

SD 액세스 패브릭에서 헤드 엔드 복제 확인

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소개

이 문서에서는 SDA(SD-Access) 패브릭에서 HeadEnd 복제 문제를 해결하는 방법에 대해 설명합니다.

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) 스페스 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 다음과 같은 하드웨어 및 소프트웨어 버전에서도 사용할 수 있습니다.

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

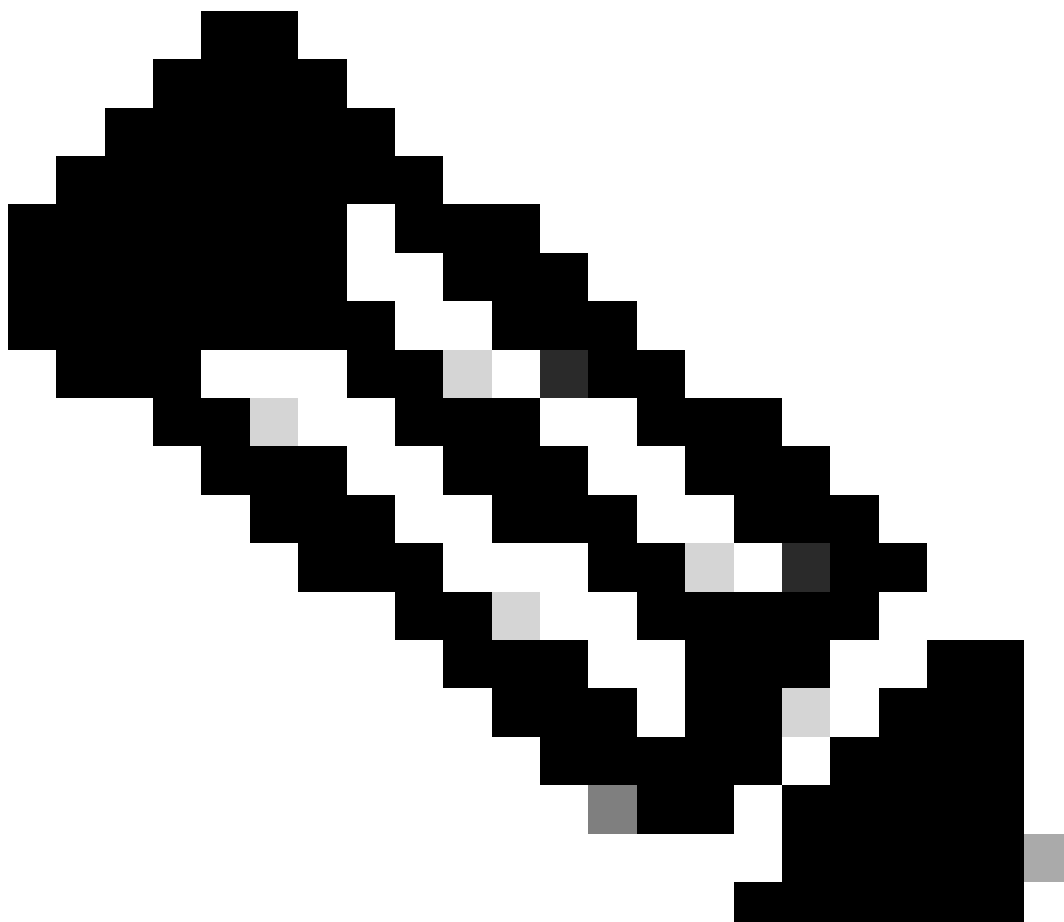
배경 정보

SDA Headend Replication은 오버레이 멀티캐스트의 한 형태로, 패브릭 디바이스 간에 멀티캐스트 트래픽을 전달하면서 유니캐스트 IP 헤더에 멀티캐스트 트래픽을 캡슐화하는 데 사용됩니다. 헤드 엔드 복제는 동일한 VLAN 또는 다른 VLAN(동일한 VLAN 멀티캐스트를 라우팅할 수 있음)에 있는 소스와 수신기 간에 멀티캐스트 트래픽을 라우팅할 수 있습니다.

동일한 패브릭 에지에 있는 소스와 수신기 간의 멀티캐스트 트래픽은 오버레이 멀티캐스트(VXLAN 캡슐화)를 사용하여 전달되지 않으며 패브릭 에지에 의해 로컬로 라우팅됩니다.

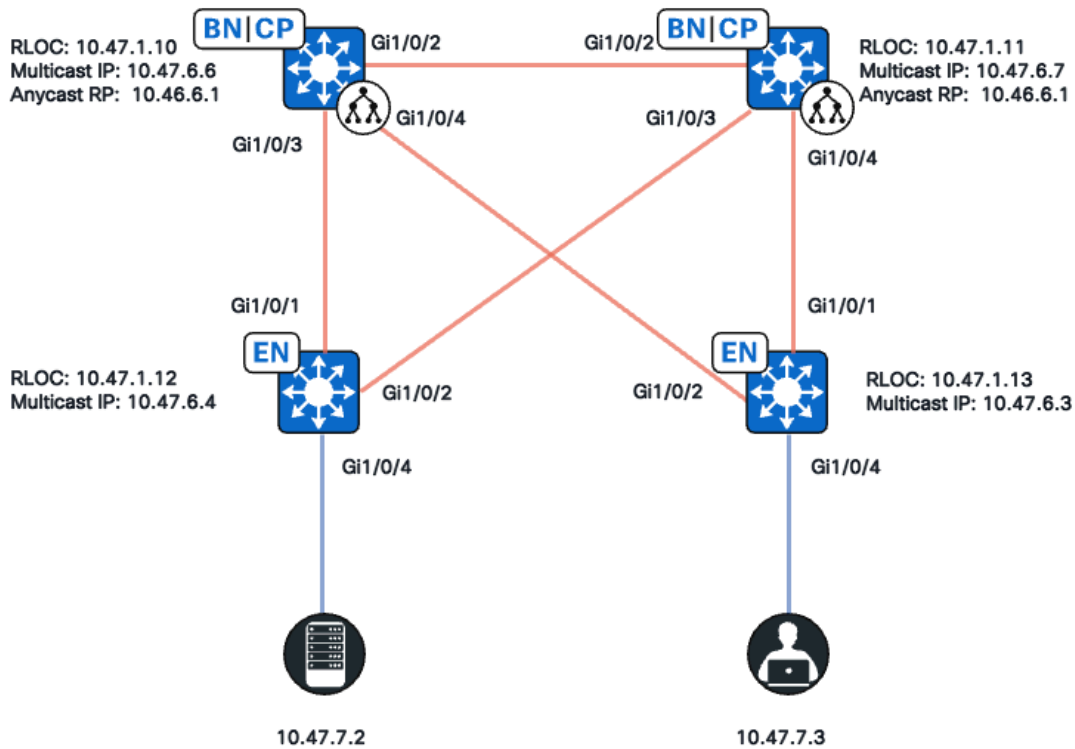
모든 형태의 오버레이 멀티캐스트(헤드엔드 또는 네이티브)는 224.0.0.0/24 범위의 그룹에 대한 멀티캐스트 트래픽을 라우팅할 수 없거나 TTL=1이면 레이어 2 플러딩을 통해 처리됩니다.

참고: 독자가 메모해야 함을 의미합니다. 참고에는 유용한 제안이나 문서에서 다루지 않는 자료에 대한 참조가 포함되어 있습니다.



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

- 10.47.10 및 10.47.1.11은 가상 네트워크(VN)/VRF에서 둘 사이의 MSDP(Multicast Source Discovery Protocol)를 통해 RP(Anycast Rendezvous Point)로도 기능하는 공동 경계입니다.
- 10.47.1.12 및 10.47.1.13은 패브릭 에지 노드입니다.
- 10.47.7.2는 멀티캐스트 소스입니다.
- 10.47.7.3은 멀티캐스트 수신기입니다.
- 239.1.1.1은 멀티캐스트 GDA(Group Destination Address)

설정

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

- 복제 구현이 헤드엔드 복제임
- 배치된 경계의 ASM(Any Source Multicast) 멀티캐스트에 대한 MSDP가 있는 Anycast RP

Catalyst Center에서 성공적으로 구성하면 디바이스당 관련 컨피그레이션에는 다음과 같은 몇 가지 섹션이 포함됩니다.

패브릭 에지(10.47.1.12) 구성

```
ip multicast-routing vrf blue_vn
ip multicast vrf blue_vn multipath
!
interface LISP0.4100
vrf forwarding blue_vn
ip pim sparse-mode
end
!
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.4 255.255.255.255
ip pim sparse-mode
end
!
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
!
interface Vlan1025
description Configured from Cisco DNA-Center
mac-address 0000.0c9f.fb87
vrf forwarding blue_vn
ip address 10.47.7.1 255.255.255.0
ip helper-address 10.47.9.9
no ip redirects
ip pim passive
ip route-cache same-interface
ip igmp version 3
ip igmp explicit-tracking
no lisp mobility liveness test
lisp mobility blue-IPV4
end
!
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
10 permit 239.0.0.0 0.255.255.255
```

패브릭 에지(10.47.1.13) 구성

```
ip multicast-routing vrf blue_vn
ip multicast vrf blue_vn multipath
!
interface LISP0.4100
vrf forwarding blue_vn
ip pim sparse-mode
end
!
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.4 255.255.255.255
ip pim sparse-mode
end
!
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
!
interface Vlan1025
```

```
description Configured from Cisco DNA-Center
mac-address 0000.0c9f.fb87
vrf forwarding blue_vn
ip address 10.47.7.1 255.255.255.0
ip helper-address 10.47.9.9
no ip redirects
ip pim passive
ip route-cache same-interface
ip igmp version 3
ip igmp explicit-tracking
no lisp mobility liveness test
lisp mobility blue-IPV4
end
!
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
10 permit 239.0.0.0 0.255.255.255
```

배치된 보더/애니캐스트 RP(10.47.1.10) 구성

```
router bgp 69420
address-family ipv4 vrf blue_vn
aggregate-address 10.47.6.0 255.255.255.0 summary-only
!
router lisp
site site_uci
eid-record instance-id 4100 10.47.6.0/24 accept-more-specifics
!
ip multicast-routing vrf blue_vn
ip multicast vrf blue_vn multipath
!
interface LISP0.4100
vrf forwarding blue_vn
ip pim sparse-mode
end
!
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.1 255.255.255.255
ip pim sparse-mode
end
!
interface Loopback4600
vrf forwarding blue_vn
ip address 10.47.6.6 255.255.255.255
ip pim sparse-mode
end
!
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 access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
10 permit 239.0.0.0 0.255.255.255
!
ip msdp vrf blue_vn peer 10.47.6.7 connect-source Loopback4600
ip msdp vrf blue_vn cache-sa-state
ip msdp vrf blue_vn originator-id Loopback4600
```

배치된 보더/애니캐스트 RP(10.47.1.11) 구성

```
router bgp 69420
address-family ipv4 vrf blue_vn
aggregate-address 10.47.6.0 255.255.255.0 summary-only
!
router lisp
site site_uci
eid-record instance-id 4100 10.47.6.0/24 accept-more-specifics
!
ip multicast-routing vrf blue_vn
ip multicast vrf blue_vn multipath
!
interface LISPO.4100
vrf forwarding blue_vn
ip pim sparse-mode
end
!
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.1 255.255.255.255
ip pim sparse-mode
end
!
interface Loopback4600
vrf forwarding blue_vn
ip address 10.47.6.7 255.255.255.255
ip pim sparse-mode
end
!
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 access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
10 permit 239.0.0.0 0.255.255.255
!
ip msdp vrf blue_vn peer 10.47.6.6 connect-source Loopback4600
ip msdp vrf blue_vn cache-sa-state
ip msdp vrf blue_vn originator-id Loopback4600
```

컨트롤 플레인 확인

다음으로 IGMP(Internet Group Membership Protocol) 및 PIM을 확인합니다.

멀티캐스트 수신자가 IGMP 멤버십 보고서 전송

멀티캐스트 수신기(10.47.7.3)는 IGMP MR(Membership Report) 또는 IGMP Join을 전송하여 멀티캐스트 트래픽 수신에 대한 관심을 나타냅니다. 수신된 IGMP MR이 있는지 확인하기 위해 EPC(Embedded Packet Capture)를 구성할 수 있습니다.

<#root>

Edge-2#

```
monitor capture 1 interface GigabitEthernet1/0/5 IN
```

Edge-2#

```
monitor capture 1 match any
```

Edge-2#

```
monitor capture 1 buffer size 10
```

Edge-2#

```
monitor capture 1 start
```

Edge-2#

```
monitor capture 1 stop
```

Edge-1#

```
show monitor capture 1 buff display-filter igmp brief
```

```
Starting the packet display ..... Press Ctrl + Shift + 6 to exit
145 63.730527 10.47.7.4 -> 239.1.1.1 IGMPv2 60 Membership Report group 239.1.1.1
```

그런 다음 패브릭 에지가 멀티캐스트 수신기가 있는 VLAN의 PIM DR(Designated Router)인지 확인합니다. 이를 LHR(Last Hop Router)이라고도 합니다. "show ip pim vrf <VN Name> interface vlan <vlan> detail" 명령을 사용할 수 있습니다 | include PIM DR"

<#root>

Edge-2#

```
show ip pim vrf blue_vn interface vlan 1025 detail | i PIM DR
```

```
PIM DR: 10.47.7.1 (this system)
```

IGMP 스누핑이 "show ip igmp vrf <VN Name> snooping group" 명령을 사용하여 IGMP MR을 선택했는지 확인합니다.

<#root>

Edge-1#

```
show ip igmp vrf blue_vn snooping groups
```

```
Vlan Group          Type Version Port List
-----
1025 239.255.255.254 igmp v2      Gi1/0/5
```

PIM Sparse-Mode 공유 트리 생성

Edge-2는 해당 세그먼트의 DR로서 Anycast RP를 향해 (*,G) PIM Join을 전송합니다. Anycast RP 주소가 LISP 맵 캐시에서 확인되지 않으면 LISP EID 감시 프로세스가 LISP 맵 요청을 트리거합니다. "show lisp instance-id <LISP L3 IID> ipv4/ipv6 eid-watch" 명령을 사용할 수 있습니다 | rloc 시작"

```
<#root>
```

```
Edge-2#
```

```
show lisp instance-id 4100 ipv4 eid-watch | begin RLOC
```

```
LISP IPv4 EID Watches for Table (RLOC mapping in vrf blue_vn IPv4) IID (4100), 1 watch entries
Watch entries for prefix 10.47.6.1/32
```

```
10.47.6.1
```

```
,
```

```
multicast
```

```
Edge-2#
```

```
show lisp instance-id 4100 ipv4 map-cache 10.47.6.1
```

```
LISP IPv4 Mapping Cache for LISP 0 EID-table vrf blue_vn (IID 4100), 1 entries
```

```
10.47.6.1/32, uptime: 9w1d, expires: 20:19:57, via map-reply, complete
```

```
Sources: map-reply
```

```
State: complete, last modified: 9w1d, map-source: 10.47.1.10
```

```
Active, Packets out: 577721(21849998 bytes), counters are not accurate (~ 00:00:12 ago)
```

```
Locator Uptime State Pri/Wgt Encap-IID
```

```
10.47.1.10
```

```
9w1d up 10/10 -
```

```
Last up-down state change: 1w1d, state change count: 3
```

```
Last route reachability change: 9w1d, state change count: 1
```

```
Last priority / weight change: never/never
```

```
RLOC-probing loc-status algorithm:
```

```
Last RLOC-probe sent: 1w1d (rtt 272ms)
```

```
10.47.1.11
```

```
9w1d up 10/10 -
```

```
Last up-down state change: 9w1d, state change count: 1
```

```
Last route reachability change: 9w1d, state change count: 1
```

Last priority / weight change: never/never
RLOC-probing loc-status algorithm:
Last RLOC-probe sent: 1w1d (rtt 602ms)

Edge-2#

```
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
```

"show ip mroute vrf <VN Name> <multicast group>" 명령을 사용하여 Edge-2에서 (*,G) 항목을 검증합니다.

<#root>

Edge-2#

```
show ip mroute vrf blue_vn 239.1.1.1
```

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 - encaps-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
(* , 239.1.1.1), 4d05h/00:02:12, RP

10.47.6.1

, flags: SC

<-- Anycast RP IP address 10.47.6.1

Incoming interface: LISP0.4100, RPF nbr

```
10.47.1.10 <-- Reverse Path Forwarding (RPF) neighbor to get to the Anycast RP IP
```

```
Outgoing interface list:
```

```
vlan1025
```

```
, Forward/Sparse-Dense, 4d05h/00:02:12, flags:
```

```
<-- Outgoing interface list (OIL) is populated via PIM Join or IGMP Membership Report
```

오버레이의 PIM 네이버

RLOC(Routing Locator)로 표시되고 LISP 인터페이스를 통해 연결할 수 있는 RPF 인접 디바이스는 VRF/VN에서 PIM 인접 디바이스로 추가됩니다.

몇 가지 주의 사항:

- PIM(*,G) 조인을 전송하는 데 사용되는 RPF 검사는 2분 만료 타이머를 사용하여 PIM 네이버 생성을 트리거합니다. 2분 동안 PIM 참여 메시지를 보내지 않으면 네이버가 시간 초과됩니다.
- PIM Hello 메시지가 SDA 오버레이에서 전송되지 않으므로 PIM은 해당 RLOC에 대한 인접 디바이스 구조를 명시적으로 생성해야 합니다

```
<#root>
```

```
Edge-2#
```

```
show ip pim vrf blue_vn neighbor
```

```
PIM Neighbor Table
```

```
Mode: B - Bidir Capable, DR - Designated Router, N - Default DR Priority,
```

```
P - Proxy Capable, S - State Refresh Capable, G - GenID Capable,
```

```
L - DR Load-balancing Capable
```

```
Neighbor    Interface Uptime/Expires Ver DR
```

```
Address                               Prio/Mode
```

```
10.47.1.10 LISP0.4100 4d23h/00:01:37 v2  0 /
```

Anycast RP에서 (*,G) 생성

Edge-2에서 수신한 PIM(*,G) 조인을 기반으로 Border-1은 Edge-2의 RLOC에 OIL을 사용하여 (*,G)를 생성합니다

```
<#root>
```

```
Border-1#
```

```
show ip mroute vrf blue_vn 239.1.1.1
```

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
(* , 239.1.1.1), 4d23h/00:02:48, RP 10.47.6.1, flags: S
Incoming interface: Null, RPF nbr 0.0.0.0
Outgoing interface list:

LISP0.4100

,

10.47.1.13

, Forward/Sparse, 4d23h/00:02:33, flags:

<-- RLOC of Edge-2

멀티캐스트 소스 등록

멀티캐스트 소스 10.47.7.2는 Edge-1을 인그레스하는 멀티캐스트 트래픽을 전송합니다. Edge-1은 패킷을 CPU에 전달하여 (S,G) 상태를 만들고 Edge-1은 소스를 Anycast RP에 등록합니다.

```
<#root>
```

```
Edge-1#
```

```
monitor capture 1 interface GigabitEthernet1/0/4 IN
```

```
Edge-1#
```

```
monitor capture 1 match any
```

```
Edge-1#
```

```
monitor capture 1 buffer size 10
```

```
Edge-1#
```

```
monitor capture 1 start
```

```
Edge-1#
```

```
monitor capture 1 stop
```

```
Edge-1#
```

```
show monitor capture 1 buffer brief
```

```
Starting the packet display ..... Press Ctrl + Shift + 6 to exit
```

```
1 0.000000 10.47.7.2 -> 239.1.1.1 ICMP 98 Echo (ping) request id=0x0007, seq=107/27392, ttl=5
2 0.355071 10.47.7.3 -> 239.1.1.1 ICMP 98 Echo (ping) request id=0x0007, seq=107/27392, ttl=5
3 1.096757 10.47.7.3 -> 239.1.1.1 ICMP 98 Echo (ping) request id=0x0007, seq=108/27648, ttl=5
4 1.102425 10.47.7.3 -> 239.1.1.1 ICMP 98 Echo (ping) request id=0x0007, seq=108/27648, ttl=5
```

Border-1이 PIM 등록을 통해 멀티캐스트 패킷을 수신하면 Border-1에는 (S,G)가 있으며 이를 MSDP를 통해 Border-2에 광고합니다

```
<#root>
```

```
Border-1#
```

```
show ip mroute vrf blue_vn 239.1.1.1 10.47.7.2
```

```
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 - encaps-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
(10.47.7.2, 239.1.1.1), 00:02:26/00:00:34, flags: T
```

```
A <-- A flag indicates that this is a candidate for MSDP advertisement
```

```
Incoming interface: LISP0.4100, RPF nbr 10.47.1.12
```

```
Outgoing interface list:
```

```
LISP0.4100, 10.47.1.13, Forward/Sparse, 00:02:26/00:02:36, flags:
```

MSDP 소스 광고

"show ip msdp vrf <VN name> sa-cache" 명령을 사용하여 소스 활성 캐시를 확인합니다.
"show ip msdp vrf <VN name> summary" 명령을 사용하여 MSDP 피어를 볼 수 있습니다

<#root>

Border-1#

```
show ip msdp vrf blue_vn sa-cache
```

MSDP Source-Active Cache - 1 entries

(10.47.7.2, 239.1.1.1), RP 10.47.6.7, BGP/AS 23456, 00:00:34/00:05:25, Peer 10.47.6.7

Border-1#

```
show ip msdp vrf blue_vn summary
```

MSDP Peer Status Summary

Peer Address	AS	State	Uptime/ Downtime	Reset Count	SA Count	Peer Name
--------------	----	-------	---------------------	----------------	-------------	-----------

10.47.6.7

23456

Up

1w1d	0	1				
------	---	---	--	--	--	--

Border-2는 MSDP 공지를 통해 Border-1로부터 (S,G) 정보를 수신합니다. Border-2가 Edge-2에서 PIM(*,G) 조인을 받은 경우 Border-2는 (S,G) 항목을 만들고 Edge-2의 RLOC를 가리키는 (*,G)에서 LISP OIL을 상속합니다. 일반적으로 MSDP SA 항목은 (*,G)가 있는 경우에만 MRIB(Multicast Routing Information Base)에 설치됩니다.

<#root>

Border-2#

```
show ip msdp vrf blue_vn sa-cache
```

MSDP Source-Active Cache - 1 entries

(10.47.7.2, 239.1.1.1), RP 10.47.6.6, BGP/AS 23456, 00:13:59/00:03:28, Peer 10.47.6.6

Border-2#

```
show ip mroute vrf blue_vn 239.1.1.1
```

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
(*, 239.1.1.1), 00:21:04/00:00:06, RP 10.47.6.1, flags: SP
Incoming interface: Null, RPF nbr 0.0.0.0
```

```
Outgoing interface list: Null <-- Indicates no PIM (*,G) Join received, if there was an OIL, then
```

Border-1은 PIM(S,G)을 소스 10.47.7.2로 전송하여 멀티캐스트 트래픽을 기본적으로 끌어들입니다. 그러면 Edge-1이 (S,G) OIL을 업데이트할 수 있습니다

```
<#root>
```

```
Edge-1#
```

```
show ip mroute vrf blue_vn 239.1.1.1 10.47.7.3
```

```
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
(10.47.7.2, 239.1.1.1), 01:19:57/00:02:29, flags: FT
Incoming interface:
```

```
vlan1025
```

```
, RPF nbr 0.0.0.0
```

```
<-- Multicast source 10.47.7.2 is in VLAN 1025
```

```
Outgoing interface list:
```

```
LISP0.4100,
```

```
10.47.1.10
```

```
, Forward/Sparse, 01:19:55/00:02:30, flags:
```

```
<-- RLOC of Border-1
```

10.47.7.2에서 239.1.1.1로의 멀티캐스트 트래픽은 유니캐스트 VXLAN 캡슐화를 통해 10.47.6.6(Border-1) 외부로 전달됩니다. Border-1은 VXLAN 트래픽을 캡슐화하고 Edge-2(10.47.1.13)에 다시 캡슐화합니다.

```
<#root>
```

```
Border-1#
```

```
show ip mroute vrf blue_vn 239.1.1.1
```

```
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 - encaps-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
```

```
(*, 239.1.1.1), 5d01h/00:03:14, RP 10.47.6.1, flags: S
```

```
Incoming interface: Null, RPF nbr 0.0.0.0
```

```
Outgoing interface list:
```

```
LISP0.4100, 10.47.1.13, Forward/Sparse, 5d01h/00:02:54, flags:
```

```
(
```

```
10.47.7.2
```

```
, 239.1.1.1), 00:02:28/00:00:30, flags: MT
```

```
<-- Unicast Source
```

```
Incoming interface: LISP0.4100, RPF nbr
```

10.47.1.12

<-- RPF neighbor to get to the source (Edge-1)

Outgoing interface list:
LISP0.4100,

10.47.1.13

, Forward/Sparse, 00:02:28/00:03:14, flags:

<-- RLOC of Edge-2

SPT(Shortest Path Tree) 컷오버

LHR(Last Hop Router) Edge-2가 (*,G) 트리를 따라 멀티캐스트 패킷을 수신하면 SPT 컷오버를 수행하고 Edge-1에 PIM(S,G) 조인을 보냅니다.

<#root>

Edge-2#

show ip mroute vrf blue_vn 239.1.1.1

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

(* , 239.1.1.1), 4d23h/stopped, RP 10.47.6.1, flags: SJC

Incoming interface: LISP0.4100, RPF nbr 10.47.1.10

Outgoing interface list:

vlan1025

, Forward/Sparse-Dense, 4d23h/00:02:40, flags:

<-- LHR creates the OIL because of receipt of an IGMP MR

(

10.47.7.2

, 239.1.1.1), 00:00:02/00:02:57, flags: JT

<-- Unicast Source

Incoming interface: LISP0.4100, RPF nbr

10.47.1.12

<-- RPF neighbor to get to 10.47.7.2, which is Edge-1 RLOC

Outgoing interface list:

vlan1025

, Forward/Sparse-Dense, 00:00:02/00:02:57, flags:

<-- Multicast traffic is forwarded into VLAN 1025, where 10.47.7.3 is

FHR(Edge-1)에는 Edge-2의 RLOC를 직접 가리키는 (S,G)가 있습니다.

<#root>

Edge-1#

show ip mroute vrf blue_vn 239.1.1.1

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

(*, 239.1.1.1), 5d01h/stopped, RP 10.47.6.1, flags: SCF

Incoming interface: LISP0.4100, RPF nbr 10.47.1.10

Outgoing interface list:

Vlan1025, Forward/Sparse-Dense, 5d01h/00:01:40, flags:

(

10.47.7.2

, 239.1.1.1), 01:53:06/00:02:42, flags: FT

<-- Unicast Source

Incoming interface: Vlan1025, RPF nbr 0.0.0.0

Outgoing interface list:

LISP0.4100,

10.47.1.13

, Forward/Sparse, 00:14:22/00:03:07, flags:

<-- Edge-2's RLOC

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.

소스 측 확인

멀티캐스트 소스와 (S,G) 생성을 위한 FHR 기능을 검증하려면 SISF(Switch Integrated Security Feature), LISP, CEF(Cisco Express Forwarding), RPF를 검증합니다.

멀티캐스트 소스는 나머지 LISP, CEF 및 궁극적으로 RPF를 구동하는 SISF/IP Device-Tracking(IPDT)에 있어야 합니다.

"show device-tracking database address <IP address>" 명령을 사용하여 멀티캐스트 소스에 유효한 IPDT 항목이 있는지 확인할 수 있습니다.

<#root>

Edge-1#

show device-tracking database address 10.47.7.2

Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DH4 - IP
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 10.47.7.2 5254.0012.521d Gi1/0/4 1025 0024 163s REACHABLE 81 s try 0(8428

그런 다음 FHR의 LISP 데이터베이스에 멀티캐스트 소스에 대한 항목이 있는지 확인합니다. "show lisp instance-id <LISP L3 IID> ipv4 database ip address/32" 명령을 사용합니다.

<#root>

Edge-1#

```
show lisp instance-id 4100 ipv4 database 10.47.7.2/32
```

```
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-b
Uptime: 1w2d, Last-change: 1w2d
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 1w2d Yes 0
10.47.1.11 1w2d Yes 0
```

Edge-1#

```
show ip lisp instance-id 4100 forwarding eid local 10.47.7.2
```

Prefix

10.47.7.2/32

CEF는 LISP를 기반으로 항목을 만듭니다. CEF는 LISP가 아닌 /32 호스트 항목을 가리킵니다.

<#root>

Edge-1#

```
show ip cef vrf blue_vn 10.47.7.2
```

```
10.47.7.2/32
nexthop 10.47.7.2 Vlan1025
```

다음으로, RPF는 CEF에서 파생됩니다.

<#root>

Edge-1#

```
show ip rpf vrf blue_vn 10.47.7.2
```

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

```
10.47.7.2
```

```
) - directly connected
RPF route/mask: 10.47.7.2/32
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 않으며, 이로 인해 CEF 및 RPF가 테두리를 가리킵니다. 멀티캐스트 소스가 잘못된 인터페이스로 트래픽 RPF 포인트를 보내 RPF 실패가 발생하는 경우 (S,G)가 형성되지 않습니다.

```
<#root>
```

```
Edge-1#
```

```
show device-tracking database address 10.47.7.2
```

```
Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DH4 - I
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-1#
```

```
show lisp instance-id 4100 ipv4 database 10.47.7.2/32
```

```
% No database-mapping entry for 10.47.7.2/32.
```

```
Edge-1#
```

```
show ip cef vrf blue_vn 10.47.7.2
```

```
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-1#

```
show ip rpf vrf blue_vn 10.47.7.2
```

```
RPF information for (10.47.7.2)
```

```
RPF interface:
```

```
LISP0.4100
```

```
RPF neighbor: ? (
```

```
10.47.1.11
```

```
)
```

```
RPF route/mask: 10.47.7.2/32
```

```
RPF type: unicast ( )
```

```
Doing distance-preferred lookups across tables
```

```
Multicast Multipath enabled.
```

```
RPF topology: ipv4 multicast base
```

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

소스 등록

PIM 등록은 다른 유니캐스트 패킷과 마찬가지로 LISP/VXLAN을 사용하는 유니캐스트 패킷 흐름입니다. FHR이 멀티캐스트 소스를 Anycast RP에 올바르게 등록할 수 있는지 검증하기 위해 몇 가지 필수 검사가 있습니다.

먼저 Anycast RP가 GDA에 대해 올바르게 구성되었는지 확인합니다.

```
<#root>
```

```
Edge-1#
```

```
show ip pim vrf blue_vn rp 239.1.1.1
```

```
Group: 239.1.1.1, RP: 10.47.6.1, uptime 5d22h, expires never
```

PIM 레지스터 터널이 구성되었는지 확인합니다.

```
<#root>
```

```
Edge-1#
```

```
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 :

10.47.6.4 <-- This is from "ip pim vrf blue_vn register-source Loopback4100"

State : UP

Last event : Created (1w2d)

Anycast RP에 대한 IP 연결 보장

<#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

<-- RLOC of Border-1

nexthop

10.47.1.11

LISP0.4100

<-- RLOC of Border-2

Edge-1#

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 10.47.6.4

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 257/275/294 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
- "ip multicast group-range"가 구성되지 않았는지 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

RP가 멀티캐스트 그룹에 대해 구성되었는지 확인합니다

```
<#root>
```

```
Edge-2#
```

```
show ip mroute vrf blue_vn 239.1.1.1
```

```
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
```

```
(*, 239.1.1.1), 6d01h/stopped,
```

```
RP 10.47.6.1
```

```
, flags: SCF
```

```
Incoming interface: LISP0.4100, RPF nbr 10.47.1.10
```

Outgoing interface list:
Vlan1025, Forward/Sparse-Dense, 6d01h/00:01:34, flags:

Anycast RP에 대한 RPF가 올바른지 확인합니다.

<#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  
nexthop 10.47.1.11 LISP0.4100
```

Edge-2#

```
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 - 소스 측 확인

"show ip mfib vrf <VN Name> <multicast group> <unicast source> verbose" 명령을 사용하여 패킷 전달에 대한 추가 정보를 얻을 수 있습니다

<#root>

Edge-1#

```
show ip mfib vrf blue_vn 239.1.1.1 10.47.7.2 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
(10.47.7.2,239.1.1.1) Flags: K HW DDE
0x42 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 272/272/0
HW Forwarding: 7431223059161284608/0/0/0, Other: 0/0/0
Vlan1025 Flags: RA A MA NS
LISP0.4100,

10.47.1.13

Flags: RF F NS

<-- RLOC of Edge-2

CEF: Adjacency with MAC: 4500000000004000001164770A2F010D0A2F010C000012B5000000000840000000100400

Pkts: 0/0/0 Rate: 0 pps

Edge-1#

show adjacency lisp0.4100

Protocol Interface Address
IP LISP0.4100 10.47.1.10(23)
IP LISP0.4100 10.47.1.11(27)
IP LISP0.4100

10.47.1.13

(8)

Edge-2#

show adjacency lisp0.4100 10.47.1.13 detail

Protocol Interface Address
IP LISP0.4100

10.47.1.13

(8)

0 packets, 0 bytes
epoch 0
sourced in sev-epoch 14
Encap length 50
4500000000004000001164770A2F010D
0A2F010C000012B50000000008400000
00100400BA25CDF4AD3852540017FE73
0000
L2 destination address byte offset 0
L2 destination address byte length 0
Link-type after encap: ip
LISP
Next chain element:

```
IP adj out of GigabitEthernet1/0/1
, addr 10.47.1.6
```

EPC를 사용하여 멀티캐스트 패킷의 VXLAN 캡슐화를 검증할 수 있습니다

```
<#root>
```

```
Edge-1#monitor capture 1 interface GigabitEthernet1/0/4 IN
Edge-1#monitor capture 1 interface GigabitEthernet1/0/1 OUT
Edge-1#monitor capture 1 match any
Edge-1#monitor capture 1 buffer size 10
Edge-1#monitor capture 1 limit pps 1000
Edge-1#monitor capture 1 start
Edge-1#monitor capture 1 stop
```

```
Edge-1#
```

```
show monitor capture 1 buffer brief
```

```
Starting the packet display ..... Press Ctrl + Shift + 6 to exit
```

```
1 0.000000 10.47.7.2 -> 239.1.1.1 ICMP 98 Echo (ping) request id=0x0008, seq=28213/13678,
ttl=5 <-- Packet as it ingresses the FHR, TTL is 5
```

```
2 0.014254 10.47.7.2 -> 239.1.1.1 ICMP 148 Echo (ping) request id=0x0008, seq=28213/13678,
ttl=4 <-- Packet as it leaves the FHR, TTL is 4 as is it decremented
```

MFIB 전달 - 수신자측 확인

언더레이 네트워크는 유니캐스트 라우팅을 사용하여 이 패킷을 Edge-1에서 Edge-2로 라우팅합니다.

```
<#root>
```

```
Edge-2#
```

```
show ip mroute vrf blue_vn 239.1.1.1 10.47.7.2
```

```
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
(

10.47.7.2

,

239.1.1.1

), 00:01:39/00:01:20, flags: JT
Incoming interface: LISPO.4100, RPF nbr

10.47.1.12

Outgoing interface list:

Vlan1025

, Forward/Sparse-Dense, 00:01:39/00:02:45, flags:

"show ip mfib vrf <VN Name> <group address> <unicast source> counters" 명령을 사용하면 하드웨어 포워딩 카운터가 늘어납니다

<#root>

Edge-2#

show ip mfib vrf blue_vn 239.1.1.1 counters

Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kilobits per second

Other counts: Total/RPF failed/Other drops(OIF-null, rate-limit etc)

VRF blue_vn

12 routes, 7 (*,G)s, 4 (*,G/m)s

Group: 239.1.1.1

RP-tree,

SW Forwarding: 0/0/0/0, Other: 0/0/0

HW Forwarding: 0/0/2/0, Other: 0/0/0

Source: 10.47.7.2,

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

HW Forwarding:

6118996613340856320

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

Totals - Source count: 1, Packet count:

6118996613340856320

Edge-2#

```
show ip igmp snooping groups vlan 1025 239.1.1.1
```

```
Vlan Group      Type Version Port List
```

```
-----  
1025 239.1.1.1 igmp v2      Gi1/0/4
```

이그레스(egress) 멀티캐스트 카운터를 사용하여 멀티캐스트 트래픽이 LHR에서 멀티캐스트 수신기로 이동했는지 여부를 확인할 수 있습니다. "show controllers ethernet-controller <interface> 명령을 사용합니다. | include Multicast|Transmit"

<#root>

Edge-2#

```
show controllers ethernet-controller g1/0/4 | include Multicast|Transmit  
Transmit
```

GigabitEthernet1/0/5

Receive

426729240 Total bytes

100803109 Total bytes

5732 Unicast frames

949355 Unicast frames

5732 Unicast bytes

93563018 Unicast bytes

4388433

Multicast frames

32346 Multicast frames

4388433

Multicast bytes

7236178 Multicast bytes

<snip>

Edge-2#

```
show controllers ethernet-controller g1/0/5 | include |Multicast|Transmit
```

Transmit

GigabitEthernet1/0/5

Receive

426742895 Total bytes

100813570 Total bytes

5733 Unicast frames

949456 Unicast frames

5733 Unicast bytes

93573016 Unicast bytes

4388569

Multicast frames

32348 Multicast frames

4388569

Multicast bytes

7236641 Multicast bytes

LHR에서 나가는 멀티캐스트 트래픽을 검증하는 또 다른 방법은 멀티캐스트 수신자를 향해 EPC를 수행하는 것입니다.

<#root>

Edge-2#

show monitor capture 1 buffer brief

Starting the packet display Press Ctrl + Shift + 6 to exit

1 0.168401 10.47.7.2 -> 239.1.1.1 ICMP 106 Echo (ping) request id=0x0008, seq=35903/16268, ttl=3
2 0.969138 10.47.7.2 -> 239.1.1.1 ICMP 106 Echo (ping) request id=0x0008, seq=35904/16524, ttl=3

데이터 플레인 확인(플랫폼에 따라 다름)

(S,G) 생성 - CPU 펀트 경로

FHR이 (S,G) 상태를 생성하기 위해, 멀티캐스트 소스에서 전송된 멀티캐스트 패킷 중 몇 개가 MFIB에 의해 처리될 CPU까지 펀팅됩니다. 멀티캐스트 패킷은 FED 큐 "CPU_Q_MCAST_DATA"로 전송됩니다.

<#root>

Edge-1#

show platform software fed switch active punt cpuq 30

Punt CPU Q Statistics

=====

CPU Q Id : 30

CPU Q Name : CPU_Q_MCAST_DATA

Packets received from ASIC : 27124

Send to IOSd total attempts : 27124

Send to IOSd failed count : 0

RX suspend count : 0

RX unsuspend count : 0

RX unsuspend send count : 0

```
RX unsuspend send failed count : 0
RX consumed count : 0
RX dropped count : 0
RX non-active dropped count : 0
RX conversion failure dropped : 0
RX INTACK count : 0
RX packets dq'd after intack : 0
Active RxQ event : 0
RX spurious interrupt : 0
RX phy_idb fetch failed: 0
RX table_id fetch failed: 0
RX invalid punt cause: 0
```

Replenish Stats for all rxq:

```
-----
Number of replenish : 0
Number of replenish suspend : 0
Number of replenish un-suspend : 0
-----
```

또한 MCAST 데이터에 대한 CoPP 큐는 손실되지 않아야 합니다. "show platform hardware fed active qos queue stats internal cpu policer" 명령을 사용합니다 | 포함 MCAST 데이터 |QId"

<#root>

Edge-1#

```
show platform hardware fed active qos queue stats internal cpu policer | include MCAST Data|QId
```

QId	PlcIdx	Queue Name	Enabled	Rate	Rate
30	9	MCAST Data	No	500	400

트래픽이 직접 연결된 소스에서 오는 경우, Linux LSMPI(Shared Memory Punt Interface) 대기열에서 "직접 연결된 소스"에 대해 처리하며, (S,G) 조인에서 오는 경우 "Mcast PIM Signaling"입니다.

"show platform software infrastructure lsmipi punt" 명령을 사용합니다 | 원인 포함|Mcast"

<#root>

Edge-1#

```
show platform software infrastructure lsmipi punt | include Cause|Mcast
```

Cause	Total	Total	Length	Dot1q encap	Other
Mcast Directly Connected Source	0				
	27038				

	0	0	0	0	0	0	0
Mcast IPv4 Options data packet	0	0	0	0	0	0	0
Mcast Internal Copy	0	0	0	0	0	0	0
Mcast IGMP Unroutable	0	0	0	0	0	0	0
Mcast PIM signaling							
	0	0	0	0	0	0	0
Mcast punt to RP	0	0	0	0	0	0	0
Mcast UDLR	0	0	0	0	0	0	0

다음으로, FED Punject 패킷 캡처를 수행하여 CPU의 소스 및 그룹 이온에서 멀티캐스트 패킷을 확인할 수 있습니다. 그러면 수신 인터페이스 및 CPU 대기열이 확인됩니다.

```
<#root>
```

```
Edge-1#
```

```
debug platform software fed switch active punt packet-capture set-filter "ip.addr==239.1.1.1"
```

```
Edge-1#
```

```
debug platform software fed switch active punt packet-capture start
```

```
Edge-1#
```

```
debug platform software fed switch active punt packet-capture stop
```

```
Punt packet capturing stopped. Captured 2 packet(s)
```

```
Edge-1#
```

```
show platform software fed switch active punt packet-capture brief
```

```
Punt packet capturing: disabled. Buffer wrapping: disabled
Total captured so far: 2 packets. Capture capacity : 4096 packets
Capture filter : "ip.addr==239.255.255.254"
----- Punt Packet Number: 1, Timestamp: 2024/08/26 15:38:27.341 -----
interface : physical:

GigabitEthernet1/0/4

[if-id: 0x0000000c], pa1:

Vlan1025

[if-id: 0x0000001d]
metadata : cause: 12 [

Mcast Directly Connected Source

], sub-cause: 0, q-no: 30, linktype: MCP_LINK_TYPE_IP [1]
ether hdr : dest mac: 0100.5e7f.ffffe, src mac: 5254.0012.521d
ether hdr : ethertype: 0x0800 (IPv4)
ipv4 hdr : dest ip:

239.1.1.1,
```

```
src ip: 10.47.7.2
ipv4 hdr : packet len: 84, ttl: 5, protocol: 1 (ICMP)
icmp hdr : icmp type: 8, code: 0
```

Mroute 하드웨어 프로그래밍 - IOS Mroute

(S,G)의 하드웨어 프로그래밍은 다른 프로그래밍 경로와 동일한 구조를 사용합니다. IOS-FMAN RP-FMAN FP, FED.

```
<#root>
```

```
Edge-1#
```

```
show ip mroute vrf blue_vn 239.1.1.1
```

```
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
```

```
(*, 239.255.255.254), 00:08:29/stopped, RP
```

```
10.47.6.1
```

```
, flags: SCF
```

```
<-- Anycast RP address
```

```
Incoming interface: LISP0.4100, RPF nbr
```

```
10.47.1.10 <-- RLOC of Border-1
```

```
Outgoing interface list:
```

```
Vlan1025, Forward/Sparse-Dense, 00:08:29/00:00:30, flags:
```

```
(
```

```
10.47.7.2
```

```

,
239.1.1.1
), 00:08:28/00:02:54, flags: FT
<-- Unicast source

Incoming interface:
Vlan1025
, RPF nbr 0.0.0.0
<-- Multicast source is in VLAN 1025

Outgoing interface list:
LISP0.4100
,
10.47.1.13
, Forward/Sparse, 00:08:23/00:03:07, flags:
<-- Forwarding to Edge-2

```

Mroute 하드웨어 프로그래밍 - IOS MFIB

그런 다음 멀티캐스트 경로가 MFIB(Multicast Forwarding Information Base)에 추가됩니다. 이는 RIB(Routing Information Base)가 CEF(Cisco Express Forwarding)에 추가되는 것과 비슷하며, 멀티캐스트에 해당하는 경로는 MFIB입니다.

```
<#root>
```

```
Edge-1#
```

```
show ip mfib vrf blue_vn 239.1.1.1 10.47.7.2 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
(

```

10.47.7.2,239.1.1.1

) Flags: K HW DDE

<-- Multicast source and GDA

0x21 OIF-IC count: 0, OIF-A count: 1

SW Forwarding: 0/0/0/0, Other: 2/2/0

HW Forwarding: 0/0/0/0, Other: 0/0/0

Vlan1025 Flags: RA A MA NS

LISP0.4100, 10.47.1.13

Flags: RF F NS

<-- RLOC of Edge-2 and the RPF interface to reach 10.47.1.13

CEF: Adjacency with MAC: 4500000000004000001164770A2F010D0A2F010C000012B5000000000840000000100400

Pkts: 0/0/0 Rate: 0 pps

Mroute 하드웨어 프로그래밍 - RP MFIB

"show platform software ip switch active r0 mfib vrf index <VRF index> group <GDA/32>"
명령을 사용합니다.

<#root>

Edge-1#

show vrf detail blue_vn | inc Id

VRF blue_vn (

VRF Id = 2

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

Edge-1#

show platform software ip switch active r0 mfib vrf index 2 group 239.1.1.1/32

Route flags:

S - Signal; C - Directly connected;

IA - Inherit A Flag; L - Local;

BR - Bidir route

*,

239.1.1.1/32

--> OBJ_INTF_LIST (0x6b)

Obj id:

0x6b

, Flags: C

OM handle: 0x34803c47f0

Edge-2#

```
show platform software ip switch active r0 mfib vrf index 2 group address 239.1.1.1 10.47.7.2
```

Route flags:

S - Signal; C - Directly connected;

IA - Inherit A Flag; L - Local;

BR - Bidir route

239.1.1.1, 10.47.7.2/64

--> OBJ_INTF_LIST (0x21)

Obj id:

0x21

, Flags: unknown

OM handle: 0x34803c4088

Mroute 하드웨어 프로그래밍 - FP MFIB

동일한 경로에 대한 FMAN RP 항목에는 AOM(Asynchronous Object Manager) ID가 포함되어 있으며, 이 AOM ID는 추가 프로그래밍을 검증하는 데 사용됩니다.

"show platform software ip switch active f0 mfib vrf index <VRF Index> group <GDA/32>" 명령을 사용합니다.

<#root>

Edge-1#

```
show platform software ip switch active f0 mfib vrf index 2 group 239.1.1.1/32
```

Route flags:

S - Signal; C - Directly connected;

IA - Inherit A Flag; L - Local;

BR - Bidir route

*,

239.1.1.1/32

--> OBJ_INTF_LIST (0x6b)

Obj id:

0x6b

, Flags: C

aom id:

29154

, HW handle: (nil) (created)

Edge-1#

```
show platform software ip switch active f0 mfib vrf index 2 group address 239.1.1.1 10.47.7.2
```

Route flags:
S - Signal; C - Directly connected;
IA - Inherit A Flag; L - Local;
BR - Bidir route

239.1.1.1., 10.47.7.2/64

--> OBJ_INTF_LIST (0x21)

Obj id:

0x21

, Flags: unknown

aom id:

36933

, HW handle: (nil) (created)

Mroute 하드웨어 프로그래밍 - Mroute 개체

AOM ID를 사용하는 경우 object-manager 명령을 사용하여 (*,G) 및 (S,G) 둘 다에 대한 개체 및 상위 개체를 확인합니다. "show platform software object-manager switch active f0 object <AOM ID>" 또는 "show platform software object-manager switch active f0 object <AOM ID> parents" 명령을 사용할 수 있습니다.

각 경로에는 두 개의 상위 객체가 있습니다. 개체 중 하나는 ipv4_mcast 테이블을 참조하고 다른 하나는 mlist이며, 이는 후속 명령에서 사용됩니다.

<#root>

Edge-1#

```
show platform software object-manager switch active f0 object 29154
```

Object identifier: 29154

Description:

PREFIX 0.0.0.0 , 239.1.1.1/32

(Table id 2)

Obj type id: 72

Obj type:

mroute-pfx

Status:

Done

, Epoch: 0, Client data: 0xa3e23c48

Edge-1#

```
show platform software object-manager switch active f0 object 29154 parents
```

Object identifier: 26509

Description:

ipv4_mcast table 2 (blue_vn

), vrf id 2

Status: Done

Object identifier: 29153

Description:

mlist 107

Status:

Done

Edge-1#

show platform software object-manager switch active f0 object 36933

Object identifier: 36933

Description:

PREFIX 10.47.7.2 , 239.1.1.164

(Table id 2)

Obj type id: 72

Obj type:

mroute-pfx

Status:

Done

, Epoch: 0, Client data: 0xa413c928

Edge-1#

show platform software object-manager switch active f0 object 36933 parents

Object identifier: 26509

Description: ipv4_mcast table 2 (blue_vn), vrf id 2

Status:

Done

Object identifier: 47695

Description:

mlist 33

Status:

Done

Mroute 하드웨어 프로그래밍 - Mlist 개체

MLIST 객체는 Incoming Interface 및 Outgoing Interface List의 조합입니다. "show platform software mlist switch active f0 index <index>" 명령을 사용할 수 있습니다.

```
<#root>
```

```
This is for (*,G)
```

```
Edge-1#
```

```
show platform software mlist switch active f0 index 107
```

```
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
```

```
<-- A Flag indicates an Incoming interface for (*,G)
```

```
0xf80001d1  OBJ_ADJACENCY      NS,
```

```
  F
```

```
      Vlan1025
```

```
<-- F Flag indicates an Outgoing interface for (*,G)
```

```
This is for (S,G)
```

```
Edge-1#
```

```
show platform software mlist switch active f0 index 33
```

```
Multicast List entries
```

```
OCE Flags:
```

```
NS - Negate Signalling; IC - Internal copy;
```

```
A - Accept; F - Forward;
```

```
OCE      Type                OCE Flags  Interface
```

```
-----  
0x5c      OBJ_ADJACENCY      NS,
```

```
  F
```

```
      LISP0.4100
```

```
<-- F Flag indicates an Outgoing interface(s), for (S,G)
```

0xf80001d1 OBJ_ADJACENCY

A

Vlan1025

<-- A Flag indicates an Incoming interface, for (S,G)

Mroute 하드웨어 프로그래밍 - FED Mroute

FED 프로그래밍의 유효성을 검사하려면 "show platform software fed switch active ip mfib vrf <VN Name> <GDA> <unicast source>" 명령을 사용합니다.

<#root>

Edge-1#

```
show platform software fed switch active ip mfib vrf blue_vn 239.1.1.1 10.47.7.2
```

Multicast (S,G) Information

VRF : 2

Source Address : 10.47.7.2

HTM Handler : 0x7f45d98c7728

SI Handler : 0x7f45d9a44a28

DI Handler : 0x7f45d9bcb2d8

REP RI handler : 0x7f45d97e7188

Flags :

Packet count : 0

State : 4

RPF :

Vlan1025 A

OIF :

Vlan1025 A

LISPO.4100 F NS

(Adj: 0x5c)

Rewrite Index는 Headend Replication에서 활용하는 멀티캐스트 트래픽의 캡슐화에 대한 정보를 제공합니다. "show platform hardware fed switch active fwd-asic abstraction print-resource-handle <REP RI Handle> 1" 명령을 사용할 수 있습니다.

<#root>

Edge-1#

```
show platform hardware fed switch active fwd-asic abstraction print-resource-handle 0x7f45d97e7188
```

```
Handle:0x7f45d97e7188 Res-Type:ASIC_RSC_RI_REP Res-Switch-Num:255 Asic-Num:255 Feature-ID:AL_FID
```

```
priv_r/priv_si Handle: (nil)Hardware Indices/Handles: index0:0x19 mtu_index/13u_ri_index0:0x0 in
Cookie length: 56
00 00 00 00 00 00 00 00 02 00 00 00 03 07 2f 0a fe ff ff ef 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Detailed Resource Information (ASIC_INSTANCE# 0)
-----
Replication list RI handle = 7f45d97e7188
~~~~~
ASIC [0] Replication Expansion Handle [0x7f45d9b9c048]
Replication list :
Number of RIs = 6
Start RI = 25
Common rewrite = No
Replication REP_RI 0x19 [elements = 1]
[0] ri_list[0]=4 RI_MCAST_BRIDGE_V6 port=88 ri_ref_count:1 dirty=0
RIL first:4 last:4 start:4 ril_total:4 ref_count:0
RI list this:4 num_pairs:4 free:3 next:0 prev:0 ---->
uri1:

50

    ri_ref_count_1:1 uri0:

26

    ri_ref_count_0:1 ptr_type:0 last:1 dirty:1
uri1:

49151

    ri_ref_count_1:0 uri0:49151 ri_ref_count_0:1 ptr_type:1 last:1 dirty:1
uri1:49151 ri_ref_count_1:0 uri0:49151 ri_ref_count_0:0 ptr_type:1 last:1 dirty:0
uri1:49151 ri_ref_count_1:0 uri0:49151 ri_ref_count_0:0 ptr_type:1 last:1 dirty:0
<snip>
```

다음으로 URI 값을 사용하여 rewrite-index 범위를 확인합니다. "show platform hardware fed switch active fwd-asic resource ASIC all rewrite-index range <URI> <URI>" 명령을 사용합니다.

```
<#root>
```

```
Edge-1#
```

```
show platform hardware fed switch active fwd-asic resource ASIC all rewrite-index range 50 50
```

```
ASIC#:0
```

```
RI:50
```

```
  Rewrite_type:AL_RRM_REWRITE_IPV4_VXLAN_INNER_IPV4_ENCAP(110) Mapped_rii:LVX_L3_ENCAP_L2_PAYLOAD
```

```
  Dst Mac: MAC Addr: ba:25:cd:f4:ad:38,
```

```
  Src IP: 10.47.1.12 <-- RLOC of Edge-1
```

```
  Dst IP: 10.47.1.13 <--
```

```
    RLOC of Edge-2
```

```
IPv4 TTL: 0
LISP INSTANCEID: 0
L3IF LE Index: 49
ASIC#:1
```

```
RI:50
```

```
Rewrite_type:AL_RRM_REWRITE_IPV4_VXLAN_INNER_IPV4_ENCAP(110) Mapped_rii:LVX_L3_ENCAP_L2_PAYLOAD
Dst Mac: MAC Addr: ba:25:cd:f4:ad:38,
```

```
Src IP: 10.47.1.12 <-- RLOC of Edge-1
```

```
Dst IP: 10.47.1.13 <-- RLOC of Edge-2
```

```
IPv4 TTL: 0
LISP INSTANCEID: 0
L3IF LE Index: 49
```

그런 다음 추가 확인을 위해 이전 명령에서 RI를 가져옵니다. "show platform software fed switch active ip mfib vrf <VN Name> <GDA> <source>" 명령을 사용합니다.

```
<#root>
```

```
Edge-1#
```

```
show platform software fed switch active ip mfib vrf blue_vn 239.1.1.1 10.47.7.2
```

```
Multicast (S,G) Information
VRF : 2
Source Address : 10.47.7.2
HTM Handler : 0x7f45d98c7728
SI Handler : 0x7f45d9a44a28
DI Handler : 0x7f45d9bcb2d8
REP RI handler : 0x7f45d97e7188
Flags :
Packet count : 0
State : 4
RPF :
Vlan1025 A
OIF :
Vlan1025 A
LISP0.4100 F NS

(Adj: 0x5c )
```

"show platform software fed switch active ip adj" 명령을 사용합니다 | <destination RLOC>" 포함

```
<#root>
```

Edge-1#

```
show platform software fed switch active ip adj 10.47.1.12
```

```
IPV4 Adj entries
```

dest	if_name	dst_mac	si_hdl	ri_hdl	pd_flags	adj_id	Last-modified
10.47.1.12	LISP0.4100	4500.0000.0000	0x7f45d9a4a5e8	0x7f45d9a4a798	0x60		

```
0x5c
```

```
2024/08/21 16:18:58.948
```

```
<-- 0x5c matches the Adj in the previous command
```

LHR에서 멀티캐스트 패킷이 어디로 전달되는지 확인하기 위해 대상 인덱스를 검증할 수 있습니다. 이는 멀티캐스트 수신기입니다. "show platform software fed switch active ip mfib vrf <VN Name> <GDA> <source>" 명령을 사용할 수 있습니다.

```
<#root>
```

```
Edge-2#
```

```
show platform software fed switch active ip mfib vrf blue_vn 239.1.1.1 10.47.7.2
```

```
Multicast (S,G) Information
```

```
VRF : 2
```

```
Source Address : 10.47.7.2
```

```
HTM Handler : 0x7f0efdad33a8
```

```
SI Handler : 0x7f0efdad2648
```

```
DI Handler : 0x7f0efdad7668
```

```
REP RI handler : 0x7f0efdad4858
```

```
Flags :
```

```
Packet count : 0
```

```
State : 4
```

```
RPF :
```

```
LISP0.4100 A
```

```
OIF :
```

```
Vlan1025 F NS
```

```
LISP0.4100 A
```

```
(Adj: 0xf8000171 )
```

DI Handler를 가져와서 "show platform hardware fed switch active fwd-asic abstraction print-resource-handle <DI handle> 1" 명령에 사용합니다.

```
<#root>
```

```
Edge-2#
```

show platform hardware fed switch active fwd-asic abstraction print-resource-handle 0x7f0efdad7668

Handle:0x7f0efdad7668 Res-Type:ASIC_RSC_DI Res-Switch-Num:255 Asic-Num:255 Feature-ID:AL_FID_L3_M
priv_ri/priv_si Handle: (nil)Hardware Indices/Handles: index0:0x527c mtu_index/13u_ri_index0:0x0
Cookie length: 56

00 00 00 00 00 00 00 00 02 00 00 00 03 07 2f 0a fe ff ff ef 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Detailed Resource Information (ASIC_INSTANCE# 0)

Destination index = 0x527c

pmap = 0x00000000 0x00000010

pmap_intf : [GigabitEthernet1/0/4]

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 = 0x527c

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

=====

이 번역에 관하여

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