits/sec [5]: 0 kbits/sec
[6]: 0 kbits/sec [7]: 0 kbits/sec
Admin. Weight: 10
Ext Admin Group: Length: 32
0x00000000 0x00000000
0x00000000 0x00000000
0x00000000 0x00000000
0x00000000 0x00000000
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24004 System ID:P-4
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24005 System ID:P-4
Metric: 10 IS-Extended P-5.07
Affinity: 0x00000000
Interface IP Address: 10.5.7.5
Neighbor IP Address: 10.5.7.5
Physical BW: 1000000 kbits/sec
Reservable Global pool BW: 0 kbits/sec
Global Pool BW Unreserved:
[0]: 0 kbits/sec [1]: 0 kbits/sec
[2]: 0 kbits/sec [3]: 0 kbits/sec
[4]: 0 kbits/sec [5]: 0 kbits/sec
[6]: 0 kbits/sec [7]: 0 kbits/sec
Admin. Weight: 10
Ext Admin Group: Length: 32
0x00000000 0x00000000
0x00000000 0x00000000
0x00000000 0x00000000
0x00000000 0x00000000
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24006 System ID:P-7
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24007 System ID:P-7
Metric: 10 IS-Extended P-2.03
Affinity: 0x00000000
Interface IP Address: 10.2.5.5
Neighbor IP Address: 10.2.5.2
Physical BW: 1000000 kbits/sec
Reservable Global pool BW: 0 kbits/sec
Global Pool BW Unreserved:
[0]: 0 kbits/sec [1]: 0 kbits/sec
[2]: 0 kbits/sec [3]: 0 kbits/sec
[4]: 0 kbits/sec [5]: 0 kbits/sec
[6]: 0 kbits/sec [7]: 0 kbits/sec
Admin. Weight: 10
Ext Admin Group: Length: 32
0x00000000 0x00000000
0x00000000 0x00000000
0x00000000 0x00000000
0x00000000 0x00000000
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24000 System ID:P-2
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24001 System ID:P-2
Metric: 10 IP-Extended 5.5.5.5/32
Prefix-SID Index: 5, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
Metric: 10 IP-Extended 10.2.5.0/24
Metric: 10 IP-Extended 10.4.5.0/24
Metric: 10 IP-Extended 10.5.7.0/24
Metric: 10 IP-Extended 11.4.5.0/24
P-5.01-00 0x0000005b 0xeb64 739 0/0/0
Metric: 0 IS-Extended P-5.00
Metric: 0 IS-Extended P-4.00
P-5.03-00 0x0000005d 0xd972 711 0/0/0
Metric: 0 IS-Extended P-5.00
Metric: 0 IS-Extended P-4.00
P-5.05-00 0x0000001f 0x0000 0 (1200) 0/0/0
TLV 13: Length: 15
Hostname: P-4
P-5.07-00 0x0000007c 0xc164 589 0/0/0
Metric: 0 IS-Extended P-5.00
Metric: 0 IS-Extended P-7.00
P-6.00-00 0x0000009a 0xe4bd 1028 0/0/0
Area Address: 49.0000
NLPID: 0xcc
Hostname: P-6
IP Address: 6.6.6.6
Router Cap: 6.6.6.6, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10 IS-Extended P-6.03
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24030 System ID:P-7
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24031 System ID:P-7
Metric: 10 IS-Extended P-3.07
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24000 System ID:P-3
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24001 System ID:P-3
Metric: 10 IS-Extended P-8.01
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24002 System ID:P-8
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24003 System ID:P-8
Metric: 10 IP-Extended 6.6.6.6/32
Prefix-SID Index: 6, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
Metric: 10 IP-Extended 10.3.6.0/24
Metric: 10 IP-Extended 10.6.7.0/24
Metric: 10 IP-Extended 10.6.8.0/24
P-6.03-00 0x0000005a 0x2327 1142 0/0/0
Metric: 0 IS-Extended P-6.00
Metric: 0 IS-Extended P-7.00
P-7.00-00 0x0000008b 0x1a24 1136 0/0/0
Area Address: 49.0000
NLPID: 0xcc
Router Cap: 7.7.7.7, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
SubTLV 19: Length: 2
Hostname: P-7

```

```

Metric: 10      IS-Extended P-5.07
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 44 System ID:P-5
Metric: 10      IS-Extended P-6.03
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 45 System ID:P-6
Metric: 10      IS-Extended P-9.01
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 46 System ID:P-9
IP Address: 7.7.7.7
Metric: 10      IP-Extended 7.7.7.7/32
SubTLV 4: Length: 1
Prefix-SID Index: 7, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
Metric: 10      IP-Extended 10.6.7.0/24
SubTLV 4: Length: 1
Metric: 10      IP-Extended 10.7.9.0/24
SubTLV 4: Length: 1
Metric: 10      IP-Extended 10.5.7.0/24
SubTLV 4: Length: 1
P-7.03-00      0x0000001c 0x7d59 0 (1200) 0/0/0
P-7.05-00      0x0000001b 0x7164 0 (1200) 0/0/0
P-8.00-00      0x0000009a 0x1dba 817 0/0/0
Area Address: 49.0002
NLPID: 0xcc
Hostname: P-8
IP Address: 8.8.8.8
Metric: 10      IS-Extended P-8.01
Metric: 10      IP-Extended 8.8.8.8/32
Metric: 20      IP-Extended 9.9.9.9/32
Metric: 10      IP-Extended 10.6.8.0/24
Metric: 10      IP-Extended 10.8.9.0/24
Metric: 10      IP-Extended 10.8.10.0/24
Metric: 20      IP-Extended 10.9.10.0/24
Metric: 20      IP-Extended 10.10.10.10/32
P-8.01-00      0x00000059 0x1f2b 677 0/0/0
Metric: 0      IS-Extended P-8.00
Metric: 0      IS-Extended P-6.00
P-9.00-00      0x0000007b 0x9e4f 1103 0/0/0
Area Address: 49.0002
NLPID: 0xcc
Hostname: P-9
IP Address: 9.9.9.9
Metric: 10      IS-Extended P-9.01
Metric: 20      IP-Extended 8.8.8.8/32
Metric: 10      IP-Extended 9.9.9.9/32
Metric: 10      IP-Extended 10.7.9.0/24
Metric: 10      IP-Extended 10.8.9.0/24
Metric: 20      IP-Extended 10.8.10.0/24
Metric: 10      IP-Extended 10.9.10.0/24
Metric: 20      IP-Extended 10.10.10.10/32
P-9.01-00      0x0000005b 0x3213 560 0/0/0
Metric: 0      IS-Extended P-9.00
Metric: 0      IS-Extended P-7.00
P-11.00-00     0x00000095 0x8b8d 1122 0/0/0
Area Address: 49.0001
NLPID: 0xcc
Hostname: P-11
IP Address: 11.11.11.11
Router Cap: 11.11.11.11, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10      IS-Extended P-1.03
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24004 System ID:P-1
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24005 System ID:P-1
Metric: 10      IP-Extended 10.1.11.0/24
Metric: 10      IP-Extended 10.11.12.0/24
Metric: 10      IP-Extended 10.11.13.0/24
Metric: 20      IP-Extended 10.12.13.0/24
Metric: 10      IP-Extended 11.11.11.11/32
Prefix-SID Index: 11, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
Metric: 20      IP-Extended 12.12.12.12/32
Prefix-SID Index: 12, Algorithm:0, R:1 N:1 P:1 E:0 V:0 L:0
Metric: 20      IP-Extended 13.13.13.13/32
Prefix-SID Index: 13, Algorithm:0, R:1 N:1 P:1 E:0 V:0 L:0
SID Binding: 10.10.10.10/32 F:0 M:0 S:0 D:0 A:0 Weight:0 Range:1
SID: Start:2000, Algorithm:0, R:0 N:0 P:0 E:0 V:0 L:0
P-12.00-00     0x000000ca 0xd99 593 0/0/0
Area Address: 49.0001
NLPID: 0xcc
Hostname: P-12
IP Address: 12.12.12.12
Router Cap: 12.12.12.12, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10      IS-Extended P-2.02
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24004 System ID:P-2
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24005 System ID:P-2
Metric: 10      IP-Extended 10.2.12.0/24
Metric: 10      IP-Extended 10.11.12.0/24
Metric: 20      IP-Extended 10.11.13.0/24
Metric: 10      IP-Extended 10.12.13.0/24
Metric: 20      IP-Extended 11.11.11.11/32
Prefix-SID Index: 11, Algorithm:0, R:1 N:1 P:1 E:0 V:0 L:0
Metric: 10      IP-Extended 12.12.12.12/32
Prefix-SID Index: 12, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
Metric: 20      IP-Extended 13.13.13.13/32
Prefix-SID Index: 13, Algorithm:0, R:1 N:1 P:1 E:0 V:0 L:0

Total Level-2 LSP count: 28 Local Level-2 LSP count: 1
RP/0/0/CPU0:P-3#

```

b) Area 2 isis database

```
RP/0/0/CPU0:PE-10#term len 0
Sat Jan 26 03:46:28.212 UTC
RP/0/0/CPU0:PE-10#show isis database verbose
Sat Jan 26 03:46:33.402 UTC

IS-IS 1 (Level-1) Link State Database
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
P-8.00-00      0x00000070   0x8b28        391           1/0/0
Area Address: 49.0002
NLPID:         0xcc
Hostname:      P-8
IP Address:    8.8.8.8
Metric: 10     IS-Extended P-8.03
Metric: 10     IS-Extended PE-10.01
Metric: 10     IP-Extended 8.8.8.8/32
Metric: 10     IP-Extended 10.8.9.0/24
Metric: 10     IP-Extended 10.8.10.0/24
Metric: 60     IP-Extended-Interarea 13.13.13.13/32
Prefix-SID Index: 13, Algorithm:0, R:1 N:1 P:1 E:0 V:0 L:0
P-8.03-00      0x0000005b   0x4ff3        368           0/0/0
Metric: 0       IS-Extended P-8.00
Metric: 0       IS-Extended P-9.00
P-9.00-00      0x0000009c   0x0b6f        400           1/0/0
Area Address: 49.0002
NLPID:         0xcc
Hostname:      P-9
IP Address:    9.9.9.9
Metric: 10     IS-Extended P-8.03
Metric: 10     IS-Extended PE-10.03
Metric: 10     IP-Extended 9.9.9.9/32
Metric: 10     IP-Extended 10.8.9.0/24
Metric: 10     IP-Extended 10.9.10.0/24
Metric: 60     IP-Extended-Interarea 13.13.13.13/32
Prefix-SID Index: 13, Algorithm:0, R:1 N:1 P:1 E:0 V:0 L:0
PE-10.00-00    * 0x00000068 0xa5ef        527           0/0/0
Area Address: 49.0002
NLPID:         0xcc
Hostname:      PE-10
IP Address:    10.10.10.10
Metric: 10     IS-Extended PE-10.01
Metric: 10     IS-Extended PE-10.03
Metric: 10     IP-Extended 10.8.10.0/24
Metric: 10     IP-Extended 10.9.10.0/24
Metric: 10     IP-Extended 10.10.10.10/32
PE-10.01-00    0x00000057   0x55e6        850           0/0/0
Metric: 0       IS-Extended PE-10.00
Metric: 0       IS-Extended P-8.00
PE-10.03-00    0x00000058   0x5bdc        1093          0/0/0
Metric: 0       IS-Extended PE-10.00
Metric: 0       IS-Extended P-9.00

Total Level-1 LSP count: 6    Local Level-1 LSP count: 1
RP/0/0/CPU0:PE-10#
```

c) Area 1 isis database

```
RP/0/0/CPU0:PE-13#show isis database verbose
Sat Jan 26 03:47:39.591 UTC

IS-IS 1 (Level-1) Link State Database
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
P-11.00-00     0x000000b4   0x7e6e        494           1/0/0
Area Address: 49.0001
NLPID:         0xcc
Hostname:      P-11
IP Address:    11.11.11.11
Router Cap:    11.11.11.11, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10     IS-Extended P-12.03
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24000 System ID:P-12
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24001 System ID:P-12
Metric: 10     IS-Extended PE-13.01
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24002 System ID:PE-13
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24003 System ID:PE-13
Metric: 60     IP-Extended-Interarea 10.10.10.10/32
Metric: 10     IP-Extended 10.11.12.0/24
Metric: 10     IP-Extended 10.11.13.0/24
Metric: 10     IP-Extended 11.11.11.11/32
Prefix-SID Index: 11, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
SID Binding:   10.10.10.10/32 F:0 M:0 S:0 D:0 A:0 Weight:0 Range:1
SID: Start:2000, Algorithm:0, R:0 N:0 P:0 E:0 V:0 L:0
P-12.00-00     0x00000108   0xd583        1023          1/0/0
Area Address: 49.0001
NLPID:         0xcc
Hostname:      P-12
IP Address:    12.12.12.12
Router Cap:    12.12.12.12, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10     IS-Extended P-12.03
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24000 System ID:P-11
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24001 System ID:P-11
Metric: 10     IS-Extended PE-13.03
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24002 System ID:PE-13
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24003 System ID:PE-13
Metric: 60     IP-Extended-Interarea 10.10.10.10/32
```

```

Metric: 10      IP-Extended 10.11.12.0/24
Metric: 10      IP-Extended 10.12.13.0/24
Metric: 10      IP-Extended 12.12.12.12/32
Prefix-SID Index: 12, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
P-12.03-00     0x00000078 0xcf3a 792 0/0/0
Metric: 0      IS-Extended P-12.00
Metric: 0      IS-Extended P-11.00
PE-13.00-00    * 0x00000094 0xa5ec 838 0/0/0
Area Address: 49.0001
NLPID: 0xcc
Hostname: PE-13
IP Address: 13.13.13.13
Router Cap: 13.13.13.13, D:0, S:0
Segment Routing: I:1 V:0, SRGB Base: 16000 Range: 8000
Metric: 10      IS-Extended PE-13.01
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24002 System ID:P-11
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24003 System ID:P-11
Metric: 10      IS-Extended PE-13.03
LAN-ADJ-SID: F:0 B:1 V:1 L:1 S:0 weight:0 Adjacency-sid: 24000 System ID:P-12
LAN-ADJ-SID: F:0 B:0 V:1 L:1 S:0 weight:0 Adjacency-sid: 24001 System ID:P-12
Metric: 10      IP-Extended 10.11.13.0/24
Metric: 10      IP-Extended 10.12.13.0/24
Metric: 10      IP-Extended 13.13.13.13/32
Prefix-SID Index: 13, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0
PE-13.01-00    0x0000007b 0xd632 894 0/0/0
Metric: 0      IS-Extended PE-13.00
Metric: 0      IS-Extended P-11.00
PE-13.03-00    0x00000079 0xe225 469 0/0/0
Metric: 0      IS-Extended PE-13.00
Metric: 0      IS-Extended P-12.00

Total Level-1 LSP count: 6 Local Level-1 LSP count: 1
RP/0/0/CPU0:PE-13#

```

d) PE-13 Routing Table and LFIB

```

RP/0/0/CPU0:PE-13#show ip route
Sat Jan 26 03:49:53.841 UTC

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - ISIS, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
U - per-user static route, o - ODR, L - local, G - DAGR, l - LISP
A - access/subscriber, a - Application route
M - mobile route, r - RPL, (!) - FRR Backup path

Gateway of last resort is 10.11.13.11 to network 0.0.0.0

i*L1 0.0.0.0/0 [115/10] via 10.11.13.11, 00:16:49, GigabitEthernet0/0/0/0
[115/10] via 10.12.13.12, 00:16:49, GigabitEthernet0/0/0/1
i ia 10.10.10.10/32 [115/70] via 10.11.13.11, 00:16:49, GigabitEthernet0/0/0/0
[115/70] via 10.12.13.12, 00:16:49, GigabitEthernet0/0/0/1
i L1 10.11.12.0/24 [115/20] via 10.11.13.11, 10:21:14, GigabitEthernet0/0/0/0
[115/20] via 10.12.13.12, 10:21:14, GigabitEthernet0/0/0/1
C 10.11.13.0/24 is directly connected, 1d01h, GigabitEthernet0/0/0/0
L 10.11.13.13/32 is directly connected, 1d01h, GigabitEthernet0/0/0/0
C 10.12.13.0/24 is directly connected, 1d01h, GigabitEthernet0/0/0/1
L 10.12.13.13/32 is directly connected, 1d01h, GigabitEthernet0/0/0/1
i L1 11.11.11.11/32 [115/20] via 10.11.13.11, 07:55:17, GigabitEthernet0/0/0/0
i L1 12.12.12.12/32 [115/20] via 10.12.13.12, 10:20:58, GigabitEthernet0/0/0/1
L 13.13.13.13/32 is directly connected, 1d01h, Loopback0

```

```

RP/0/0/CPU0:PE-13#show mpls forwarding
Sat Jan 26 03:50:05.071 UTC
Local Outgoing Prefix Outgoing Next Hop Bytes
Label Label or ID Interface Interface Switched
-----
16011 Pop SR Pfx (idx 11) Gi0/0/0/0 10.11.13.11 0
16012 Pop SR Pfx (idx 12) Gi0/0/0/1 10.12.13.12 0
18000 18000 SR Pfx (idx 2000) Gi0/0/0/0 10.11.13.11 1134
18000 18000 SR Pfx (idx 2000) Gi0/0/0/1 10.12.13.12 1863
24000 Pop SR Adj (idx 0) Gi0/0/0/1 10.12.13.12 0
24001 Pop SR Adj (idx 2) Gi0/0/0/1 10.12.13.12 0
24002 Pop SR Adj (idx 0) Gi0/0/0/0 10.11.13.11 0
24003 Pop SR Adj (idx 2) Gi0/0/0/0 10.11.13.11 0
24004 Aggregate A: Per-VRF Aggr[V] A 6552
24005 Unlabelled 100.0.1.0/24[V] Gi0/0/0/2 100.0.0.2 3496
RP/0/0/CPU0:PE-13#

```

e) P-11 Routing Table and LFIB

```

RP/0/0/CPU0:P-11#show ip route
Sat Jan 26 03:58:57.064 UTC

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - ISIS, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, su - IS-IS summary null, * - candidate default

```

U - per-user static route, o - ODR, L - local, G - DAGR, l - LISP
 A - access/subscriber, a - Application route
 M - mobile route, r - RPL, (!) - FRR Backup path

Gateway of last resort is not set

```
i L2 1.1.1.1/32 [115/20] via 10.1.11.1, 00:12:53, GigabitEthernet0/0/0/2
i L2 2.2.2.2/32 [115/30] via 10.1.11.1, 00:00:03, GigabitEthernet0/0/0/2
i L2 3.3.3.3/32 [115/30] via 10.1.11.1, 00:21:05, GigabitEthernet0/0/0/2
i L2 4.4.4.4/32 [115/40] via 10.1.11.1, 00:13:05, GigabitEthernet0/0/0/2
i L2 5.5.5.5/32 [115/40] via 10.1.11.1, 00:00:09, GigabitEthernet0/0/0/2
i L2 6.6.6.6/32 [115/40] via 10.1.11.1, 00:18:51, GigabitEthernet0/0/0/2
i L2 7.7.7.7/32 [115/50] via 10.1.11.1, 01:40:29, GigabitEthernet0/0/0/2
i L2 8.8.8.8/32 [115/50] via 10.1.11.1, 08:04:26, GigabitEthernet0/0/0/2
i L2 9.9.9.9/32 [115/60] via 10.1.11.1, 02:08:46, GigabitEthernet0/0/0/2
i L2 10.1.2.0/24 [115/20] via 10.1.11.1, 19:57:23, GigabitEthernet0/0/0/2
i L2 10.1.3.0/24 [115/20] via 10.1.11.1, 19:57:23, GigabitEthernet0/0/0/2
C 10.1.11.0/24 is directly connected, 1d01h, GigabitEthernet0/0/0/2
L 10.1.11.11/32 is directly connected, 1d01h, GigabitEthernet0/0/0/2
i L2 10.2.5.0/24 [115/30] via 10.1.11.1, 00:25:59, GigabitEthernet0/0/0/2
i L2 10.2.12.0/24 [115/30] via 10.1.11.1, 00:25:59, GigabitEthernet0/0/0/2
i L2 10.3.4.0/24 [115/30] via 10.1.11.1, 19:53:07, GigabitEthernet0/0/0/2
i L2 10.3.6.0/24 [115/30] via 10.1.11.1, 19:53:07, GigabitEthernet0/0/0/2
i L2 10.4.5.0/24 [115/40] via 10.1.11.1, 00:25:59, GigabitEthernet0/0/0/2
i L2 10.5.7.0/24 [115/40] via 10.1.11.1, 00:25:59, GigabitEthernet0/0/0/2
i L2 10.6.7.0/24 [115/40] via 10.1.11.1, 10:52:47, GigabitEthernet0/0/0/2
i L2 10.6.8.0/24 [115/40] via 10.1.11.1, 10:52:47, GigabitEthernet0/0/0/2
i L2 10.7.9.0/24 [115/50] via 10.1.11.1, 02:08:46, GigabitEthernet0/0/0/2
i L2 10.8.9.0/24 [115/50] via 10.1.11.1, 08:04:26, GigabitEthernet0/0/0/2
i L2 10.8.10.0/24 [115/50] via 10.1.11.1, 08:04:26, GigabitEthernet0/0/0/2
i L2 10.9.10.0/24 [115/60] via 10.1.11.1, 02:08:46, GigabitEthernet0/0/0/2
i L2 10.10.10.0/32 [115/60] via 10.1.11.1, 00:59:48, GigabitEthernet0/0/0/2
C 10.11.12.0/24 is directly connected, 1d01h, GigabitEthernet0/0/0/1
L 10.11.12.11/32 is directly connected, 1d01h, GigabitEthernet0/0/0/1
C 10.11.13.0/24 is directly connected, 1d01h, GigabitEthernet0/0/0/0
L 10.11.13.11/32 is directly connected, 1d01h, GigabitEthernet0/0/0/0
i L1 10.12.13.0/24 [115/20] via 10.11.13.13, 10:30:15, GigabitEthernet0/0/0/0
[115/20] via 10.11.12.12, 10:30:15, GigabitEthernet0/0/0/1
i L2 11.3.4.0/24 [115/30] via 10.1.11.1, 19:53:07, GigabitEthernet0/0/0/2
i L2 11.4.5.0/24 [115/40] via 10.1.11.1, 00:25:59, GigabitEthernet0/0/0/2
L 11.11.11.11/32 is directly connected, 1d01h, Loopback0
i L1 12.12.12.12/32 [115/20] via 10.11.12.12, 00:14:20, GigabitEthernet0/0/0/1
i L1 13.13.13.13/32 [115/20] via 10.11.13.13, 02:02:32, GigabitEthernet0/0/0/0
RP/0/0/CPU0:P-11#
```

RP/0/0/CPU0:P-11#=====

RP/0/0/CPU0:P-11#

RP/0/0/CPU0:P-11#show mpls forwarding

Sat Jan 26 03:58:57.344 UTC

Local Label	Outgoing Label	Prefix or ID	Outgoing Interface	Next Hop	Bytes Switched
16001	Pop	SR Pfx (idx 1)	Gi0/0/0/2	10.1.11.1	0
16002	16002	SR Pfx (idx 2)	Gi0/0/0/2	10.1.11.1	0
16003	16003	SR Pfx (idx 3)	Gi0/0/0/2	10.1.11.1	0
16005	16005	SR Pfx (idx 5)	Gi0/0/0/2	10.1.11.1	0
16006	16006	SR Pfx (idx 6)	Gi0/0/0/2	10.1.11.1	0
16007	16007	SR Pfx (idx 7)	Gi0/0/0/2	10.1.11.1	0
16012	Pop	SR Pfx (idx 12)	Gi0/0/0/1	10.11.12.12	0
16013	Pop	SR Pfx (idx 13)	Gi0/0/0/0	10.11.13.13	465911
18000	18000	SR Pfx (idx 2000)	Gi0/0/0/2	10.1.11.1	1512
24000	Pop	SR Adj (idx 0)	Gi0/0/0/1	10.11.12.12	0
24001	Pop	SR Adj (idx 2)	Gi0/0/0/1	10.11.12.12	0
24002	Pop	SR Adj (idx 0)	Gi0/0/0/0	10.11.13.13	0
24003	Pop	SR Adj (idx 2)	Gi0/0/0/0	10.11.13.13	0
24004	Pop	SR Adj (idx 1)	Gi0/0/0/2	10.1.11.1	0
24005	Pop	SR Adj (idx 3)	Gi0/0/0/2	10.1.11.1	0

RP/0/0/CPU0:P-11#

RP/0/0/CPU0:P-11#

f) P-12 Routing Table and LFIB

RP/0/0/CPU0:P-12#show ip route

Sat Jan 26 04:00:46.107 UTC

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
 E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
 i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2
 ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
 U - per-user static route, o - ODR, L - local, G - DAGR, l - LISP
 A - access/subscriber, a - Application route
 M - mobile route, r - RPL, (!) - FRR Backup path

Gateway of last resort is not set

```
i L2 1.1.1.1/32 [115/30] via 10.2.12.2, 00:14:45, GigabitEthernet0/0/0/2
i L2 2.2.2.2/32 [115/20] via 10.2.12.2, 00:00:25, GigabitEthernet0/0/0/2
i L2 3.3.3.3/32 [115/40] via 10.2.12.2, 00:22:57, GigabitEthernet0/0/0/2
i L2 4.4.4.4/32 [115/40] via 10.2.12.2, 00:14:56, GigabitEthernet0/0/0/2
i L2 5.5.5.5/32 [115/30] via 10.2.12.2, 00:02:00, GigabitEthernet0/0/0/2
i L2 6.6.6.6/32 [115/50] via 10.2.12.2, 00:20:43, GigabitEthernet0/0/0/2
i L2 7.7.7.7/32 [115/40] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
```

```

i L2 8.8.8.8/32 [115/60] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 9.9.9.9/32 [115/50] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.1.2.0/24 [115/20] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.1.3.0/24 [115/30] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.1.11.0/24 [115/30] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.2.5.0/24 [115/20] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
C 10.2.12.0/24 is directly connected, 1d01h, GigabitEthernet0/0/0/2
L 10.2.12.12/32 is directly connected, 1d01h, GigabitEthernet0/0/0/2
i L2 10.3.4.0/24 [115/40] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.3.6.0/24 [115/40] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.4.5.0/24 [115/30] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.5.7.0/24 [115/30] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.6.7.0/24 [115/40] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.6.8.0/24 [115/50] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.7.9.0/24 [115/40] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.8.9.0/24 [115/50] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.8.10.0/24 [115/60] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.9.10.0/24 [115/50] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 10.10.10.0/32 [115/60] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
C 10.11.12.0/24 is directly connected, 1d01h, GigabitEthernet0/0/0/1
L 10.11.12.12/32 is directly connected, 1d01h, GigabitEthernet0/0/0/1
i L1 10.11.13.0/24 [115/20] via 10.12.13.13, 19:29:30, GigabitEthernet0/0/0/0
[115/20] via 10.11.12.11, 19:29:30, GigabitEthernet0/0/0/1
C 10.12.13.0/24 is directly connected, 1d01h, GigabitEthernet0/0/0/0
L 10.12.13.12/32 is directly connected, 1d01h, GigabitEthernet0/0/0/0
i L2 11.3.4.0/24 [115/40] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L2 11.4.5.0/24 [115/30] via 10.2.12.2, 00:27:51, GigabitEthernet0/0/0/2
i L1 11.11.11.11/32 [115/20] via 10.11.12.11, 01:58:45, GigabitEthernet0/0/0/1
L 12.12.12.12/32 is directly connected, 1d01h, Loopback0
i L1 13.13.13.13/32 [115/20] via 10.12.13.13, 01:51:52, GigabitEthernet0/0/0/0
RP/0/0/CPU0:P-12#
RP/0/0/CPU0:P-12#
RP/0/0/CPU0:P-12#
RP/0/0/CPU0:P-12#!=====
RP/0/0/CPU0:P-12#
RP/0/0/CPU0:P-12#
RP/0/0/CPU0:P-12#
RP/0/0/CPU0:P-12#
RP/0/0/CPU0:P-12#show mpls forwarding
Sat Jan 26 04:00:46.407 UTC
Local  Outgoing  Prefix      Outgoing  Next Hop    Bytes
Label  Label      or ID      Interface  Hop         Switched
-----
16001  16001      SR Pfx (idx 1)  Gi0/0/0/2  10.2.12.2  0
16002  16002      SR Pfx (idx 2)  Gi0/0/0/2  10.2.12.2  0
16003  16003      SR Pfx (idx 3)  Gi0/0/0/2  10.2.12.2  0
16005  16005      SR Pfx (idx 5)  Gi0/0/0/2  10.2.12.2  0
16006  16006      SR Pfx (idx 6)  Gi0/0/0/2  10.2.12.2  0
16007  16007      SR Pfx (idx 7)  Gi0/0/0/2  10.2.12.2  0
16011  Pop        SR Pfx (idx 11) Gi0/0/0/1  10.11.12.11 0
16013  Pop        SR Pfx (idx 13) Gi0/0/0/0  10.12.13.13 12023258
18000  18000      SR Pfx (idx 2000) Gi0/0/0/2  10.2.12.2  3166
24000  Pop        SR Adj (idx 0)  Gi0/0/0/1  10.11.12.11 0
24001  Pop        SR Adj (idx 2)  Gi0/0/0/1  10.11.12.11 0
24002  Pop        SR Adj (idx 0)  Gi0/0/0/0  10.12.13.13 0
24003  Pop        SR Adj (idx 2)  Gi0/0/0/0  10.12.13.13 0
24004  Pop        SR Adj (idx 1)  Gi0/0/0/2  10.2.12.2  0
24005  Pop        SR Adj (idx 3)  Gi0/0/0/2  10.2.12.2  0
RP/0/0/CPU0:P-12#
RP/0/0/CPU0:P-12#

```

g) P-1 Routing Table and LFIB

```

RP/0/0/CPU0:P-1#show ip route
Sat Jan 26 05:51:10.869 UTC

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
U - per-user static route, o - ODR, L - local, G - DAGR, l - LISP
A - access/subscriber, a - Application route
M - mobile route, r - RPL, (!) - FRR Backup path

Gateway of last resort is not set

L 1.1.1.1/32 is directly connected, 1d03h, Loopback0
i L2 2.2.2.2/32 [115/20] via 10.1.2.2, 00:00:08, GigabitEthernet0/0/0/2
i L2 3.3.3.3/32 [115/20] via 10.1.3.3, 00:04:38, GigabitEthernet0/0/0/1
i L2 4.4.4.4/32 [115/30] via 10.1.3.3, 00:43:27, GigabitEthernet0/0/0/1
i L2 5.5.5.5/32 [115/30] via 10.1.2.2, 00:19:17, GigabitEthernet0/0/0/2
i L2 6.6.6.6/32 [115/30] via 10.1.3.3, 00:42:24, GigabitEthernet0/0/0/1
i L2 7.7.7.7/32 [115/40] via 10.1.3.3, 00:19:17, GigabitEthernet0/0/0/1
[115/40] via 10.1.2.2, 00:19:17, GigabitEthernet0/0/0/2
i L2 8.8.8.8/32 [115/40] via 10.1.3.3, 09:56:41, GigabitEthernet0/0/0/1
i L2 9.9.9.9/32 [115/50] via 10.1.3.3, 00:19:17, GigabitEthernet0/0/0/1
[115/50] via 10.1.2.2, 00:19:17, GigabitEthernet0/0/0/2
C 10.1.2.0/24 is directly connected, 1d03h, GigabitEthernet0/0/0/2
L 10.1.2.1/32 is directly connected, 1d03h, GigabitEthernet0/0/0/2
C 10.1.3.0/24 is directly connected, 1d03h, GigabitEthernet0/0/0/1
L 10.1.3.1/32 is directly connected, 1d03h, GigabitEthernet0/0/0/1
C 10.1.11.0/24 is directly connected, 1d03h, GigabitEthernet0/0/0/0
L 10.1.11.1/32 is directly connected, 1d03h, GigabitEthernet0/0/0/0
i L2 10.2.5.0/24 [115/20] via 10.1.2.2, 00:19:18, GigabitEthernet0/0/0/2
i L2 10.2.12.0/24 [115/20] via 10.1.2.2, 00:19:18, GigabitEthernet0/0/0/2
i L2 10.3.4.0/24 [115/20] via 10.1.3.3, 21:45:22, GigabitEthernet0/0/0/1
i L2 10.3.6.0/24 [115/20] via 10.1.3.3, 21:45:22, GigabitEthernet0/0/0/1

```

```

i L2 10.4.5.0/24 [115/30] via 10.1.3.3, 00:19:17, GigabitEthernet0/0/0/1
[115/30] via 10.1.2.2, 00:19:17, GigabitEthernet0/0/0/2
i L2 10.5.7.0/24 [115/30] via 10.1.2.2, 00:19:17, GigabitEthernet0/0/0/2
i L2 10.6.7.0/24 [115/30] via 10.1.3.3, 12:45:01, GigabitEthernet0/0/0/1
i L2 10.6.8.0/24 [115/30] via 10.1.3.3, 12:45:01, GigabitEthernet0/0/0/1
i L2 10.7.9.0/24 [115/40] via 10.1.3.3, 00:19:17, GigabitEthernet0/0/0/1
[115/40] via 10.1.2.2, 00:19:17, GigabitEthernet0/0/0/2
i L2 10.8.9.0/24 [115/40] via 10.1.3.3, 09:56:41, GigabitEthernet0/0/0/1
i L2 10.8.10.0/24 [115/40] via 10.1.3.3, 09:56:41, GigabitEthernet0/0/0/1
i L2 10.9.10.0/24 [115/50] via 10.1.3.3, 00:19:17, GigabitEthernet0/0/0/1
[115/50] via 10.1.2.2, 00:19:17, GigabitEthernet0/0/0/2
i L2 10.10.10.10/32 [115/50] via 10.1.3.3, 02:51:54, GigabitEthernet0/0/0/1
i L2 10.11.12.0/24 [115/20] via 10.1.11.11, 1d02h, GigabitEthernet0/0/0/0
i L2 10.11.13.0/24 [115/20] via 10.1.11.11, 1d02h, GigabitEthernet0/0/0/0
i L2 10.12.13.0/24 [115/30] via 10.1.11.11, 00:19:18, GigabitEthernet0/0/0/0
[115/30] via 10.1.2.2, 00:19:18, GigabitEthernet0/0/0/2
i L2 11.3.4.0/24 [115/20] via 10.1.3.3, 21:45:22, GigabitEthernet0/0/0/1
i L2 11.4.5.0/24 [115/30] via 10.1.3.3, 00:19:17, GigabitEthernet0/0/0/1
[115/30] via 10.1.2.2, 00:19:17, GigabitEthernet0/0/0/2
i L2 11.11.11.11/32 [115/20] via 10.1.11.11, 01:31:38, GigabitEthernet0/0/0/0
i L2 12.12.12.12/32 [115/30] via 10.1.11.11, 00:04:58, GigabitEthernet0/0/0/0
[115/30] via 10.1.2.2, 00:04:58, GigabitEthernet0/0/0/2
i L2 13.13.13.13/32 [115/30] via 10.1.11.11, 01:31:38, GigabitEthernet0/0/0/0
RP/0/0/CPU0:P-1#
RP/0/0/CPU0:P-1#
RP/0/0/CPU0:P-1#
RP/0/0/CPU0:P-1#
RP/0/0/CPU0:P-1#
RP/0/0/CPU0:P-1#
RP/0/0/CPU0:P-1#
RP/0/0/CPU0:P-1#
RP/0/0/CPU0:P-1#show mpls forwarding
Sat Jan 26 05:51:11.229 UTC
Local   Outgoing   Prefix      Outgoing   Next Hop    Bytes
Label   Label      or ID       Interface  Hop         Switched
-----
16002  16002      SR Pfx (idx 2)  Gi0/0/0/1  10.1.3.3    0
16003  Pop        SR Pfx (idx 3)  Gi0/0/0/1  10.1.3.3    0
16005  16005      SR Pfx (idx 5)  Gi0/0/0/2  10.1.2.2    0
16006  16006      SR Pfx (idx 6)  Gi0/0/0/1  10.1.3.3    1328
16007  16007      SR Pfx (idx 7)  Gi0/0/0/1  10.1.3.3    0
16007  16007      SR Pfx (idx 7)  Gi0/0/0/2  10.1.2.2    0
16011  Pop        SR Pfx (idx 11) Gi0/0/0/0  10.1.11.11  0
16012  16012      SR Pfx (idx 12) Gi0/0/0/0  10.1.11.11  0
16012  16012      SR Pfx (idx 12) Gi0/0/0/2  10.1.2.2    0
16013  16013      SR Pfx (idx 13) Gi0/0/0/0  10.1.11.11  735832
18000  18000      SR Pfx (idx 2000) Gi0/0/0/1  10.1.3.3    1890
24000  Pop        SR Adj (idx 1)  Gi0/0/0/2  10.1.2.2    0
24001  Pop        SR Adj (idx 3)  Gi0/0/0/2  10.1.2.2    0
24002  Pop        SR Adj (idx 1)  Gi0/0/0/0  10.1.11.11  0
24003  Pop        SR Adj (idx 3)  Gi0/0/0/0  10.1.11.11  0
24004  Pop        SR Adj (idx 1)  Gi0/0/0/1  10.1.3.3    0
24005  Pop        SR Adj (idx 3)  Gi0/0/0/1  10.1.3.3    0
RP/0/0/CPU0:P-1#
RP/0/0/CPU0:P-1#

```

h) P-2 Routing Table and LFIB

```

P-2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets
i L2 1.1.1.1 [115/20] via 10.1.2.1, 06:04:02, GigabitEthernet1
2.0.0.0/32 is subnetted, 1 subnets
C 2.2.2.2 is directly connected, Loopback0
3.0.0.0/32 is subnetted, 1 subnets
i L2 3.3.3.3 [115/30] via 10.1.2.1, 06:04:02, GigabitEthernet1
4.0.0.0/32 is subnetted, 1 subnets
i L2 4.4.4.4 [115/30] via 10.2.5.5, 06:04:02, GigabitEthernet3
5.0.0.0/32 is subnetted, 1 subnets
i L2 5.5.5.5 [115/20] via 10.2.5.5, 06:04:02, GigabitEthernet3
6.0.0.0/32 is subnetted, 1 subnets
i L2 6.6.6.6 [115/40] via 10.2.5.5, 05:07:54, GigabitEthernet3
[115/40] via 10.1.2.1, 05:07:54, GigabitEthernet1
7.0.0.0/32 is subnetted, 1 subnets
i L2 7.7.7.7 [115/30] via 10.2.5.5, 05:07:54, GigabitEthernet3
8.0.0.0/32 is subnetted, 1 subnets
i L2 8.8.8.8 [115/50] via 10.2.5.5, 05:07:54, GigabitEthernet3
[115/50] via 10.1.2.1, 05:07:54, GigabitEthernet1
9.0.0.0/32 is subnetted, 1 subnets
i L2 9.9.9.9 [115/40] via 10.2.5.5, 05:07:54, GigabitEthernet3
10.0.0.0/8 is variably subnetted, 22 subnets, 2 masks
C 10.1.2.0/24 is directly connected, GigabitEthernet1
L 10.1.2.2/32 is directly connected, GigabitEthernet1
i L2 10.1.3.0/24 [115/20] via 10.1.2.1, 06:04:02, GigabitEthernet1
i L2 10.1.11.0/24 [115/20] via 10.1.2.1, 06:04:02, GigabitEthernet1
C 10.2.5.0/24 is directly connected, GigabitEthernet3
L 10.2.5.2/32 is directly connected, GigabitEthernet3
C 10.2.12.0/24 is directly connected, GigabitEthernet2
L 10.2.12.2/32 is directly connected, GigabitEthernet2

```



```

i L2 10.3.4.0/24 [115/30] via 10.2.5.5, 06:04:02, GigabitEthernet3
[115/30] via 10.1.2.1, 06:04:02, GigabitEthernet1
i L2 10.3.6.0/24 [115/30] via 10.1.2.1, 06:04:02, GigabitEthernet1
i L2 10.4.5.0/24 [115/20] via 10.2.5.5, 06:04:02, GigabitEthernet3
i L2 10.5.7.0/24 [115/20] via 10.2.5.5, 06:04:02, GigabitEthernet3
i L2 10.6.7.0/24 [115/30] via 10.2.5.5, 05:07:54, GigabitEthernet3
i L2 10.6.8.0/24 [115/40] via 10.2.5.5, 05:07:54, GigabitEthernet3
[115/40] via 10.1.2.1, 05:07:54, GigabitEthernet1
i L2 10.7.9.0/24 [115/30] via 10.2.5.5, 05:07:54, GigabitEthernet3
i L2 10.8.9.0/24 [115/40] via 10.2.5.5, 05:07:54, GigabitEthernet3
i L2 10.8.10.0/24 [115/50] via 10.2.5.5, 05:07:54, GigabitEthernet3
[115/50] via 10.1.2.1, 05:07:54, GigabitEthernet1
i L2 10.9.10.0/24 [115/40] via 10.2.5.5, 05:07:54, GigabitEthernet3
i L2 10.10.10.10/32 [115/50] via 10.2.5.5, 02:54:33, GigabitEthernet3
i L2 10.11.12.0/24 [115/20] via 10.2.12.12, 06:04:02, GigabitEthernet2
i L2 10.11.13.0/24 [115/30] via 10.2.12.12, 06:04:02, GigabitEthernet2
[115/30] via 10.1.2.1, 06:04:02, GigabitEthernet1
i L2 10.12.13.0/24 [115/20] via 10.2.12.12, 06:04:02, GigabitEthernet2
11.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
i L2 11.3.4.0/24 [115/30] via 10.2.5.5, 06:04:02, GigabitEthernet3
[115/30] via 10.1.2.1, 06:04:02, GigabitEthernet1
i L2 11.4.5.0/24 [115/20] via 10.2.5.5, 06:04:02, GigabitEthernet3
i L2 11.11.11.11/32 [115/30] via 10.2.12.12, 02:54:33, GigabitEthernet2
[115/30] via 10.1.2.1, 02:54:33, GigabitEthernet1
12.0.0.0/32 is subnetted, 1 subnets
i L2 12.12.12.12 [115/20] via 10.2.12.12, 02:54:33, GigabitEthernet2
13.0.0.0/32 is subnetted, 1 subnets
i L2 13.13.13.13 [115/30] via 10.2.12.12, 02:54:33, GigabitEthernet2
P-2#!
P-2#
P-2#
P-2#!=====
P-2#
P-2#
P-2#
P-2#
P-2#show mpls forwarding
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or Tunnel Id Switched interface interface
16 Pop Label 10.1.2.1-A 0 Gi1 10.1.2.1
17 Pop Label 10.2.12.12-A 0 Gi2 10.2.12.12
18 Pop Label 10.2.5.5-A 0 Gi3 10.2.5.5
16001 Pop Label 1.1.1.1/32 0 Gi1 10.1.2.1
16002 16002 4.4.4.4/32 0 Gi3 10.2.5.5
16003 16003 3.3.3.3/32 0 Gi1 10.1.2.1
16005 Pop Label 5.5.5.5/32 0 Gi3 10.2.5.5
16006 16006 6.6.6.6/32 540 Gi1 10.1.2.1
16006 16006 6.6.6.6/32 0 Gi3 10.2.5.5
16007 16007 7.7.7.7/32 0 Gi3 10.2.5.5
16011 16011 11.11.11.11/32 0 Gi1 10.1.2.1
16011 16011 11.11.11.11/32 0 Gi2 10.2.12.12
16012 Pop Label 12.12.12.12/32 0 Gi2 10.2.12.12
16013 16013 13.13.13.13/32 59499 Gi2 10.2.12.12
18000 18000 10.10.10.10/32 25912 Gi3 10.2.5.5

A - Adjacency SID
P-2#
P-2#

```

i) P-3 Routing Table and LFIB

```

RP/0/0/CPU0:P-3#show ip route
Sat Jan 26 05:54:44.081 UTC

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - ISIS, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
U - per-user static route, o - ODR, L - local, G - DAGR, I - LISP
A - access/subscriber, a - Application route
M - mobile route, r - RPL, (!) - FRR Backup path

Gateway of last resort is not set

i L2 1.1.1.1/32 [115/20] via 10.1.3.1, 00:08:24, GigabitEthernet0/0/0/0
i L2 2.2.2.2/32 [115/30] via 10.1.3.1, 00:00:25, GigabitEthernet0/0/0/0
L 3.3.3.3/32 is directly connected, 1d03h, Loopback0
i L2 4.4.4.4/32 [115/20] via 10.3.4.4, 01:54:40, GigabitEthernet0/0/0/2
[115/20] via 11.3.4.4, 01:54:40, GigabitEthernet0/0/0/3
i L2 5.5.5.5/32 [115/30] via 10.3.4.4, 02:10:22, GigabitEthernet0/0/0/2
[115/30] via 11.3.4.4, 02:10:22, GigabitEthernet0/0/0/3
i L2 6.6.6.6/32 [115/20] via 10.3.6.6, 01:22:50, GigabitEthernet0/0/0/1
i L2 7.7.7.7/32 [115/30] via 10.3.6.6, 03:36:14, GigabitEthernet0/0/0/1
i L2 8.8.8.8/32 [115/30] via 10.3.6.6, 10:00:14, GigabitEthernet0/0/0/1
i L2 9.9.9.9/32 [115/40] via 10.3.6.6, 04:04:31, GigabitEthernet0/0/0/1
i L2 10.1.2.0/24 [115/20] via 10.1.3.1, 21:48:56, GigabitEthernet0/0/0/0
C 10.1.3.0/24 is directly connected, 1d03h, GigabitEthernet0/0/0/0
L 10.1.3.3/32 is directly connected, 1d03h, GigabitEthernet0/0/0/0
i L2 10.1.11.0/24 [115/20] via 10.1.3.1, 21:48:56, GigabitEthernet0/0/0/0
i L2 10.2.5.0/24 [115/30] via 10.1.3.1, 00:22:49, GigabitEthernet0/0/0/0
[115/30] via 10.3.4.4, 00:22:49, GigabitEthernet0/0/0/2
[115/30] via 11.3.4.4, 00:22:49, GigabitEthernet0/0/0/3
i L2 10.2.12.0/24 [115/30] via 10.1.3.1, 00:22:49, GigabitEthernet0/0/0/0
C 10.3.4.0/24 is directly connected, 1d03h, GigabitEthernet0/0/0/2

```



```

L 10.3.4.3/32 is directly connected, 1d03h, GigabitEthernet0/0/0/2
C 10.3.6.0/24 is directly connected, 1d03h, GigabitEthernet0/0/0/1
L 10.3.6.3/32 is directly connected, 1d03h, GigabitEthernet0/0/0/1
i L2 10.4.5.0/24 [115/20] via 10.3.4.4, 02:59:19, GigabitEthernet0/0/0/2
[115/20] via 11.3.4.4, 02:59:19, GigabitEthernet0/0/0/3
i L2 10.5.7.0/24 [115/30] via 10.3.6.6, 02:59:19, GigabitEthernet0/0/0/1
[115/30] via 10.3.4.4, 02:59:19, GigabitEthernet0/0/0/2
[115/30] via 11.3.4.4, 02:59:19, GigabitEthernet0/0/0/3
i L2 10.6.7.0/24 [115/20] via 10.3.6.6, 12:48:35, GigabitEthernet0/0/0/1
i L2 10.6.8.0/24 [115/20] via 10.3.6.6, 12:48:35, GigabitEthernet0/0/0/1
i L2 10.7.9.0/24 [115/30] via 10.3.6.6, 04:04:31, GigabitEthernet0/0/0/1
i L2 10.8.9.0/24 [115/30] via 10.3.6.6, 10:00:14, GigabitEthernet0/0/0/1
i L2 10.8.10.0/24 [115/30] via 10.3.6.6, 10:00:14, GigabitEthernet0/0/0/1
i L2 10.9.10.0/24 [115/40] via 10.3.6.6, 04:04:31, GigabitEthernet0/0/0/1
i L2 10.10.10.10/32 [115/40] via 10.3.6.6, 02:55:26, GigabitEthernet0/0/0/1
i L2 10.11.12.0/24 [115/30] via 10.1.3.1, 21:48:56, GigabitEthernet0/0/0/0
i L2 10.11.13.0/24 [115/30] via 10.1.3.1, 21:48:56, GigabitEthernet0/0/0/0
i L2 10.12.13.0/24 [115/40] via 10.1.3.1, 00:22:49, GigabitEthernet0/0/0/0
C 11.3.4.0/24 is directly connected, 1d03h, GigabitEthernet0/0/0/3
L 11.3.4.3/32 is directly connected, 1d03h, GigabitEthernet0/0/0/3
i L2 11.4.5.0/24 [115/20] via 10.3.4.4, 02:59:19, GigabitEthernet0/0/0/2
[115/20] via 11.3.4.4, 02:59:19, GigabitEthernet0/0/0/3
i L2 11.11.11.11/32 [115/30] via 10.1.3.1, 05:05:22, GigabitEthernet0/0/0/0
i L2 12.12.12.12/32 [115/40] via 10.1.3.1, 00:08:29, GigabitEthernet0/0/0/0
i L2 13.13.13.13/32 [115/40] via 10.1.3.1, 05:05:22, GigabitEthernet0/0/0/0
RP/0/0/CPU0:P-3#
RP/0/0/CPU0:P-3#
RP/0/0/CPU0:P-3#
RP/0/0/CPU0:P-3#=====
RP/0/0/CPU0:P-3#
RP/0/0/CPU0:P-3#
RP/0/0/CPU0:P-3#
RP/0/0/CPU0:P-3#
RP/0/0/CPU0:P-3#show mpls forwarding
Sat Jan 26 05:54:44.471 UTC
Local Outgoing Prefix Outgoing Next Hop Bytes
Label Label or ID Interface Interface Switched
-----
16001 Pop SR Pfx (idx 1) Gi0/0/0 10.1.3.1 1204
16002 Pop SR Pfx (idx 2) Gi0/0/2 10.3.4.4 0
Pop SR Pfx (idx 2) Gi0/0/3 11.3.4.4 0
16005 16005 SR Pfx (idx 5) Gi0/0/2 10.3.4.4 0
16005 SR Pfx (idx 5) Gi0/0/3 11.3.4.4 0
16006 Pop SR Pfx (idx 6) Gi0/0/1 10.3.6.6 2058
16007 16007 SR Pfx (idx 7) Gi0/0/1 10.3.6.6 0
16011 16011 SR Pfx (idx 11) Gi0/0/0 10.1.3.1 0
16012 16012 SR Pfx (idx 12) Gi0/0/0 10.1.3.1 0
16013 16013 SR Pfx (idx 13) Gi0/0/0 10.1.3.1 751488
18000 18000 SR Pfx (idx 2000) Gi0/0/1 10.3.6.6 2268
24000 Pop SR Adj (idx 1) Gi0/0/2 10.3.4.4 0
24001 Pop SR Adj (idx 3) Gi0/0/2 10.3.4.4 0
24002 Pop SR Adj (idx 1) Gi0/0/3 11.3.4.4 0
24003 Pop SR Adj (idx 3) Gi0/0/3 11.3.4.4 0
24004 Pop SR Adj (idx 1) Gi0/0/0 10.1.3.1 0
24005 Pop SR Adj (idx 3) Gi0/0/0 10.1.3.1 0
24006 Pop SR Adj (idx 1) Gi0/0/1 10.3.6.6 0
24007 Pop SR Adj (idx 3) Gi0/0/1 10.3.6.6 0
RP/0/0/CPU0:P-3#
RP/0/0/CPU0:P-3#

```

j) P-4 Routing Table and LFIB

```

P-4#
P-4#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from Pfr

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets
i L2 1.1.1.1 [115/30] via 11.3.4.3, 03:00:16, GigabitEthernet2
[115/30] via 10.3.4.3, 03:00:16, GigabitEthernet1
2.0.0.0/32 is subnetted, 1 subnets
i L2 2.2.2.2 [115/30] via 11.4.5.5, 02:22:36, GigabitEthernet4
[115/30] via 10.4.5.5, 02:22:36, GigabitEthernet3
3.0.0.0/32 is subnetted, 1 subnets
i L2 3.3.3.3 [115/20] via 11.3.4.3, 02:22:31, GigabitEthernet2
[115/20] via 10.3.4.3, 02:22:31, GigabitEthernet1
4.0.0.0/32 is subnetted, 1 subnets
C 4.4.4.4 is directly connected, Loopback0
5.0.0.0/32 is subnetted, 1 subnets
i L2 5.5.5.5 [115/20] via 11.4.5.5, 02:22:31, GigabitEthernet4
[115/20] via 10.4.5.5, 02:22:31, GigabitEthernet3
6.0.0.0/32 is subnetted, 1 subnets
i L2 6.6.6.6 [115/30] via 11.3.4.3, 02:22:31, GigabitEthernet2
[115/30] via 10.3.4.3, 02:22:31, GigabitEthernet1
7.0.0.0/32 is subnetted, 1 subnets
i L2 7.7.7.7 [115/30] via 11.4.5.5, 02:22:31, GigabitEthernet4
[115/30] via 10.4.5.5, 02:22:31, GigabitEthernet3
8.0.0.0/32 is subnetted, 1 subnets
i L2 8.8.8.8 [115/40] via 11.3.4.3, 03:00:16, GigabitEthernet2
[115/40] via 10.3.4.3, 03:00:16, GigabitEthernet1

```

```

9.0.0.0/32 is subnetted, 1 subnets
i L2 9.9.9.9 [115/40] via 11.4.5.5, 03:00:16, GigabitEthernet4
      [115/40] via 10.4.5.5, 03:00:16, GigabitEthernet3
10.0.0.0/8 is variably subnetted, 21 subnets, 2 masks
i L2 10.1.2.0/24 [115/30] via 11.4.5.5, 02:22:36, GigabitEthernet4
      [115/30] via 11.3.4.3, 02:22:36, GigabitEthernet2
      [115/30] via 10.4.5.5, 02:22:36, GigabitEthernet3
      [115/30] via 10.3.4.3, 02:22:36, GigabitEthernet1
i L2 10.1.3.0/24 [115/20] via 11.3.4.3, 03:00:16, GigabitEthernet2
      [115/20] via 10.3.4.3, 03:00:16, GigabitEthernet1
i L2 10.1.11.0/24 [115/30] via 11.3.4.3, 03:00:16, GigabitEthernet2
      [115/30] via 10.3.4.3, 03:00:16, GigabitEthernet1
i L2 10.2.5.0/24 [115/20] via 11.4.5.5, 03:00:16, GigabitEthernet4
      [115/20] via 10.4.5.5, 03:00:16, GigabitEthernet3
i L2 10.2.12.0/24 [115/30] via 11.4.5.5, 02:22:36, GigabitEthernet4
      [115/30] via 10.4.5.5, 02:22:36, GigabitEthernet3
C 10.3.4.0/24 is directly connected, GigabitEthernet1
L 10.3.4.4/32 is directly connected, GigabitEthernet1
i L2 10.3.6.0/24 [115/20] via 11.3.4.3, 03:00:16, GigabitEthernet2
      [115/20] via 10.3.4.3, 03:00:16, GigabitEthernet1
C 10.4.5.0/24 is directly connected, GigabitEthernet3
L 10.4.5.4/32 is directly connected, GigabitEthernet3
i L2 10.5.7.0/24 [115/20] via 11.4.5.5, 03:00:16, GigabitEthernet4
      [115/20] via 10.4.5.5, 03:00:16, GigabitEthernet3
i L2 10.6.7.0/24 [115/30] via 11.4.5.5, 03:00:16, GigabitEthernet4
      [115/30] via 11.3.4.3, 03:00:16, GigabitEthernet2
      [115/30] via 10.4.5.5, 03:00:16, GigabitEthernet3
      [115/30] via 10.3.4.3, 03:00:16, GigabitEthernet1
i L2 10.6.8.0/24 [115/30] via 11.3.4.3, 03:00:16, GigabitEthernet2
      [115/30] via 10.3.4.3, 03:00:16, GigabitEthernet1
i L2 10.7.9.0/24 [115/30] via 11.4.5.5, 03:00:16, GigabitEthernet4
      [115/30] via 10.4.5.5, 03:00:16, GigabitEthernet3
i L2 10.8.9.0/24 [115/40] via 11.4.5.5, 03:00:16, GigabitEthernet4
      [115/40] via 11.3.4.3, 03:00:16, GigabitEthernet2
      [115/40] via 10.4.5.5, 03:00:16, GigabitEthernet3
      [115/40] via 10.3.4.3, 03:00:16, GigabitEthernet1
i L2 10.8.10.0/24 [115/40] via 11.3.4.3, 03:00:16, GigabitEthernet2
      [115/40] via 10.3.4.3, 03:00:16, GigabitEthernet1
i L2 10.9.10.0/24 [115/40] via 11.4.5.5, 03:00:16, GigabitEthernet4
      [115/40] via 10.4.5.5, 03:00:16, GigabitEthernet3
i L2 10.10.10.10/32 [115/50] via 11.4.5.5, 02:56:24, GigabitEthernet4
      [115/50] via 11.3.4.3, 02:56:24, GigabitEthernet2
      [115/50] via 10.4.5.5, 02:56:24, GigabitEthernet3
      [115/50] via 10.3.4.3, 02:56:24, GigabitEthernet1
i L2 10.11.12.0/24 [115/40] via 11.4.5.5, 02:22:36, GigabitEthernet4
      [115/40] via 11.3.4.3, 02:22:36, GigabitEthernet2
      [115/40] via 10.4.5.5, 02:22:36, GigabitEthernet3
      [115/40] via 10.3.4.3, 02:22:36, GigabitEthernet1
i L2 10.11.13.0/24 [115/40] via 11.3.4.3, 03:00:16, GigabitEthernet2
      [115/40] via 10.3.4.3, 03:00:16, GigabitEthernet1
i L2 10.12.13.0/24 [115/40] via 11.4.5.5, 02:22:36, GigabitEthernet4
      [115/40] via 10.4.5.5, 02:22:36, GigabitEthernet3
11.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C 11.3.4.0/24 is directly connected, GigabitEthernet2
L 11.3.4.4/32 is directly connected, GigabitEthernet2
C 11.4.5.0/24 is directly connected, GigabitEthernet4
L 11.4.5.4/32 is directly connected, GigabitEthernet4
i L2 11.11.11.11/32 [115/40] via 11.3.4.3, 02:22:31, GigabitEthernet2
      [115/40] via 10.3.4.3, 02:22:31, GigabitEthernet1
12.0.0.0/32 is subnetted, 1 subnets
i L2 12.12.12.12 [115/40] via 11.4.5.5, 02:22:31, GigabitEthernet4
      [115/40] via 10.4.5.5, 02:22:31, GigabitEthernet3
13.0.0.0/32 is subnetted, 1 subnets
i L2 13.13.13.13 [115/50] via 11.4.5.5, 02:22:31, GigabitEthernet4
      [115/50] via 11.3.4.3, 02:22:31, GigabitEthernet2
      [115/50] via 10.4.5.5, 02:22:31, GigabitEthernet3
      [115/50] via 10.3.4.3, 02:22:31, GigabitEthernet1

P-4#!
P-4#
P-4#
P-4#!=====
P-4#
P-4#
P-4#
P-4#
P-4#show mpls forwarding
Local   Outgoing Prefix      Bytes Label  Outgoing  Next Hop
Label   Label    or Tunnel Id  Switched    interface
16      Pop Label 11.4.5.5-A    0           Gi4       11.4.5.5
17      Pop Label 10.4.5.5-A    0           Gi3       10.4.5.5
18      Pop Label 10.3.4.3-A    0           Gi1       10.3.4.3
19      Pop Label 11.3.4.3-A    0           Gi2       11.3.4.3
16001   16001     1.1.1.1/32    0           Gi1       10.3.4.3
        16001     1.1.1.1/32    0           Gi2       11.3.4.3
16002   16002     2.2.2.2/32    0           Gi3       10.4.5.5
        16002     2.2.2.2/32    0           Gi4       11.4.5.5
16003   Pop Label 3.3.3.3/32    0           Gi1       10.3.4.3
        Pop Label 3.3.3.3/32    0           Gi2       11.3.4.3
16005   Pop Label 5.5.5.5/32    0           Gi3       10.4.5.5
        Pop Label 5.5.5.5/32    0           Gi4       11.4.5.5
16006   16006     6.6.6.6/32    0           Gi1       10.3.4.3
        16006     6.6.6.6/32    0           Gi2       11.3.4.3
16007   16007     7.7.7.7/32    0           Gi3       10.4.5.5
        16007     7.7.7.7/32    0           Gi4       11.4.5.5
16011   16011     11.11.11.11/32 0           Gi1       10.3.4.3
        16011     11.11.11.11/32 0           Gi2       11.3.4.3
16012   16012     12.12.12.12/32 0           Gi3       10.4.5.5
        16012     12.12.12.12/32 0           Gi4       11.4.5.5
16013   16013     13.13.13.13/32 0           Gi1       10.3.4.3
        16013     13.13.13.13/32 0           Gi3       10.4.5.5

```

	16013	13.13.13.13/32	5076	Gi2	11.3.4.3
	16013	13.13.13.13/32	0	Gi4	11.4.5.5
18000	18000	10.10.10.10/32	0	Gi1	10.3.4.3
	18000	10.10.10.10/32	0	Gi3	10.4.5.5
	18000	10.10.10.10/32	0	Gi2	11.3.4.3
	18000	10.10.10.10/32	0	Gi4	11.4.5.5

A - Adjacency SID
P-4#
P-4#

k) P-5 Routing Table and LFIB

```
RP/0/0/CPU0:P-5#show ip route
Sat Jan 26 05:56:41.372 UTC

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
U - per-user static route, o - ODR, L - local, G - DAGR, l - LISP
A - access/subscriber, a - Application route
M - mobile route, r - RPL, (!) - FRR Backup path

Gateway of last resort is not set

i L2 1.1.1.1/32 [115/30] via 10.2.5.2, 00:10:06, GigabitEthernet0/0/0/2
i L2 2.2.2.2/32 [115/20] via 10.2.5.2, 00:00:21, GigabitEthernet0/0/0/2
i L2 3.3.3.3/32 [115/30] via 10.4.5.4, 02:58:42, GigabitEthernet0/0/0/0
[115/30] via 11.4.5.4, 02:58:42, GigabitEthernet0/0/0/1
i L2 4.4.4.4/32 [115/20] via 10.4.5.4, 00:48:40, GigabitEthernet0/0/0/0
[115/20] via 11.4.5.4, 00:48:40, GigabitEthernet0/0/0/1
L 5.5.5.5/32 is directly connected, 21:33:22, Loopback0
i L2 6.6.6.6/32 [115/30] via 10.5.7.7, 03:01:12, GigabitEthernet0/0/0/3
i L2 7.7.7.7/32 [115/20] via 10.5.7.7, 03:01:12, GigabitEthernet0/0/0/3
i L2 8.8.8.8/32 [115/40] via 10.5.7.7, 03:01:12, GigabitEthernet0/0/0/3
i L2 9.9.9.9/32 [115/30] via 10.5.7.7, 03:01:12, GigabitEthernet0/0/0/3
i L2 10.1.2.0/24 [115/20] via 10.2.5.2, 00:24:30, GigabitEthernet0/0/0/2
i L2 10.1.3.0/24 [115/30] via 10.4.5.4, 00:24:30, GigabitEthernet0/0/0/0
[115/30] via 11.4.5.4, 00:24:30, GigabitEthernet0/0/0/1
[115/30] via 10.2.5.2, 00:24:30, GigabitEthernet0/0/0/2
i L2 10.1.11.0/24 [115/30] via 10.2.5.2, 00:24:30, GigabitEthernet0/0/0/2
C 10.2.5.0/24 is directly connected, 21:33:21, GigabitEthernet0/0/0/2
L 10.2.5.5/32 is directly connected, 21:33:21, GigabitEthernet0/0/0/2
i L2 10.2.12.0/24 [115/20] via 10.2.5.2, 00:24:30, GigabitEthernet0/0/0/2
i L2 10.3.4.0/24 [115/20] via 10.4.5.4, 03:01:03, GigabitEthernet0/0/0/0
[115/20] via 11.4.5.4, 03:01:03, GigabitEthernet0/0/0/1
i L2 10.3.6.0/24 [115/30] via 10.4.5.4, 03:01:03, GigabitEthernet0/0/0/0
[115/30] via 11.4.5.4, 03:01:03, GigabitEthernet0/0/0/1
[115/30] via 10.5.7.7, 03:01:03, GigabitEthernet0/0/0/3
C 10.4.5.0/24 is directly connected, 21:33:21, GigabitEthernet0/0/0/0
L 10.4.5.5/32 is directly connected, 21:33:21, GigabitEthernet0/0/0/0
C 10.5.7.0/24 is directly connected, 21:33:21, GigabitEthernet0/0/0/3
L 10.5.7.5/32 is directly connected, 21:33:21, GigabitEthernet0/0/0/3
i L2 10.6.7.0/24 [115/20] via 10.5.7.7, 03:01:12, GigabitEthernet0/0/0/3
i L2 10.6.8.0/24 [115/30] via 10.5.7.7, 03:01:12, GigabitEthernet0/0/0/3
i L2 10.7.9.0/24 [115/20] via 10.5.7.7, 03:01:12, GigabitEthernet0/0/0/3
i L2 10.8.9.0/24 [115/30] via 10.5.7.7, 03:01:12, GigabitEthernet0/0/0/3
i L2 10.8.10.0/24 [115/40] via 10.5.7.7, 03:01:12, GigabitEthernet0/0/0/3
i L2 10.9.10.0/24 [115/30] via 10.5.7.7, 03:01:12, GigabitEthernet0/0/0/3
i L2 10.10.10.10/32 [115/40] via 10.5.7.7, 02:57:07, GigabitEthernet0/0/0/0/3
i L2 10.11.12.0/24 [115/30] via 10.2.5.2, 00:24:30, GigabitEthernet0/0/0/2
i L2 10.11.13.0/24 [115/40] via 10.2.5.2, 00:24:30, GigabitEthernet0/0/0/2
i L2 10.12.13.0/24 [115/30] via 10.2.5.2, 00:24:30, GigabitEthernet0/0/0/2
i L2 11.3.4.0/24 [115/20] via 10.4.5.4, 03:01:03, GigabitEthernet0/0/0/0
[115/20] via 11.4.5.4, 03:01:03, GigabitEthernet0/0/0/1
C 11.4.5.0/24 is directly connected, 21:33:21, GigabitEthernet0/0/0/1
L 11.4.5.5/32 is directly connected, 21:33:21, GigabitEthernet0/0/0/1
i L2 11.11.11.11/32 [115/40] via 10.2.5.2, 00:24:30, GigabitEthernet0/0/0/2
i L2 12.12.12.12/32 [115/30] via 10.2.5.2, 00:24:30, GigabitEthernet0/0/0/2
i L2 13.13.13.13/32 [115/40] via 10.2.5.2, 00:24:30, GigabitEthernet0/0/0/2
RP/0/0/CPU0:P-5#!
RP/0/0/CPU0:P-5#
RP/0/0/CPU0:P-5#
RP/0/0/CPU0:P-5#!=====
RP/0/0/CPU0:P-5#
RP/0/0/CPU0:P-5#
RP/0/0/CPU0:P-5#
RP/0/0/CPU0:P-5#
RP/0/0/CPU0:P-5#
RP/0/0/CPU0:P-5#show mpls forwarding
Sat Jan 26 05:56:41.662 UTC
```

Local Label	Outgoing Label	Prefix or ID	Outgoing Interface	Next Hop	Bytes Switched
16001	16001	SR Pfx (idx 1)	Gi0/0/0/2	10.2.5.2	0
16002	Pop	SR Pfx (idx 2)	Gi0/0/0/0	10.4.5.4	0
	Pop	SR Pfx (idx 2)	Gi0/0/0/1	11.4.5.4	0
16003	16003	SR Pfx (idx 3)	Gi0/0/0/0	10.4.5.4	0
	16003	SR Pfx (idx 3)	Gi0/0/0/1	11.4.5.4	0
16006	16006	SR Pfx (idx 6)	Gi0/0/0/3	10.5.7.7	0
16007	Pop	SR Pfx (idx 7)	Gi0/0/0/3	10.5.7.7	0
16011	16011	SR Pfx (idx 11)	Gi0/0/0/2	10.2.5.2	0
16012	16012	SR Pfx (idx 12)	Gi0/0/0/2	10.2.5.2	0
16013	16013	SR Pfx (idx 13)	Gi0/0/0/2	10.2.5.2	128075
18000	18000	SR Pfx (idx 2000)	Gi0/0/0/3	10.5.7.7	21897
24000	Pop	SR Adj (idx 1)	Gi0/0/0/2	10.2.5.2	0
24001	Pop	SR Adj (idx 3)	Gi0/0/0/2	10.2.5.2	0
24002	Pop	SR Adj (idx 1)	Gi0/0/0/0	10.4.5.4	0

24003	Pop	SR Adj (idx 3)	Gi0/0/0/0	10.4.5.4	0
24004	Pop	SR Adj (idx 1)	Gi0/0/0/1	11.4.5.4	0
24005	Pop	SR Adj (idx 3)	Gi0/0/0/1	11.4.5.4	0
24006	Pop	SR Adj (idx 1)	Gi0/0/0/3	10.5.7.7	0
24007	Pop	SR Adj (idx 3)	Gi0/0/0/3	10.5.7.7	0
RP/0/0/CPU0:P-5#					
RP/0/0/CPU0:P-5#					

l) P-6 Routing Table and LFIB

```
RP/0/0/CPU0:P-6#show mpls forwarding
Sat Jan 26 05:57:33.679 UTC
```

Local Label	Outgoing Label	Prefix or ID	Outgoing Interface	Next Hop	Bytes Switched	
16001	16001	SR Pfx (idx 1)	Gi0/0/0/0	10.3.6.3	0	
16002	16002	SR Pfx (idx 2)	Gi0/0/0/0	10.3.6.3	0	
16003	Pop	SR Pfx (idx 3)	Gi0/0/0/0	10.3.6.3	0	
16005	16005	SR Pfx (idx 5)	Gi0/0/0/1	10.6.7.7	0	
16007	Pop	SR Pfx (idx 7)	Gi0/0/0/1	10.6.7.7	0	
16011	16011	SR Pfx (idx 11)	Gi0/0/0/0	10.3.6.3	0	
16012	16012	SR Pfx (idx 12)	Gi0/0/0/0	10.3.6.3	0	
		16012	SR Pfx (idx 12)	Gi0/0/0/1	10.6.7.7	0
16013	16013	SR Pfx (idx 13)	Gi0/0/0/0	10.3.6.3	2961	
18000	24028	SR Pfx (idx 2000)	Gi0/0/0/2	10.6.8.8	2646	
24000	Pop	SR Adj (idx 1)	Gi0/0/0/0	10.3.6.3	0	
24001	Pop	SR Adj (idx 3)	Gi0/0/0/0	10.3.6.3	0	
24002	Pop	SR Adj (idx 1)	Gi0/0/0/2	10.6.8.8	0	
24003	Pop	SR Adj (idx 3)	Gi0/0/0/2	10.6.8.8	0	
24004	Pop	8.8.8.8/32	Gi0/0/0/2	10.6.8.8	68470	
24005	Pop	3.3.3.3/32	Gi0/0/0/0	10.3.6.3	0	
24006	Unlabelled	11.3.4.0/24	Gi0/0/0/0	10.3.6.3	0	
24007	Unlabelled	10.3.4.0/24	Gi0/0/0/0	10.3.6.3	0	
24008	Unlabelled	10.1.3.0/24	Gi0/0/0/0	10.3.6.3	3304	
24009	16001	1.1.1.1/32	Gi0/0/0/0	10.3.6.3	0	
24010	16002	4.4.4.4/32	Gi0/0/0/0	10.3.6.3	0	
24011	16005	5.5.5.5/32	Gi0/0/0/1	10.6.7.7	0	
24012	Unlabelled	10.1.11.0/24	Gi0/0/0/0	10.3.6.3	0	
24013	Unlabelled	10.2.12.0/24	Gi0/0/0/0	10.3.6.3	0	
		Unlabelled	10.2.12.0/24	Gi0/0/0/1	10.6.7.7	0
24014	Unlabelled	10.1.2.0/24	Gi0/0/0/0	10.3.6.3	0	
24015	Unlabelled	11.4.5.0/24	Gi0/0/0/0	10.3.6.3	0	
		Unlabelled	11.4.5.0/24	Gi0/0/0/1	10.6.7.7	0
24016	Unlabelled	10.5.7.0/24	Gi0/0/0/1	10.6.7.7	0	
24017	Unlabelled	10.4.5.0/24	Gi0/0/0/0	10.3.6.3	0	
		Unlabelled	10.4.5.0/24	Gi0/0/0/1	10.6.7.7	0
24018	Unlabelled	10.2.5.0/24	Gi0/0/0/1	10.6.7.7	1008	
24019	Unlabelled	9.9.9.9/32	Gi0/0/0/1	10.6.7.7	0	
		24000	9.9.9.9/32	Gi0/0/0/2	10.6.8.8	0
24020	16013	13.13.13.13/32	Gi0/0/0/0	10.3.6.3	2949	
24021	16011	11.11.11.11/32	Gi0/0/0/0	10.3.6.3	0	
24022	Unlabelled	10.9.10.0/24	Gi0/0/0/1	10.6.7.7	0	
		24003	10.9.10.0/24	Gi0/0/0/2	10.6.8.8	0
24023	Pop	10.8.10.0/24	Gi0/0/0/2	10.6.8.8	0	
24024	Pop	10.8.9.0/24	Gi0/0/0/2	10.6.8.8	0	
24025	Unlabelled	10.12.13.0/24	Gi0/0/0/0	10.3.6.3	0	
		Unlabelled	10.12.13.0/24	Gi0/0/0/1	10.6.7.7	0
24026	Unlabelled	10.11.13.0/24	Gi0/0/0/0	10.3.6.3	7500	
24027	Unlabelled	10.11.12.0/24	Gi0/0/0/0	10.3.6.3	0	
24028	16012	12.12.12.12/32	Gi0/0/0/0	10.3.6.3	0	
		16012	12.12.12.12/32	Gi0/0/0/1	10.6.7.7	0
24029	Unlabelled	2.2.2.2/32	Gi0/0/0/0	10.3.6.3	0	
		Unlabelled	2.2.2.2/32	Gi0/0/0/1	10.6.7.7	0
24030	Pop	SR Adj (idx 1)	Gi0/0/0/1	10.6.7.7	0	
24031	Pop	SR Adj (idx 3)	Gi0/0/0/1	10.6.7.7	0	
24032	Pop	7.7.7.7/32	Gi0/0/0/1	10.6.7.7	0	
24033	Unlabelled	10.7.9.0/24	Gi0/0/0/1	10.6.7.7	0	
24034	24028	10.10.10.10/32	Gi0/0/0/2	10.6.8.8	19200	
RP/0/0/CPU0:P-6#						
RP/0/0/CPU0:P-6#						

m) P-7 Routing Table and LFIB

```
P-7#
P-7#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets
i L2 1.1.1.1 [115/40] via 10.6.7.6, 01:17:50, GigabitEthernet2
[115/40] via 10.5.7.5, 01:17:50, GigabitEthernet1
2.0.0.0/32 is subnetted, 1 subnets
i L2 2.2.2.2 [115/30] via 10.5.7.5, 01:17:50, GigabitEthernet1
3.0.0.0/32 is subnetted, 1 subnets
i L2 3.3.3.3 [115/30] via 10.6.7.6, 10:27:53, GigabitEthernet2
4.0.0.0/32 is subnetted, 1 subnets
i L2 4.4.4.4 [115/30] via 10.5.7.5, 04:07:50, GigabitEthernet1
5.0.0.0/32 is subnetted, 1 subnets
i L2 5.5.5.5 [115/20] via 10.5.7.5, 05:12:05, GigabitEthernet1
6.0.0.0/32 is subnetted, 1 subnets
```

```

i L2 6.6.6.6 [115/20] via 10.6.7.6, 10:27:53, GigabitEthernet2
7.0.0.0/32 is subnetted, 1 subnets
C 7.7.7.7 is directly connected, Loopback0
8.0.0.0/32 is subnetted, 1 subnets
i L2 8.8.8.8 [115/30] via 10.7.9.9, 05:12:05, GigabitEthernet3
[115/30] via 10.6.7.6, 05:12:05, GigabitEthernet2
9.0.0.0/32 is subnetted, 1 subnets
i L2 9.9.9.9 [115/20] via 10.7.9.9, 05:12:05, GigabitEthernet3
10.0.0.0/8 is variably subnetted, 22 subnets, 2 masks
i L2 10.1.2.0/24 [115/30] via 10.5.7.5, 01:17:50, GigabitEthernet1
i L2 10.1.3.0/24 [115/30] via 10.6.7.6, 10:27:53, GigabitEthernet2
i L2 10.1.11.0/24 [115/40] via 10.6.7.6, 01:17:50, GigabitEthernet2
[115/40] via 10.5.7.5, 01:17:50, GigabitEthernet1
i L2 10.2.5.0/24 [115/20] via 10.5.7.5, 05:12:05, GigabitEthernet1
i L2 10.2.12.0/24 [115/30] via 10.5.7.5, 01:17:50, GigabitEthernet1
i L2 10.3.4.0/24 [115/30] via 10.6.7.6, 04:07:50, GigabitEthernet2
[115/30] via 10.5.7.5, 04:07:50, GigabitEthernet1
i L2 10.3.6.0/24 [115/20] via 10.6.7.6, 10:27:53, GigabitEthernet2
i L2 10.4.5.0/24 [115/20] via 10.5.7.5, 05:12:05, GigabitEthernet1
C 10.5.7.0/24 is directly connected, GigabitEthernet1
L 10.5.7.7/32 is directly connected, GigabitEthernet1
C 10.6.7.0/24 is directly connected, GigabitEthernet2
L 10.6.7.7/32 is directly connected, GigabitEthernet2
i L2 10.6.8.0/24 [115/20] via 10.6.7.6, 10:27:53, GigabitEthernet2
C 10.7.9.0/24 is directly connected, GigabitEthernet3
L 10.7.9.7/32 is directly connected, GigabitEthernet3
i L2 10.8.9.0/24 [115/20] via 10.7.9.9, 05:12:05, GigabitEthernet3
i L2 10.8.10.0/24 [115/30] via 10.7.9.9, 05:12:05, GigabitEthernet3
[115/30] via 10.6.7.6, 05:12:05, GigabitEthernet2
i L2 10.9.10.0/24 [115/20] via 10.7.9.9, 05:12:05, GigabitEthernet3
i L2 10.10.10.10/32 [115/30] via 10.7.9.9, 02:58:48, GigabitEthernet3
i L2 10.11.12.0/24 [115/40] via 10.5.7.5, 01:17:50, GigabitEthernet1
i L2 10.11.13.0/24 [115/50] via 10.6.7.6, 01:17:50, GigabitEthernet2
[115/50] via 10.5.7.5, 01:17:50, GigabitEthernet1
i L2 10.12.13.0/24 [115/40] via 10.5.7.5, 01:17:50, GigabitEthernet1
11.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
i L2 11.3.4.0/24 [115/30] via 10.6.7.6, 04:07:50, GigabitEthernet2
[115/30] via 10.5.7.5, 04:07:50, GigabitEthernet1
i L2 11.4.5.0/24 [115/20] via 10.5.7.5, 05:12:05, GigabitEthernet1
i L2 11.11.11.11/32 [115/50] via 10.6.7.6, 01:17:50, GigabitEthernet2
[115/50] via 10.5.7.5, 01:17:50, GigabitEthernet1
12.0.0.0/32 is subnetted, 1 subnets
i L2 12.12.12.12 [115/40] via 10.5.7.5, 01:17:50, GigabitEthernet1
13.0.0.0/32 is subnetted, 1 subnets
i L2 13.13.13.13 [115/50] via 10.5.7.5, 01:17:50, GigabitEthernet1
P-7#!
P-7#
P-7#
P-7#!=====
P-7#
P-7#
P-7#
P-7#show mpls forwarding
Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or Tunnel Id Switched interface
16 [M] Pop Label 6.6.6.6/32 182 Gi2 10.6.7.6
17 No Label 10.3.6.0/24 0 Gi2 10.6.7.6
18 No Label 10.6.8.0/24 0 Gi2 10.6.7.6
19 24000 8.8.8.8/32 0 Gi3 10.7.9.9
No Label 8.8.8.8/32 0 Gi2 10.6.7.6
20 Pop Label 9.9.9.9/32 0 Gi3 10.7.9.9
21 [M] 16003 3.3.3.3/32 0 Gi2 10.6.7.6
22 [M] 16002 4.4.4.4/32 0 Gi1 10.5.7.5
23 [M] 16001 1.1.1.1/32 0 Gi1 10.5.7.5
[M] 16001 1.1.1.1/32 0 Gi2 10.6.7.6
24 [M] 16011 11.11.11.11/32 0 Gi1 10.5.7.5
[M] 16011 11.11.11.11/32 0 Gi2 10.6.7.6
25 [M] 16012 12.12.12.12/32 0 Gi1 10.5.7.5
26 [M] 16013 13.13.13.13/32 10840 Gi1 10.5.7.5
27 [M] 16002 2.2.2.2/32 0 Gi1 10.5.7.5
28 [M] Pop Label 5.5.5.5/32 0 Gi1 10.5.7.5
29 Pop Label 10.8.9.0/24 0 Gi3 10.7.9.9
30 24001 10.8.10.0/24 0 Gi3 10.7.9.9
No Label 10.8.10.0/24 0 Gi2 10.6.7.6
31 Pop Label 10.9.10.0/24 0 Gi3 10.7.9.9
32 No Label 10.1.3.0/24 766 Gi2 10.6.7.6
33 No Label 10.3.4.0/24 0 Gi1 10.5.7.5
No Label 10.3.4.0/24 0 Gi2 10.6.7.6
34 No Label 11.3.4.0/24 0 Gi1 10.5.7.5
No Label 11.3.4.0/24 0 Gi2 10.6.7.6
35 No Label 10.4.5.0/24 0 Gi1 10.5.7.5
36 No Label 11.4.5.0/24 0 Gi1 10.5.7.5
37 No Label 10.1.2.0/24 0 Gi1 10.5.7.5
38 No Label 10.1.11.0/24 0 Gi1 10.5.7.5
No Label 10.1.11.0/24 0 Gi2 10.6.7.6
39 No Label 10.11.12.0/24 0 Gi1 10.5.7.5
40 No Label 10.11.13.0/24 0 Gi1 10.5.7.5
No Label 10.11.13.0/24 2208 Gi2 10.6.7.6
41 No Label 10.12.13.0/24 0 Gi1 10.5.7.5
42 No Label 10.2.12.0/24 0 Gi1 10.5.7.5
43 No Label 10.2.5.0/24 766 Gi1 10.5.7.5
44 Pop Label 10.5.7.5-A 0 Gi1 10.5.7.5
45 Pop Label 10.6.7.6-A 0 Gi2 10.6.7.6
46 Pop Label 10.7.9.9-A 0 Gi3 10.7.9.9
47 [M] 24028 10.10.10.10/32 3562 Gi3 10.7.9.9
16001 [M] 16001 1.1.1.1/32 0 Gi1 10.5.7.5
[M] 16001 1.1.1.1/32 0 Gi2 10.6.7.6
16002 [M] 16002 4.4.4.4/32 0 Gi1 10.5.7.5
16003 [M] 16003 3.3.3.3/32 0 Gi2 10.6.7.6

```

16005	[M]	Pop Label	5.5.5.5/32	0	Gi1	10.5.7.5
16006	[M]	Pop Label	6.6.6.6/32	182	Gi2	10.6.7.6
16011	[M]	16011	11.11.11.11/32	0	Gi1	10.5.7.5
	[M]	16011	11.11.11.11/32	0	Gi2	10.6.7.6
16012	[M]	16012	12.12.12.12/32	0	Gi1	10.5.7.5
16013	[M]	16013	13.13.13.13/32	10840	Gi1	10.5.7.5
18000	[M]	24028	10.10.10.10/32	3562	Gi3	10.7.9.9

A - Adjacency SID

[M] - Merged
P-7#
P-7#

n) P-8 Routing Table and LFIB

```
RP/0/0/CPU0:P-8#show ip route
Sat Jan 26 05:59:17.342 UTC

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
U - per-user static route, o - ODR, L - local, G - DAGR, l - LISP
A - access/subscriber, a - Application route
M - mobile route, r - RPL, (!) - FRR Backup path

Gateway of last resort is not set

i L2 1.1.1.1/32 [115/40] via 10.6.8.6, 00:12:39, GigabitEthernet0/0/0/0
i L2 2.2.2.2/32 [115/50] via 10.6.8.6, 00:13:53, GigabitEthernet0/0/0/0
i L2 3.3.3.3/32 [115/30] via 10.6.8.6, 00:12:23, GigabitEthernet0/0/0/0
i L2 4.4.4.4/32 [115/40] via 10.6.8.6, 00:03:16, GigabitEthernet0/0/0/0
i L2 5.5.5.5/32 [115/40] via 10.6.8.6, 02:14:36, GigabitEthernet0/0/0/0
i L2 6.6.6.6/32 [115/20] via 10.6.8.6, 01:14:49, GigabitEthernet0/0/0/0
i L2 7.7.7.7/32 [115/30] via 10.6.8.6, 00:03:07, GigabitEthernet0/0/0/0
L 8.8.8.8/32 is directly connected, 21:36:00, Loopback0
i L1 9.9.9.9/32 [115/20] via 10.8.9.9, 04:09:17, GigabitEthernet0/0/0/1
i L2 10.1.2.0/24 [115/40] via 10.6.8.6, 10:04:26, GigabitEthernet0/0/0/0
i L2 10.1.3.0/24 [115/30] via 10.6.8.6, 10:04:26, GigabitEthernet0/0/0/0
i L2 10.1.11.0/24 [115/40] via 10.6.8.6, 10:04:26, GigabitEthernet0/0/0/0
i L2 10.2.5.0/24 [115/40] via 10.6.8.6, 04:08:45, GigabitEthernet0/0/0/0
i L2 10.2.12.0/24 [115/50] via 10.6.8.6, 00:27:04, GigabitEthernet0/0/0/0
i L2 10.3.4.0/24 [115/30] via 10.6.8.6, 10:04:26, GigabitEthernet0/0/0/0
i L2 10.3.6.0/24 [115/20] via 10.6.8.6, 10:04:26, GigabitEthernet0/0/0/0
i L2 10.4.5.0/24 [115/40] via 10.6.8.6, 03:03:41, GigabitEthernet0/0/0/0
i L2 10.5.7.0/24 [115/30] via 10.6.8.6, 04:08:45, GigabitEthernet0/0/0/0
i L2 10.6.7.0/24 [115/20] via 10.6.8.6, 10:04:26, GigabitEthernet0/0/0/0
C 10.6.8.0/24 is directly connected, 21:36:00, GigabitEthernet0/0/0/0
L 10.6.8.8/32 is directly connected, 21:36:00, GigabitEthernet0/0/0/0
i L2 10.7.9.0/24 [115/30] via 10.6.8.6, 04:08:45, GigabitEthernet0/0/0/0
C 10.8.9.0/24 is directly connected, 21:36:00, GigabitEthernet0/0/0/1
L 10.8.9.8/32 is directly connected, 21:36:00, GigabitEthernet0/0/0/1
C 10.8.10.0/24 is directly connected, 21:36:00, GigabitEthernet0/0/0/2
L 10.8.10.8/32 is directly connected, 21:36:00, GigabitEthernet0/0/0/2
i L1 10.9.10.0/24 [115/20] via 10.8.9.9, 04:09:16, GigabitEthernet0/0/0/1
[115/20] via 10.8.10.10, 04:09:16, GigabitEthernet0/0/0/2
i L1 10.10.10.10/32 [115/20] via 10.8.10.10, 10:28:55, GigabitEthernet0/0/0/2
i L2 10.11.12.0/24 [115/50] via 10.6.8.6, 10:04:26, GigabitEthernet0/0/0/0
i L2 10.11.13.0/24 [115/50] via 10.6.8.6, 10:04:26, GigabitEthernet0/0/0/0
i L2 10.12.13.0/24 [115/60] via 10.6.8.6, 00:27:04, GigabitEthernet0/0/0/0
i L2 11.3.4.0/24 [115/30] via 10.6.8.6, 10:04:26, GigabitEthernet0/0/0/0
i L2 11.4.5.0/24 [115/40] via 10.6.8.6, 03:03:41, GigabitEthernet0/0/0/0
i L2 11.11.11.11/32 [115/50] via 10.6.8.6, 03:31:37, GigabitEthernet0/0/0/0
i L2 12.12.12.12/32 [115/60] via 10.6.8.6, 00:12:44, GigabitEthernet0/0/0/0
i L2 13.13.13.13/32 [115/60] via 10.6.8.6, 03:31:37, GigabitEthernet0/0/0/0
RP/0/0/CPU0:P-8#!
RP/0/0/CPU0:P-8#
RP/0/0/CPU0:P-8#
RP/0/0/CPU0:P-8#!=====
RP/0/0/CPU0:P-8#
RP/0/0/CPU0:P-8#
RP/0/0/CPU0:P-8#
RP/0/0/CPU0:P-8#
RP/0/0/CPU0:P-8#show mpls forwarding
Sat Jan 26 05:59:17.702 UTC
```

Local Label	Outgoing Label	Prefix or ID	Outgoing Interface	Next Hop	Bytes Switched
24000	Pop	9.9.9.9/32	Gi0/0/0/1	10.8.9.9	76790
24001	Pop	10.6.7.0/24	Gi0/0/0/0	10.6.8.6	0
24002	Pop	10.3.6.0/24	Gi0/0/0/0	10.6.8.6	0
24003	Pop	10.9.10.0/24	Gi0/0/0/1	10.8.9.9	0
	Pop	10.9.10.0/24	Gi0/0/0/2	10.8.10.10	0
24004	24005	3.3.3.3/32	Gi0/0/0/0	10.6.8.6	0
24005	24009	1.1.1.1/32	Gi0/0/0/0	10.6.8.6	0
24006	24010	4.4.4.4/32	Gi0/0/0/0	10.6.8.6	0
24007	24029	2.2.2.2/32	Gi0/0/0/0	10.6.8.6	0
24008	24011	5.5.5.5/32	Gi0/0/0/0	10.6.8.6	0
24009	24020	13.13.13.13/32	Gi0/0/0/0	10.6.8.6	1943
24010	24021	11.11.11.11/32	Gi0/0/0/0	10.6.8.6	0
24011	Pop	6.6.6.6/32	Gi0/0/0/0	10.6.8.6	68522
24012	24008	10.1.3.0/24	Gi0/0/0/0	10.6.8.6	0
24013	24006	11.3.4.0/24	Gi0/0/0/0	10.6.8.6	0
24014	24007	10.3.4.0/24	Gi0/0/0/0	10.6.8.6	0
24015	24014	10.1.2.0/24	Gi0/0/0/0	10.6.8.6	0
24016	24015	11.4.5.0/24	Gi0/0/0/0	10.6.8.6	0


```

24016 34 11.3.4.0/24 Gi0/0/0/0 10.7.9.7 0
24017 33 10.3.4.0/24 Gi0/0/0/0 10.7.9.7 0
24018 37 10.1.2.0/24 Gi0/0/0/0 10.7.9.7 0
24019 36 11.4.5.0/24 Gi0/0/0/0 10.7.9.7 0
24020 Pop 10.5.7.0/24 Gi0/0/0/0 10.7.9.7 0
24021 35 10.4.5.0/24 Gi0/0/0/0 10.7.9.7 0
24022 43 10.2.5.0/24 Gi0/0/0/0 10.7.9.7 0
24023 38 10.1.11.0/24 Gi0/0/0/0 10.7.9.7 0
24024 41 10.12.13.0/24 Gi0/0/0/0 10.7.9.7 0
24025 40 10.11.13.0/24 Gi0/0/0/0 10.7.9.7 0
24026 39 10.11.12.0/24 Gi0/0/0/0 10.7.9.7 0
24027 42 10.2.12.0/24 Gi0/0/0/0 10.7.9.7 0
24028 Pop 10.10.10.10/32 Gi0/0/0/2 10.9.10.10 1257279
RP/0/0/CPU0:P-9#
RP/0/0/CPU0:P-9#

```

p) P-10 Routing Table and LFIB

```

RP/0/0/CPU0:PE-10#show ip route
Sat Jan 26 06:01:16.828 UTC

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - ISIS, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
U - per-user static route, o - ODR, L - local, G - DAGR, l - LISP
A - access/subscriber, a - Application route
M - mobile route, r - RPL, (!) - FRR Backup path

Gateway of last resort is 10.8.10.8 to network 0.0.0.0

i*L1 0.0.0.0/0 [115/10] via 10.8.10.8, 04:10:48, GigabitEthernet0/0/0/1
[115/10] via 10.9.10.9, 04:10:48, GigabitEthernet0/0/0/2
i L1 8.8.8.8/32 [115/20] via 10.8.10.8, 10:30:56, GigabitEthernet0/0/0/1
i L1 9.9.9.9/32 [115/20] via 10.9.10.9, 04:11:19, GigabitEthernet0/0/0/2
i L1 10.8.9.0/24 [115/20] via 10.8.10.8, 04:11:18, GigabitEthernet0/0/0/1
[115/20] via 10.9.10.9, 04:11:18, GigabitEthernet0/0/0/2
C 10.8.10.0/24 is directly connected, 20:45:43, GigabitEthernet0/0/0/1
L 10.8.10.10/32 is directly connected, 20:45:43, GigabitEthernet0/0/0/1
C 10.9.10.0/24 is directly connected, 20:45:43, GigabitEthernet0/0/0/2
L 10.9.10.10/32 is directly connected, 20:45:43, GigabitEthernet0/0/0/2
L 10.10.10.10/32 is directly connected, 20:45:44, Loopback0
l ia 13.13.13.13/32 [115/70] via 10.8.10.8, 00:16:00, GigabitEthernet0/0/0/1
[115/70] via 10.9.10.9, 00:16:00, GigabitEthernet0/0/0/2

RP/0/0/CPU0:PE-10#!
RP/0/0/CPU0:PE-10#
RP/0/0/CPU0:PE-10#
RP/0/0/CPU0:PE-10#!=====
RP/0/0/CPU0:PE-10#
RP/0/0/CPU0:PE-10#
RP/0/0/CPU0:PE-10#
RP/0/0/CPU0:PE-10#
RP/0/0/CPU0:PE-10#show mpls forwarding
Sat Jan 26 06:01:17.058 UTC
Local Outgoing Prefix Outgoing Next Hop Bytes
Label Label or ID Interface Interface
-----
24000 Pop 9.9.9.9/32 Gi0/0/0/2 10.9.10.9 72440
24001 24009 13.13.13.13/32 Gi0/0/0/1 10.8.10.8 1943
24002 24002 13.13.13.13/32 Gi0/0/0/2 10.9.10.9 3103
24002 Pop 8.8.8.8/32 Gi0/0/0/1 10.8.10.8 71806
24003 Pop 10.8.9.0/24 Gi0/0/0/1 10.8.10.8 0
Pop 10.8.9.0/24 Gi0/0/0/2 10.9.10.9 0
24004 Aggregate A: Per-VRF Aggr[V] A 0
24005 Unlabelled 200.0.1.0/24[V] Gi0/0/0/0 200.0.0.2 3222
RP/0/0/CPU0:PE-10#
RP/0/0/CPU0:PE-10#

```

q) Trace result from CE2

```

CE-2#traceroute 100.0.1.1 source lo 0

Type escape sequence to abort.
Tracing the route to 100.0.1.1

 1 200.0.0.1 32 msec 4 msec 8 msec
 2 10.9.10.9 [MPLS: Labels 24002/24005 Exp 0] 100 msec 32 msec 28 msec
 3 10.7.9.7 [MPLS: Labels 26/24005 Exp 0] 80 msec 188 msec 124 msec
 4 10.5.7.5 [MPLS: Labels 16013/24005 Exp 0] 64 msec 48 msec 24 msec
 5 10.2.5.2 [MPLS: Labels 16013/24005 Exp 0] 52 msec 44 msec 28 msec
 6 10.2.12.12 [MPLS: Labels 16013/24005 Exp 0] 40 msec 88 msec 32 msec
 7 10.12.13.13 [MPLS: Label 24005 Exp 0] 92 msec 28 msec 32 msec
 8 100.0.0.2 28 msec 36 msec *
CE-2#

```