

驗證SD訪問交換矩陣中的本地組播

目錄

[簡介](#)

[必要條件](#)

[需求](#)

[採用元件](#)

[背景資訊](#)

[拓撲](#)

[組態](#)

[控制平面驗證](#)

[建立FHR\(S, G\)](#)

[FHR\(S, G\)註冊](#)

[LHR IGMP成員報告](#)

[LHR\(*, G\)覆蓋建立](#)

[襯底SSM組中的LHR\(*, G\)對映](#)

[邊界/RP在重疊中建立\(*, G\)並在底層中建立\(S, G\)](#)

[Border-1從MSDP SA快取建立\(S, G\)](#)

[邊界覆蓋\(S, G\)建立襯底\(S, G\)](#)

[FHR在重疊和底層接收\(S, G\)加入](#)

[LHR接收共用樹上的組播流量](#)

[資料層面驗證 \(與平台無關\)](#)

[建立FHR\(S, G\)](#)

[來源註冊](#)

[接收方驗證](#)

[LHR PIM\(*, G\)驗證](#)

[LHR PIM共用樹狀結構驗證](#)

[MFIB轉送-原生多點傳送 \(重疊\) 來源端驗證](#)

[MFIB轉送-原生多點傳送 \(底層\) 來源端驗證](#)

[MFIB轉送-原生多點傳送 \(解除封裝後\)](#)

[資料層面驗證 \(取決於平台\)](#)

[Mroute硬體程式設計- IOS mroute](#)

[Mroute硬體程式設計- IOS MFIB](#)

[Mroute硬體程式設計- FMAN RP](#)

[Mroute硬體程式設計- FMAN FP](#)

[Mroute硬體程式設計- FMAN FP資料庫](#)

[Mroute硬體程式設計- FED](#)

簡介

本檔案介紹如何驗證SD-Access (SDA)光纖中的原生多點傳送。

必要條件

需求

思科建議您瞭解以下主題：

- 網際網路通訊協定(IP)轉送
- 定位器ID/分隔通訊協定(LISP)
- 通訊協定無關多點傳送(PIM)稀疏模式

採用元件

- Cisco IOS® XE 17.10.1上的C9000v
- Cisco Catalyst中心版本2.3.5.3

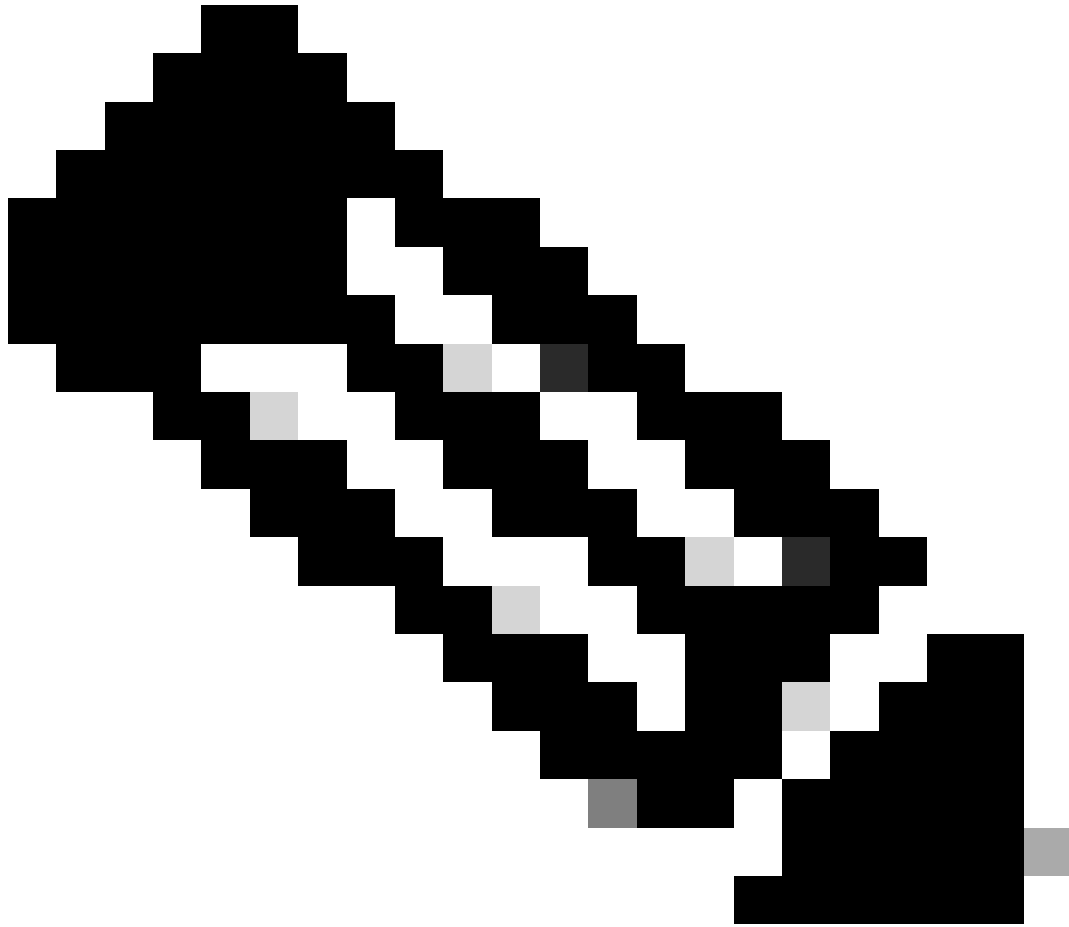
本文中的資訊是根據特定實驗室環境內的裝置所建立。文中使用到的所有裝置皆從已清除（預設）的組態來啟動。如果您的網路運作中，請確保您瞭解任何指令可能造成的影響。

本文件也適用於以下硬體和軟體版本：

- C9200
- C9300
- C9400
- C9500
- C9600
- Cisco IOS® XE 16.12及更高版本

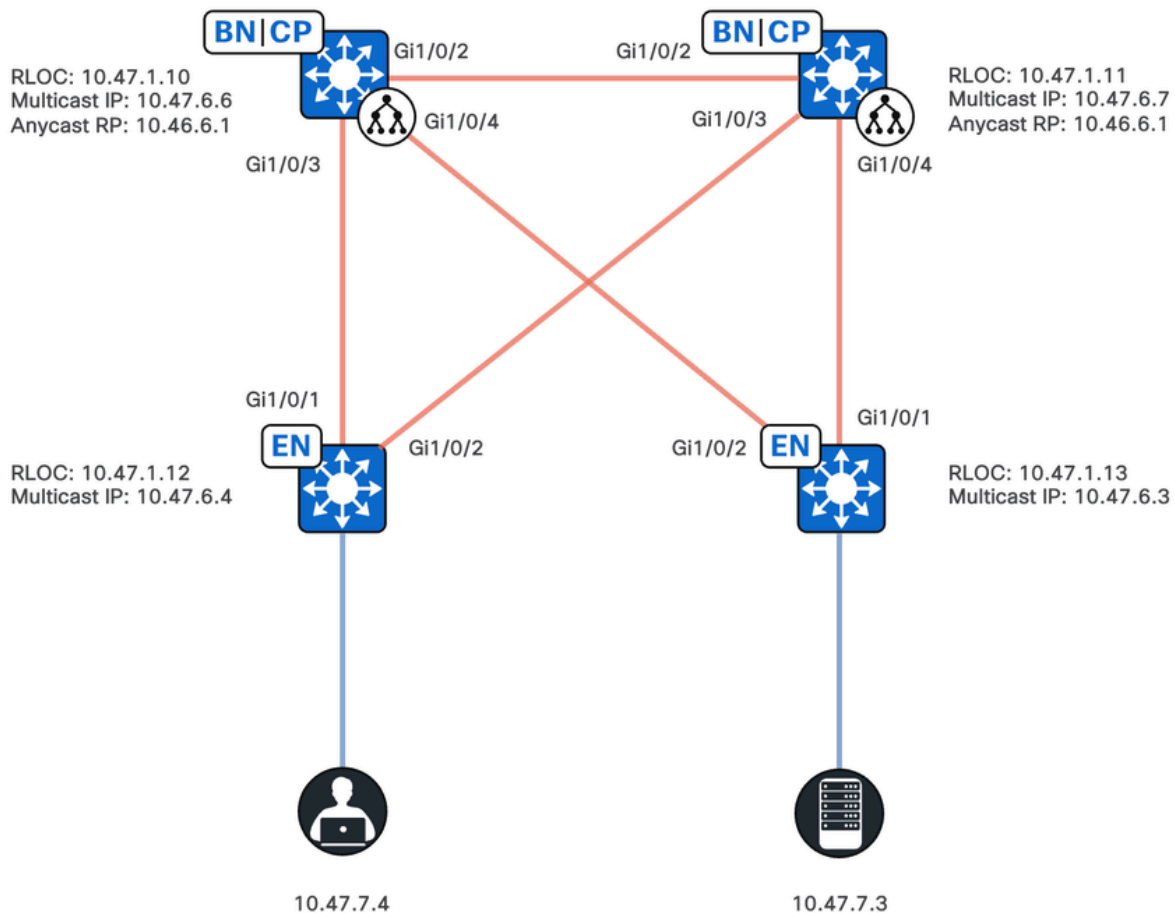
背景資訊

SDA本地組播是一種重疊組播，用於在交換矩陣裝置之間傳送組播流量，將組播流量封裝到另一個組播組中。本地組播可以在同一個VLAN或不同VLAN中的源和接收器之間路由組播流量（可以路由同一個VLAN組播）。同一交換矩陣邊緣(FE)上的源和接收之間的組播流量不使用重疊組播（VXLAN封裝）進行轉發，而是由FE進行本地路由。本機多點傳送無法路由符合224.0.0.0/24或Time To Live (TTL) =1的群組多點傳送流量，這些流量是透過第2層(L2)泛洪處理。原生多點傳送可以設定為轉送任何來源多點傳送(ASM)、來源特定多點傳送(SSM)或兩者的組合。本地組播依賴於底層組播。



附註：平台 (fed) 命令可能有所不同。命令可以是「show platform fed <active|standby>」或「show platform fed switch <active|standby>」。「」。如果示例中註明的語法未解析出，請嘗試該變體。

拓撲



網路拓撲

在此拓撲中：

- 遠端定位器ID (RLOC) 10.47.1.10和10.47.1.11配置在任意邊界處，還用作任播集合點 (RP)，在虛擬網路(VN)或虛擬路由和轉發(VRF)中的兩者之間使用組播源發現協定(MSDP)。
- 10.47.1.12和10.47.1.13是FE節點
- 10.47.7.4是組播接收器
- 10.47.7.3是組播源
- 239.0.0.5是組播組目標地址(GDA)

組態

假設Cisco Catalyst Center用於使用以下設定調配SDA交換矩陣：

- 複製模式實施是本地組播
- 多點傳送模式是任何來源多點傳送(ASM)
- 任播交匯點(RP)與組播源發現協定(MSDP)配置在任意位置邊界上
- 底層組播要麼是手動配置的，要麼是作為初始LAN自動化的一部分配置的，本地組播依靠底層組播正常運行。

交換矩陣邊緣(10.47.1.12)配置

```

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

```

交換矩陣邊緣(10.47.1.13)配置

```

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

```

Collocated Anywhere Border/Anycast RP (10.47.1.10)配置

```
ip access-list standard ASM_ACL_IPV4_blue_vn_10.47.6.1
permit 239.0.0.0 0.0.0.255
ip multicast-routing vrf blue_vn
interface LISP0.4100
ip pim lisp transport multicast
ip pim lisp core-group-range 232.0.0.1 1000
interface Vlan3001
ip pim sparse-mode
exit
interface Loopback4100
vrf forwarding blue_vn
ip address 10.47.6.1 255.255.255.255
ip pim sparse-mode
interface Loopback4600
vrf forwarding blue_vn
ip address 10.47.6.6 255.255.255.255
ip pim sparse-mode
ip pim vrf blue_vn rp-address 10.47.6.1 ASM_ACL_IPV4_blue_vn_10.47.6.1
ip pim vrf blue_vn register-source Loopback4100
ip pim vrf blue_vn ssm default
ip msdp vrf blue_vn cache-sa-state
ip msdp vrf blue_vn originator-id Loopback4600
ip msdp vrf blue_vn peer 10.47.6.7 connect-source Loopback4600
ip msdp originator-id Loopback4600
router bgp 69420
address-family ipv4 vrf blue_vn
aggregate-address 10.47.6.0 255.255.255.0 summary-only
network 10.47.6.1 mask 255.255.255.255
router lisp
service ipv4
etr map-server 10.47.1.11 key *****
etr map-server 10.47.1.10 key *****
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
service ethernet
etr map-server 10.47.1.11 key *****
etr map-server 10.47.1.10 key *****
etr map-server 10.47.1.10 proxy-reply
etr map-server 10.47.1.11 proxy-reply
instance-id 4099
service ipv4
sgt
route-export site-registrations
route-import database bgp 69420 route-map DENY-red_vn locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e1
distance site-registrations 250
map-cache site-registration
instance-id 4100
service ipv4
map-cache 10.47.6.7/32 10.47.1.11 priority 1 weight 100
sgt
route-export site-registrations
route-import database bgp 69420 route-map DENY-blue_vn locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e1
distance site-registrations 250
map-cache site-registration
database-mapping 10.47.6.6/32 locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
database-mapping 10.47.6.1/32 locator-set rloc_9080ed56-a6c6-482d-9f46-28eda0e18501
site site_uci
authentication-key *****
eid-record instance-id 4100 10.47.6.0/24 accept-more-specifics
```

Collocated Anywhere Border/Anycast RP (10.47.1.10)配置

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



```
site site_uci
authentication-key *****
eid-record instance-id 4100 10.47.6.0/24 accept-more-specifics
```

控制平面驗證

本節將驗證通訊協定無關多點傳送(PIM)，首先驗證第一躍點路由器(FHR)上建立的(S, G)

FHR (S, G)建立

組播源10.47.7.3將UDP組播資料包傳送到239.0.0.5。驗證IP裝置跟蹤(IPDT)、思科快速轉發(CEF)和反向路徑轉發(RPF)是否正確指向組播源。此外，確保任播網關SVI是此網段的PIM指定路由器(DR)。

使用命令「show device-tracking database address <ip address>」確儲存在有效的IPDT條目

```
<#root>
```

```
Edge-2#
```

```
show device-tracking database address 10.47.7.3
```

```
Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DH4 - IPv4 DHCP
Preflevel flags (prlvl):
```

```
0001:MAC and LLA match 0002:Orig trunk 0004:Orig access
```

```
0008:Orig trusted trunk 0010:Orig trusted access 0020:DHCP assigned
```

```
0040:Cga authenticated 0080:Cert authenticated 0100:Statically assigned
```

```
Network Layer Address Link Layer Address Interface vlan prlvl age state Time left
DH4 10.47.7.3 5254.0012.521d Gi1/0/4 1025 0024 166s
```

```
REACHABLE
```

```
81 s try 0(2276 s)
```

使用命令「show ip cef vrf <VN Name> <ip address>」並確保組播源已直接連線

```
<#root>
```

```
Edge-2#
```

```
show ip cef vrf blue_vn 10.47.7.3
```

```
10.47.7.3/32
```

```
nexthop 10.47.7.3 Vlan1025
```

然後，使用命令「show ip rpf vrf <VN> <ip address>」確保RPF介面是源所處的VLAN，而不是

LISP。

```
<#root>
```

```
Edge-1#
```

```
show ip rpf vrf blue_vn 10.47.7.3
```

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

```
RPF interface: Vlan1025
```

```
RPF neighbor: ? (
```

```
10.47.7.3
```

```
) - directly connected
```

```
RPF route/mask: 10.47.7.3/32
```

```
RPF type:
```

```
unicast (lisp)
```

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

```
Multicast Multipath enabled.
```

```
RPF topology: ipv4 multicast base, originated from ipv4 unicast base
```

使用命令「show ip pim vrf <VN name> interface vlan <vlan> detail | include DR|enabled」以驗證 FE節點是網段的PIM DR還是FHR。

```
<#root>
```

```
Edge-2#
```

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

```
PIM: enabled
```

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

```
PIM State-Refresh processing: enabled
```

```
PIM Non-DR-Join: FALSE
```

使用命令「show ip mroute vrf <VN name> <multicast group address>」驗證(S, G)建立。(S, G)將具有空傳出介面清單(OIL)，因為還沒有相關的接收方或PIM路由器加入FHR。

```
<#root>
```

```
Edge-2#
```

```
show ip mroute vrf blue_vn 239.0.0.5
```

```
IP Multicast Routing Table
```

```
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,  
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
```

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

(*, 239.0.0.5), 00:00:10/stopped, RP 10.47.6.1, flags: SPF1
Incoming interface: LISPO.4100, RPF nbr 10.47.1.10
Outgoing interface list: Null

```
(
10.47.7.3
,
239.0.0.5
), 00:00:10/00:02:50, flags: PFT
Incoming interface: Vlan1025, RPF nbr 0.0.0.0
Outgoing interface list:
Null
```

FHR (S , G)註冊

FHR使用配置為「registered-source」PIM註冊消息的介面將單播源註冊到任播RP。

- 外部標頭，RLOC到RLOC (10.47.1.13到10.47.1.10)
- 內部報頭，環回至環回 (10.47.6.3到10.47.6.1)
- 實際多點傳送

<#root>

Edge-2#

```
show ip pim vrf blue_vn tunnel
```

Tunnel1

Type : PIM Encap

RP : 10.47.6.1

Source : 10.47.6.3

State : UP

Last event : Created (00:42:43)

Edge-2#

```
show ip cef vrf blue_vn 10.47.6.1

10.47.6.1/32
nexthop
10.47.1.10
LISP0.4100
<-- FHR happened to register to this RP

nexthop 10.47.1.11 LISP0.4100
```

LHR IGMP成員報告

組播接收方傳送IGMP成員報告/加入以表示接收組播流量的興趣，該流量在最後一跳路由器(LHR)上建立IGMP監聽和IGMP組條目。使用命令「show ip igmp snooping groups vlan <vlan id> <group destination address>」和「show ip igmp vrf <VN Name> groups <group>」。

<#root>

Edge-1#

```
show ip igmp snooping groups vlan 1025 239.0.0.5
```

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

Edge-1#

```
show ip igmp vrf blue_vn groups 239.0.0.5
```

IGMP Connected Group Membership

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

接下來，請確保LHR確實是此分段的PIM DR，請使用命令「show ip pim vrf <VN name> interface vlan <vlan> detail | 包含DR|enabled」

<#root>

Edge-1#

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

PIM: enabled

PIM DR: 10.47.7.1 (this system)

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

LHR (*, G)覆蓋建立

當LHR收到IGMP成員報告時，它還建立PIM狀態，特別是(*, G)，您可以使用命令「show ip mroute vrf <VN Name><overlay group> verbose」檢視(*, G)狀態

<#root>

Edge-1#

```
show ip mroute vrf blue_vn 239.0.0.5 verbose
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,

* - determined by Assert, # - iif-starg configured on rpf intf,

e - encap-helper tunnel flag, l - LISP decap ref count contributor

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join

t - LISP transit group

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

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

10.47.6.1

, flags: SJC1

<-- Anycast RP IP address

Incoming interface: LISP0.4100,

RPF nbr 10.47.1.10

, LISP: [

10.47.1.10

,

232.0.2.245

]

<-- RPF neighbor to reach the Anycast RP, Overlay Group 239.0.0.5 is mapped to Underlay Group 232.0.2.245

Outgoing interface list:

Vlan1025

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

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

襯底SSM組中的LHR (* , G)對映

從(* , G)導出襯底SSM(S , G)。源是RP RPF , 組是重疊對映。

<#root>

Edge-1#

show ip mroute 232.0.2.245 10.47.1.10

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,

* - determined by Assert, # - iif-starg configured on rpf intf,

e - encap-helper tunnel flag, l - LISP decap ref count contributor

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join

t - LISP transit group

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(

10.47.1.10, 232.0.2.245

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

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

Incoming interface:

GigabitEthernet1/0/1

, RPF nbr 10.47.1.0

<-- RPF interface to reach 10.47.1.10

Outgoing interface list:

Null0

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

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

邊界/RP在重疊中建立(*, G)並在底層中建立(S, G)

LHR在重疊中傳送了PIM(*, G)加入, 您可以使用命令「show ip mroute vrf <VN name> <overlay group> verbose」檢視重疊中的(*, G)

<#root>

Border-1#

show ip mroute vrf blue_vn 239.0.0.5 verbose

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,

* - determined by Assert, # - iif-starg configured on rpf intf,

e - encap-helper tunnel flag, l - LISP decap ref count contributor

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join

t - LISP transit group

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(

*, 239.0.0.5

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

Incoming interface:

Null

,

RPF nbr 0.0.0.0

Outgoing interface list:

LISP0.4100, (

10.47.1.10, 232.0.2.245

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

10.47.1.12

, 2d01h/00:03:05

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

在底層中，您可以使用命令「show ip mroute <底層組地址> <RP RLOC>」

<#root>

Border-1#

show ip mroute 232.0.2.245 10.47.1.10

IP Multicast Routing Table

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

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(

10.47.1.10

,

232.0.2.245

), 2d01h/00:03:13, flags: sT

Incoming interface:

Null0

,

RPF nbr 0.0.0.0

Outgoing interface list:

GigabitEthernet1/0/3

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

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

Border-1從MSDP SA快速获取建立(S, G)

FHR恰好將組播源註冊到Border-2。Border-2透過MSDP將組播源通告給Border-1。您可以使用命令show ip msdp vrf <VN Name> summary檢視MSDP狀態。

```
<#root>
```

```
Border-1#
```

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

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

使用命令「show ip msdp vrf <VN Name> peer <Peer Address> accepted-SAs」檢視從對等體接受的SA

```
<#root>
```

```
Border-1#
```

```
show ip msdp vrf blue_vn peer 10.47.6.7 accepted-SAs
```

```
MSDP SA accepted from peer 10.47.6.7 (?)
```

```
239.0.0.5
```

```
10.47.7.3
```

```
(?) RP:
```

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

使用命令show ip mroute vrf <VN Name> <group destination address> verbose檢視(S, G)

```
<#root>
```

```
Border-1#
```

```
show ip mroute vrf blue_vn 239.0.0.5 verbose
```

```
IP Multicast Routing Table
```

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

```

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

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

(
10.47.7.3
,
239.0.0.5
), 00:18:26/00:02:50, flags: PTA
<-- True multicast source

Incoming interface: LISP0.4100, RPF nbr 10.47.1.13, LISP: [
10.47.1.13
,
232.0.2.245
]
<-- RLOC of Edge-2, which is FHR, and 232.0.2.245 is the Underlay multicast group

Outgoing interface list:
10.47.1.12, 00:00:05/00:03:24
<-- RLOC of Edge-1

```

邊界覆蓋(S , G)建立襯底(S , G)

Border-1根據重疊(S , G)建立襯底(S , G) , 您可以使用show ip mroute <group destination address>命令檢視其他資訊。

對於FHR和它本身 , 有兩個(S , G)。10.47.1.13、232.0.2.245的Null0 OIL表示解封 , 10.47.1.10的Null0作為IIF表示封裝。

```
<#root>
```

```
Border-1#
```

```
show ip mroute 232.0.2.245
```

```
IP Multicast Routing Table
```

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

```
(
10.47.1.13
,
232.0.2.245
), 00:02:34/00:00:25, flags: sPT
<-- RLOC of the FHR, underlay multicast group IP

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

Outgoing interface list: Null <-- Indicates decapsulation
```

```
(
10.47.1.10
,
232.0.2.245
), 2d02h/00:02:41, flags: sT
<-- RLOC of Border-1, underlay multicast group IP

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

Outgoing interface list:

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

FHR在重疊和底層接收(S , G)加入

邊界/RP向FHR傳送PIM (S , G)加入，您可以使用「show ip mroute」命令獲取資訊。在重疊中，使用「show ip mroute vrf <VN Name> <重疊組地址>

```
<#root>
```

```
Edge-2#
```

```
show ip mroute vrf blue_vn 239.0.0.5
```

```
IP Multicast Routing Table
```

```
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
```

```
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
```

```
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
```

```
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
```

```
U - URD, I - Received Source Specific Host Report,
```

```
Z - Multicast Tunnel, z - MDT-data group sender,
```

```
Y - Joined MDT-data group, y - Sending to MDT-data group,
```

```
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
```

```
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
```

```
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
```

```
V - RD & Vector, v - Vector, p - PIM Joins on route,
```

```
x - VxLAN group, c - PFP-SA cache created entry,
```

```
* - determined by Assert, # - iif-starg configured on rpf intf,
```

```
e - encap-helper tunnel flag, l - LISP decap ref count contributor
```

```
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
```

```
t - LISP transit group
```

```
Timers: Uptime/Expires
```

```
Interface state: Interface, Next-Hop or VCD, State/Mode
```

```
(* , 239.0.0.5), 1w3d/stopped, RP 10.47.6.1, flags: SPF1
```

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

```
Outgoing interface list: Null
```

```
(
```

```
10.47.7.3
```

```
,
```

```
239.0.0.5
```

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

```
<-- Multicast source, true multicast group
```

```
Incoming interface: Vlan1025, RPF nbr 0.0.0.0
```

```
Outgoing interface list:
```

```
LISPO.4100, (
```

```
10.47.1.13
```

```
,
```

```
232.0.2.245
```

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

```
<-- FHR RLOC, underlay group IP
```

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

在底層中，請使用show ip mroute <底層組地址>

```
<#root>
```

```
Edge-2#
```

```
show ip mroute 232.0.2.245
```

```
IP Multicast Routing Table
```

```
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
```

```
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
```

```
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
```

```
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
```

```
U - URD, I - Received Source Specific Host Report,
```

```
Z - Multicast Tunnel, z - MDT-data group sender,
```

```
Y - Joined MDT-data group, y - Sending to MDT-data group,
```

```
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
```

```
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
```

```
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
```

```
V - RD & Vector, v - Vector, p - PIM Joins on route,
```

```
x - VxLAN group, c - PFP-SA cache created entry,
```

```
* - determined by Assert, # - iif-starg configured on rpf intf,
```

```
e - encap-helper tunnel flag, l - LISP decap ref count contributor
```

```
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
```

```
t - LISP transit group
```

```
Timers: Uptime/Expires
```

```
Interface state: Interface, Next-Hop or VCD, State/Mode
```

```
(
```

```
10.47.1.13
```

```
,
```

```
232.0.2.245
```

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

```
<-- RLOC of the FHR, Underlay multicast group
```

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

```
Outgoing interface list:
```

```
GigabitEthernet1/0/1
```

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

```
<-- Where the multicast traffic is forwarded
```

LHR接收共用樹上的組播流量

在LHR從RP接收沿共用樹的封裝組播流量後，它解封裝組播流量，因為底層(S, G)中的OIL為Null0，然後在重疊中建立(S, G)條目。您可以使用命令「show ip mroute <underlay group address>」和「show ip mroute vrf <VN Name> <overlay group address>」

```
<#root>
```

```
Edge-1#
```

```
show ip mroute 232.0.2.245
```

```
IP Multicast Routing Table
```

```
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
```

```
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
```

```
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
```

```
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
```

```
U - URD, I - Received Source Specific Host Report,
```

```
Z - Multicast Tunnel, z - MDT-data group sender,
```

```
Y - Joined MDT-data group, y - Sending to MDT-data group,
```

```
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
```

```
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
```

```
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
```

```
V - RD & Vector, v - Vector, p - PIM Joins on route,
```

```
x - VxLAN group, c - PFP-SA cache created entry,
```

```
* - determined by Assert, # - iif-starg configured on rpf intf,
```

```
e - encap-helper tunnel flag, l - LISP decap ref count contributor
```

```
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
```

```
t - LISP transit group
```

```
Timers: Uptime/Expires
```

```
Interface state: Interface, Next-Hop or VCD, State/Mode
```

```
(
```

```
10.47.1.10
```

```
,
```

```
232.0.2.245
```

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

```
<-- RLOC of the RP, Underlay group
```

```
Incoming interface:
```

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

```
Outgoing interface list:
```

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

在重疊中「show ip mroute vrf <VN Name> <重疊組地址>」

```
<#root>
```

Edge-1#

```
show ip mroute vrf blue_vn 239.0.0.5
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,

* - determined by Assert, # - iif-starg configured on rpf intf,

e - encap-helper tunnel flag, l - LISP decap ref count contributor

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join

t - LISP transit group

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(* , 239.0.0.5), 1w3d/stopped, RP 10.47.6.1, flags: SJC1

Incoming interface: LISP0.4100, RPF nbr 10.47.1.10

Outgoing interface list:

Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:03, flags:

(

10.47.7.3, 239.0.0.5

), 00:01:21/00:01:38, flags: JT1

<-- Multicast Source, Overlay Group

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

[

10.47.1.13, 232.0.2.245

]

<-- RLOC of the FHR, Underlay Group

Outgoing interface list:

Vlan1025

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

<-- Multicast traffic is forwarded into VLAN 1025

現在，LHR加入最短路徑樹(SPT)，並透過重疊和底層中的PIM(S,G)連線修剪共用樹。在LHR修剪共用樹後，(S,G)的RP OIL不再包括LHR。轉到RP並使用命令「show ip mroute vrf <VN Name> <重疊組地址>」

<#root>

Border-1#

```
show ip mroute vrf blue_vn 239.0.0.5
```

IP Multicast Routing Table

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

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

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

```
Outgoing interface list: Null
```

由於(S, G)結構不再具有底層對映，即使透過底層接收到239.0.0.5的流量，RP也不會將其重新封裝為任何LHR，從而會修剪共用樹。但是，來源樹和共用樹的(S, G)結構仍然存在。轉到RP，使用命令「show ip mroute <underlay group address>」檢查底層組

<#root>

Border-1#

```
show ip mroute 232.0.2.245
```

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

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

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

如果RP刪除了其所有OIL，也會從FHR OIL中修剪，並且FHR OIL只包括LHR。轉到FHR並使用命令「show ip mroute vrf <VN Name> <overlay group address>」

<#root>

Edge-2#

```
show ip mroute vrf blue_vn 239.0.0.5
```

IP Multicast Routing Table

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

(* , 239.0.0.5), 1w4d/stopped, RP 10.47.6.1, flags: SPF1
Incoming interface: LISPO.4100, RPF nbr 10.47.1.10
Outgoing interface list: Null

(

10.47.7.3

,

239.0.0.5

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

```

<-- Multicast Source, Overlay Group

Incoming interface: Vlan1025, RPF nbr 0.0.0.0
Outgoing interface list:
LISP0.4100, (
10.47.1.13, 232.0.2.245
), Forward/Sparse, 20:16:48/stopped, flags:
<-- RLOC of the LHR, Underlay Group

```

資料層面驗證 (與平台無關)

可能有多種問題會阻止組播源或組播接收器傳送/接收流量。本節重點介紹如何驗證會影響組播源和組播接收方的問題，重點介紹與硬體程式設計無關的問題。

建立FHR (S , G)

要使FHR建立(S , G)驗證SISF、LISP、CEF和RPF是否全部有效並且正確，請使用命令「show device-tracking database address <IPv4 address>」

```
<#root>
```

```
Edge-2#
```

```
show device-tracking database address 10.47.7.3
```

```
Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DH4 - IPv4 DHCP
Preflevel flags (prlvl):
```

```
0001:MAC and LLA match 0002:Orig trunk 0004:Orig access
```

```
0008:Orig trusted trunk 0010:Orig trusted access 0020:DHCP assigned
```

```
0040:Cga authenticated 0080:Cert authenticated 0100:Statically assigned
```

```

Network Layer Address Link Layer Address Interface vlan prlvl age state Time left
DH4 10.47.7.3          5254.0012.521d   Gi1/0/4   1025 0024 16s REACHABLE 232 s try 0(84662 s)

```

LISP利用SISF，請使用命令「show lisp instance-id <L3 LISP Instance ID> ipv4 database <IP/32>」

```
<#root>
```

```
Edge-2#
```

```
show lisp instance-id 4100 ipv4 database 10.47.7.3/32
```

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

```
10.47.7.3/32
```

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

Edge-2#

```
show ip lisp instance-id 4100 forwarding eid local 10.47.7.3
```

Prefix

```
10.47.7.3/32
```

LISP對CEF進程式設計，請使用命令「show ip cef vrf <VN Name> <ip address>」，並確保它是VLAN中的下一跳，而不是指向LISP。

<#root>

Edge-2#

```
show ip cef vrf blue_vn 10.47.7.3
```

```
10.47.7.3/32
```

```
nexthop 10.47.7.3 Vlan1025
```

最後，請確保RPF指向正確，並且指示直接連線。

<#root>

Edge-2#

```
show ip rpf vrf blue_vn 10.47.7.3
```

```
RPF information for (10.47.7.3)
```

```
RPF interface: Vlan1025
```

```
RPF neighbor: ?
```

```
(10.47.7.3) - directly connected
```

```
RPF route/mask: 10.47.7.3/32
```

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

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

```
Multicast Multipath enabled.
```

```
RPF topology: ipv4 multicast base, originated from ipv4 unicast base
```

如果SISF/IPDT中沒有有效條目，則會導致FHR上沒有LISP資料庫對映，從而導致CEF和RPF指向邊框。如果組播源傳送流量，則RPF指向不正確的介面，這會導致RPF故障，(S, G)不會形成。

```
<#root>
```

```
Edge-2#
```

```
show device-tracking database address 10.47.7.3
```

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

```
Edge-2#
```

```
show lisp instance-id 4100 ipv4 database 10.47.7.3/32
```

```
% No database-mapping entry for 10.47.7.3/32.
```

```
Edge-2#
```

```
show ip cef vrf blue_vn 10.47.7.3
```

```
10.47.7.0/24  
nexthop 10.47.1.10
```

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

```
nexthop 10.47.1.11
```

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

```
Edge-2#
```

```
show ip rpf vrf blue_vn 10.47.7.3
```

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

```
LISP0.4100
```

```
RPF neighbor: ? (
```

```
10.47.1.11
```

```
)
```

```
RPF route/mask: 10.47.7.3/32
```

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

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

```
Multicast Multipath enabled.
```

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

要避免這種情況，請將組播源視為靜默主機，在這裡，IP定向廣播、泛洪、靜態SISF/IPDT繫結可以解決此問題。

來源註冊

PIM註冊是一種單播資料包流，它像使用任何其他單播資料包一樣使用LISP/VXLAN。有幾個請求技術人員驗證FHR是否能夠將組播源正確註冊到任播RP。

首先，確保已為GDA正確配置任播RP。

```
<#root>
```

```
Edge-2#
```

```
show ip pim vrf blue_vn rp 239.0.0.5
```

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

確保PIM暫存器隧道已形成。

```
<#root>
```

```
Edge-2#
```

```
show ip pim vrf blue_vn tunnel
```

```
Tunnel1
```

```
Type : PIM Encap
```

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

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

```
State : UP
```

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

確保任播RP具有IP可達性

```
<#root>
```

```
Edge-2#
```

```
show ip cef vrf blue_vn 10.47.6.1
```

```
10.47.6.1/32
```

```
nexthop
```

```
10.47.1.10
```

```
LISPO.4100
```

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

```
nexthop
```

```
10.47.1.11
```

```
LISPO.4100
```

```
<-- RLOC of Border-2
```

```
Edge-2#
```

```
ping vrf blue_vn 10.47.6.1 source lo4100
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 10.47.6.1, timeout is 2 seconds:
```

```
Packet sent with a source address of 10.47.6.3
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/3 ms
```

接收方驗證

- 確保組播接收方正在傳送IGMP MR。
- 確保啟用IGMP監聽。僅L2 VN是唯一未啟用IGMP監聽的VN型別
- 確保未配置可丟棄IGMP MR的埠ACL、VLAN ACL、路由埠ACL。
- 驗證IGMP MR的版本，預設情況下，如果組播接收器是IGMPv3，則需要「ip igmp version 3」
- 確保未配置「ip option drop」

LHR PIM (*, G)驗證

- 確保LHR是接收方子網/網段的PIM DR
- 確保未配置「ip組播組範圍」
- 確保未配置可丟棄IGMP MR的埠ACL、VLAN ACL、路由埠ACL。
- 確保沒有高CPU或控制平面管制(CoPP)丟棄IGMP MR。

LHR PIM共用樹狀結構驗證

確保為組配置了RP

```
<#root>
```

```
Edge-1#
```

```
show ip mroute vrf blue_vn 239.0.0.5
```

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - 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

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

10.47.6.1

, flags: SJC1

<-- Anycast RP address

Incoming interface: LISP0.4100, RPF nbr 10.47.1.10

Outgoing interface list:

Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:36, flags:

確保任播RP的RPF是正確的

<#root>

Edge-1#

show ip cef vrf blue_vn 10.47.6.1

10.47.6.1/32

nexthop 10.47.1.10 LISP0.4100

nexthop 10.47.1.11 LISP0.4100

Edge-1#

show ip rpf vrf blue_vn 10.47.6.1

RPF information for (10.47.6.1)

RPF interface: LISP0.4100

RPF neighbor: ? (10.47.1.10)

RPF route/mask: 10.47.6.1/32

RPF type: unicast ()

Doing distance-preferred lookups across tables

Multicast Multipath enabled.

RPF topology: ipv4 multicast base

MFIB轉送-原生多點傳送 (重疊) 來源端驗證

您可以使用命令「show ip mfib vrf <VN Name> <overlay group address> <unicast source> verbose」獲取有關資料包轉發的其他資訊。

```
<#root>
```

```
Edge-2#
```

```
show ip mfib vrf blue_vn 239.0.0.5 10.47.7.3 verbose
```

```
Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,
ET - Data Rate Exceeds Threshold, K - Keepalive
DDE - Data Driven Event, HW - Hardware Installed
ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts: Total/RPF failed/Other drops
I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
VRF blue_vn
(10.47.7.3,239.0.0.5) Flags: K HW DDE
0x530 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 352467143981268992/0/19/0, Other: 0/0/0
Vlan1025 Flags: RA A MA
LISP0.4100, (
10.47.1.13
,
232.0.2.245
) Flags: RF F NS
<-- RLOC of FHR, Underlay Group IP address

CEF: Adjacency with MAC:
4500000000004000001184BC0A2F010DE80002F5000012B500000000084000000100400BA25CDF4AD38BA25CDF4AD380000

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

MFIB轉送-原生多點傳送 (底層) 來源端驗證

使用show ip mroute <underlay group address> <RLOC of FHR>檢視底層組

<#root>

Edge-2#

show ip mroute 232.0.2.245 10.47.1.13

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,

* - determined by Assert, # - iif-starg configured on rpf intf,

e - encap-helper tunnel flag, l - LISP decap ref count contributor

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join

t - LISP transit group

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(

10.47.1.13

,

232.0.2.245

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

<-- RLOC of the FHR, Underlay Group

Incoming interface:

Null0

, RPF nbr 0.0.0.0

<-- Indicates Encapsulation

Outgoing interface list:

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

Edge-2#

show ip mfib 232.0.2.245 10.47.1.13 verbo

se

Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,

ET - Data Rate Exceeds Threshold, K - Keepalive

DDE - Data Driven Event, HW - Hardware Installed

ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB

MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary

MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,

e - Encap helper tunnel flag.

I/O Item Flags: IC - Internal Copy, NP - Not platform switched,

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

10.47.1.13,232.0.2.245

) Flags: K HW

0x348 OIF-IC count: 0, OIF-A count: 1

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

HW Forwarding:

5268151634814304256

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

Null0

Flags: RA A MA

GigabitEthernet1/0/1 Flags: RF F NS

CEF: Adjacency with MAC: 01005E0002F552540017FE730800

Pkts: 0/0/0 Rate: 0 pps

MFIB轉送-原生多點傳送 (解除封裝後)

當組播流量到達源IP為10.47.1.13且目標地址為232.0.2.245的LHR時，它將路由到Null0傳出介面。此操作將觸發資料包解封。

<#root>

Edge-1#

show ip mroute 232.0.2.245 10.47.1.13

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,

* - determined by Assert, # - iif-starg configured on rpf intf,

e - encap-helper tunnel flag, l - LISP decap ref count contributor

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join

t - LISP transit group

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(

10.47.1.13

,

232.0.2.245

), 00:38:22/00:00:37, flags: sT

Incoming interface: GigabitEthernet1/0/2, RPF nbr 10.47.1.4

Outgoing interface list:

Null0

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

Edge-1#

show ip mfib 232.0.2.245 10.47.1.13 verbose

Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,

ET - Data Rate Exceeds Threshold, K - Keepalive

DDE - Data Driven Event, HW - Hardware Installed

ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB

MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary

MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,

e - Encap helper tunnel flag.

I/O Item Flags: IC - Internal Copy, NP - Not platform switched,

NS - Negate Signalling, SP - Signal Present,

A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,

MA - MFIB Accept, A2 - Accept backup,

RA2 - MRIB Accept backup, MA2 - MFIB Accept backup

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

Other counts: Total/RPF failed/Other drops

I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps

Default

(

10.47.1.13,232.0.2.245

) Flags: K HW

0x77 OIF-IC count: 0, OIF-A count: 1

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

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

GigabitEthernet1/0/2

Flags: RA A MA

Null0, LISPv4 Decap Flags: RF F NS

CEF: OCE (lisp decap)

Pkts: 0/0/0 Rate: 0 pps

解封後，LHR確定VNI 4100內的實際目標IP地址為239.0.0.5，源IP地址為10.47.7.3

<#root>

Edge-1#

```
show ip mroute vrf blue_vn 239.0.0.5
```

IP Multicast Routing Table

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

Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.0.0.5), 1w3d/stopped, RP 10.47.6.1, flags: SJC1

Incoming interface: LISPO.4100, RPF nbr 10.47.1.10

Outgoing interface list:

Vlan1025, Forward/Sparse-Dense, 1w3d/00:02:01, flags:

(

10.47.7.3

,

239.0.0.5

), 00:01:29/00:01:30, flags: JT1

Incoming interface: LISPO.4100, RPF nbr 10.47.1.13

Outgoing interface list:

Vlan1025

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

Edge-1#

```
show ip mfib vrf blue_vn 239.0.0.5 10.47.7.3
```

Entry Flags: C - Directly Connected, S - Signal, IA - Inherit A flag,

ET - Data Rate Exceeds Threshold, K - Keepalive

DDE - Data Driven Event, HW - Hardware Installed

ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB

MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary

MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,

e - Encap helper tunnel flag.

I/O Item Flags: IC - Internal Copy, NP - Not platform switched,

NS - Negate Signalling, SP - Signal Present,

A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,

MA - MFIB Accept, A2 - Accept backup,

RA2 - MRIB Accept backup, MA2 - MFIB Accept backup

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

Other counts: Total/RPF failed/Other drops

```

I/O Item Counts: HW Pkt Count/FS Pkt Count/PS Pkt Count Egress Rate in pps
VRF blue_vn
(
10.47.7.3,239.0.0.5
) Flags: HW
<-- Unicast Source and Overlay Group

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

LISP0.4100 Flags: A <-- Incoming Interface

Vlan1025 Flags: F NS <-- Outgoing Interface

Pkts: 0/0/0 Rate: 0 pps

```

使用命令 `show ip igmp snooping groups vlan <VLAN>` 檢視哪些埠將接收多播資料流。

```

<#root>
Edge-1#
show ip igmp snooping groups vlan 1025

```

```

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

```

資料層面驗證 (取決於平台)

Mroute 硬體程式設計- IOS mroute

硬體程式設計使用以下鍵：IOS，然後FMAN RP，再到FMAN FP，然後FED。首先驗證IOS，使用命令「`show ip mroute vrf <VN Name> <overlay group address> verbose`」和「`show ip mroute <underlay group address> verbose`」

```

<#root>
Edge-1#
show ip mroute vrf blue_vn 239.0.0.5 verbose

```

```

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

```

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector, p - PIM Joins on route,
x - VxLAN group, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - 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

(

*, 239.0.0.5

), 1w3d/stopped, RP 10.47.6.1, flags: SJCl

Incoming interface: LISPO.4100, RPF nbr 10.47.1.10, LISP: [10.47.1.10, 232.0.2.245]

Outgoing interface list:

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

(

10.47.7.3, 239.0.0.5

), 00:02:19/00:00:40, flags: JTl

Incoming interface: LISPO.4100, RPF nbr 10.47.1.13, LISP: [10.47.1.13, 232.0.2.245]

Outgoing interface list:

Vlan1025, Forward/Sparse-Dense, 00:02:19/00:02:58, Pkts:0, flags:

在下層

<#root>

Edge-1#

show ip mroute 232.0.2.245 verbose

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector, p - PIM Joins on route,

x - VxLAN group, c - PFP-SA cache created entry,

* - determined by Assert, # - iif-starg configured on rpf intf,

e - 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

(

10.47.1.13, 232.0.2.245

), 01:18:55/00:02:04, flags: sT

Incoming interface: GigabitEthernet1/0/2, RPF nbr 10.47.1.4

LISP EID ref count: 1, Underlay ref timer: 00:05:13

Outgoing interface list:

Null0, Forward/Dense, 00:01:46/stopped, Pkts:0, flags:

(

10.47.1.10, 232.0.2.245

), 2d06h/00:02:59, flags: sT

Incoming interface: GigabitEthernet1/0/1, RPF nbr 10.47.1.0

LISP EID ref count: 1, Underlay ref timer: 00:05:12

Outgoing interface list:

Null0, Forward/Dense, 2d06h/stopped, Pkts:0, flags:

Mroute硬體程式設計- IOS MFIB

使用命令「show ip mfib vrf <VN Name> <overlay group address> verbose」和「show ip mroute <underlay group address> verbose」驗證重疊和底層MFIB

在覆蓋中

<#root>

Edge-1#

```
show ip mfib vrf blue_vn 239.0.0.5 verbose
```

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

(

*,239.0.0.5

) Flags: C K HW

0x6D OIF-IC count: 0, OIF-A count: 1

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

```
HW Forwarding: 16218869633044709376/0/0/0, Other: 0/0/0
LISPO.4100 Flags: RA A MA NS
Vlan1025 Flags: RF F NS
CEF: Adjacency with MAC: 01005E00000500000C9FFB870800
Pkts: 0/0/0 Rate: 0 pps
(
```

```
10.47.7.3,239.0.0.5
```

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

在下層

```
<#root>
```

```
Edge-1#
```

```
show ip mfib 232.0.2.245 verbose
```

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

```
10.47.1.10,232.0.2.245
```

```
) Flags: K HW
0x18 OIF-IC count: 0, OIF-A count: 1
SW Forwarding: 0/0/0/0, Other: 0/0/0
HW Forwarding: 8384858081233731584/0/0/0, Other: 0/0/0
GigabitEthernet1/0/1 Flags: RA A MA
Null0, LISPV4 Decap Flags: RF F NS
CEF: OCE (lisp decap)
Pkts: 0/0/0 Rate: 0 pps
(
```

```
10.47.1.13,232.0.2.245
```

```
) Flags: K HW
```



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

Mroute硬體程式設計- FMAN RP

要驗證FMAN RP，請先捕獲VRF ID。

```
<#root>
```

```
Edge-1#
```

```
show vrf detail blue_vn | include Id
```

```
VRF blue_vn (
```

```
VRF Id = 2
```

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

接下來，使用VRF索引值作為下一個命令。要驗證重疊(*, G)，請使用命令「show platform software ip switch active r0 mfib vrf index <VRF Index> group <overlay group address>/32」

```
<#root>
```

```
Edge-1#
```

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

```
Route flags:
```

```
S - Signal; C - Directly connected;
```

```
IA - Inherit A Flag; L - Local;
```

```
BR - Bidir route
```

```
*, 239.0.0.5/32 --> OBJ_INTF_LIST (0x6d)
```

```
Obj id: 0x6d, Flags: C
```

```
OM handle: 0x348030b738
```

要驗證重疊(S, G)，請使用命令「show platform software ip switch active r0 mfib vrf index 2 group address <overlay group address> <unicast source>」

```
<#root>
```

```
Edge-1#
```

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

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

要驗證重疊(*, G)的襯底(S, G), 請使用命令「show platform software ip switch active r0 mfib group address <underlay group address> <RP address>」

<#root>

Edge-1#

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

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

要驗證重疊(S, G)的襯底(S, G), 請使用命令「show platform software ip switch active r0 mfib group address <underlay group address> <RLOC of FHR>」

<#root>

Edge-1#

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

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

Mroute硬體程式設計- FMAN FP

要驗證重疊(*, G), 請使用命令「show platform software ip switch switch active f0 mfib vrf index <VRF ID> group <overlay group address>」

<#root>

Edge-1#

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

Route flags:

S - Signal; C - Directly connected;

IA - Inherit A Flag; L - Local;

BR - Bidir route

*, 239.0.0.5/32 --> OBJ_INTF_LIST (0x6d)

Obj id: 0x6d, Flags: C

aom id:

100880

, HW handle: (nil) (created)

要驗證重疊(S, G), 請使用命令「show platform software ip switch active f0 mfib vrf index <VRF ID> group address <overlay group address> <unicast source>」

<#root>

Edge-1#

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

Route flags:

S - Signal; C - Directly connected;

IA - Inherit A Flag; L - Local;

BR - Bidir route

239.0.0.5, 10.47.7.3/64 --> OBJ_INTF_LIST (0x8f)

Obj id: 0x8f, Flags: unknown

aom id:

161855

, HW handle: (nil) (created)

要驗證重疊(*, G)的襯底(S, G), 請使用命令「"show platform software ip switch active f0 mfib group address <underlay group address> <RP address>」

<#root>

Edge-1#

```
show platform ip switch active f0 mfib group address 232.0.2.245 10.47.1.10
```

Route flags:

S - Signal; C - Directly connected;

IA - Inherit A Flag; L - Local;

BR - Bidir route

232.0.2.245, 10.47.1.10/64 --> OBJ_INTF_LIST (0x18)

Obj id: 0x18, Flags: unknown

```
aom id:  
138716  
, HW handle: (nil) (created)
```

要驗證重疊(S, G)的襯底(S, G), 請使用命令「show platform software ip switch active f0 mfib group address <underlay group address> <RLOC of FHR>」

```
<#root>
```

```
Edge-1#
```

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

```
Route flags:
```

```
S - Signal; C - Directly connected;
```

```
IA - Inherit A Flag; L - Local;
```

```
BR - Bidir route
```

```
232.0.2.245, 10.47.1.13/64 --> OBJ_INTF_LIST (0x5)
```

```
Obj id: 0x5, Flags: unknown
```

```
aom id:
```

```
161559
```

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

Mroute硬體程式設計- FMAN FP資料庫

要驗證FMAN FP對象, 請使用命令「show platform software object-manager switch active f0 object <object ID> parents」

例如, 驗證覆蓋(*, G)

```
<#root>
```

```
Edge-1#
```

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

```
Object identifier: 100605
```

```
Description: ipv4_mcast table 2 (
```

```
blue_vn
```

```
), vrf id 2
```

```
Status: Done
```

```
Object identifier: 100878
```

```
Description:
```

```
mlist 109
```

```
Status: Done
```

驗證覆蓋(S , G)

<#root>

Edge-1#

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

Object identifier: 100605

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

Status: Done

Object identifier: 161854

Description:

```
mlist 143
```

Status: Done

mlist是在不同對象中與mroute分隔的傳入介面(IIF)和傳出介面清單(OIL)的組合。要驗證mlist，請使用命令「show platform software mlist switch active f0 index <index>」

<#root>

Edge-1#

```
show platform software mlist switch active f0 index 109
```

Multicast List entries

OCE Flags:

NS - Negate Signalling; IC - Internal copy;

A - Accept; F - Forward;

OCE Type OCE Flags Interface

0xf8000171 OBJ_ADJACENCY NS, A LISP0.4100

<-- Incoming Interface for (*,G)

0xf80001f1 OBJ_ADJACENCY NS, F Vlan1025

<-- Outgoing Interface for (S,G)

<#root>

Edge-1#

```
show platform software mlist switch active f0 index 143
```

Multicast List entries

OCE Flags:

NS - Negate Signalling; IC - Internal copy;

A - Accept; F - Forward;
OCE Type OCE Flags Interface

0xf8000171 OBJ_ADJACENCY A LISPO.4100

<-- Outgoing Interface for (S,G)

0xf80001f1 OBJ_ADJACENCY NS, F Vlan1025

<-- Incoming Interface for (S,G)

Mroute硬體程式設計- FED

要驗證重疊(S , G) , 請使用命令 「show platform software fed switch active ip mfib vrf <VN Name>
<overlay group address> <Unicast Source>」

<#root>

Edge-1#

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

Multicast (S,G) Information

VRF : 2

Source Address : 10.47.7.3

HTM Handler : 0x7f0efe53a638

SI Handler : 0x7f0efe50ec68

DI Handler :

0x7f0efe530768

REP RI handler : 0x7f0efe5387e8

Flags :

Packet count : 0

State : 4

RPF :

LISPO.4100 A

OIF :

Vlan1025 F NS

LISPO.4100 A

(Adj: 0xf8000171)

要驗證襯底(S , G) , 請使用show platform software fed switch active ip mfib <underlay group
address> <RLOC of FHR>命令

<#root>

Edge-1#

```
show platform software fed switch active ip mfib 232.0.2.245 10.47.1.13
```

```

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

```

```
0x7f0efe525538
```

```

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

```

接下來，目標索引(DI)同時針對重疊和底層(S, G)進行驗證，您可以使用命令「show platform hardware fed switch active fwd-asic abstraction print-resource-handle <DI Handler> 1」

對於疊加(S, G)

```
<#root>
```

```
Edge-1#
```

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

```

Handle:0x7f0efe530768 Res-Type:ASIC_RSC_DI Res-Switch-Num:255 Asic-Num:255 Feature-ID:AL_FID_L3_MULTICA
priv_rri/priv_si Handle: (nil)Hardware Indices/Handles: index0:0x5279 mtu_index/13u_rri_index0:0x0 index1
Cookie length: 56
00 00 00 00 00 00 00 00 02 00 00 00 03 07 2f 0a 05 00 00 ef 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Detailed Resource Information (ASIC_INSTANCE# 0)
-----

```

```

Destination index = 0x5279
pmap = 0x00000000 0x00000010

```

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

```

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

```

```
pmap = 0x00000000 0x00000000  
cmi = 0x0  
rcp_pmap = 0x0  
al_rsc_cmi  
CPU Map Index (CMI) [0]  
ctiLo0 = 0  
ctiLo1 = 0  
ctiLo2 = 0  
cpuQNum0 = 0  
cpuQNum1 = 0  
cpuQNum2 = 0  
npuIndex = 0  
stripSeg = 0  
copySeg = 0  
=====
```

對於襯底(S , G)

<#root>

Edge-1#

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

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

Destination index = 0x5284

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

```
cmi = 0x0
```

```
rcp_pmap = 0x1 <-- Indicates recirculation is required
```

```
al_rsc_cmi  
CPU Map Index (CMI) [0]  
ctiLo0 = 0  
ctiLo1 = 0  
ctiLo2 = 0  
cpuQNum0 = 0  
cpuQNum1 = 0  
cpuQNum2 = 0  
npuIndex = 0  
stripSeg = 0  
copySeg = 0  
Detailed Resource Information (ASIC_INSTANCE# 1)
```

Destination index = 0x5284

```
pmap = 0x00000000 0x00000000  
cmi = 0x0  
rcp_pmap = 0x0  
al_rsc_cmi  
CPU Map Index (CMI) [0]  
ctiLo0 = 0  
ctiLo1 = 0
```


ctiLo2 = 0
cpuQNum0 = 0
cpuQNum1 = 0
cpuQNum2 = 0
npuIndex = 0
stripSeg = 0
copySeg = 0

=====

關於此翻譯

思科已使用電腦和人工技術翻譯本文件，讓全世界的使用者能夠以自己的語言理解支援內容。請注意，即使是最佳機器翻譯，也不如專業譯者翻譯的內容準確。Cisco Systems, Inc. 對這些翻譯的準確度概不負責，並建議一律查看原始英文文件（提供連結）。