Verificar a replicação de head-end na malha de acesso SD

Contents

Introdução

Este documento descreve como solucionar problemas de Replicação de HeadEnd na estrutura

SD-Access (SDA).

Pré-requisitos

Requisitos

A Cisco recomenda que você tenha conhecimento destes tópicos:

- Encaminhamento de Internet Protocol (IP)
- Protocolo de separação de localizador/ID (LISP)
- Protocol Independent Multicast (PIM) Modo escasso

Componentes Utilizados

- C9000v no Cisco IOS® XE 17.10.1
- Cisco Catalyst Center versão 2.3.5.3

As informações neste documento foram criadas a partir de dispositivos em um ambiente de laboratório específico. Todos os dispositivos utilizados neste documento foram iniciados com uma configuração (padrão) inicial. Se a rede estiver ativa, certifique-se de que você entenda o impacto potencial de qualquer comando.

Este documento também pode ser usado com as seguintes versões de hardware e software:

- C9200
- C9300
- C9400
- C9500
- C9600
- Cisco IOS® XE 16.12 e posterior

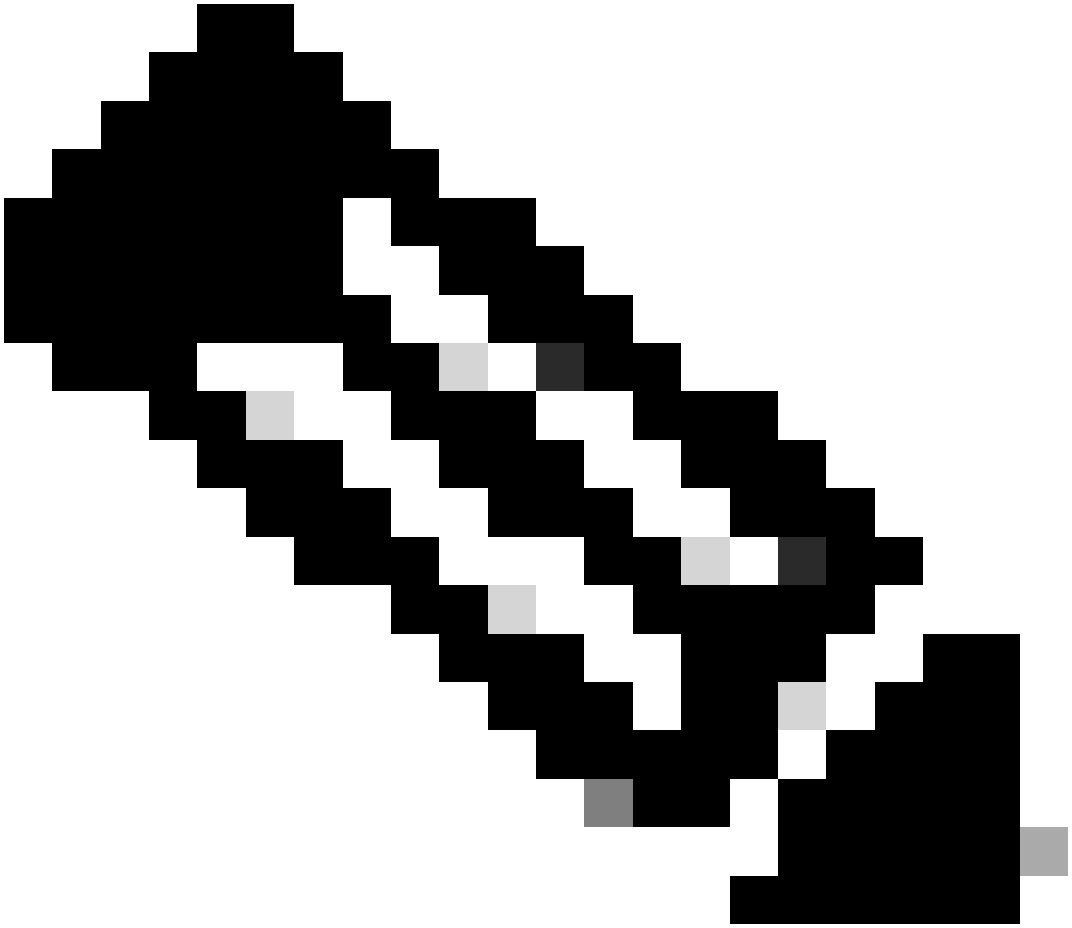
Informações de Apoio

A Replicação de SDA Headend é uma forma de multicast de sobreposição, que é usada para transportar o tráfego de multicast entre os dispositivos de estrutura, encapsulando o tráfego de multicast em um cabeçalho IP unicast. A replicação de headend pode rotear tráfego multicast entre origem(ns) e receptor(es) na mesma VLAN ou em uma VLAN diferente (o mesmo multicast de VLAN pode ser roteado).

O tráfego multicast entre origens e receptores na mesma Borda de estrutura não é encaminhado usando multicast de sobreposição (encapsulamento VXLAN), mas é roteado localmente pela Borda de estrutura.

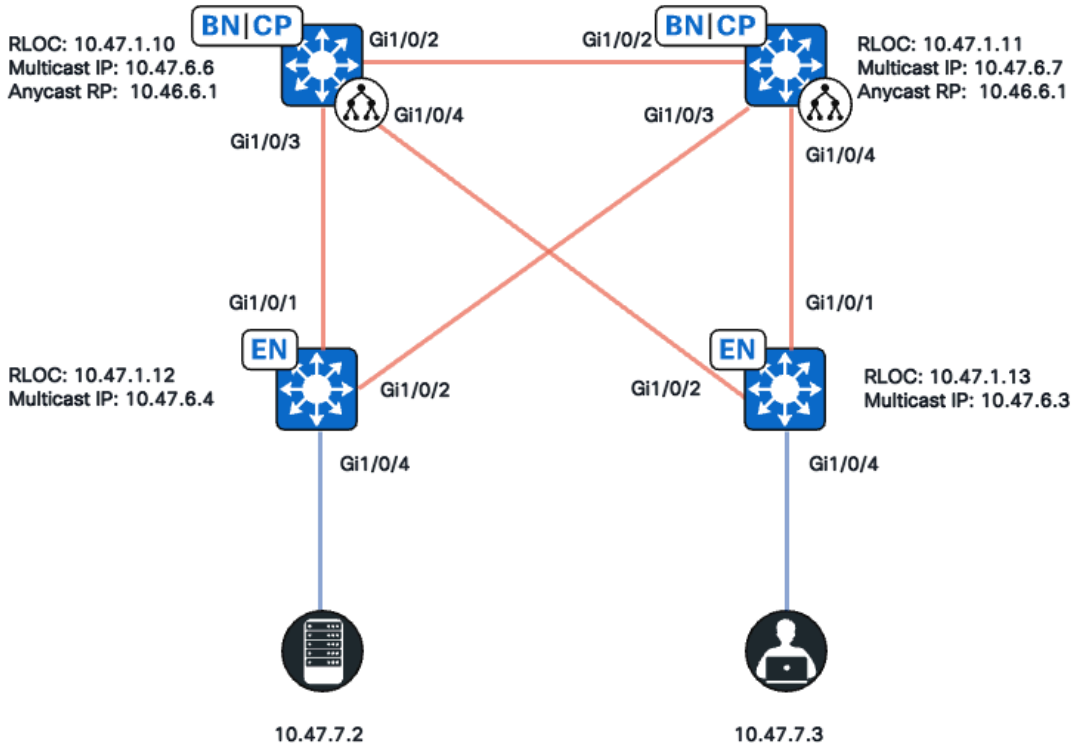
Qualquer forma de multicast de sobreposição (headend ou nativo) não pode rotear o tráfego de multicast para grupos no intervalo 224.0.0.0/24, ou com TTL=1, isso é tratado através da inundação de Camada 2

Nota: Significa que o leitor deve tomar nota. As notas contêm sugestões úteis ou referências a materiais não abordados no documento.



Nota:Os comandos de plataforma (feed) podem variar. O comando pode ser "show platform fed <ative|standby>" versus "show platform fed switch <ative|standby>". Se a sintaxe anotada nos exemplos não for analisada, tente a variante.

Topologia



Topologia de rede

Nesta topologia:

- 10.47.10 e 10.47.1.11 são Bordas Agrupadas que também funcionam como Ponto de Encontro Anycast (RP - Anycast Rendezvous Point) com Protocolo de Descoberta de Origem Multicast (MSDP - Multicast Source Discovery Protocol) entre os dois na Rede Virtual (VN - Virtual Network)/VRF.
- 10.47.1.12 e 10.47.1.13 são nós de borda de malha
- 10.47.7.2 é a origem multicast
- 10.47.7.3 é o receptor multicast
- 239.1.1.1 é o GDA (Group Destination Address, endereço de destino de grupo) multicast

Configuração

Supõe-se que o Cisco Catalyst Center seja usado para provisionar a estrutura SDA com as configurações padrão:

- Implementação de replicação é replicação de headend
- RP Anycast com MSDP para multicast Any Source Multicast (ASM) nas bordas colocalizadas

Após a configuração bem-sucedida do Catalyst Center, a configuração relevante por dispositivo contém várias seções:

Configuração da borda da estrutura (10.47.1.12)

```
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
```

Configuração da borda da estrutura (10.47.1.13)

```
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
```

Configuração de RP (10.47.1.10) de borda/anycast colocado

```
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
```

Configuração de RP (10.47.1.11) de borda/anycast colocado

```
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 10.47.6.7 255.255.255.255
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
```

Verificação do plano de controle

Em seguida, verifique o Internet Group Membership Protocol (IGMP) e o PIM.

O receptor multicast envia o relatório de associação IGMP

O receptor multicast (10.47.7.3) envia um Relatório de Associação IGMP (MR) ou Ingresso IGMP para indicar o interesse em receber tráfego multicast. Você pode

configurar um EPC (Embedded Packet Capture) para confirmar se há um MR IGMP recebido:

<#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 exi
145 63.730527 10.47.7.4 -> 239.1.1.1 IGMPv2 60 Membership Report group 239.1.1.1
```

Em seguida, verifique se Fabric Edge é o roteador designado (DR) PIM para a VLAN em que o receptor multicast está. Isso também é conhecido como o Roteador de Último Salto (LHR). Você pode usar o comando "show ip pim vrf <VN Name> interface vlan <vlan> detail | incluir 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)
```

Valide se o Snooping IGMP selecionou o IGMP MR com o comando "show ip igmp vrf <VN Name> snooping group"

<#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
```

Criação de Árvore Compartilhada de Modo Escasso PIM

Edge-2, que é o DR nesse segmento, envia uma (*,G) PIM Join em direção ao RP Anycast. Se o endereço RP Anycast não for resolvido no cache de mapa LISP, o processo de observação EID LISP será responsável por acionar as solicitações de mapa LISP. Você pode usar o comando "show lisp instance-id <LISP L3 IID> ipv4/ipv6 eid-watch | begin RLOC"

<#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
```

Valide a entrada (*,G) em Edge-2 com o comando "show ip mroute vrf <VN Name> <multicast group>"

<#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), 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

Vizinhos PIM na Sobreposição

Uma vez que o vizinho de RPF que é representado por seu localizador de roteamento (RLOC) e é alcançável através da interface LISP, ele é adicionado como um vizinho PIM no VRF/VN.

Várias coisas que devem ser consideradas:

- Verificação de RPF, que é usada para enviar o PIM (*,G) Join aciona a criação do vizinho PIM com um temporizador de expiração de dois minutos. Se nenhuma mensagem de PIM Join for enviada por 2 minutos, o vizinho expira.
- O PIM precisa criar explicitamente uma estrutura de vizinhos para o RLOC correspondente, pois as mensagens de saudação do PIM não são enviadas na Sobreposição de SDA

<#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 /
```

RP Anycast cria (*,G)

Com base no PIM (*,G) Join recebido de Edge-2, Border-1 cria (*,G) com o OIL em direção ao RLOC de Edge-2

<#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

Registro de origem de multicast

A origem multicast 10.47.7.2 envia tráfego multicast, que entra na Borda-1. Edge-1 empurra o pacote para a CPU para criar o estado (S,G) e Edge-1 registra a origem para o RP Anycast.

<#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
```

Quando Border-1 recebe o pacote multicast via PIM Registration, Border-1 tem (S,G) e anuncia isso para Border-2 via MSDP

<#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 - 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), 00:02:26/00:00:34, 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:
```

Anúncio de origem MSDP

Use o comando "show ip msdp vrf <VN name> sa-cache" para exibir o Cache ativo de origem. Você pode usar o comando "show ip msdp vrf <VN name> summary" para ver o peer MSDP

<#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/  Reset SA   Peer Name
                       Downtime Count Count
```

10.47.6.7

```
    23456
```

Up

```
    1w1d     0     1
```

Border-2 recebe informações (S,G) de Border-1 através de anúncio MSDP. Se Border-2 recebeu uma Junção PIM (*,G) de Edge-2, Border-2 cria uma entrada (S,G) e herda o ÓLEO LISP de (*,G) apontando para o RLOC de Edge-2. A regra prática é que as entradas SA MSDP só são instaladas na base de informações de roteamento multicast (MRIB) se existir um (*,G).

<#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, ther

Border-1 envia um PIM (S,G) Join em direção à origem 10.47.7.2 para atrair o tráfego multicast nativamente, o que permite que Edge-1 atualize o (S,G) OIL

<#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

O tráfego multicast de 10.47.7.2 a 239.1.1.1 é encaminhado por 10.47.6.6 (borda 1) através do encapsulamento VXLAN Unicast. Border-1 desencapsula o tráfego VXLAN e o reencapsula para Edge-2 (10.47.1.13)

<#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), 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
```

Transição para a Shortest Path Tree (SPT)

Uma vez que o Roteador de Último Salto (LHR) Edge-2, recebe o pacote multicast ao longo da árvore (*,G), ele tenta fazer a transferência de SPT e enviar uma junção PIM (S,G) para Edge-1.

```
<#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

O FHR (Edge-1) tem (S,G) apontando diretamente para o RLOC do Edge-2

<#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

Verificação do plano de dados (independente de plataforma)

Pode haver vários problemas que podem impedir a origem de multicast ou o receptor de multicast de enviar/receber o tráfego. Esta seção se concentra na validação de problemas que podem afetar a origem e o receptor multicast, com ênfase em problemas que não estão relacionados à programação de hardware.

Verificação do lado da origem

Para validar a origem de multicast e a capacidade do FHR de criar (S,G), valide o recurso de segurança integrada do switch (SISF), LISP, Cisco Express Forwarding (CEF) e, em seguida, RPF.

A origem de multicast deve estar no SISF/IP Device-Tracking (IPDT) que orienta o restante do LISP, CEF e, por fim, RPF.

Você pode usar o comando "show device-tracking database address <IP address>" para

garantir que a origem de multicast tenha uma entrada IPDT válida.

<#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
DH4  10.47.7.2             5254.0012.521d     Gi1/0/4   1025 0024  163s REACHABLE 81 s try 0(8428
```

Em seguida, certifique-se de que o banco de dados LISP no FHR tenha uma entrada para a origem de multicast. Use o comando "show lisp instance-id <LISP L3 IID> ipv4 database ip address/32"

<#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
```

O CEF cria uma entrada com base no LISP, o CEF aponta para uma entrada de host /32, não LISP.

<#root>

Edge-1#

show ip cef vrf blue_vn 10.47.7.2

10.47.7.2/32
nexthop 10.47.7.2 Vlan1025

Em seguida, o RPF é derivado do CEF

<#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

Se não houver uma entrada válida no SISF/IPDT, isso resultará em nenhum mapeamento de banco de dados LISP no FHR, o que resultará em CEF e RPF apontando para as Bordas. Se a origem multicast envia tráfego RPF aponta para a interface incorreta, o que resulta em falha de RPF, (S,G) não é formado.

<#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 interfac


nexthop 10.47.1.11

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



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
```

Para evitar isso, trate a origem de multicast como um host silencioso, onde as vinculações de transmissão direcionada por IP, inundação, SISF estático/IPDT podem superar esse problema.

Registro de Origem

O registro PIM é um fluxo de pacote unicast, que usa LISP/VXLAN como qualquer outro pacote unicast. Há várias verificações de requisitos para validar se o FHR pode registrar corretamente a origem de multicast para o RP Anycast.

Primeiro, verifique se o RP Anycast está configurado corretamente para o GDA.

<#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

Verifique se o túnel PIM Register está formado.

<#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.

Source :

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

State : UP
Last event : Created (1w2d)

Garanta o alcance do IP para o RP Anycast

<#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
```

Verificação no lado do receptor

- Verifique se o receptor multicast está enviando um IGMP MR.
- Certifique-se de que o Snooping IGMP esteja habilitado. As VLANs somente L2 são o único tipo de VLAN que não tem o Snooping IGMP habilitado
- Verifique se não há uma ACL de porta, ACL de VLAN, ACL de porta roteada configurada que descartaria o IGMP MR.
- Validar a versão do IGMP MR; por padrão, é IGMPv2, se o receptor multicast for IGMPv3, isso exigirá "ip igmp version 3"
- Certifique-se de que a opção "ip option drop" não esteja configurada

Verificação LHR PIM (*,G)

- Certifique-se de que o LHR seja o DR PIM para a sub-rede/segmento do receptor
- Verifique se não há "ip multicast group-range" configurado
- Verifique se não há uma ACL de porta, ACL de VLAN, ACL de porta roteada configurada que descartaria o IGMP MR.
- Certifique-se de que não haja CPU alta ou Política de Plano de Controle (CoPP) descartando o IGMP MR.

Verificação de Árvore Compartilhada PIM LHR

Verifique se o RP está configurado para o grupo multicast

```
<#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:
```

Verifique se o RPF para o RP Anycast está correto

<#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
```

Encaminhamento de MFIB - Verificação da origem

Você pode usar o comando "show ip mfib vrf <VN Name> <multicast group> <unicast source> verbose" para obter informações adicionais sobre o encaminhamento de pacotes

<#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: 450000000000400000011647 70A2F010D0A2F010C000012B500000000084000000010040 0

```
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
450000000000400000 1164770A2F010D
0A2F010C000012B500000000008400000
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

Um EPC pode ser usado para validar o encapsulamento VXLAN do pacote multicast

<#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

Encaminhamento de MFIB - Verificação no lado do receptor

A rede subjacente roteia esse pacote de Edge-1 para Edge-2 usando o roteamento unicast.

<#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: LISP0.4100, RPF nbr
```

10.47.1.12

```
Outgoing interface list:
```

Vlan1025

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

Com o comando "show ip mfib vrf <VN Name> <group address> <unicast source> counters" você pode garantir que os contadores de encaminhamento de hardware

aumentem

<#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
```

Você pode usar contadores multicast de saída para validar se o tráfego multicast deixou ou não o LHR, em direção ao receptor multicast. Use o comando "show controllers ethernet-controller <interface> | incluir multicast|transmissão"

<#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
```

Outra maneira de validar o tráfego multicast que sai do LHR é fazer um EPC em direção ao receptor multicast.

<#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
```

Verificação do plano de dados (dependente da plataforma)

Criação (S,G) - Caminho de Punt da CPU

Para que o FHR crie o estado (S,G), alguns pacotes multicast enviados da origem multicast são enviados para a CPU para serem processados pelo MFIB. Os pacotes multicast são enviados para a fila de FED "CPU_Q_MCAST_DATA"

<#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
-----------------------------------------
```

Além disso, a fila CoPP para dados MCAST não deve ter nenhuma perda. Use o comando "show platform hardware fed ative qos queue stats internal cpu policer | incluir dados MCAST|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
```

Se o tráfego vier de uma origem diretamente conectada, ele será processado pela fila LSMPI (Linux Shared Memory Punt Interface) para "origem diretamente conectada" se for de um Join (S,G), é "Sinalização Mcast PIM"

Use o comando "show platform software infrastructure lsmpi punt | incluir Causa|Mcast"

<#root>

```
Edge-1#
```

show platform software infrastructure lsmpi punt | include Cause|Mcast

```
Cause                           Total        Total      Length        Dot1q encap        Other
```

Mcast Directly Connected Source

```
 0
```

27038

```
      0             0                 0           0
Mcast IPv4 Options data packet  0           0         0             0                  0
Mcast Internal Copy             0           0         0             0                  0
Mcast IGMP Unroutable           0           0         0             0                  0
```

Mcast PIM signaling

```
 0            0          0            0                 0           0
Mcast punt to RP                0           0         0             0                  0
Mcast UDLR                      0           0         0             0                  0
```

Em seguida, uma captura de pacote FED Punject pode ser feita para ver pacotes multicast da origem e do grupo na CPU, o que confirma a interface de entrada e a fila da CPU.

<#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], pal:
```

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.fffe, 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
```

Programação de hardware Mroute - IOS Mroute

A programação de hardware do (S,G) usa a mesma estrutura de qualquer outro caminho de programação: IOS para FMAN RP para FMAN FP, para 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

Programação de hardware Mroute - IOS MFIB

As rotas multicast são adicionadas à Base de Informações de Encaminhamento Multicast (MFIB), que é semelhante à forma como a Base de Informações de Roteamento (RIB) é adicionada ao Cisco Express Forwarding (CEF), o equivalente multicast é a MFIB.

<#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: 450000000000400000116477 0A2F010D0A2F010C000012B500000000084000000010040
Pkts: 0/0/0 Rate: 0 pps
```

Programação de hardware Mroute - RP MFIB

Use o comando "show platform software ip switch ative r0 mfib vrf index <VRF index> group <GDA/32>"

<#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

Programação de hardware Mroute - FP MFIB

A entrada FMAN RP para as mesmas mroutes inclui um ID de AOM (Asynchronous Object Manager), este ID de AOM é usado para validar mais programação.

Use o comando "show platform software ip switch ative f0 mfib vrf index <VRF Index> group <GDA/32>"

<#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)

Programação De Hardware Mroute - Objetos Mroute

Com os IDs de AOM, verifique o objeto e os objetos pai para (*,G) e (S,G) usando os comandos do gerenciador de objetos. Você pode usar o comando "show platform software object-manager switch ative f0 object <AOM ID>" ou "show platform software object-manager switch ative f0 object <AOM ID> parent"

Cada mroute tem dois objetos pai. Um dos objetos faz referência à tabela ipv4_mcast, o

outro é um mlist, que é usado em comandos subsequentes.

<#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

Programação De Hardware Mroute - Objetos Mlist

Os objetos MLIST são uma combinação de interfaces de entrada e listas de interface de saída. Você pode usar o comando "show platform software mlist switch ative f0 index <index>"

<#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)
```

Programação de hardware Mroute - FED Mroute

Para validar a programação do FED, use o comando "show platform software fed switch ative ip mfib vrf <VN Name> <GDA> <unicast source>"

<#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 )
```

O índice de regravação fornece informações sobre o encapsulamento do tráfego de multicast, que é o que a replicação de headend aproveita. Você pode usar o comando "show platform hardware fed switch ative fwd-asic abstraction print-resource-handle <REP RI Handle> 1"

<#root>

```
Edge-1#

show platform hardware fed switch active fwd-asic abstraction print-resource-handle 0x7f45d97e718


Handle:0x7f45d97e7188 Res-Type:ASIC_RSC_RI_REP Res-Switch-Num:255 Asic-Num:255 Feature-ID:AL_FID_
priv_ri/priv_si Handle: (nil)Hardware Indices/Handles: index0:0x19 mtu_index/l3u_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 0
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>
```

Em seguida, utilize os valores de URI para validar o intervalo de índice de regravação. Use o comando "show platform hardware fed switch ative fwd-asic resource asic all rewrite-index range <URI> <URI>"

<#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
```

Em seguida, obtenha o RI do comando anterior para verificação posterior. Use o comando "show platform software fed switch ative ip mfib vrf <VN Name> <GDA> <source>"

<#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)

Use o comando "show platform software fed switch ative ip adj | include <destination RLOC>"

<#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-modifie
----       -------    -------        ------         ------          -------- ------ ------------
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

No LHR, você pode validar o índice de destino para ver para onde o pacote multicast é encaminhado, que são os receptores multicast. Você pode usar o comando "show platform software fed switch ative ip mfib vrf <VN Name> <GDA> <source>"

<#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 )
```

Pegue o manipulador DI e use o comando "show platform hardware fed switch ative fwd-asic abstraction print-resource-handle <DI handle> 1"

<#root>

```
Edge-2#
```

show platform hardware fed switch active fwd-asic abstraction print-resource-handle 0x7f0efdad766

```
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/l3u_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 0
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
================================================================
```

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