SD 액세스 패브릭에서 네이티브 멀티캐스트 확인

목차

소개

이 문서에서는 SDA(SD-Access) 패브릭에서 네이티브 멀티캐스트를 확인하는 방법에 대해 설명합

니다.

사전 요구 사항

요구 사항

다음 주제에 대한 지식을 보유하고 있으면 유용합니다.

- IP(인터넷 프로토콜) 포워딩
- LISP(Locator ID/Separation Protocol)
- PIM(Protocol Independent Multicast) 스파스 모드

사용되는 구성 요소

- Cisco IOS® XE 17.10.1의 C9000v
- Cisco Catalyst Center 버전 2.3.5.3

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

이 문서는 다음 하드웨어 및 소프트웨어 버전에서도 사용할 수 있습니다.

- C9200
- C9300
- C9400
- C9500
- C9600
- Cisco IOS® XE 16.12 이상

배경 정보

SDA Native Multicast는 오버레이 멀티캐스트의 한 형태로, 패브릭 디바이스 간에 멀티캐스트 트래픽을 전달하면서 멀티캐스트 트래픽을 다른 멀티캐스트 그룹으로 캡슐화하는 데 사용됩니다. Native Multicast는 동일한 VLAN 또는 다른 VLAN에 있는 소스와 수신기 간에 멀티캐스트 트래픽을 라우팅할 수 있습니다(동일한 VLAN 멀티캐스트는 라우팅 가능). 동일한 FE(Fabric Edge)에서 소스와 수신 간의 멀티캐스트 트래픽은 오버레이 멀티캐스트(VXLAN 캡슐화)를 사용하여 전달되지 않고 FE에 의해 로컬로 라우팅됩니다. 네이티브 멀티캐스트는 224.0.0.0/24 또는 TTL(Time To Live)=1과 일치하는 그룹의 멀티캐스트 트래픽을 라우팅할 수 없습니다. 이러한 트래픽은 L2(Layer 2) 플러딩을 통해 처리됩니다. Native Multicast는 모든 ASM(Source Multicast), SSM(Source Specific Multicast) 또는 이 둘의 조합을 전달하도록 구성할 수 있습니다. 네이티브 멀티캐스트는 언더레이 멀티캐스트에 의존합니다.
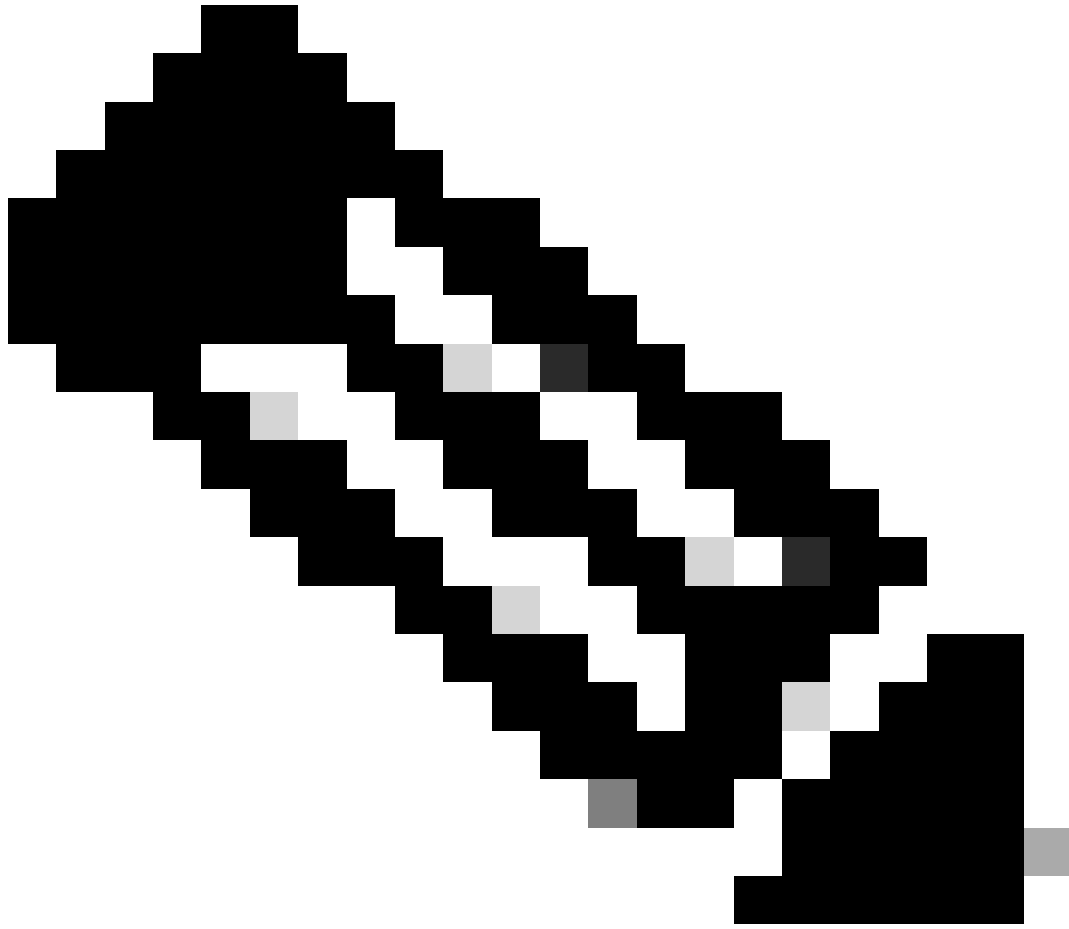
참고: 플랫폼(fed) 명령은 다를 수 있습니다. "show platform fed <active|standby>"와 "show platform fed switch <active|standby>가 비교 가능합니다.". 예제에 나와 있는 구문이 구문 분석되지 않으면 variant를 사용해 보십시오.

토폴로지
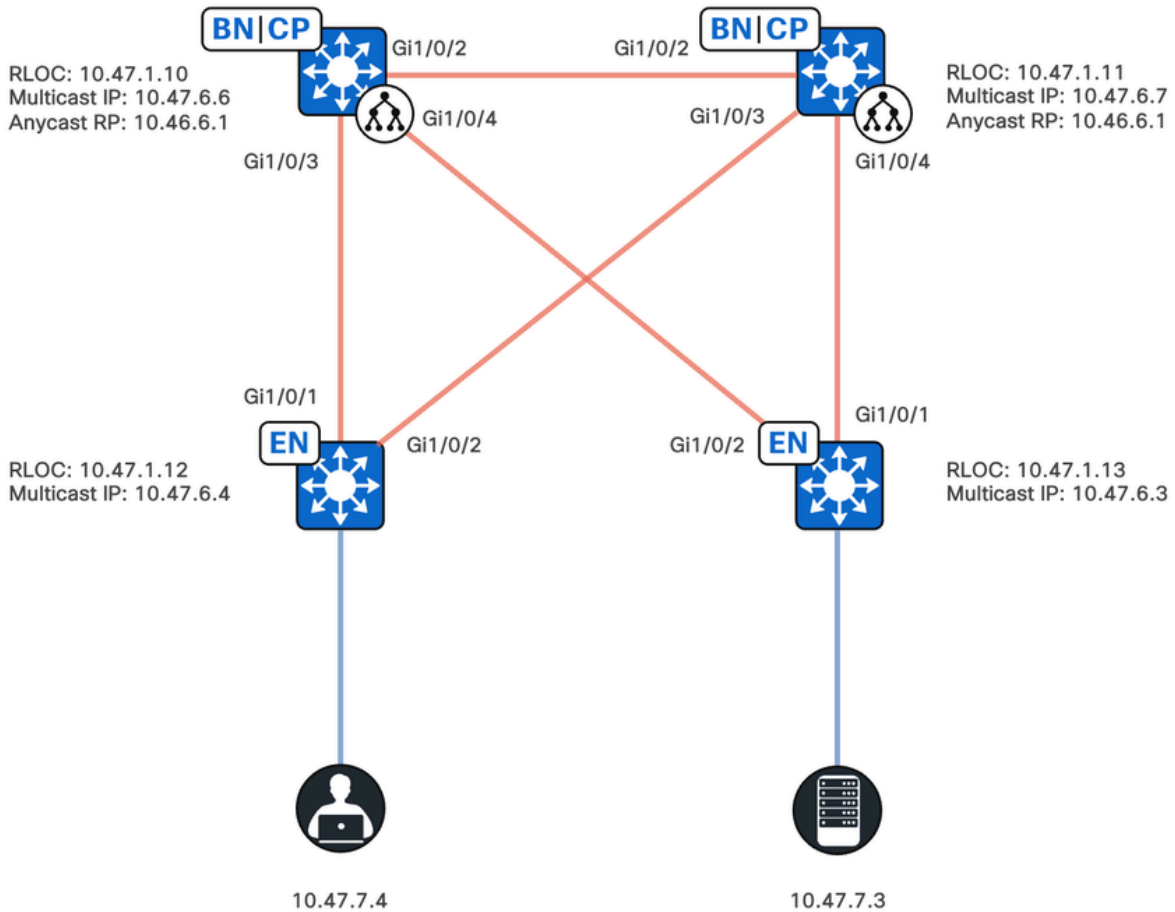
네트워크 토폴로지

이 토폴로지에서는

- RLOC(Remote Locator ID) 10.47.1.10 및 10.47.1.10은 경계 어디에나 배치되며 VN(Virtual Network) 또는 VRF(Virtual Routing and Forwarding)에서 둘 사이의 MSDP(Multicast Source Discovery Protocol)를 통해 RP(Anycast Rendezvous Point)로 작동합니다.
- 10.47.1.12 및 10.47.1.3은 FE 노드입니다.
- 10.47.7.4는 멀티캐스트 수신기입니다.
- 10.47.7.3은 멀티캐스트 소스입니다.
- 239.0.0.5는 멀티캐스트 GDA(Group Destination Address)

설정

Cisco Catalyst Center를 사용하여 다음 설정으로 SDA 패브릭을 프로비저닝하는 것으로 가정합니다.

- 복제 모드 구현은 기본 멀티캐스트입니다.
- 멀티캐스트 모드가 ASM(Any Source Multicast)입니다.
- MSDP(Multicast Source Discovery Protocol)가 배치된 Collocated Anywhere 테두리에 구성된 애니캐스트 RP(Rendezvous Point)

- Underlay Multicast는 수동으로 구성되었거나 초기 LAN 자동화의 일부로 구성되었습니다. Native Multicast는 Underlay Multicast를 사용하여 제대로 작동합니다.

패브릭 에지(10.47.1.12) 구성

```
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
permit 239.0.0.0 0.0.0.255
ip multicast-routing vrf blue_vn
interface LISP0.4100
ip pim lisp transport multicast
ip pim lisp core-group-range 232.0.0.1 1000
interface Vlan1025
ip pim passive
exit
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.4 255.255.255.255
ip pim sparse-mode
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn ssm default
router lisp
service ipv4
etr map-server 10.47.1.11 key ******
etr map-server 10.47.1.10 key ******
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
service ethernet
etr map-server 10.47.1.11 key ******
etr map-server 10.47.1.10 key ******
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
instance-id-range 8188 , 8190 , 8192 , 8193 override
remote-rloc-probe on-route-change
service ethernet
eid-table vlan 1025 , 1026 , 1028 , 2727
database-mapping mac locator-set rloc_222e1707-175d-4019-a783-060404f8bc2f
instance-id 4099
service ipv4
sgt
instance-id 4100
service ipv4
sgt
database-mapping 10.47.6.4/32 locator-set rloc_222e1707-175d-4019-a783-060404f8bc2f
instance-id 8188
service ethernet
eid-table vlan 1025
dynamic-eid detection multiple-addr bridged-vm
instance-id 8190
service ethernet
eid-table vlan 1026
dynamic-eid detection multiple-addr bridged-vm
instance-id 8192
service ethernet
eid-table vlan 1028
dynamic-eid detection multiple-addr bridged-vm
ip domain lookup source-interface Loopback0
ip domain lookup
ip multicast vrf blue_vn multipath
```

패브릭 에지(10.47.1.13) 구성

```
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
permit 239.0.0.0 0.0.0.255
ip multicast-routing vrf blue_vn
interface LISP0.4100
ip pim lisp transport multicast
ip pim lisp core-group-range 232.0.0.1 1000
interface Vlan1025
ip pim passive
exit
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.3 255.255.255.255
ip pim sparse-mode
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn ssm default
router lisp
service ipv4
etr map-server 10.47.1.11 key ******
etr map-server 10.47.1.10 key ******
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
service ethernet
etr map-server 10.47.1.11 key ******
etr map-server 10.47.1.10 key ******
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
instance-id-range 8188 , 8190 , 8192 , 8193 override
remote-rloc-probe on-route-change
service ethernet
eid-table vlan 1025 , 1026 , 1028 , 2727
database-mapping mac locator-set rloc_691b1fe4-5264-44c2-bb1b-0903b3eb2c51
instance-id 4099
service ipv4
sgt
instance-id 4100
service ipv4
sgt
database-mapping 10.47.6.3/32 locator-set rloc_691b1fe4-5264-44c2-bb1b-0903b3eb2c51
instance-id 8188
service ethernet
eid-table vlan 1025
dynamic-eid detection multiple-addr bridged-vm
instance-id 8190
service ethernet
eid-table vlan 1026
dynamic-eid detection multiple-addr bridged-vm
instance-id 8192
service ethernet
eid-table vlan 1028
dynamic-eid detection multiple-addr bridged-vm
ip domain lookup source-interface Loopback0
ip domain lookup
ip multicast vrf blue_vn multipath
```

Collocated Anywhere Border/Anycast RP(10.47.1.10) 구성

```
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
permit 239.0.0.0 0.0.0.255
ip multicast-routing vrf blue_vn
interface LISP0.4100
ip pim lisp transport multicast
ip pim lisp core-group-range 232.0.0.1 1000
interface Vlan3001
ip pim sparse-mode
exit
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.1 255.255.255.255
ip pim sparse-mode
interface Loopback4600
vrf forwarding blue_vn
ip address 10.47.6.6 255.255.255.255
ip pim sparse-mode
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn ssm default
ip msdp vrf blue_vn cache-sa-state
ip msdp vrf blue_vn originator-id Loopback4600
ip msdp vrf blue_vn peer 10.47.6.7 connect-source Loopback4600
ip msdp originator-id Loopback4600
router bgp 69420
address-family ipv4 vrf blue_vn
aggregate-address 10.47.6.0 255.255.255.0 summary-only
network 10.47.6.1 mask 255.255.255.255
router lisp
service ipv4
etr map-server 10.47.1.11 key ******
etr map-server 10.47.1.10 key ******
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
service ethernet
etr map-server 10.47.1.11 key ******
etr map-server 10.47.1.10 key ******
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
instance-id 4099
service ipv4
sgt
route-export site-registrations
route-import database bgp 69420 route-map DENY-red_vn locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e1
distance site-registrations 250
map-cache site-registration
instance-id 4100
service ipv4
map-cache 10.47.6.7/32 10.47.1.11 priority 1 weight 100
sgt
route-export site-registrations
route-import database bgp 69420 route-map DENY-blue_vn locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e
distance site-registrations 250
map-cache site-registration
database-mapping 10.47.6.6/32 locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
```

```
database-mapping 10.47.6.1/32 locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
site site_uci
authentication-key ******
eid-record instance-id 4100 10.47.6.0/24 accept-more-specifics
```

Collocated Anywhere Border/Anycast RP(10.47.1.10) 구성

```
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
permit 239.0.0.0 0.0.0.255
ip multicast-routing vrf blue_vn
interface LISP0.4100
ip pim lisp transport multicast
ip pim lisp core-group-range 232.0.0.1 1000
interface Vlan3001
ip pim sparse-mode
exit
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.1 255.255.255.255
ip pim sparse-mode
interface Loopback4600
vrf forwarding blue_vn
ip address 10.47.6.6 255.255.255.255
ip pim sparse-mode
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn ssm default
ip msdp vrf blue_vn cache-sa-state
ip msdp vrf blue_vn originator-id Loopback4600
ip msdp vrf blue_vn peer 10.47.6.7 connect-source Loopback4600
ip msdp originator-id Loopback4600
router bgp 69420
address-family ipv4 vrf blue_vn
aggregate-address 10.47.6.0 255.255.255.0 summary-only
network 10.47.6.1 mask 255.255.255.255
router lisp
service ipv4
etr map-server 10.47.1.11 key ******
etr map-server 10.47.1.10 key ******
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
service ethernet
etr map-server 10.47.1.11 key ******
etr map-server 10.47.1.10 key ******
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
instance-id 4099
service ipv4
sgt
route-export site-registrations
route-import database bgp 69420 route-map DENY-red_vn locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e1
distance site-registrations 250
map-cache site-registration
instance-id 4100
service ipv4
map-cache 10.47.6.7/32 10.47.1.11 priority 1 weight 100
```

```
sgt
route-export site-registrations
route-import database bgp 69420 route-map DENY-blue_vn locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e:
distance site-registrations 250
map-cache site-registration
database-mapping 10.47.6.6/32 locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
database-mapping 10.47.6.1/32 locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
site site_uci
authentication-key ******
eid-record instance-id 4100 10.47.6.0/24 accept-more-specifics
```

컨트롤 플레인 확인

PIM(Protocol Independent Multicast) 확인은 FHR(First Hop Router)에서 (S,G) 생성을 확인하는 것부터 시작합니다

FHR (S,G) 생성

멀티캐스트 소스 10.47.7.3은 239.0.0.5로 UDP 멀티캐스트 패킷을 전송합니다. IPDT(IP Device-Tracking), CEF(Cisco Express Forwarding) 및 RPF(Reverse Path Forwarding)가 멀티캐스트 소스를 향해 올바르게 가리키는지 확인합니다. 또한 Anycast Gateway SVI가 이 세그먼트의 PIM DR(Designated Router)인지 확인합니다.

"show device-tracking database address <ip address>" 명령을 사용하여 유효한 IPDT 항목이 있는지 확인합니다

<#root>

Edge-2#

show device-tracking database address 10.47.7.3

```
Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DH4 - IPv4 DH(
Preflevel flags (prlvl):
0001:MAC and LLA match 0002:Orig trunk 0004:Orig access
0008:Orig trusted trunk 0010:Orig trusted access 0020:DHCP assigned
0040:Cga authenticated 0080:Cert authenticated 0100:Statically assigned
    Network Layer Address Link Layer Address Interface vlan prlvl age  state        Time left
DH4 10.47.7.3           5254.0012.521d     Gi1/0/4   1025 0024  166s
```

REACHABLE

 81 s try 0(2276 s)

"show ip cef vrf <VN Name> <ip address>" 명령을 사용하여 멀티캐스트 소스가 직접 연결되었는지 확인합니다

<#root>

```
Edge-2#
```

show ip cef vrf blue_vn 10.47.7.3

```
10.47.7.3/32
nexthop 10.47.7.3 Vlan1025
```

그런 다음 "show ip rpf vrf <VN> <ip address>" 명령을 사용하여 RPF 인터페이스가 LISP가 아니라 소스가 있는 VLAN인지 확인합니다.

<#root>

```
Edge-1#
```

show ip rpf vrf blue_vn 10.47.7.3

```
RPF information for (10.47.7.2)
RPF interface: Vlan1025
RPF neighbor: ? (
```

10.47.7.3

```
) - directly connected
RPF route/mask: 10.47.7.3/32
RPF type:
```

unicast (lisp)

```
Doing distance-preferred lookups across tables
Multicast Multipath enabled.
RPF topology: ipv4 multicast base, originated from ipv4 unicast base
```

"show ip pim vrf <VN name> interface vlan <vlan> detail" 명령을 사용합니다. | FE 노드가 세그먼트의 PIM DR이고 FHR인지 확인하려면 DR|enabled"를 포함합니다.

<#root>

```
Edge-2#
```

show ip pim vrf blue_vn interface vlan 1025 detail | include DR|enabled

```
PIM: enabled
PIM DR: 10.47.7.1 (this system)
PIM State-Refresh processing: enabled
PIM Non-DR-Join: FALSE
```

"show ip mroute vrf <VN name> <multicast group address>" 명령을 사용하여 (S,G) 생성을 검증합니다. (S,G)는 FHR에 연결된 관심 있는 수신기 또는 PIM 라우터가 없으므로 OIL(Null Outgoing Interface List)을 갖게 됩니다.

<#root>

Edge-2#

show ip mroute vrf blue_vn 239.0.0.5

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 00:00:10/stopped, RP 10.47.6.1, flags: SPFl
Incoming interface: LISP0.4100, RPF nbr 10.47.1.10
Outgoing interface list: Null

(

10.47.7.3

,

239.0.0.5

), 00:00:10/00:02:50, flags: PFT
Incoming interface: Vlan1025, RPF nbr 0.0.0.0
Outgoing interface list:

Null

FHR(S,G) 등록

FHR은 "registered-source" PIM 레지스터 메시지로 구성된 인터페이스를 사용하여 유니캐스트 소스를 Anycast RP에 등록합니다.

- 외부 헤더, RLOC에서 RLOC(10.47.1.13~10.47.1.10)으로 RLOC
- 내부 헤더, 루프백으로 루프백(10.47.6.3~10.47.6.1)
- 실제 멀티캐스트

<#root>

Edge-2#

```
show ip pim vrf blue_vn tunnel


Tunnel1
Type : PIM Encap
RP : 10.47.6.1
Source : 10.47.6.3
State : UP
Last event : Created (00:42:43)

Edge-2#
```

show ip cef vrf blue_vn 10.47.6.1


```
10.47.6.1/32
nexthop
```

10.47.1.10

```
 LISP0.4100
```

<-- FHR happened to register to this RP


```
nexthop 10.47.1.11 LISP0.4100
```


LHR IGMP 멤버십 보고서

멀티캐스트 수신기는 IGMP Membership Report/Join(IGMP 멤버십 보고서/가입)을 전송하여 멀티캐스트 트래픽 수신에 대한 관심을 나타내므로 LHR(Last Hop Router)에 IGMP 스누핑 및 IGMP 그룹 항목이 생성됩니다. "show ip igmp snooping groups vlan <vlan id> <group destination address>" 명령과 "show ip igmp vrf <VN Name> groups <group>" 명령을 사용합니다.

<#root>

Edge-1#

show ip igmp snooping groups vlan 1025 239.0.0.5


```
Vlan Group      Type Version Port List
-----------------------------------------------------------------------
1025 239.0.0.5 igmp v2       Gi1/0/5
```

Edge-1#

show ip igmp vrf blue_vn groups 239.0.0.5


```
IGMP Connected Group Membership
Group Address Interface Uptime   Expires  Last Reporter Group Accounted
239.0.0.5     Vlan1025  00:02:01 00:02:58 10.47.7.4
```


그런 다음 LHR이 이 세그먼트의 PIM DR인지 확인합니다. "show ip pim vrf <VN name> interface vlan <vlan> detail 명령을 사용합니다 | DR|enabled 포함"

<#root>

Edge-1#

show ip pim vrf blue_vn interface vlan 1025 detail | include DR|enabled

PIM: enabled

PIM DR: 10.47.7.1 (this system)

PIM State-Refresh processing: enabled
PIM Non-DR-Join: FALSE

LHR (*,G) 오버레이 생성

LHR이 IGMP 멤버십 보고서를 수신하면 PIM 상태가 생성됩니다. 특히 (*,G) "show ip mroute vrf
<VN Name><overlay group> verbose" 명령을 사용하여 (*,G) 상태를 확인할 수 있습니다

<#root>

Edge-1#

show ip mroute vrf blue_vn 239.0.0.5 verbose

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 1w3d/stopped, RP

10.47.6.1

, flags: SJCl

<-- Anycast RP IP address

Incoming interface: LISP0.4100,

RPF nbr 10.47.1.10

, LISP: [

10.47.1.10

,

232.0.2.245

]

<-- RPF neighbor to reach the Anycast RP, Overlay Group 239.0.0.5 is mapped to Underlay Group 232.0.2.24

Outgoing interface list:

Vlan1025

, Forward/Sparse-Dense, 1w3d/00:02:31, Pkts:0, flags:

<-- IGMP Membership Report/PIM Join received in VLAN 1025, multicast traffic is sent into VLAN 1025

언더레이 SSM 그룹의 LHR(*,G) 매핑

(*,G)에서 언더레이 SSM(S,G)이 파생됩니다. 소스는 RP RPF이고 그룹은 오버레이 매핑입니다.

<#root>

Edge-1#

show ip mroute 232.0.2.245 10.47.1.10

```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode
```

(

10.47.1.10, 232.0.2.245

), 2d01h/00:02:28, flags: sT

<-- 10.47.1.10 in this example is the RPF IP/neighbor to get to the RP, 232.0.2.245 is the Underlay Grou

Incoming interface:

GigabitEthernet1/0/1

, RPF nbr 10.47.1.0

<-- RPF interface to reach 10.47.1.10

Outgoing interface list:

Null0

, Forward/Dense, 2d01h/stopped, flags:

<-- The Outgoing Interface List (OIL) is Null0, and in Native Multicast, this is treated as a De-Encapsu

Border/RP가 오버레이에 (*,G), 언더레이에 (S,G) 생성

LHR이 오버레이에서 PIM(*,G) 조인을 보냅니다. "show ip mroute vrf <VN name> <overlay group> verbose" 명령을 사용하여 오버레이 내(*,G)를 볼 수 있습니다

<#root>

Border-1#

show ip mroute vrf blue_vn 239.0.0.5 verbose


```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode
```

(

*, 239.0.0.5

), 2d01h/00:03:05, RP 10.47.6.1, flags: Sp
Incoming interface:

Null

,

RPF nbr 0.0.0.0

```
Outgoing interface list:
LISP0.4100, (
```

10.47.1.10, 232.0.2.245

```
), Forward/Sparse, 2d01h/stopped, Pkts:0, flags: p
```

10.47.1.12

```
, 2d01h/00:03:05
```

<-- This is the RLOC of Edge-1, which is the LHR

언더레이에서 "show ip mroute <underlay group address> <RP RLOC>" 명령을 사용할 수 있습니다.

<#root>

Border-1#

show ip mroute 232.0.2.245 10.47.1.10

```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(
```

10.47.1.10

```
,
```

232.0.2.245

```
), 2d01h/00:03:13, flags: sT
Incoming interface:
```

Null0

```
,
```

RPF nbr 0.0.0.0

Outgoing interface list:

GigabitEthernet1/0/3

, Forward/Sparse, 2d01h/00:03:13, flags:

<-- Interface that connects to Edge-1, which is the LHR, a PIM Join was received off this interface

Border-1은 MSDP SA-Cache에서 (S,G)를 생성합니다.

FHR에서 멀티캐스트 소스를 Border-2에 등록했습니다. Border-2는 MSDP를 통해 멀티캐스트 소스를 Border-1에 광고합니다. "show ip msdp vrf <VN Name> summary" 명령을 사용하여 MSDP 상태를 볼 수 있습니다.

<#root>

Border-1#

show ip msdp vrf blue_vn summary

```
MSDP Peer Status Summary
Peer Address AS      State Uptime/  Reset SA    Peer Name
                           Downtime Count Count
10.47.6.7    23456 Up     2d02h    1     1
```

"show ip msdp vrf <VN Name> peer <Peer Address> accepted-SAs" 명령을 사용하여 피어에서 수락된 SA를 확인합니다

<#root>

Border-1#

show ip msdp vrf blue_vn peer 10.47.6.7 accepted-SAs

MSDP SA accepted from peer 10.47.6.7 (?)

239.0.0.5

10.47.7.3

 (?) RP:

10.47.6.7 <-- 239.0.0.5 is the Overlay Group, 10.47.7.3 is the multicast source, 10.47.6.7 is the IP add

(S,G)를 보려면 "show ip mroute vrf <VN Name> <group destination address> verbose" 명령을 사용합니다

<#root>

```
Border-1#

show ip mroute vrf blue_vn 239.0.0.5 verbose


IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 2d02h/00:03:27, RP 10.47.6.1, flags: Sp
Incoming interface: Null, RPF nbr 0.0.0.0
Outgoing interface list:
LISP0.4100, (10.47.1.10, 232.0.2.245), Forward/Sparse, 2d02h/stopped, Pkts:0, flags: p
10.47.1.12, 2d02h/00:03:27

(
```

10.47.7.3

,

239.0.0.5

```
), 00:18:26/00:02:50, flags: PTA
```

<-- True multicast source

```
Incoming interface: LISP0.4100, RPF nbr 10.47.1.13, LISP: [
```

10.47.1.13

,

232.0.2.245

]

<-- RLOC of Edge-2, which is FHR, and 232.0.2.245 is the Underlay multicast group

```
Outgoing interface list:
```

10.47.1.12, 00:00:05/00:03:24

<-- RLOC of Edge-1

테두리 오버레이(S,G)는 언더레이(S,G)를 생성합니다.

Border-1은 오버레이(S,G)의 결과로 언더레이(S,G)를 생성합니다. "show ip mroute <group destination address>" 명령을 사용하여 추가 정보를 볼 수 있습니다.

FHR과 자체에는 S,G가 두 개 있습니다. 10.47.1.13, 232.0.2.245의 Null0 OIL은 캡슐화 해제를 나타내고, 10.47.1.10의 IIF인 Null0은 캡슐화를 나타냅니다.

<#root>

Border-1#

show ip mroute 232.0.2.245

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(

10.47.1.13

,

232.0.2.245

), 00:02:34/00:00:25, flags: sPT

<-- RLOC of the FHR, underlay multicast group IP

Incoming interface: GigabitEthernet1/0/4, RPF nbr 10.47.1.3 <-- RPF interface towards the FHR

Outgoing interface list: Null <-- Indicates decapsulation

(

10.47.1.10

,

232.0.2.245

), 2d02h/00:02:41, flags: sT

<-- RLOC of Border-1, underlay multicast group IP

Incoming interface: Null0, RPF nbr 0.0.0.0 <-- Indicates encapsulation

Outgoing interface list:

GigabitEthernet1/0/3, Forward/Sparse, 2d02h/00:02:41, flags: <-- where multicast traffic is sent

FHR이 오버레이 및 언더레이에서 조인 수신(S,G)

Border/RP는 FHR에 PIM(S,G) 조인을 보냅니다. "show ip mroute" 명령을 사용하여 정보를 가져올 수 있습니다. 오버레이에서 "show ip mroute vrf <VN Name> <overlay group address"를 사용합니다.

<#root>

Edge-2#

show ip mroute vrf blue_vn 239.0.0.5


```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 1w3d/stopped, RP 10.47.6.1, flags: SPFl
Incoming interface: LISP0.4100, RPF nbr 10.47.1.10
Outgoing interface list: Null
```

(

10.47.7.3

,

239.0.0.5

), 1w3d/00:01:23, flags: FT

<-- Multicast source, true multicast group

Incoming interface: Vlan1025, RPF nbr 0.0.0.0
Outgoing interface list:
LISP0.4100, (

10.47.1.13

,

232.0.2.245

), Forward/Sparse, 19:12:56/stopped, flags:

<-- FHR RLOC, underlay group IP

10.47.1.10, 00:00:09/00:03:19 <-- Border/RP RLOC

언더레이에서 "show ip mroute <underlay group address>"를 사용합니다.

<#root>

Edge-2#

show ip mroute 232.0.2.245

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(

10.47.1.13

,

232.0.2.245

), 1w3d/00:03:01, flags: sT

<-- RLOC of the FHR, Underlay multicast group

Incoming interface: Null0, RPF nbr 0.0.0.0 <-- Indicates encapsulation

Outgoing interface list:

GigabitEthernet1/0/1

, Forward/Sparse, 00:01:42/00:03:01, flags:

<-- Where the multicast traffic is forwarded

LHR이 공유 트리를 따라 멀티캐스트 트래픽 수신

LHR은 RP로부터 공유 트리를 따라 캡슐화된 멀티캐스트 트래픽을 수신한 후, 언더레이(S,G)의 OIL이 Null0이므로 멀티캐스트 트래픽을 역캡슐화한 다음 오버레이에 (S,G) 항목을 생성합니다. "show ip mroute <underlay group address>" 및 "show ip mroute vrf <VN Name> <overlay group address" 명령을 사용할 수 있습니다.

<#root>

Edge-1#

show ip mroute 232.0.2.245


```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode
```

(

10.47.1.10

,

232.0.2.245

), 2d03h/00:00:36, flags: sT

<-- RLOC of the RP, Underlay group

Incoming interface:

GigabitEthernet1/0/1, RPF nbr 10.47.1.0 <-- RPF interface towards the RP

Outgoing interface list:

Null0, Forward/Dense, 2d03h/stopped, flags: <-- Indicates Decapsulation

오버레이에서 "show ip mroute vrf <VN Name> <overlay group address>"

<#root>

Edge-1#

show ip mroute vrf blue_vn 239.0.0.5


```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 1w3d/stopped, RP 10.47.6.1, flags: SJCl
Incoming interface: LISP0.4100, RPF nbr 10.47.1.10
Outgoing interface list:
Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:03, flags:
```

(

10.47.7.3, 239.0.0.5

), 00:01:21/00:01:38, flags: JTl

<-- Multicast Source, Overlay Group

Incoming interface: LISP0.4100, RPF nbr 10.47.1.13, LISP:
 [

10.47.1.13, 232.0.2.245

]

<-- RLOC of the FHR, Underlay Group

Outgoing interface list:

Vlan1025

, Forward/Sparse-Dense, 00:01:21/00:02:03, flags:

<-- Multicast traffic is fowarded into VLAN 1025

이제 LHR이 SPT(Shortest Path Tree)에 참여하고 PIM(S,G) 조인을 통해 오버레이 및 언더레이에서 공유 트리를 정리합니다. LHR이 공유 트리를 정리하면 (S,G)에 대한 RP OIL에 더 이상 LHR이 포함되지 않습니다. RP로 이동하여 "show ip mroute vrf <VN Name> <overlay group address>" 명령을 사용합니다.

<#root>

Border-1#

show ip mroute vrf blue_vn 239.0.0.5


```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 2d04h/00:03:10, RP 10.47.6.1, flags: S
Incoming interface: Null, RPF nbr 0.0.0.0
Outgoing interface list:
LISP0.4100, (10.47.1.10, 232.0.2.245), Forward/Sparse, 2d04h/stopped, flags:

(10.47.7.3, 239.0.0.5), 00:14:17/00:02:42, flags: PT
Incoming interface: LISP0.4100, RPF nbr 10.47.1.13
```

Outgoing interface list: Null

(S,G) 구조에는 더 이상 언더레이 매핑이 없으므로, 언더레이를 통해 239.0.0.5에 대한 트래픽을 수신하더라도 RP는 이를 LHR로 다시 캡슐화하지 않으므로 공유 트리가 정리됩니다. 그러나 소스 트리와 공유 트리 모두에 대한 (S,G) 구조는 여전히 존재합니다. RP로 이동하여 "show ip mroute

<underlay group address>" 명령으로 언더레이 그룹을 확인합니다.

<#root>

Border-1#

show ip mroute 232.0.2.245


```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(10.47.1.13, 232.0.2.245), 00:01:07/00:01:52, flags: sPT
Incoming interface: GigabitEthernet1/0/4, RPF nbr 10.47.1.3
Outgoing interface list: Null

(10.47.1.10, 232.0.2.245), 2d04h/00:03:23, flags: sT
Incoming interface: Null0, RPF nbr 0.0.0.0
Outgoing interface list:
GigabitEthernet1/0/3, Forward/Sparse, 2d04h/00:03:23, flags:
```


RP가 모든 OIL을 제거한 경우 FHR OIL에서도 자신을 제거합니다. FHR OIL에는 LHR만 포함됩니다. FHR로 이동하여 "show ip mroute vrf <VN Name> <overlay group address>" 명령을 사용합니다.

<#root>

Edge-2#

show ip mroute vrf blue_vn 239.0.0.5


```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
```

```
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 1w4d/stopped, RP 10.47.6.1, flags: SPFl
Incoming interface: LISP0.4100, RPF nbr 10.47.1.10
Outgoing interface list: Null

(
```

10.47.7.3

,

239.0.0.5

), 1w3d/00:01:25, flags: FT

<-- Multicast Source, Overlay Group

```
Incoming interface: Vlan1025, RPF nbr 0.0.0.0
Outgoing interface list:
LISP0.4100, (
```

10.47.1.13, 232.0.2.245

), Forward/Sparse, 20:16:48/stopped, flags:

<-- RLOC of the LHR, Underlay Group

데이터 플레인 확인(플랫폼에 구애받지 않음)

멀티캐스트 소스 또는 멀티캐스트 수신자가 트래픽을 송/수신하는 것을 막을 수 있는 다양한 문제가 있을 수 있습니다. 이 섹션에서는 멀티캐스트 소스와 멀티캐스트 수신기 모두에 영향을 미칠 수 있는 문제를 검증하고 하드웨어 프로그래밍과 관련이 없는 문제를 중점적으로 다룹니다.

FHR(S,G) 생성

FHR에서 SISF, LISP, CEF 및 RPF가 모두 유효하고 올바른지 확인하려면 "show device-tracking database address <IPv4 address>" 명령을 사용합니다.

<#root>

Edge-2#

show device-tracking database address 10.47.7.3

```
Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DH4 - IPv4 DHC
Preflevel flags (prlvl):
0001:MAC and LLA match 0002:Orig trunk 0004:Orig access
0008:Orig trusted trunk 0010:Orig trusted access 0020:DHCP assigned
0040:Cga authenticated 0080:Cert authenticated 0100:Statically assigned
    Network Layer Address Link Layer Address Interface vlan prlvl age state     Time left
DH4 10.47.7.3            5254.0012.521d    Gi1/0/4   1025 0024  16s REACHABLE 232 s try 0(84662 s)
```

 SISF는 LISP에서 활용합니다. "show lisp instance-id <L3 LISP Instance ID> ipv4 database <IP/32>" 명령을 사용하십시오.

<#root>

Edge-2#

show lisp instance-id 4100 ipv4 database 10.47.7.3/32

```
LISP ETR IPv4 Mapping Database for LISP 0 EID-table vrf blue_vn (IID 4100), LSBs: 0x1
Entries total 1, no-route 0, inactive 0, do-not-register 1
```

10.47.7.3/32

```
, dynamic-eid blue-IPV4, inherited from default locator-set rloc_691b1fe4-5264-44c2-bb1b-0903b3eb2c51
Uptime: 5w0d, Last-change: 5w0d
Domain-ID: local
Service-Insertion: N/A
Locator Pri/Wgt Source State
10.47.1.13 10/10 cfg-intf site-self, reachable
Map-server Uptime ACK Domain-ID
10.47.1.10 2d04h Yes 0
10.47.1.11 2d15h Yes 0
```

Edge-2#

show ip lisp instance-id 4100 forwarding eid local 10.47.7.3

```
Prefix
10.47.7.3/32
```

 LISP는 CEF를 프로그래밍하고 "show ip cef vrf <VN Name> <ip address>" 명령을 사용하여 LISP를 가리키지 않고 VLAN의 다음 홉인지 확인합니다.

<#root>

Edge-2#

show ip cef vrf blue_vn 10.47.7.3

```
10.47.7.3/32
nexthop 10.47.7.3 Vlan1025
```

마지막으로, RPF가 올바르게 가리키고 있으며 직접 연결되었다고 표시되는지 확인합니다.

<#root>

Edge-2#

show ip rpf vrf blue_vn 10.47.7.3

RPF information for (10.47.7.3)
RPF interface: Vlan1025
RPF neighbor: ?

(10.47.7.3) - directly connected

RPF route/mask: 10.47.7.3/32
RPF type: unicast (lisp)
Doing distance-preferred lookups across tables
Multicast Multipath enabled.
RPF topology: ipv4 multicast base, originated from ipv4 unicast base

 SISF/IPDT에 유효한 항목이 없으면 FHR에서 LISP 데이터베이스 매핑이 수행되지 않으므로 CEF 및 RPF가 Border(s)를 가리킵니다. 멀티캐스트 소스가 트래픽을 전송하는 경우 RPF가 잘못된 인터페이스를 가리키므로 RPF 실패(S,G)가 형성되지 않습니다.

<#root>

Edge-2#

show device-tracking database address 10.47.7.3

Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DH4 - IPv4 DH
Preflevel flags (prlvl):
0001:MAC and LLA match 0002:Orig trunk 0004:Orig access
0008:Orig trusted trunk 0010:Orig trusted access 0020:DHCP assigned
0040:Cga authenticated 0080:Cert authenticated 0100:Statically assigned
Network Layer Address Link Layer Address Interface vlan prlvl age state Time left

Edge-2#

show lisp instance-id 4100 ipv4 database 10.47.7.3/32

% No database-mapping entry for 10.47.7.3/32.

Edge-2#

show ip cef vrf blue_vn 10.47.7.3

10.47.7.0/24
nexthop 10.47.1.10

LISP0.4100 <-- Result of a LISP Negative Map-Reply, so the LISP interface is now the RPF interface

nexthop 10.47.1.11

```
LISP0.4100 <-- Result of a LISP Negative Map-Reply, so the LISP interface is now the RPF interface
```

```
Edge-2#
```

show ip rpf vrf blue_vn 10.47.7.3

```
RPF information for (10.47.7.3)
RPF interface:
```

LISP0.4100

```
RPF neighbor: ? (
```

10.47.1.11

```
)
RPF route/mask: 10.47.7.3/32
RPF type: unicast ()
Doing distance-preferred lookups across tables
Multicast Multipath enabled.
RPF topology: ipv4 multicast base
```

이를 방지하려면 멀티캐스트 소스를 IP Directed Broadcast, Flooding, Static SISF/IPDT 바인딩이 이 문제를 해결할 수 있는 무음 호스트로 취급합니다.

소스 등록

PIM 등록은 다른 유니캐스트 패킷과 마찬가지로 LISP/VXLAN을 사용하는 유니캐스트 패킷 흐름입니다. FHR이 멀티캐스트 소스를 Anycast RP에 올바르게 등록할 수 있는지 검증하는 데 필요한 몇 가지 요구 사항이 있습니다.

먼저 Anycast RP가 GDA에 대해 올바르게 구성되었는지 확인합니다.

<#root>

```
Edge-2#
```
show ip pim vrf blue_vn rp 239.0.0.5

```
Group: 239.0.0.5, RP: 10.47.6.1, uptime 1w4d, expires never
```

PIM 레지스터 터널이 구성되었는지 확인합니다.

<#root>

```
Edge-2#
```

show ip pim vrf blue_vn tunnel

```
Tunnel1
Type : PIM Encap
```

RP : 10.47.6.1 <-- This is from "ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1'

Source : 10.47.6.3 <-- This is from ip pim vrf blue_vn register-source Loopback4100

```
State : UP
Last event : Created (1w4d)
```

 Anycast RP에 대한 IP 연결 가능성 확인

<#root>

Edge-2#

show ip cef vrf blue_vn 10.47.6.1

```
10.47.6.1/32
nexthop
```

10.47.1.10

```
 LISP0.4100
```

<-- RLOC of Border-1

```
nexthop
```

10.47.1.11

```
 LISP0.4100
```

<-- RLOC of Border-2

Edge-2#

ping vrf blue_vn 10.47.6.1 source lo4100

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.47.6.1, timeout is 2 seconds:
Packet sent with a source address of 10.47.6.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/3 ms
```

수신자측 확인

- 멀티캐스트 수신기가 IGMP MR을 전송하는지 확인합니다.
- IGMP 스누핑이 활성화되었는지 확인합니다. L2 전용 VN은 IGMP 스누핑이 활성화되지 않은 유일한 VN 유형입니다

- IGMP MR을 삭제하도록 구성된 포트 ACL, VLAN ACL, 라우팅된 포트 ACL이 없는지 확인합니다.
- IGMP MR의 버전을 확인합니다. 기본적으로 멀티캐스트 수신기가 IGMPv3인 경우 "ip igmp version 3"이 필요합니다.
- "ip 옵션 삭제"가 구성되지 않았는지 확인

LHR PIM (*,G) 확인

- LHR이 수신기 서브넷/세그먼트의 PIM DR인지 확인합니다
- 구성된 "ip 멀티캐스트 그룹 범위"가 없는지 확인합니다.
- IGMP MR을 삭제하도록 구성된 포트 ACL, VLAN ACL, 라우팅된 포트 ACL이 없는지 확인합니다.
- IGMP MR을 삭제하는 높은 CPU 또는 CoPP(Control-Plane Policing)가 없는지 확인합니다.

LHR PIM 공유 트리 확인

그룹에 대해 구성된 RP가 있는지 확인합니다

<#root>

Edge-1#

show ip mroute vrf blue_vn 239.0.0.5

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 1w3d/stopped, RP

10.47.6.1

, flags: SJCl

<-- Anycast RP address

Incoming interface: LISP0.4100, RPF nbr 10.47.1.10
Outgoing interface list:
Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:36, flags:

Anycast RP에 대한 RPF가 올바른지 확인합니다.

<#root>

Edge-1#

show ip cef vrf blue_vn 10.47.6.1


```
10.47.6.1/32
nexthop 10.47.1.10 LISP0.4100
nexthop 10.47.1.11 LISP0.4100
```

Edge-1#

show ip rpf vrf blue_vn 10.47.6.1


```
RPF information for (10.47.6.1)
RPF interface: LISP0.4100
RPF neighbor: ? (10.47.1.10)
RPF route/mask: 10.47.6.1/32
RPF type: unicast ()
Doing distance-preferred lookups across tables
Multicast Multipath enabled.
RPF topology: ipv4 multicast base
```

MFIB 전달 - 네이티브 멀티캐스트(오버레이) 소스 측 확인

패킷 전달에 대한 추가 정보를 보려면 "show ip mfib vrf <VN Name> <overlay group address> <unicast source> verbose" 명령을 사용할 수 있습니다.

<#root>

Edge-2#

show ip mfib vrf blue_vn 239.0.0.5 10.47.7.3 verbose


```
Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
VRF blue_vn
```

```
(10.47.7.3,239.0.0.5) Flags: K HW DDE
0x530 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 352467143981268992/0/19/0, Other: 0/0/0
Vlan1025 Flags: RA A MA
LISP0.4100, (
```

10.47.1.13

,

232.0.2.245

) Flags: RF F NS

<-- RLOC of FHR, Underlay Group IP address

CEF: Adjacency with MAC:

450000000000400000001184BC0A2F010DE80002F5000012B5000000000840000000100400BA25CDF4AD38BA25CDF4AD380000

Pkts: 0/0/0 Rate: 0 pps

MFIB 전달 - 네이티브 멀티캐스트(언더레이) 소스 측 확인

"show ip mroute <underlay group address> <RLOC of FHR>"를 사용하여 언더레이 그룹을 봅니다
.

<#root>

Edge-2#

show ip mroute 232.0.2.245 10.47.1.13

```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode
```

(

10.47.1.13

,

232.0.2.245

), 1w4d/00:03:17, flags: sT

<-- RLOC of the FHR, Underlay Group

Incoming interface:

Null0

, RPF nbr 0.0.0.0

<-- Indicates Encapsulation

Outgoing interface list:

GigabitEthernet1/0/1, Forward/Sparse, 00:00:26/00:03:17, flags <-- Where the multicast traffic is forwar

Edge-2#

show ip mfib 232.0.2.245 10.47.1.13 verbo

```
se
Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
Default
(
```

10.47.1.13,232.0.2.245

```
) Flags: K HW
0x348 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding:
```

5268151634814304256

/0/1/0, Other: 0/0/0

Null0

```
 Flags: RA A MA
GigabitEthernet1/0/1 Flags: RF F NS
CEF: Adjacency with MAC: 01005E0002F552540017FE730800
Pkts: 0/0/0 Rate: 0 pps
```

MFIB 포워딩 - 네이티브 멀티캐스트(역캡슐화 후)

멀티캐스트 트래픽이 소스 IP 10.47.1.13과 목적지 주소 232.0.2.245로 캡슐화된 LHR에 도착하면 Null0 발신 인터페이스로 라우팅됩니다. 이 작업은 패킷의 역캡슐화를 트리거합니다.

<#root>

Edge-1#

show ip mroute 232.0.2.245 10.47.1.13

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode
(

10.47.1.13

,

232.0.2.245

), 00:38:22/00:00:37, flags: sT
Incoming interface: GigabitEthernet1/0/2, RPF nbr 10.47.1.4
Outgoing interface list:

Null0

, Forward/Dense, 00:01:12/stopped, flags:

Edge-1#

show ip mfib 232.0.2.245 10.47.1.13 verbose

Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,

```
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
Default
(
```

10.47.1.13,232.0.2.245

```
) Flags: K HW
0x77 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 0/0/0/0, Other: 0/0/0
```

GigabitEthernet1/0/2

```
 Flags: RA A MA
```

Null0, LISPv4 Decap Flags: RF F NS

CEF: OCE (lisp decap)

```
Pkts: 0/0/0 Rate: 0 pps
```

역캡슐화 후 LHR은 VNI 4100 내에서 실제 목적지 IP 주소가 239.0.0.5이며 소스 IP가 10.47.7.3으로 시작됨을 식별합니다

<#root>

Edge-1#

show ip mroute vrf blue_vn 239.0.0.5

```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 1w3d/stopped, RP 10.47.6.1, flags: SJCl
```

```
Incoming interface: LISP0.4100, RPF nbr 10.47.1.10
Outgoing interface list:
Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:01, flags:

(

10.47.7.3

,

239.0.0.5

), 00:01:29/00:01:30, flags: JTl
Incoming interface: LISP0.4100, RPF nbr 10.47.1.13
Outgoing interface list:

Vlan1025

, Forward/Sparse-Dense, 00:01:29/00:02:01, flags:

Edge-1#
```

show ip mfib vrf blue_vn 239.0.0.5 10.47.7.3

```
Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
VRF blue_vn
(
```

10.47.7.3,239.0.0.5

```
) Flags: HW
```

<-- Unicast Source and Overlay Group

```
SW Forwarding: 0/0/0/0, Other: 2/1/1
HW Forwarding: 0/0/0/0, Other: 0/0/0
```

LISP0.4100 Flags: A <-- Incoming Interface

Vlan1025 Flags: F NS <-- Outgoing Interface

```
Pkts: 0/0/0 Rate: 0 pps
```

"show ip igmp snooping groups vlan <VLAN>" 명령을 사용하여 어떤 포트가 멀티캐스트 트래픽을

수신할지 확인합니다.

<#root>

Edge-1#

show ip igmp snooping groups vlan 1025


```
Vlan Group      Type Version Port List
-----------------------------------------------------------------------
1025 239.0.0.5 igmp v2      Gi1/0/5
```


데이터 플레인 확인(플랫폼에 따라 다름)

Mroute 하드웨어 프로그래밍 - IOS mroute

하드웨어 프로그래밍에서는 IOS, FMAN RP, FMAN FP, FED 체인을 사용합니다. "show ip mroute vrf <VN Name> <overlay group address> verbose" 및 "show ip mroute <underlay group address> verbose" 명령을 사용하여 IOS를 먼저 확인합니다.

<#root>

Edge-1#

show ip mroute vrf blue_vn 239.0.0.5 verbose


```
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode
```

(

*, 239.0.0.5

```
), 1w3d/stopped, RP 10.47.6.1, flags: SJCl
Incoming interface: LISP0.4100, RPF nbr 10.47.1.10, LISP: [10.47.1.10, 232.0.2.245]
Outgoing interface list:
```

Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:58, Pkts:0, flags:

(

10.47.7.3, 239.0.0.5

), 00:02:19/00:00:40, flags: JTl
Incoming interface: LISP0.4100, RPF nbr 10.47.1.13, LISP: [10.47.1.13, 232.0.2.245]
Outgoing interface list:
Vlan1025, Forward/Sparse-Dense, 00:02:19/00:02:58, Pkts:0, flags:

언더레이

<#root>

Edge-1#

show ip mroute 232.0.2.245 verbose

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(

10.47.1.13, 232.0.2.245

), 01:18:55/00:02:04, flags: sT
Incoming interface: GigabitEthernet1/0/2, RPF nbr 10.47.1.4
LISP EID ref count: 1, Underlay ref timer: 00:05:13
Outgoing interface list:
Null0, Forward/Dense, 00:01:46/stopped, Pkts:0, flags:
(

10.47.1.10, 232.0.2.245

), 2d06h/00:02:59, flags: sT
Incoming interface: GigabitEthernet1/0/1, RPF nbr 10.47.1.0
LISP EID ref count: 1, Underlay ref timer: 00:05:12
Outgoing interface list:
Null0, Forward/Dense, 2d06h/stopped, Pkts:0, flags:

Mroute 하드웨어 프로그래밍 - IOS MFIB

"show ip mfib vrf <VN Name> <overlay group address> verbose" 및 "show ip mroute <underlay group address> verbose" 명령을 사용하여 오버레이 및 언더레이 MFIB를 확인합니다.

오버레이

<#root>

Edge-1#

show ip mfib vrf blue_vn 239.0.0.5 verbose

```
Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
VRF blue_vn
(
```

*,239.0.0.5

```
) Flags: C K HW
0x6D OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 16218869633044709376/0/0/0, Other: 0/0/0
LISP0.4100 Flags: RA A MA NS
Vlan1025 Flags: RF F NS
CEF: Adjacency with MAC: 01005E00000500000C9FFB870800
Pkts: 0/0/0 Rate: 0 pps
(
```

10.47.7.3,239.0.0.5

```
) Flags: K HW DDE
0x7B OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 2/0/2
HW Forwarding: 0/0/0/0, Other: 0/0/0
LISP0.4100 Flags: RA A MA
Vlan1025 Flags: RF F NS
CEF: Adjacency with MAC: 01005E00000500000C9FFB870800
Pkts: 0/0/0 Rate: 0 pps
```

언더레이

<#root>

Edge-1#

show ip mfib 232.0.2.245 verbose

Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
Default
(

10.47.1.10,232.0.2.245

) Flags: K HW
0x18 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 8384858081233731584/0/0/0, Other: 0/0/0
GigabitEthernet1/0/1 Flags: RA A MA
Null0, LISPv4 Decap Flags: RF F NS
CEF: OCE (lisp decap)
Pkts: 0/0/0 Rate: 0 pps
(

10.47.1.13,232.0.2.245

) Flags: K HW
0x77 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 0/0/0/0, Other: 0/0/0
GigabitEthernet1/0/2 Flags: RA A MA
Null0, LISPv4 Decap Flags: RF F NS
CEF: OCE (lisp decap)
Pkts: 0/0/0 Rate: 0 pps

Mroute 하드웨어 프로그래밍 - FMAN RP

FMAN RP를 검증하려면 먼저 VRF ID를 캡처합니다.

<#root>

Edge-1#

show vrf detail blue_vn | include Id

VRF blue_vn (

```
VRF Id = 2

); default RD <not set>; default VPNID <not set>
```

그런 다음 다음 다음 명령에 VRF 인덱스 값을 사용합니다. 오버레이(*,G)의 유효성을 검사하려면 "show platform software ip switch active r0 mfib vrf index <VRF Index> group <overlay group address>/32" 명령을 사용합니다.

<#root>

Edge-1#

show platform software ip switch active r0 mfib vrf index 2 group 239.0.0.5/32

```
Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
*, 239.0.0.5/32 --> OBJ_INTF_LIST (0x6d)
Obj id: 0x6d, Flags: C
OM handle: 0x348030b738
```

오버레이의 유효성을 검사하려면 "show platform software ip switch active r0 mfib vrf index 2 group address <overlay group address> <unicast source>" 명령을 사용합니다.

<#root>

Edge-1#

show platform software ip switch active r0 mfib vrf index 2 group address 239.0.0.5 10.47.7.3

```
Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
239.0.0.5, 10.47.7.3/64 --> OBJ_INTF_LIST (0x7f)
Obj id: 0x7f, Flags: unknown
OM handle: 0x34803a3800
```

오버레이(*,G)에 대한 언더레이(S,G)의 유효성을 검사하려면 "show platform software ip switch active r0 mfib group address <underlay group address> <RP address>" 명령을 사용합니다.

<#root>

Edge-1#

show platform software ip switch active r0 mfib group address 232.0.2.245 10.47.1.10

```
Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
232.0.2.245, 10.47.1.10/64 --> OBJ_INTF_LIST (0x18)
Obj id: 0x18, Flags: unknown
OM handle: 0x34803b9be8
```

오버레이(S,G)에 대한 언더레이(S,G)의 유효성을 검사하려면 "show platform software ip switch active r0 mfib group address <underlay group address> <RLOC of FHR>" 명령을 사용합니다.

<#root>

Edge-1#

show platform software ip switch active r0 mfib group address 232.0.2.245 10.47.1.13

```
Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
232.0.2.245, 10.47.1.13/64 --> OBJ_INTF_LIST (0x77)
Obj id: 0x77, Flags: unknown
OM handle: 0x348026b988
```

Mroute 하드웨어 프로그래밍 - FMAN FP

오버레이(*,G)의 유효성을 검사하려면 "show platform software ip switch active f0 mfib vrf index <VRF ID> group <overlay group address>" 명령을 사용합니다.

<#root>

Edge-1#

show platform software software ip switch active f0 mfib vrf index 2 group 239.0.0.5/32

```
Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
*, 239.0.0.5/32 --> OBJ_INTF_LIST (0x6d)
Obj id: 0x6d, Flags: C
aom id:
```

100880

```
, HW handle: (nil) (created)
```

오버레이의 유효성을 검사하려면 "show platform software ip switch active f0 mfib vrf index <VRF

ID> group address <overlay group address> <unicast source>" 명령을 사용합니다.

<#root>

Edge-1#

show platform software ip switch active f0 mfib vrf index 2 group address 239.0.0.5 10.47.7.3

```
Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
239.0.0.5, 10.47.7.3/64 --> OBJ_INTF_LIST (0x8f)
Obj id: 0x8f, Flags: unknown
aom id:
```

161855

```
, HW handle: (nil) (created)
```

오버레이(*,G)에 대한 언더레이(S,G)의 유효성을 검사하려면 ""show platform software ip switch active f0 mfib group address <underlay group address> <RP address>" 명령을 사용합니다.

<#root>

Edge-1#

show platform ip switch active f0 mfib group address 232.0.2.245 10.47.1.10

```
Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
232.0.2.245, 10.47.1.10/64 --> OBJ_INTF_LIST (0x18)
Obj id: 0x18, Flags: unknown
aom id:
```

138716

```
, HW handle: (nil) (created)
```

오버레이(S,G)에 대한 언더레이(S,G)의 유효성을 검사하려면 "show platform software ip switch active f0 mfib group address <underlay group address> <RLOC of FHR>" 명령을 사용합니다.

<#root>

Edge-1#

show platform software ip switch active f0 mfib group address 232.0.2.245 10.47.1.13

```
Route flags:
```

```
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route
232.0.2.245, 10.47.1.13/64 --> OBJ_INTF_LIST (0x5)
Obj id: 0x5, Flags: unknown
aom id:
```

161559

```
, HW handle: (nil) (created)
```

Mroute 하드웨어 프로그래밍 - FMAN FP 데이터베이스

FMAN FP 객체의 유효성을 검사하려면 "show platform software object-manager switch active f0 object <object ID> parents" 명령을 사용합니다.

예를 들어, 오버레이의 유효성을 검사하려면(*,G)

<#root>

```
Edge-1#
```

show platform software object-manager switch active f0 object 100880 parents

```
Object identifier: 100605
Description: ipv4_mcast table 2 (
```

blue_vn

```
), vrf id 2
Status: Done
Object identifier: 100878
Description:
```

mlist 109

```
Status: Done
```

오버레이의 유효성을 검사하려면(S,G)

<#root>

```
Edge-1#
```

show platform software object-manager switch active f0 object 161855 parents

```
Object identifier: 100605
Description: ipv4_mcast table 2 (blue_vn), vrf id 2
Status: Done
Object identifier: 161854
Description:
```

mlist 143

```
Status: Done
```

mlist는 IIF(Incoming Interface)와 OIL(Outgoing Interface List)의 조합으로 mroute에서 다른 object로 구분됩니다. mlist의 유효성을 검사하려면 "show platform software mlist switch active f0 index <index>" 명령을 사용합니다.

<#root>

Edge-1#

show platform software mlist switch active f0 index 109

```
Multicast List entries
OCE Flags:
NS - Negate Signalling; IC - Internal copy;
A - Accept; F - Forward;
OCE Type OCE Flags Interface
------------------------------------------------------------------------------
0xf8000171 OBJ_ADJACENCY NS, A LISP0.4100
```

<-- Incoming Interface for (*,G)

```
0xf80001f1 OBJ_ADJACENCY NS, F Vlan1025
```

<-- Outgoing Interface for (S,G)

<#root>

Edge-1#

show platform software mlist switch active f0 index 143

```
Multicast List entries
OCE Flags:
NS - Negate Signalling; IC - Internal copy;
A - Accept; F - Forward;
OCE Type OCE Flags Interface
------------------------------------------------------------------------------
0xf8000171 OBJ_ADJACENCY A LISP0.4100
```

<-- Outgoing Interface for (S,G)

```
0xf80001f1 OBJ_ADJACENCY NS, F Vlan1025
```

<-- Incoming Interface for (S,G)

Mroute 하드웨어 프로그래밍 - FED

오버레이의 유효성을 검사하려면 "show platform software fed switch active ip mfib vrf <VN Name>

<overlay group address> <Unicast Source>" 명령을 사용합니다.

<#root>

Edge-1#

show platform software fed switch active ip mfib vrf blue_vn 239.0.0.5 10.47.7.3

```
Multicast (S,G) Information
VRF : 2
Source Address : 10.47.7.3
HTM Handler : 0x7f0efe53a638
SI Handler : 0x7f0efe50ec68
DI Handler :
```

0x7f0efe530768

```
REP RI handler : 0x7f0efe5387e8
Flags :
Packet count : 0
State : 4
RPF :
LISP0.4100 A
OIF :
Vlan1025 F NS
LISP0.4100 A
(Adj: 0xf8000171 )
```

언더레이(S,G)의 유효성을 검사하려면 "show platform software fed switch active ip mfib <underlay group address> <RLOC of FHR>" 명령을 사용합니다.

<#root>

Edge-1#

show platform software fed switch active ip mfib 232.0.2.245 10.47.1.13

```
Multicast (S,G) Information
VRF : 0
Source Address : 10.47.1.13
HTM Handler : 0x7f0efe512408
SI Handler : 0x7f0efe5158f8
DI Handler :
```

0x7f0efe525538

```
REP RI handler : 0x7f0efe52ca18
Flags :
Packet count : 0
State : 4
RPF :
GigabitEthernet1/0/2 A
OIF :
LISP0 LISP Decap F NS
```

```
GigabitEthernet1/0/2 A
```

다음으로, 오버레이 및 언더레이(S,G) 모두에 대해 DI(Destination Index)를 검증합니다. "show platform hardware fed switch active fwd-asic abstraction print-resource-handle <DI Handler> 1" 명령을 사용할 수 있습니다.

오버레이(S,G)

<#root>

Edge-1#

show platform hardware fed switch active fwd-asic abs print-resource-handle 0x7f0efe512408 1

```
Handle:0x7f0efe530768 Res-Type:ASIC_RSC_DI Res-Switch-Num:255 Asic-Num:255 Feature-ID:AL_FID_L3_MULTICA
priv_ri/priv_si Handle: (nil)Hardware Indices/Handles: index0:0x5279 mtu_index/l3u_ri_index0:0x0 index1
Cookie length: 56
00 00 00 00 00 00 00 00 02 00 00 00 03 07 2f 0a 05 00 00 ef 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Detailed Resource Information (ASIC_INSTANCE# 0)
----------------------------------------
Destination index = 0x5279
pmap = 0x00000000 0x00000010
```

pmap_intf : [GigabitEthernet1/0/5] <-- From IGMP Snooping

```
cmi = 0x0
rcp_pmap = 0x0
al_rsc_cmi
CPU Map Index (CMI) [0]
ctiLo0 = 0
ctiLo1 = 0
ctiLo2 = 0
cpuQNum0 = 0
cpuQNum1 = 0
cpuQNum2 = 0
npuIndex = 0
stripSeg = 0
copySeg = 0
Detailed Resource Information (ASIC_INSTANCE# 1)
----------------------------------------
Destination index = 0x5279
pmap = 0x00000000 0x00000000
cmi = 0x0
rcp_pmap = 0x0
al_rsc_cmi
CPU Map Index (CMI) [0]
ctiLo0 = 0
ctiLo1 = 0
ctiLo2 = 0
cpuQNum0 = 0
cpuQNum1 = 0
cpuQNum2 = 0
npuIndex = 0
stripSeg = 0
copySeg = 0
============================================================
```

언더레이(S,G)

<#root>

Edge-1#

show platform hardware fed switch active fwd-asic abs print-resource-handle 0x7f0efe525538 1

```
Handle:0x7f0efe525538 Res-Type:ASIC_RSC_DI Res-Switch-Num:255 Asic-Num:255 Feature-ID:AL_FID_L3_MULTICA
00 00 00 00 00 00 00 00 00 00 00 00 0d 01 2f 0a f5 02 00 e8 00 00 00 00 00 00 00 00 00 00 00 00 00 00 0
Detailed Resource Information (ASIC_INSTANCE# 0)
----------------------------------------
Destination index = 0x5284
```

pmap = 0x00000000 0x00000000 <-- Expected since this is the Underlay, and recirculation is required to s

```
cmi = 0x0
```

rcp_pmap = 0x1 <-- Indicates recirculation is required

```
al_rsc_cmi
CPU Map Index (CMI) [0]
ctiLo0 = 0
ctiLo1 = 0
ctiLo2 = 0
cpuQNum0 = 0
cpuQNum1 = 0
cpuQNum2 = 0
npuIndex = 0
stripSeg = 0
copySeg = 0
Detailed Resource Information (ASIC_INSTANCE# 1)
----------------------------------------
Destination index = 0x5284
pmap = 0x00000000 0x00000000
cmi = 0x0
rcp_pmap = 0x0
al_rsc_cmi
CPU Map Index (CMI) [0]
ctiLo0 = 0
ctiLo1 = 0
ctiLo2 = 0
cpuQNum0 = 0
cpuQNum1 = 0
cpuQNum2 = 0
npuIndex = 0
stripSeg = 0
copySeg = 0
============================================================
```