

排除SD-Access交換矩陣中的ARP解析故障

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簡介

本檔案將說明如何對SD存取光纖中的位址解析通訊協定(ARP)進行疑難排解。

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
- Locator/ID Separation Protocol(LISP)
- 位址解析通訊協定(ARP)

採用元件

本文中的資訊係根據以下軟體和硬體版本：

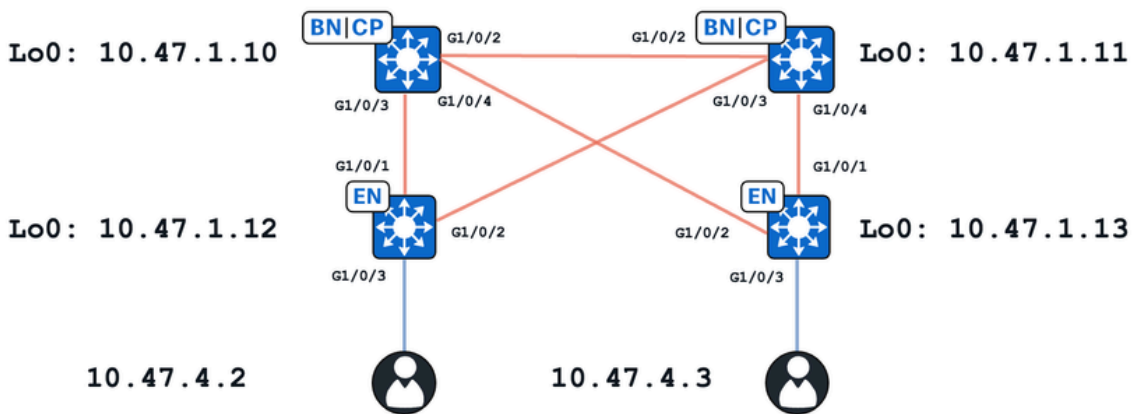
- Cisco IOS® XE 17.10.1上的C9000v
- SDA 1.0 (非LISP PubSub)

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

拓撲



在本練習中：

- 10.47.1.10和10.47.1.11是並置邊界
- 10.47.1.12和10.47.1.13是交換矩陣邊緣節點
- 10.47.4.2和10.47.4.3是SDA交換矩陣中的端點，位於同一個VLAN/子網和同一個VN(red_vn)中

本文檔介紹了兩個主要使用案例：

- 通過單播路徑在10.47.4.2和10.47.4.3之間進行ARP解析
- 通過泛洪路徑解析10.47.4.2和10.47.4.3之間的ARP

單播路徑初始狀態

在SDA中，交換矩陣內的ARP解析有兩種主要方法。所謂的單點傳播路徑表示沒有配置第2層(L2)ARP泛洪，或者沒有在LISP第2層例項ID(IID)下配置與所涉VLAN對應的「泛洪arp nd」。除了

此警告，為符合單播ARP路徑，沒有配置「IP本地代理ARP」或不存在第3層專用池。

如果滿足這些警告，請繼續此故障排除部分，並假設兩個端點（10.47.4.2和10.47.4.3）都可以到達存在於10.47.4.1的交換矩陣邊緣交換機上的各自預設網關

```
<#root>
```

```
Edge-1#
```

```
ping vrf red_vn 10.47.4.2
```

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

```
Sending 5, 100-byte ICMP Echos to 10.47.4.2, timeout is 2 seconds:
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 257/292/344 ms
```

```
<#root>
```

```
Edge-2#
```


```
ping vrf red_vn 10.47.4.3
```

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

```
Sending 5, 100-byte ICMP Echos to 10.47.4.3, timeout is 2 seconds:
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 221/321/566 ms
```

 提示：建議從終端主機向邊緣交換機ping預設網關，而不是反之，以避免與終端主機裝置上的防火牆丟棄ICMP資料包相關的錯誤結論。

接下來，驗證每個交換矩陣邊緣節點在IP裝置跟蹤(IPDT)、LISP第2層資料庫、第2層地址解析(AR)資料庫和第3層資料庫中都有各自的端點。

```
Edge-1:
```

要驗證IPDT中的端點，請使用命令show device-tracking database interface <interface connecting to endpoint>

```
<#root>
```

```
Edge-1#
```

```
show device-tracking database interface gi1/0/3
```

```
portDB has 2 entries for interface Gi1/0/3, 2 dynamic
```

```
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	prlv1	ag
DH4					
10.47.4.2					
5254.0019.93e9					
Gi1/0/3	1026	0024	15s	REACHABLE	228 s try 0(6374 s)

要驗證LISP L2資料庫中的端點，請使用命令show lisp eid-table vlan <vlan id> ethernet database <mac address>使用上一個命令中的VLAN和MAC地址

<#root>

Edge-1#

```
show lisp eid-table vlan 1026 ethernet database 5254.0019.93e9
```

```
LISP ETR MAC Mapping Database for LISP 0 EID-table Vlan 1026 (IID 8190), LSBs: 0x1
Entries total 1, no-route 0, inactive 0, do-not-register 2
```

```
5254.0019.93e9/48, dynamic-eid Auto-L2-group-8190, inherited from default locator-set rloc_222e1707-175
```

```
Uptime: 3w5d, Last-change: 3w5d
```

```
Domain-ID: local
```

```
Service-Insertion: N/A
```

```
Locator Pri/Wgt Source State
```

```
10.47.1.12 10/10 cfg-intf site-self, reachable <-- Edge-1's RLOC
```

```
Map-server Uptime ACK Domain-ID
```

```
10.47.1.10 1w3d Yes 0
```

```
10.47.1.11 3w5d Yes 0
```

要驗證L2 AR資料庫，請使用命令show lisp eid-table vlan <vlan-id> ethernet database address-resolution <mac address>

<#root>

Edge-1#

```
show lisp eid-table vlan 1026 ethernet database address-resolution 5254.0019.93e9
```

```
LISP ETR Address Resolution for LISP 0 EID-table Vlan 1026 (IID 8190)
```

```
(* ) -> entry being deleted
```

```
Hardware Address L3 InstID Host Address
```

```
5254.0019.93e9 4099 10.47.4.2/32 <-- Endpoint MAC address, LISP L3 IID, and IPv4 address, r
```

要驗證LISP第3層資料庫，請使用命令show lisp instance-id <L3 IID> ipv4 資料庫<IPv4地址>/子網掩碼使用前面命令中的LISP第3層IID

<#root>

Edge-1#

```
show lisp instance-id 4099 ipv4 database 10.47.4.2/32
```

```
LISP ETR IPv4 Mapping Database for LISP 0 EID-table vrf red_vn (IID 4099), LSBs: 0x1
Entries total 1, no-route 0, inactive 0, do-not-register 1
```

10.47.4.2/32

```
, dynamic-eid red-IPV4, inherited from default locator-set rloc_222e1707-175d-4019-a783-060404f8bc2f
Uptime: 3w5d, Last-change: 3w5d
Domain-ID: local
Service-Insertion: N/A
Locator      Pri/Wgt  Source      State
```

10.47.1.12

```
10/10  cfg-intf  site-self, reachable
```

<-- Edge-1's own RLOC

Map-server	Uptime	ACK	Domain-ID
10.47.1.10	1w0d	Yes	0
10.47.1.11	1w0d	Yes	0

Edge-2:

要驗證IPDT中的端點，請使用命令show device-tracking database interface <interface connecting to local endpoint>

<#root>

Edge-2#

```
show device-tracking database interface gi1/0/3
```

```
portDB has 3 entries for interface Gi1/0/3, 3 dynamic
```

```
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	ag
-----------------------	--------------------	-----------	------	-------	----

DH4

10.47.4.3

```
5254.001e.ad00
Gi1/0/3 1026 0024 122s REACHABLE 124 s try 0(5810 s)
```

要驗證LISP L2資料庫中的端點，請使用命令show lisp eid-table vlan <vlan id> ethernet database <mac address>使用前面命令中的VLAN和MAC地址

```
<#root>
```

```
Edge-2#
```

```
show lisp eid-table vlan 1026 ethernet database 5254.001e.ad00
```

```
LISP ETR MAC Mapping Database for LISP 0 EID-table Vlan 1026 (IID 8190), LSBs: 0x1
Entries total 1, no-route 0, inactive 0, do-not-register 2
```

```
5254.001e.ad00/48, dynamic-eid Auto-L2-group-8190, inherited from default locator-set rloc_691b1fe4-526
```

```
Uptime: 3w5d, Last-change: 3w5d
```

```
Domain-ID: local
```

```
Service-Insertion: N/A
```

```
Locator Pri/Wgt Source State
```

```
10.47.1.13 10/10 cfg-intf site-self, reachable <-- Edge-2's RLOC
```

```
Map-server Uptime ACK Domain-ID
```

```
10.47.1.10 1w2d Yes 0
```

```
10.47.1.11 1w2d Yes 0
```

要驗證L2 AR資料庫，請使用命令show lisp eid-table vlan <vlan-id> ethernet database address-resolution <mac address>

```
<#root>
```

```
Edge-2#
```

```
show lisp eid-table vlan 1026 ethernet database address-resolution 5254.001e.ad00
```

```
LISP ETR Address Resolution for LISP 0 EID-table Vlan 1026 (IID 8190)
```

```
(*) -> entry being deleted
```

```
Hardware Address L3 InstID Host Address
```

```
5254.001e.ad00 4099 10.47.4.3/32 <-- Endpoint MAC address, LISP L3 IID, and IPv4 address, r
```

要驗證LISP第3層資料庫，請使用命令show lisp instance-id <L3 IID> ipv4資料庫<IPv4地址>/子網掩碼使用前面命令中的LISP第3層IID

```
<#root>
```

Edge-2#

```
show lisp instance-id 4099 ipv4 database 10.47.4.3/32
```

```
LISP ETR IPv4 Mapping Database for LISP 0 EID-table vrf ed_vn (IID 4099), LSBs: 0x1  
Entries total 1, no-route 0, inactive 0, do-not-register 2
```

10.47.4.3/32

```
, dynamic-eid red-IPv4, inherited from default locator-set rloc_691b1fe4-5264-44c2-bb1b-0903b3eb2c51  
Uptime: 1w0d, Last-change: 1w0d  
Domain-ID: local  
Service-Insertion: N/A  
Locator      Pri/Wgt Source      State
```

10.47.1.13

```
10/10 cfg-intf site-self, reachable
```

<-- Edge-2, RLOC

Map-server	Uptime	ACK	Domain-ID
10.47.1.10	1w0d	Yes	0
10.47.1.11	1w0d	Yes	0

並置邊框：

理想情況下，兩個終端都從L2 LISP、L2 AR和L3視角註冊到交換矩陣控制平面（Border-1和Border-2）。要派生L2 LISP ID，請檢查交換矩陣邊緣節點並使用命令show vlan id <vlan id>

<#root>

Edge-1#

```
show vlan id 1026
```

VLAN Name	Status	Ports
1026 red	active	

L2LI0:8190

, Gi1/0/3

<-- L2 LISP IID

VLAN Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Trans1	Trans2
1026 enet	101026	1500	-	-	-	-	-	0	0

Remote SPAN VLAN

Disabled

Primary	Secondary	Type	Ports
-----	-----	-----	-----

使用show lisp instance-id <L2 IID> ethernet server命令中的L2 IID，從L2 LISP角度驗證伺服器

```
<#root>
```

```
Border-1#
```

```
show lisp instance-id 8190 ethernet server
```

```
LISP Site Registration Information
```

```
* = Some locators are down or unreachable
```

```
# = Some registrations are sourced by reliable transport
```

Site Name	Last Register	Up	Who Last Registered	Inst ID	EID Prefix
site_uci	never 1w3d	no yes#	--	8190	any-mac

```
10.47.1.12
```

```
:21038 8190
```

```
5254.0019.93e9/48 <-- RLOC of the FE node, EID prefix that was registered
```

```
1w2d yes#
```

```
10.47.1.13
```

```
:16056 8190
```

```
5254.001e.ad00/48 <-- RLOC of the FE node, EID prefix that was registered
```

要驗證L2 AR伺服器，請使用命令show lisp instance-id <L2 IID> ethernet server address-resolution

```
<#root>
```

```
Border-1#
```

```
show lisp instance-id 8190 ethernet server address-resolution
```

```
Address-resolution data for router lisp 0 instance-id 8190
```

L3 InstID	Host Address	Hardware Address
4099	10.47.4.2/32	5254.0019.93e9 <-- L3 LISP IID, Endpoint IPv4 A
4099	10.47.4.3/32	5254.001e.ad00 <-- L3 LISP IID, Endpoint IPv4 A

要驗證第3層伺服器，請使用命令show lisp instance-id <L3 IID> ipv4 server

```
<#root>
```

```
Border-1#
```



```
show lisp instance-id 4099 ipv4 server
```

LISP Site Registration Information

* = Some locators are down or unreachable

= Some registrations are sourced by reliable transport

Site Name	Last Register	Up	Who Last Registered	Inst ID	EID Prefix
site_uci	never	no	--	4099	0.0.0.0/0
	6d01h	yes#	10.47.1.11:22876	4099	8.8.8.8/32
	1w0d	yes#	10.47.1.10:21610	4099	10.47.2.4/30
	1w0d	yes#	10.47.1.11:22876	4099	10.47.2.12/30
	never	no	--	4099	10.47.4.0/24
	1w0d	yes#	10.47.1.12:21038	4099	10.47.4.2/32
	1w0d	yes#	10.47.1.13:16056	4099	10.47.4.3/32
	1w0d	yes#	10.47.1.11:22876	4099	10.47.6.0/24
	1w0d	yes#	10.47.1.11:22876	4099	10.47.7.0/24
	1w0d	yes#	10.47.1.11:22876	4099	10.47.9.8/29
	never	no	--	4099	10.47.10.0/24
	1w0d	yes#	10.47.1.13:16056	4099	10.47.10.2/32

控制平面向包含L3、L2和AR條目的註冊事件的簡要歷史記錄，在排查漫遊客戶端故障或可能出現的環路時（其中客戶端在極短時間內被多個交換矩陣邊緣意外註冊），這些記錄非常有用。

```
<#root>
```

```
Border-1#
```

```
show lisp instance-id 8190 ethernet server resolution registration-history | include Timestamp|10.47.4.2
```

```
Timestamp (UTC) Instance Proto Roam WLC Source
```

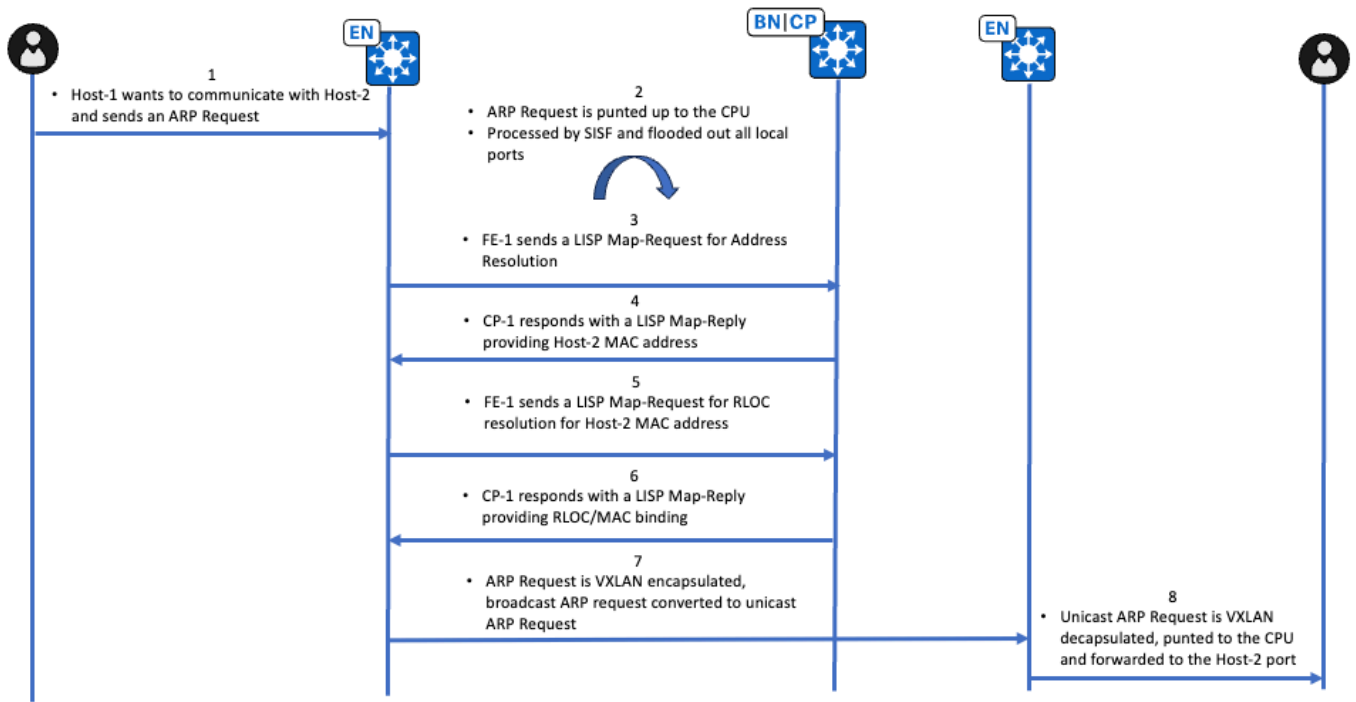
```
*Oct 9 19:14:39.183 8190 TCP No No 10.47.1.12
```

```
+*10.47.4.2/32 / 5254.0019.93e9 <-- Last registered at Oct 9
```

```
*Oct 9 19:14:41.183 8190 TCP No No 10.47.1.13
```

```
+*10.47.4.3/32 / 5254.001e.ad00 <-- Last registered at Oct 9
```

單播路徑ARP請求高級 workflow



單點傳送路徑ARP要求驗證

擁有IP地址10.47.4.2的終端傳送廣播ARP請求，通過邊緣1上的嵌入式資料包捕獲(EPC)進行確認

Edge-1(10.47.1.12)

<#root>

Edge-1#

```
monitor capture 1 interface g1/0/3 in match any
```

Edge-1#

```
monitor capture 1 start
```

Edge-1#

```
monitor capture 1 stop
```

Capture statistics collected at software:

Capture duration - 39 seconds

Packets received - 21

Packets dropped - 0

Packets oversized - 0

Number of Bytes dropped at asic not collected

Capture buffer will exists till exported or cleared

Stopped capture point : 1

Edge-1#

show monitor capture 1 buffer brief

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

1 0.000000

52:54:00:19:93:e9 -> ff:ff:ff:ff:ff:ff ARP 60 Who has 10.47.4.3? Tell 10.47.4.

Edge-1#

show monitor capture 1 buffer detailed

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

Frame 1: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface /tmp/epc_ws/wif_to_ts_p

Interface id: 0 (/tmp/epc_ws/wif_to_ts_pipe)

Interface name: /tmp/epc_ws/wif_to_ts_pipe

Encapsulation type: Ethernet (1)

Arrival Time: Oct 19, 2023 23:43:31.893095000 UTC

[Time shift for this packet: 0.000000000 seconds]

Epoch Time: 1697759011.893095000 seconds

[Time delta from previous captured frame: 0.000000000 seconds]

[Time delta from previous displayed frame: 0.000000000 seconds]

[Time since reference or first frame: 0.000000000 seconds]

Frame Number: 1

Frame Length: 60 bytes (480 bits)

Capture Length: 60 bytes (480 bits)

[Frame is marked: False]

[Frame is ignored: False]

[Protocols in frame: eth:ethertype:arp]

Ethernet II, Src: 52:54:00:19:93:e9 (

52:54:00:19:93:e9

), Dst: ff:ff:ff:ff:ff:ff (

ff:ff:ff:ff:ff:ff

)

Destination: ff:ff:ff:ff:ff:ff (ff:ff:ff:ff:ff:ff)

Address: ff:ff:ff:ff:ff:ff (ff:ff:ff:ff:ff:ff)

.... ..1. = LG bit: Locally administered address (this is NOT the factory d

.... ..1. = IG bit: Group address (multicast/broadcast)

Source: 52:54:00:19:93:e9 (52:54:00:19:93:e9)

Address: 52:54:00:19:93:e9 (52:54:00:19:93:e9)

.... ..1. = LG bit: Locally administered address (this is NOT the factory d

.... ..0. = IG bit: Individual address (unicast)

Type: ARP (0x0806)

Padding: 00000000000000000000000000000000

Address Resolution Protocol (request)

Hardware type: Ethernet (1)

Protocol type: IPv4 (0x0800)

Hardware size: 6

Protocol size: 4

Opcode: request (1)

Sender MAC address: 52:54:00:19:93:e9 (

52:54:00:19:93:e9

)

Sender IP address:

10.47.4.2

Target MAC address: 00:00:00:00:00:00 (

00:00:00:00:00:00

```
)  
  Target IP address:  
10.47.4.3
```

此ARP請求將傳送到CPU進行進一步處理。利用FED Punject捕獲獲取其他資訊。

<#root>

Edge-1#

```
debug platform software fed switch active punt packet-capture set-filter "arp"
```

Edge-1#

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

Edge-1#

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

Edge-1#

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

```
Punt packet capturing: disabled. Buffer wrapping: disabled  
Total captured so far: 8 packets. Capture capacity : 4096 packets  
Capture filter : "arp"
```

```
----- Punt Packet Number: 1, Timestamp: 2023/10/19 23:55:03.552 -----  
interface : physical: GigabitEthernet1/0/3[if-id: 0x0000000b], pa:  
GigabitEthernet1/0/3 [if-id: 0x0000000b] <-- Physical interface the ARP Request was received from  
metadata : cause: 109 [snoop packets], sub-cause: 1,  
q-no: 16  
, linktype: MCP_LINK_TYPE_IP [1]  
<-- Punted for cause snoop packets to CPU queue 16  
ether hdr : dest mac:  
ffff.ffff.ffff  
, src mac:  
5254.0019.93e9  
ether hdr : ethertype:  
0x0806 (ARP)
```

要檢視CPU隊列16，請使用命令show platform software fed switch active punt cpuq 16

```
<#root>
```

```
Edge-1#
```

```
show platform software fed switch active punt cpuq 16
```

```
Punt CPU Q Statistics
```

```
=====
```

```
CPU Q Id           : 16  
CPU Q Name         : CPU_Q_PROTO_SNOOPING  
Packets received from ASIC : 49054  
Send to IOSd total attempts  :
```

```
49054 <-- Same number as received from ASIC
```

```
Send to IOSd failed count :
```

```
0 <-- No failures
```

理想情況下，在CPU管制器（隊列16）的Proto Snooping隊列中沒有丟棄，請使用命令show platform hardware fed switch active qos queue stats internal cpu policer

```
<#root>
```

```
Edge-1#
```

```
show platform hardware fed switch active qos queue stats internal cpu policer | include QId|Proto
```

QId	PlcIdx	Queue Name	Enabled	Rate	Rate	Drop(Bytes)	Drop(Frames)
16	12	Proto Snooping	No	2000	2000	0	0

```
<-- No drops
```

接下來，Punt Service會處理已傳送的ARP請求。您可以通過debug，debug platform software infrastructure punt看到此行為

```
<#root>
```

```
Edge-1#
```

```
debug platform software infrastructure punt
```

```
*Oct 20 00:07:01.509: PUNT RX: mcprp_process_receive_packet: pak->vlan_id: 1026
```

```
*Oct 20 00:07:01.509: Punt: IP proto src 147.233.
```

```
10.47
```


```
, dst
```

```
4.2
```

```
.0.0, from table 0, intf Gi1/0/3, encap ARPA, size 60, cause snoop packets(L3)
```

```
<-- The IP address is obscured, but it is 10.47.4.2
```

```
*Oct 20 00:07:01.509: punt cause:snoop packets invoking reg_invoke_mcprp_punt_feature_msg
*Oct 20 00:07:01.509: punt cause:snoop packets MCPRP_PUNT_PAK_PROC_OK_DONE
```

 注意：此調試是頻繁的，請謹慎使用。

Punt Service處理資料包後，會將資料包傳給Proto Snoop和Proto ARP snoop進程。這會在ARP監聽表中建立一個條目，並將資料包傳送到Device-Tracking/SISF。若要看到此情況，debug arp以及debug platform fall

```
<#root>
```

```
Edge-1#
```


```
debug arp
```

```
Edge-1#
```

```
debug platform fhs all
```

```
*Oct 20 00:12:06.908:
```

```
ARP packet received from ARP snooper(Gil/0/3 10.47.4.2 (5254.0019.93e9) VLAN:1026)
```

 注意：這些調試過程比較雜亂，請謹慎使用

使用命令show platform arpsnooping client <MAC address> 檢視ARP請求會發生什麼情況

```
<#root>
```

```
Edge-1#
```

```
show platform arpsnooping client 5254.0019.93e9
```

```
PLAT_DAI      : Platform DAI shim
FWDPLANE     : Dataplane forwarding
BRIDGE       : Packet to be bridged
ARPSN        : Arp Snooping
Packet Trace for client MAC 5254.0019.93E9:
```

Timestamp	Sender Mac	Sender IP	Target Mac	Target IP	Opcode
2023/10/24 14:37:15.045	5254.0019.93e9	10.47.4.2	0000.0000.0000	10.47.4.3	ARP_REQUEST
2023/10/24 14:37:15.045	5254.0019.93e9	10.47.4.2	0000.0000.0000	10.47.4.3	ARP_REQUEST
2023/10/24 14:37:15.045	5254.0019.93e9	10.47.4.2	0000.0000.0000	10.47.4.3	ARP_REQUEST

```
INJECT:BD_DPIDX_TO_FWDPLANE
```

在IPDT/SISF處理資料包時，它會驗證ARP請求的內容並建立一個臨時條目，同時等待通過LISP進行解析。

```
<#root>
```

```
Edge-1#
```

```
show device-tracking messages detailed 255 | i 5254.0019.93e9
```

```
[Tue Oct 24 14:37:12.000] VLAN 1026, From Gi1/0/3 seclvl [guard], MAC 5254.0019.93e9: ARP::REQ,  
[Tue Oct 24 14:37:13.000] VLAN 1026, From Gi1/0/3 seclvl [guard], MAC 5254.0019.93e9: ARP::REQ,
```

如果使用debug device-tracking，您會看到裝置跟蹤中有一個指向000.0000.00fd的條目。所有這一切都意味著Gi1/0/3背後的主機正在查詢尚未解析的主機，該主機處於臨時狀態（或者永久狀態，如果正在查詢的不存在的主機，這未必是件壞事）

```
<#root>
```

```
Edge-1
```

```
#debug device-tracking
```

```
Device-tracking - General debugging is on  
*Oct 24 14:55:02.967: SISF[POL]: vlan 1026 matches vlan list on policy IPDT_POLICY for target Gi1/0/3  
*Oct 24 14:55:02.967: SISF[POL]: Found matching policy IPDT_POLICY for feature Device-tracking on Gi1/0/3  
*Oct 24 14:55:02.967: SISF[GLN]: Checking if ARP ownership can be taken by device-tracking  
*Oct 24 14:55:02.967: SISF[GLN]: Not an ARP reply, do not take over  
*Oct 24 14:55:02.967: SISF[POL]: Found matching policy LISP-AR-RELAY-VLAN for feature Address Resolution  
*Oct 24 14:55:02.967: SISF[MAC]:
```

```
Creating new MAC entry for 0000.0000.00fd on interface          if none exists
```

```
*Oct 24 14:55:02.967: SISF[MAC]: Number of MAC entries in MAC-CREATING state incremented to 1  
*Oct 24 14:55:02.968: SISF[BT ]: Attaching 0000.0000.00fd entry in MacAdrDB for 10.47.4.3  
*Oct 24 14:55:02.968: SISF[GLN]: Binding entry event 1 for 10.47.4.3
```

由於LISP-AR-RELAY-VLAN策略，SISF使用LISP觸發ARP解析，此LISP控制平面進程可以接管。

```
<#root>
```

```
Edge-1#
```

```
debug lisp control-plane all
```

```
Edge-1#
```

```
debug l2lisp all
```

```
*Oct 24 15:10:27.677: LISP Client 'SISF client':
```

```
SISF request to resolve 10.47.4.3 in Vlan 1026.
```

Edge-1通過LISP控制平面傳送LISP對映請求以解析MAC地址10.47.4.3

<#root>

Edge-1#

```
debug lisp control-plane all
```

Edge-1#

```
debug l2lisp all
```

```
*Oct 24 15:10:27.681: LISP[REMT ]-0: Map Request: Delay is over for IID 8190 EID 10.47.4.3/32, requester 'AR'.
```

```
*Oct 24 15:10:27.681: LISP[REMT ]-0 IID 8190: Schedule processing of Map-Requests from 'remote EID pref'
```

```
*Oct 24 15:10:27.681: LISP[REMT ]-0: Map Request:
```

```
Sending request for IID 8190 EID 10.47.4.3/32, requester 'AR'.
```

在Edge-1的CPU (控制平面) 上完成的雙向嵌入式資料包捕獲(EPC)演示傳入的ARP請求和後續的LISP對映請求

<#root>

Edge-1#

```
monitor capture 1 control-plane both match any
```

Edge-1#

```
monitor capture 1 start
```

```
Started capture point : 1
```

Edge-1#

```
monitor capture 1 stop
```

Edge-1#

```
show monitor capture 1 buffer display-filter "arp.dst.proto_ipv4==10.47.4.3 or lisp"
```

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

```
60  10.110293 52:54:00:19:93:e9 -> ff:ff:ff:ff:ff:ff ARP 60 Who has 10.47.4.3? Tell 10.47.4.2
```

```
61  10.111714 10.47.4.3 -> 10.47.4.3 LISP 114 Encapsulated Map-Request for Unknown LCAF Type (5
```

您可以更詳細地檢視LISP對映請求

<#root>

Edge-1#

```
show monitor capture 1 buffer display-filter "frame.number==61" detailed
```


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

```
Frame 61: 114 bytes on wire (912 bits), 114 bytes captured (912 bits) on interface /tmp/epc_ws/wif_to_t
  Interface id: 0 (/tmp/epc_ws/wif_to_ts_pipe)
    Interface name: /tmp/epc_ws/wif_to_ts_pipe
  Encapsulation type: Ethernet (1)
  Arrival Time: Oct 24, 2023 15:20:08.948469000 UTC
  [Time shift for this packet: 0.000000000 seconds]
  Epoch Time: 1698160808.948469000 seconds
  [Time delta from previous captured frame: 0.001421000 seconds]
  [Time delta from previous displayed frame: 0.000000000 seconds]
  [Time since reference or first frame: 10.111714000 seconds]
  Frame Number: 61
  Frame Length: 114 bytes (912 bits)
  Capture Length: 114 bytes (912 bits)
  [Frame is marked: False]
  [Frame is ignored: False]
  [Protocols in frame: eth:ethertype:ip:udp:lisp:ip:udp:lisp]
Ethernet II, Src: 00:00:00:00:00:00 (
00:00:00:00:00:00
), Dst: 00:00:00:00:00:00 (
00:00:00:00:00:00
)
<-- Ignore the SMAC/DMAC this is done up at the CPU, not final MAC addresses
  Destination: 00:00:00:00:00:00 (00:00:00:00:00:00)
    Address: 00:00:00:00:00:00 (00:00:00:00:00:00)
      .... ..0. .... = LG bit: Globally unique address (factory default)
      .... ...0 .... = IG bit: Individual address (unicast)
  Source: 00:00:00:00:00:00 (00:00:00:00:00:00)
    Address: 00:00:00:00:00:00 (00:00:00:00:00:00)
      .... ..0. .... = LG bit: Globally unique address (factory default)
      .... ...0 .... = IG bit: Individual address (unicast)
  Type: IPv4 (0x0800)
Internet Protocol Version 4,
src: 10.47.1.12, Dst: 10.47.1.10 <-- Edge-1 RLOC and one of the collocated border RLOC, respectively
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
    1100 00.. = Differentiated Services Codepoint: Class Selector 6 (48)
    .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
  Total Length: 100
  Identification: 0x599c (22940)
  Flags: 0x0000
    0... .... = Reserved bit: Not set
    .0.. .... = Don't fragment: Not set
    ..0. .... = More fragments: Not set
  Fragment offset: 0
  Time to live: 255
  Protocol: UDP (17)
  Header checksum: 0x4ab9 [validation disabled]
  [Header checksum status: Unverified]
  Source: 10.47.1.12
  Destination: 10.47.1.10
User Datagram Protocol, Src Port: 4342, Dst Port: 4342
  Source Port: 4342
  Destination Port: 4342
```

Length: 80
Checksum: 0x6393 [unverified]
[Checksum Status: Unverified]
[Stream index: 0]
[Timestamps]
 [Time since first frame: 0.000000000 seconds]
 [Time since previous frame: 0.000000000 seconds]
Locator/ID Separation Protocol
1000 = Type: Encapsulated Control Message (8)
 0... = S bit (LISP-SEC capable): Not set
 0.. = D bit (DDT-originated): Not set
 00 0000 0000 0000 0000 0000 0000 = Reserved bits: 0x00000000
Internet Protocol Version 4,
Src: 10.47.4.3, Dst: 10.47.4.3

<-- MAP Request to resolve the MAC address tied to 10.47.4.3

0100 = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
 1100 00.. = Differentiated Services Codepoint: Class Selector 6 (48)
 00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 68
Identification: 0x599b (22939)
Flags: 0x0000
 0... = Reserved bit: Not set
 .0.. = Don't fragment: Not set
 ..0. = More fragments: Not set
Fragment offset: 0
Time to live: 255
Protocol: UDP (17)
Header checksum: 0x44ea [validation disabled]
[Header checksum status: Unverified]
Source: 10.47.4.3
Destination: 10.47.4.3
User Datagram Protocol, Src Port: 4342, Dst Port: 4342
Source Port: 4342
Destination Port: 4342
Length: 48
Checksum: 0x9622 [unverified]
[Checksum Status: Unverified]
[Stream index: 1]
[Timestamps]
 [Time since first frame: 0.000000000 seconds]
 [Time since previous frame: 0.000000000 seconds]
Locator/ID Separation Protocol
0001 = Type: Map-Request (1)
.... 0000 00.. = Flags: 0x00
 0... = A bit (Authoritative): Not set
 0.. = M bit (Map-Reply present): Not set
 0. = P bit (Probe): Not set
 0 = S bit (Solicit-Map-Request): Not set
 0... = p bit (Proxy ITR): Not set
 0.. = s bit (SMR-invoked): Not set
 00 0000 000. = Reserved bits: 0x000
 0 0000 = ITR-RLOC Count: 0
Record Count: 1
Nonce: 0xcffee30fb39a05b7
Source EID AFI: Reserved (0)
Source EID: not set

```

ITR-RLOC 1: 10.47.1.12
  ITR-RLOC AFI: IPv4 (1)
  ITR-RLOC Address: 10.47.1.12
Map-Request Record 1: Unknown LCAF Type (53)/32
  Reserved: 0x00
  Prefix Length: 32
  Prefix AFI: LISP Canonical Address Format (LCAF) (16387)
  Prefix: Unknown LCAF Type (53)
    LCAF: Unknown (53)
      LCAF Header: 00003520000a
        Reserved bits: 0x00
        Flags: 0x00
        Type: Unknown (53)
        Reserved bits: 0x20
        Length: 10
      [Expert Info (Error/Protocol): LCAF type 53 is not defined in draft-ietf-lisp-lcaf-05]
      [LCAF type 53 is not defined in draft-ietf-lisp-lcaf-05]
      [Severity level: Error]
      [Group: Protocol]

```

並置邊界 (10.47.1.10和10.47.1.11)

接下來，LISP控制平面使用LISP對映回覆響應邊緣1。這可以在調試以及CPU EPC中看到。

```
<#root>
```

```
Border-2#
```

```
show monitor capture 1 buffer display-filter lisp
```

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

```

113 12.767420 10.47.4.3 -> 10.47.4.3 LISP 114 Encapsulated Map-Request for Unknown LCAF Type (53)/32
114 12.774428 10.47.1.11 -> 10.47.1.12 LISP 96 Map-Reply for Unknown LCAF Type (53)/32

```

在更詳細地檢視資料包時，我們可以看到LISP對映請求和後續的LISP對映回覆

```
<#root>
```

```
Border-2#
```

```
show monitor capture 1 buffer display-filter frame.number==113 detailed
```

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

```

Frame 113: 114 bytes on wire (912 bits), 114 bytes captured (912 bits) on interface /tmp/epc_ws/wif_to_
  Interface id: 0 (/tmp/epc_ws/wif_to_ts_pipe)
  Interface name: /tmp/epc_ws/wif_to_ts_pipe
  Encapsulation type: Ethernet (1)
  Arrival Time: Oct 24, 2023 15:41:06.566253000 UTC
  [Time shift for this packet: 0.000000000 seconds]
  Epoch Time: 1698162066.566253000 seconds
  [Time delta from previous captured frame: 0.013424000 seconds]
  [Time delta from previous displayed frame: 0.000000000 seconds]
  [Time since reference or first frame: 12.767420000 seconds]

```

Frame Number: 113
Frame Length: 114 bytes (912 bits)
Capture Length: 114 bytes (912 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ethertype:ip:udp:lisp:ip:udp:lisp]
Ethernet II, Src: 52:54:00:04:84:a3 (

52:54:00:04:84:a3

), Dst: 52:54:00:1c:7d:e0 (

52:54:00:1c:7d:e0

)

<-- True MAC addresses

Destination: 52:54:00:1c:7d:e0 (52:54:00:1c:7d:e0)

Address: 52:54:00:1c:7d:e0 (52:54:00:1c:7d:e0)

.... ..1. = LG bit: Locally administered address (this is NOT the factory d

.... ..0 = IG bit: Individual address (unicast)

Source: 52:54:00:04:84:a3 (52:54:00:04:84:a3)

Address: 52:54:00:04:84:a3 (52:54:00:04:84:a3)

.... ..1. = LG bit: Locally administered address (this is NOT the factory d

.... ..0 = IG bit: Individual address (unicast)

Type: IPv4 (0x0800)

Internet Protocol Version 4,

Src: 10.47.1.12, Dst: 10.47.1.11 <-- Edge-1 RLOC and Border-2 RLOC, respectively

0100 = Version: 4

.... 0101 = Header Length: 20 bytes (5)

Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)

1100 00.. = Differentiated Services Codepoint: Class Selector 6 (48)

.... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)

Total Length: 100

Identification: 0x5e19 (24089)

Flags: 0x0000

0... = Reserved bit: Not set

.0.. = Don't fragment: Not set

..0. = More fragments: Not set

Fragment offset: 0

Time to live: 255

Protocol: UDP (17)

Header checksum: 0x463b [validation disabled]

[Header checksum status: Unverified]

Source: 10.47.1.12

Destination: 10.47.1.11

User Datagram Protocol, Src Port: 4342, Dst Port: 4342

Source Port: 4342

Destination Port: 4342

Length: 80

Checksum: 0x6392 [unverified]

[Checksum Status: Unverified]

[Stream index: 1]

[Timestamps]

[Time since first frame: 0.000000000 seconds]

[Time since previous frame: 0.000000000 seconds]

Locator/ID Separation Protocol

1000 = Type: Encapsulated Control Message (8)

.... 0... = S bit (LISP-SEC capable): Not set

.... .0.. = D bit (DDT-originated): Not set

```

.... ..00 0000 0000 0000 0000 0000 0000 = Reserved bits: 0x00000000
Internet Protocol Version 4,
Src: 10.47.4.3, Dst: 10.47.4.3 <-- LISP MAP Request for 10.47.4.3

0100 .... = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
  1100 00.. = Differentiated Services Codepoint: Class Selector 6 (48)
  .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 68
Identification: 0x5e18 (24088)
Flags: 0x0000
  0... .... = Reserved bit: Not set
  .0.. .... = Don't fragment: Not set
  ..0. .... = More fragments: Not set
Fragment offset: 0
Time to live: 255
Protocol: UDP (17)
Header checksum: 0x406d [validation disabled]
[Header checksum status: Unverified]
Source: 10.47.4.3
Destination: 10.47.4.3
User Datagram Protocol, Src Port: 4342, Dst Port: 4342
Source Port: 4342
Destination Port: 4342
Length: 48
Checksum: 0xe9a8 [unverified]
[Checksum Status: Unverified]
[Stream index: 2]
[Timestamps]
  [Time since first frame: 0.000000000 seconds]
  [Time since previous frame: 0.000000000 seconds]
Locator/ID Separation Protocol
0001 .... = Type: Map-Request (1)
.... 0000 00.. = Flags: 0x00
  .... 0... = A bit (Authoritative): Not set
  .... .0.. = M bit (Map-Reply present): Not set
  .... ..0. = P bit (Probe): Not set
  .... ...0 = S bit (Solicit-Map-Request): Not set
  .... ....0... = p bit (Proxy ITR): Not set
  .... .... .0.. = s bit (SMR-invoked): Not set
  .... .... ..00 0000 000. .... = Reserved bits: 0x0000
  .... .... .... ..0 0000 = ITR-RLOC Count: 0
Record Count: 1
Nonce: 0x50c5f2b60b41ca1c
Source EID AFI: Reserved (0)
Source EID: not set
ITR-RLOC 1: 10.47.1.12
  ITR-RLOC AFI: IPv4 (1)
  ITR-RLOC Address: 10.47.1.12
Map-Request Record 1: Unknown LCAF Type (53)/32
  Reserved: 0x00
  Prefix Length: 32
  Prefix AFI: LISP Canonical Address Format (LCAF) (16387)
  Prefix: Unknown LCAF Type (53)
    LCAF: Unknown (53)
      LCAF Header: 00003520000a
        Reserved bits: 0x00
        Flags: 0x00
        Type: Unknown (53)
        Reserved bits: 0x20
        Length: 10

```

```
[Expert Info (Error/Protocol): LCAF type 53 is not defined in draft-ietf-lisp-lcaf-05]
  [LCAF type 53 is not defined in draft-ietf-lisp-lcaf-05]
  [Severity level: Error]
  [Group: Protocol]
```

我們還可以檢視傳送回的LISP對映應答

<#root>

Border-2#

```
show monitor capture 1 buffer display-filter frame.number==114 detailed
```

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

Frame 114: 96 bytes on wire (768 bits), 96 bytes captured (768 bits) on interface /tmp/epc_ws/wif_to_ts

Interface id: 0 (/tmp/epc_ws/wif_to_ts_pipe)

Interface name: /tmp/epc_ws/wif_to_ts_pipe

Encapsulation type: Ethernet (1)

Arrival Time: Oct 24, 2023 15:41:06.573261000 UTC

[Time shift for this packet: 0.000000000 seconds]

Epoch Time: 1698162066.573261000 seconds

[Time delta from previous captured frame: 0.007008000 seconds]

[Time delta from previous displayed frame: 0.000000000 seconds]

[Time since reference or first frame: 12.774428000 seconds]

Frame Number: 114

Frame Length: 96 bytes (768 bits)

Capture Length: 96 bytes (768 bits)

[Frame is marked: False]

[Frame is ignored: False]

[Protocols in frame: eth:ethertype:ip:udp:lisp]

Ethernet II, Src: 00:00:00:00:00:00 (

00:00:00:00:00:00

), Dst: 00:00:00:00:00:00 (

00:00:00:00:00:00

)

<-- CPU Inject does not properly show MAC addresses

Destination: 00:00:00:00:00:00 (00:00:00:00:00:00)

Address: 00:00:00:00:00:00 (00:00:00:00:00:00)

.... ..0. = LG bit: Globally unique address (factory default)

.... ..0. = IG bit: Individual address (unicast)

Source: 00:00:00:00:00:00 (00:00:00:00:00:00)

Address: 00:00:00:00:00:00 (00:00:00:00:00:00)

.... ..0. = LG bit: Globally unique address (factory default)

.... ..0. = IG bit: Individual address (unicast)

Type: IPv4 (0x0800)

Internet Protocol Version 4,

Src: 10.47.1.11, Dst: 10.47.1.12 <-- Border-2 RLOC and Edge-1 RLOC, respectively

0100 = Version: 4

.... 0101 = Header Length: 20 bytes (5)

Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)

1100 00.. = Differentiated Services Codepoint: Class Selector 6 (48)

```

.... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 82
Identification: 0xe231 (57905)
Flags: 0x0000
  0... ..0.. ..0. .... = Reserved bit: Not set
  .0.. .... = Don't fragment: Not set
  ..0. .... = More fragments: Not set
Fragment offset: 0
Time to live: 255
Protocol: UDP (17)
Header checksum: 0xc234 [validation disabled]
[Header checksum status: Unverified]
Source: 10.47.1.11
Destination: 10.47.1.12
User Datagram Protocol, Src Port: 4342, Dst Port: 4342
Source Port: 4342
Destination Port: 4342
Length: 62
Checksum: 0xe1d6 [unverified]
[Checksum Status: Unverified]
[Stream index: 1]
[Timestamps]
  [Time since first frame: 0.007008000 seconds]
  [Time since previous frame: 0.007008000 seconds]
Locator/ID Separation Protocol
0010 .... = Type: Map-Reply (2)
.... 0... = P bit (Probe): Not set
.... .0.. = E bit (Echo-Nonce locator reachability algorithm enabled): Not set
.... ..0. = S bit (LISP-SEC capable): Not set
.... ...0 0000 0000 0000 0000 = Reserved bits: 0x00000
Record Count: 1
Nonce: 0x50c5f2b60b41ca1c
Mapping Record 1, EID Prefix: Unknown LCAF Type (53)/32, TTL: 1440, Action: No-Action, Not Authorit
  Record TTL: 1440
  Locator Count: 1
  EID Mask Length: 32
  000. .... = Action: No-Action (0)
  ...0 .... = Authoritative bit: Not set
  .... .000 0000 0000 = Reserved: 0x000
  0000 .... = Reserved: 0x0
  .... 0000 0000 0000 = Mapping Version: 0
  EID Prefix AFI: LISP Canonical Address Format (LCAF) (16387)
  EID Prefix: Unknown LCAF Type (53)
    LCAF: Unknown (53)
      LCAF Header: 00003520000a
        Reserved bits: 0x00
        Flags: 0x00
        Type: Unknown (53)
        Reserved bits: 0x20
        Length: 10
        [Expert Info (Error/Protocol): LCAF type 53 is not defined in draft-ietf-lisp-lcaf-05]
        [LCAF type 53 is not defined in draft-ietf-lisp-lcaf-05]
        [Severity level: Error]
        [Group: Protocol]
  Locator Record 1, RLOC: 52:54:00:1e:ad:00, Unreachable, Priority/Weight: 1/100, Multicast Prior
    Priority: 1
    Weight: 100
    Multicast Priority: 1
    Multicast Weight: 100
    Flags: 0x0000
      0000 0000 0000 0... = Reserved: 0x0000
      .... ..0.. = Local: Not set

```

```
.... .... ..0. = Probe: Not set
.... .... .... ...0 = Reachable: Not set
AFI: 802 (includes all 802 media plus Ethernet) (6)
Locator: 52:54:00:1e:ad:00
```

<#root>

Border-2#

```
debug lisp control-plane all
```

All LISP control debugging is on at verbose level

Border-2#

```
debug l2lisp all
```

All L2Lisp debugging is on

```
*Oct 24 16:02:17.854: LISP[TRNSP]-0: Processing received Encap-Control(8) message on GigabitEthernet1/0/32
```

```
*Oct 24 16:02:17.854: LISP[TRNSP]-0: Processing received Map-Request(1) message on GigabitEthernet1/0/32
```

```
*Oct 24 16:02:17.855: LISP[MR ]-0: Received Map-Request with 1 records, first EID IID 8190 10.47.4.3/32
```

```
*Oct 24 16:02:17.855: LISP[MR ]-0 IID 8190
```

```
Eth-ARP: MS EID 10.47.4.3/32: Sending proxy reply to 10.47.1.12.
```

現在Edge-1已收到用於地址解析(AR)請求的LISP對映應答，該請求稱10.47.4.3是5254.001e.ad00,Edge-1生成另一個LISP對映請求以確定終端MAC地址的RLOC

<#root>

Edge-1#

```
debug lisp control-plane all
```

Edge-1#

```
debug l2lisp all
```

```
*Oct 24 16:19:54.843: LISP[REMT ]-0: Received Map-Reply with nonce 0x37F890B9-0xAC60D2B9, 1 records.
```

```
*Oct 24 16:19:54.843: LISP[MS ]-0: This is a Address Resolution message.
```

```
*Oct 24 16:19:54.843: LISP[REMT ]-0: Map-Reply nonce matches pending request for IID 8190 EID 10.47.4.3/32
```

```
*Oct 24 16:19:54.843: LISP[REMT ]-0:
```

```
Processing Map-Reply mapping record for IID 8190 Eth-ARP 10.47.4.3/32 LCAF 53, ttl 1440, action none, no
```

```
*Oct 24 16:19:54.843: LISP[REMT ]-0:
```

```
5254.001e.ad00 pri/wei/dID/mID/met/si_type/si_id/si_flg/afn_id=1/100/0/0/4294967295/none/0/UNSPEC/UNSPEC
```



```
*Oct 24 17:11:24.056: LISP[REMT ]-0 IID 8190: Schedule processing of Map-Requests from 'remote EID pref
```

```
Map Request: Sending request for IID 8190 EID 5254.001e.ad00/48, requester 'remote EID prefix'.>
```

LISP控制平面接收LISP對映請求，該對映請求用於MAC地址10.47.4.3，查詢乙太網伺服器表以獲取L2 LISP IID 8190，並傳送帶有MAC-RLOC繫結的LISP對映應答

```
<#root>
```

```
Border-1#
```

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

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

```
 250 28.656076      0.0.0.0 -> 0.0.0.0      LISP 176 Encapsulated Map-Request for [8190] 52:54:00:1e:
 251 28.658851
```

```
10.47.1.10 -> 10.47.1.12  LISP 96 Map-Reply for [8190] 52:54:00:1e:ad:00/48
```

我們可以仔細檢視LISP對映請求和對映回覆

```
<#root>
```

```
Border-1#
```

```
show monitor capture 1 buffer display-filter frame.number==250 detailed
```

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

```
Frame 250: 176 bytes on wire (1408 bits), 176 bytes captured (1408 bits) on interface /tmp/epc_ws/wif_t
```

```
  Interface id: 0 (/tmp/epc_ws/wif_to_ts_pipe)
```

```
  Interface name: /tmp/epc_ws/wif_to_ts_pipe
```

```
  Encapsulation type: Ethernet (1)
```

```
  Arrival Time: Oct 24, 2023 17:37:11.647755000 UTC
```

```
  [Time shift for this packet: 0.000000000 seconds]
```

```
  Epoch Time: 1698169031.647755000 seconds
```

```
  [Time delta from previous captured frame: 0.315724000 seconds]
```

```
  [Time delta from previous displayed frame: 0.000000000 seconds]
```

```
  [Time since reference or first frame: 28.656076000 seconds]
```

```
  Frame Number: 250
```

```
  Frame Length: 176 bytes (1408 bits)
```

```
  Capture Length: 176 bytes (1408 bits)
```

```
  [Frame is marked: False]
```

```
  [Frame is ignored: False]
```

[Protocols in frame: eth:ethertype:ip:udp:lisp:ip:udp:lisp]
Ethernet II, Src: 52:54:00:04:84:b1 (52:54:00:04:84:b1), Dst: 52:54:00:0a:42:f3 (52:54:00:0a:42:f3)
Destination: 52:54:00:0a:42:f3 (52:54:00:0a:42:f3)
Address: 52:54:00:0a:42:f3 (52:54:00:0a:42:f3)
.... ..1. = LG bit: Locally administered address (this is NOT the factory default)
.... ..0. = IG bit: Individual address (unicast)
Source: 52:54:00:04:84:b1 (52:54:00:04:84:b1)
Address: 52:54:00:04:84:b1 (52:54:00:04:84:b1)
.... ..1. = LG bit: Locally administered address (this is NOT the factory default)
.... ..0. = IG bit: Individual address (unicast)
Type: IPv4 (0x0800)
Internet Protocol Version 4,
Src: 10.47.1.12, Dst: 10.47.1.10 <-- Edge-1 RLOC and Border-1 RLOC, respectively

0100 = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
1100 00.. = Differentiated Services Codepoint: Class Selector 6 (48)
.... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 162
Identification: 0x75e5 (30181)
Flags: 0x0000
0... = Reserved bit: Not set
.0.. = Don't fragment: Not set
..0. = More fragments: Not set
Fragment offset: 0
Time to live: 255
Protocol: UDP (17)
Header checksum: 0x2e32 [validation disabled]
[Header checksum status: Unverified]
Source: 10.47.1.12
Destination: 10.47.1.10
User Datagram Protocol, Src Port: 4342, Dst Port: 4342
Source Port: 4342
Destination Port: 4342
Length: 142
Checksum: 0x46f1 [unverified]
[Checksum Status: Unverified]
[Stream index: 4]
[Timestamps]
[Time since first frame: 0.000000000 seconds]
[Time since previous frame: 0.000000000 seconds]

Locator/ID Separation Protocol
1000 = Type: Encapsulated Control Message (8)
.... 0... = S bit (LISP-SEC capable): Not set
.... .0.. = D bit (DDT-originated): Not set
.... ..00 0000 0000 0000 0000 0000 = Reserved bits: 0x00000000

Internet Protocol Version 4, Src: 0.0.0.0, Dst: 0.0.0.0
0100 = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
1100 00.. = Differentiated Services Codepoint: Class Selector 6 (48)
.... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 130
Identification: 0x75e4 (30180)
Flags: 0x0000
0... = Reserved bit: Not set
.0.. = Don't fragment: Not set
..0. = More fragments: Not set
Fragment offset: 0
Time to live: 255

```

Protocol: UDP (17)
Header checksum: 0x44c7 [validation disabled]
[Header checksum status: Unverified]
Source: 0.0.0.0
Destination: 0.0.0.0
User Datagram Protocol, Src Port: 4342, Dst Port: 4342
Source Port: 4342
Destination Port: 4342
Length: 110
Checksum: 0x18bb [unverified]
[Checksum Status: Unverified]
[Stream index: 5]
[Timestamps]
  [Time since first frame: 0.000000000 seconds]
  [Time since previous frame: 0.000000000 seconds]
Locator/ID Separation Protocol
0001 .... = Type: Map-Request (1)
.... 0100 00.. = Flags: 0x10
.... 0... = A bit (Authoritative): Not set
.... .1.. = M bit (Map-Reply present): Set
.... ..0. = P bit (Probe): Not set
.... ...0 = S bit (Solicit-Map-Request): Not set
.... .... 0... = p bit (Proxy ITR): Not set
.... ..... 0.. = s bit (SMR-invoked): Not set
.... .... ..00 0000 000. = Reserved bits: 0x000
.... .... .... ..0 0000 = ITR-RLOC Count: 0
Record Count: 1
Nonce: 0x86438e956066d3ca
Source EID AFI: LISP Canonical Address Format (LCAF) (16387)
Source EID: [8190] 00:00:0c:9f:f3:41
  LCAF: Instance ID: 8190, Address: 00:00:0c:9f:f3:41
    LCAF Header: 00000220000c
      Reserved bits: 0x00
      Flags: 0x00
      Type: Instance ID (2)
      Reserved bits: 0x20
      Length: 12
      Instance ID: 8190
      Address AFI: 802 (includes all 802 media plus Ethernet) (6)
      Address: 00:00:0c:9f:f3:41 (00:00:0c:9f:f3:41)
ITR-RLOC 1: 10.47.1.12
  ITR-RLOC AFI: IPv4 (1)
  ITR-RLOC Address: 10.47.1.12
Map-Request Record 1: [8190]

```

52:54:00:1e:ad:00/48 <-- Map-Request for this specific MAC address

```

Reserved: 0x00
Prefix Length: 48
Prefix AFI: LISP Canonical Address Format (LCAF) (16387)
Prefix: [8190] 52:54:00:1e:ad:00
  LCAF: Instance ID: 8190, Address: 52:54:00:1e:ad:00
    LCAF Header: 00000220000c
      Reserved bits: 0x00
      Flags: 0x00
      Type: Instance ID (2)
      Reserved bits: 0x20
      Length: 12
      Instance ID: 8190
      Address AFI: 802 (includes all 802 media plus Ethernet) (6)
      Address: 52:54:00:1e:ad:00 (52:54:00:1e:ad:00)
Map-Reply Record

```

```

Mapping Record 1, EID Prefix: [8190] 00:00:0c:9f:f3:41/48, TTL: 1440, Action: No-Action, Author
Record TTL: 1440
Locator Count: 1
EID Mask Length: 48
000. .... .... .... = Action: No-Action (0)
...1 .... .... .... = Authoritative bit: Set
.... .000 0000 0000 = Reserved: 0x000
0000 .... .... .... = Reserved: 0x0
.... 0000 0000 0000 = Mapping Version: 0
EID Prefix AFI: LISP Canonical Address Format (LCAF) (16387)
EID Prefix: [8190] 00:00:0c:9f:f3:41
  LCAF: Instance ID: 8190, Address: 00:00:0c:9f:f3:41
    LCAF Header: 00000220000c
      Reserved bits: 0x00
      Flags: 0x00
      Type: Instance ID (2)
      Reserved bits: 0x20
      Length: 12
      Instance ID: 8190
      Address AFI: 802 (includes all 802 media plus Ethernet) (6)
      Address: 00:00:0c:9f:f3:41 (00:00:0c:9f:f3:41)
Locator Record 1, Local RLOC: 10.47.1.12, Reachable, Priority/Weight: 10/10, Multicast Prio
Priority: 10
Weight: 10
Multicast Priority: 10
Multicast Weight: 10
Flags: 0x0005
  0000 0000 0000 0... = Reserved: 0x0000
  .... .... .... .1.. = Local: Set
  .... .... .... ..0. = Probe: Not set
  .... .... .... ...1 = Reachable: Set
AFI: IPv4 (1)
Locator: 10.47.1.12

```

<#root>

Border-1#

show monitor capture 1 buffer display-filter frame.number==251 detailed

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

```

Frame 251: 96 bytes on wire (768 bits), 96 bytes captured (768 bits) on interface /tmp/epc_ws/wif_to_ts.
Interface id: 0 (/tmp/epc_ws/wif_to_ts_pipe)
Interface name: /tmp/epc_ws/wif_to_ts_pipe
Encapsulation type: Ethernet (1)
Arrival Time: Oct 24, 2023 17:37:11.650530000 UTC
[Time shift for this packet: 0.000000000 seconds]
Epoch Time: 1698169031.650530000 seconds
[Time delta from previous captured frame: 0.002775000 seconds]
[Time delta from previous displayed frame: 0.000000000 seconds]
[Time since reference or first frame: 28.658851000 seconds]
Frame Number: 251
Frame Length: 96 bytes (768 bits)
Capture Length: 96 bytes (768 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ethertype:ip:udp:lisp]

```

Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)

```

Destination: 00:00:00:00:00:00 (00:00:00:00:00:00)
  Address: 00:00:00:00:00:00 (00:00:00:00:00:00)
    .... ..0. .... = LG bit: Globally unique address (factory default)
    .... ...0 .... = IG bit: Individual address (unicast)
Source: 00:00:00:00:00:00 (00:00:00:00:00:00)
  Address: 00:00:00:00:00:00 (00:00:00:00:00:00)
    .... ..0. .... = LG bit: Globally unique address (factory default)
    .... ...0 .... = IG bit: Individual address (unicast)
Type: IPv4 (0x0800)
Internet Protocol Version 4,

Src: 10.47.1.10, Dst: 10.47.1.12 <-- Border-1 RLOC, Edge-1 RLOC, respectively

0100 .... = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
  1100 00.. = Differentiated Services Codepoint: Class Selector 6 (48)
  .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 82
Identification: 0x12a9 (4777)
Flags: 0x0000
  0... .... = Reserved bit: Not set
  .0.. .... = Don't fragment: Not set
  ..0. .... = More fragments: Not set
Fragment offset: 0
Time to live: 255
Protocol: UDP (17)
Header checksum: 0x91be [validation disabled]
[Header checksum status: Unverified]
Source: 10.47.1.10
Destination: 10.47.1.12
User Datagram Protocol, Src Port: 4342, Dst Port: 4342
Source Port: 4342
Destination Port: 4342
Length: 62
Checksum: 0xd63e [unverified]
[Checksum Status: Unverified]
[Stream index: 4]
[Timestamps]
  [Time since first frame: 0.002775000 seconds]
  [Time since previous frame: 0.002775000 seconds]
Locator/ID Separation Protocol
0010 .... = Type: Map-Reply (2)
.... 0... = P bit (Probe): Not set
.... .0.. = E bit (Echo-Nonce locator reachability algorithm enabled): Not set
.... ..0. = S bit (LISP-SEC capable): Not set
.... ...0 0000 0000 0000 0000 = Reserved bits: 0x00000
Record Count: 1
Nonce: 0x86438e956066d3ca
Mapping Record 1, EID Prefix: [8190] 52:54:00:1e:ad:00/48, TTL: 1440, Action: No-Action, Not Author
  Record TTL: 1440
  Locator Count: 1
  EID Mask Length: 48
  000. .... = Action: No-Action (0)
  ...0 .... = Authoritative bit: Not set
  .... .000 0000 0000 = Reserved: 0x000
  0000 .... = Reserved: 0x0
  .... 0000 0000 0000 = Mapping Version: 0
  EID Prefix AFI: LISP Canonical Address Format (LCAF) (16387)
  EID Prefix: [8190] 52:54:00:1e:ad:00
    LCAF: Instance ID: 8190, Address: 52:54:00:1e:ad:00
      LCAF Header: 00000220000c
        Reserved bits: 0x00

```

```
Flags: 0x00
Type: Instance ID (2)
Reserved bits: 0x20
Length: 12
Instance ID: 8190
Address AFI: 802 (includes all 802 media plus Ethernet) (6)
Address: 52:54:00:1e:ad:00 (52:54:00:1e:ad:00)
Locator Record 1, RLOC: 10.47.1.13, Reachable, Priority/Weight: 10/10, Multicast Priority/Weight:
Priority: 10
Weight: 10
Multicast Priority: 10
Multicast Weight: 10
Flags: 0x0001
0000 0000 0000 0... = Reserved: 0x0000
.... .... .... .0.. = Local: Not set
.... .... .... ..0. = Probe: Not set
.... .... .... ...1 = Reachable: Set
AFI: IPv4 (1)
```

Locator: 10.47.1.13 <-- This RLOC owns the MAC address

<#root>

Border-1#

```
debug lisp control-plane all
```

Border-1#

```
debug l2lisp all
```

```
*Oct 24 18:03:00.361: LISP[TRNSP]-0: Processing received Map-Request(1) message on GigabitEthernet1/0/3
```

```
*Oct 24 18:03:00.361: LISP[MR ]-0: Received Map-Request with 1 records, first EID IID 8190 5254.001e.
```

```
*Oct 24 18:03:00.361: LISP[MR ]-0
```

```
IID 8190 MAC: MS EID 5254.001e.ad00/48: Sending proxy reply to 10.47.1.12.
```

Edge-1接收來自Border-1的LISP對映應答

<#root>

Edge-1#

```
debug lisp control-plane all
```

Edge-1#

```
debug l2lisp all
```

```
*Oct 24 17:11:24.558: LISP[TRNSP]-0: Processing received Map-Reply(2) message on GigabitEthernet1/0/1 f
```

```

*Oct 24 17:11:24.558: LISP[REMT ]-0: Received Map-Reply with nonce 0x38A78BA8-0xC378149D, 1 records.
*Oct 24 17:11:24.558: LISP[REMT ]-0: Map-Reply nonce matches pending request for IID 8190 EID 5254.001e
*Oct 24 17:11:24.558: LISP[REMT ]-0:

Processing Map-Reply mapping record for IID 8190 MAC 5254.001e.ad00/48 LCAF 2, ttl 1440, action none, no

*Oct 24 17:11:24.559: LISP[REMT ]-0:

10.47.1.13

pri/wei/dID/mID/met/si_type/si_id/si_flg/afn_id=10/10/0/0/4294967295/none/0/UNSPEC/UNSPEC 1pR.

```

通過LISP/SISF交換的整個ARP請求可以通過CPU EPC在Edge-1上檢視

<#root>

Edge-1#

```
show monitor capture 1 buffer display-filter "arp.dst.proto_ipv4==10.47.4.3 or lisp"
```

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

```

120 18.415474 52:54:00:19:93:e9 -> ff:ff:ff:ff:ff:ff ARP 60 Who has 10.47.4.3? Tell 10.47.4.2
<-- Broadcast ARP Request punted up to the CPU

121 18.416092 10.47.4.3 -> 10.47.4.3 LISP 114 Encapsulated Map-Request for Unknown LCAF Type (
<-- LISP Map-Request to obtain the MAC address of 10.47.4.3

135 19.598041 10.47.1.11 -> 10.47.1.12 LISP 96 Map-Reply for Unknown LCAF Type (53)/32
<-- LISP Map-Reply providing the MAC address of 10.47.4.3

136 19.613072 0.0.0.0 -> 0.0.0.0 LISP 176 Encapsulated Map-Request for [8190] 52:54:00:1e:
<-- LISP Map-Request to obtain the RLOC for MAC address 5254.001e.ad00

138 20.119722 10.47.1.10 -> 10.47.1.12 LISP 96 Map-Reply for [8190] 52:54:00:1e:ad:00/48
<-- LISP Map-Reply for the RLOC that owns MAC address 5254.001e.ad00

143 20.477618 52:54:00:19:93:e9 -> 52:54:00:1e:ad:00 ARP 60 Who has 10.47.4.3? Tell 10.47.4.2
<-- Unicast ARP Request injected down from the CPU

```

一旦邊緣1上的控制平面收斂，就會出現一個對映快取條目以及SISF遠端條目(RMT)

<#root>

Edge-1#

```
show lisp instance-id 8190 ethernet map-cache 5254.001e.ad00
```

LISP MAC Mapping Cache for LISP 0 EID-table Vlan 1026 (IID 8190), 1 entries

```
5254.001e.ad00/48
```

```
, uptime: 00:06:26, expires: 23:53:34, via map-reply, complete
Sources: map-reply
State: complete, last modified: 00:06:26, map-source: 10.47.1.13
Active, Packets out: 11(0 bytes), counters are not accurate (~ 00:00:00 ago)
Encapsulating dynamic-EID traffic
Locator      Uptime      State Pri/Wgt      Encap-IID
```

10.47.1.13

```
00:06:26 up      10/10      -
  Last up-down state change:      00:06:26, state change count: 1
  Last route reachability change: 2w0d, state change count: 1
  Last priority / weight change:  never/never
  RLOC-probing loc-status algorithm:
    Last RLOC-probe sent:          00:06:25 (rtt 1104ms)
```

Edge-1#

show device-tracking database address 10.47.4.3

Codes: L - Local, S - Static, ND - Neighbor Discovery, ARP - Address Resolution Protocol, DHCP - 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	ag
RMT					

10.47.4.3

5254.001e.ad00

```
L2LI0      1026      0005      7mn      STALE      try 0 731 s
```

接下來，從CPU向下注入單播ARP請求。請記住，在物理介面上無法使用EPC在輸出方向捕獲CPU注入的資料包，可以使用交換機埠分析器(SPAN)或接收交換矩陣邊緣節點上的輸入EPC來確認收到VXLAN封裝的單播ARP請求

Edge-2(10.47.1.13)

首先，檢驗LISP或隧道介面是否列在VLAN 1026的VLAN ID輸出中

<#root>

Edge-2#

show vlan id 1026

VLAN Name	Status	Ports

```
1026 red active
```

```
L2LI0:8190
```

```
, Gi1/0/3
```

```
<-- L2 LISP IID is associated
```

VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Trans1	Trans2
1026	enet	101026	1500	-	-	-	-	-	0	0

```
Remote SPAN VLAN
```

```
-----  
Disabled
```

```
Primary Secondary Type Ports
```

現在，Edge-2上的輸入EPC演示了收到的VXLAN封裝的ARP應答。由於單點傳播ARP要求是VXLAN封裝的，因此您可以利用IP ACL來比對向邊緣2 RLOC傳送的邊緣1 RLOC（分別向邊緣10.47.1.12和邊緣10.47.1.13），以協助過濾流量。

```
<#root>
```

```
Edge-2(config)#
```

```
ip access-list extended tac
```

```
Edge-2(config-ext-nacl)#
```

```
permit ip host 10.47.1.12 host 10.47.1.13
```

```
Edge-2#
```

```
monitor capture 1 interface g1/0/1 in access-list tac
```

```
Edge-2#
```

```
monitor capture 1 interface g1/0/2 in access-list tac
```

```
Edge-2#
```

```
monitor capture 1 start
```

```
Started capture point : 1
```

```
Edge-2#
```

```
monitor capture 1 stop
```

```
Capture statistics collected at software:
```

```
  Capture duration - 20 seconds
```

```
  Packets received - 10
```

```
  Packets dropped - 0
```

```
  Packets oversized - 0
```

```
Number of Bytes dropped at asic not collected
```

```
Capture buffer will exist till exported or cleared
```

Stopped capture point : 1

Edge-2#

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

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

1 0.000000

52:54:00:19:93:e9 -> 52:54:00:1e:ad:00 ARP 110 Who has 10.47.4.3? Tell 10.47.4.2

仔細檢查此ARP請求後，您可以看到VXLAN封裝、UDP報頭和其他報頭，因為ARP幀很小，通常為60位元組。

<#root>

Edge-2#

```
show monitor capture 1 buffer display-filter frame.number==1 detailed
```

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

Frame 1: 110 bytes on wire (880 bits), 110 bytes captured (880 bits) on interface /tmp/epc_ws/wif_to_ts.

Interface id: 0 (/tmp/epc_ws/wif_to_ts_pipe)

Interface name: /tmp/epc_ws/wif_to_ts_pipe

Encapsulation type: Ethernet (1)

Arrival Time: Oct 24, 2023 18:57:34.642468000 UTC

[Time shift for this packet: 0.000000000 seconds]

Epoch Time: 1698173854.642468000 seconds

[Time delta from previous captured frame: 0.000000000 seconds]

[Time delta from previous displayed frame: 0.000000000 seconds]

[Time since reference or first frame: 0.000000000 seconds]

Frame Number: 1

Frame Length: 110 bytes (880 bits)

Capture Length: 110 bytes (880 bits)

[Frame is marked: False]

[Frame is ignored: False]

[Protocols in frame: eth:ethertype:ip:udp:vxlan:eth:ethertype:arp]

Ethernet II, Src: 52:54:00:0a:42:11 (52:54:00:0a:42:11), Dst: 52:54:00:17:fe:65 (52:54:00:17:fe:65)

Destination: 52:54:00:17:fe:65 (52:54:00:17:fe:65)

Address: 52:54:00:17:fe:65 (52:54:00:17:fe:65)

.... ..1. = LG bit: Locally administered address (this is NOT the factory default)

.... ..0 = IG bit: Individual address (unicast)

Source: 52:54:00:0a:42:11 (52:54:00:0a:42:11)

Address: 52:54:00:0a:42:11 (52:54:00:0a:42:11)

.... ..1. = LG bit: Locally administered address (this is NOT the factory default)

.... ..0 = IG bit: Individual address (unicast)

Type: IPv4 (0x0800)

Internet Protocol Version 4,

Src: 10.47.1.12, Dst: 10.47.1.13 <-- Edge-1 RLOC and Edge-2 RLOC, respectively

0100 = Version: 4

.... 0101 = Header Length: 20 bytes (5)

Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)

0000 00.. = Differentiated Services Codepoint: Default (0)

.... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)

Total Length: 96

Identification: 0x798a (31114)
Flags: 0x4000, Don't fragment
 0... .. = Reserved bit: Not set
 .1.. .. = Don't fragment: Set
 ..0. = More fragments: Not set
Fragment offset: 0
Time to live: 253
Protocol: UDP (17)
Header checksum: 0xed8b [validation disabled]
[Header checksum status: Unverified]
Source: 10.47.1.12
Destination: 10.47.1.13
User Datagram Protocol, Src Port: 65354, Dst Port: 4789
Source Port: 65354
Destination Port: 4789
Length: 76
[Checksum: [missing]]
[Checksum Status: Not present]
[Stream index: 0]
[Timestamps]
 [Time since first frame: 0.000000000 seconds]
 [Time since previous frame: 0.000000000 seconds]

Virtual eXtensible Local Area Network
Flags: 0x8800, GBP Extension, VXLAN Network ID (VNI)
 1... .. = GBP Extension: Defined
 0.. .. = Don't Learn: False
 1... .. = VXLAN Network ID (VNI): True
 0... = Policy Applied: False
 .000 .000 0.00 .000 = Reserved(R): 0x0000
Group Policy ID: 0
VXLAN Network Identifier (VNI):

8190 <-- LISP L2 IID

Reserved: 0
Ethernet II, Src: 52:54:00:19:93:e9 (
52:54:00:19:93:e9
) , Dst: 52:54:00:1e:ad:00 (
52:54:00:1e:ad:00
)

<-- True source and destination endpoint MAC address

Destination: 52:54:00:1e:ad:00 (52:54:00:1e:ad:00)
 Address: 52:54:00:1e:ad:00 (52:54:00:1e:ad:00)
 1. = LG bit: Locally administered address (this is NOT the factory d
 0 = IG bit: Individual address (unicast)
Source: 52:54:00:19:93:e9 (52:54:00:19:93:e9)
 Address: 52:54:00:19:93:e9 (52:54:00:19:93:e9)
 1. = LG bit: Locally administered address (this is NOT the factory d
 0 = IG bit: Individual address (unicast)
Type: ARP (0x0806)
Trailer: 00000000000000000000000000000000
Address Resolution Protocol (request)
 Hardware type: Ethernet (1)
 Protocol type: IPv4 (0x0800)
 Hardware size: 6
 Protocol size: 4
 Opcode: request (1)
 Sender MAC address: 52:54:00:19:93:e9 (

52:54:00:19:93:e9

)
Sender IP address:

10.47.4.2

Target MAC address: 00:00:00:00:00:00 (
00:00:00:00:00:00

)
Target IP address:

10.47.4.3

Edge-2會彈出VXLAN封裝，並將單播ARP請求傳送到CPU以進行進一步處理。這可以通過FED Punject捕獲看到。

<#root>

Edge-2#

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

Punt packet capturing started.

Edge-2#

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

Punt packet capturing stopped. Captured 21 packet(s)

Edge-2#

```
show platform software fed sw active punt packet-capture display-filter "arp" brief
```

Punt packet capturing: disabled. Buffer wrapping: disabled
Total captured so far: 21 packets. Capture capacity : 4096 packets

----- Punt Packet Number: 6, Timestamp: 2023/10/24 19:14:32.930 -----

interface : physical: [if-id: 0x00000000], pa1:

L2LISP0

[if-id: 0x00000017]

metadata : cause: 109 [snoop packets], sub-cause: 1,

q-no: 16,

linktype: MCP_LINK_TYPE_IP [1]

ether hdr :

dest mac: 5254.001e.ad00, src mac: 5254.0019.93e9

ether hdr : ethertype: 0x0806 (ARP)

ARP請求將傳送到ARP監聽器進程。

<#root>

```
Edge-2#debug platform software infrastructure punt
```

```
*Oct 24 19:18:38.916: PUNT RX: mcprp_process_receive_packet: pak->vlan_id: 1026
```

```
*Oct 24 19:18:38.916: Punt: IP proto src 147.233.
```

```
10.47, dst 4.2.
```

```
0.0, from table 0, intf L2LI0, encap LISP, size 60
```

```
,
```

```
cause snoop packets(L3)
```

```
<-- You can see the 10.47.4.2
```

```
*Oct 24 19:18:38.916: punt cause:snoop packets invoking reg_invoke_mcprp_punt_feature_msg
```

```
*Oct 24 19:18:38.916: punt cause:snoop packets
```

```
MCPRP_PUNT_PAK_PROC_OK_DONE
```

 注意：此調試為聊天狀態，請謹慎使用。

由於此ARP請求來自第2層LISP/隧道介面，因此Edge-2永遠不會將10.47.4.2作為LISP中動態EID的本地端點學習

<#root>

```
Edge-2#s
```

```
how platform arpsnooping client 5254.0019.93e9
```

```
PLAT_DAI      : Platform DAI shim
```

```
FWDPLANE     : Dataplane forwarding
```

```
BRIDGE       : Packet to be bridged
```

```
ARPSN        : Arp Snooping
```

```
Packet Trace for client MAC 5254.0019.93E9:
```

Timestamp	Sender Mac	Sender IP	Target Mac	Target IP	Opcode
2023/10/24 15:57:01.129	5254.0019.93e9	10.47.4.2	0000.0000.0000	10.47.4.3	ARP_REQUEST
2023/10/24 15:57:01.129	5254.0019.93e9	10.47.4.2	0000.0000.0000	10.47.4.3	ARP_REQUEST
2023/10/24 15:57:01.129	5254.0019.93e9	10.47.4.2	0000.0000.0000	10.47.4.3	ARP_REQUEST

```
PLATF_DAI:SHUNTED
```

現在，ARP請求從CPU向下注入到VLAN 1026，具體而言是Gi1/0/3,10.47.4.3與VLAN 1026連線。

<#root>

Edge-2#

show mac address-table address 5254.001e.ad00

Mac Address Table

```

-----
Vlan      Mac Address      Type      Ports
----      -
1026     5254.001e.ad00  DYNAMIC  Gi1/0/3
Total Mac Addresses for this criterion: 1

```

Edge-2#

show platform arpsnooping client 5254.001e.ad00

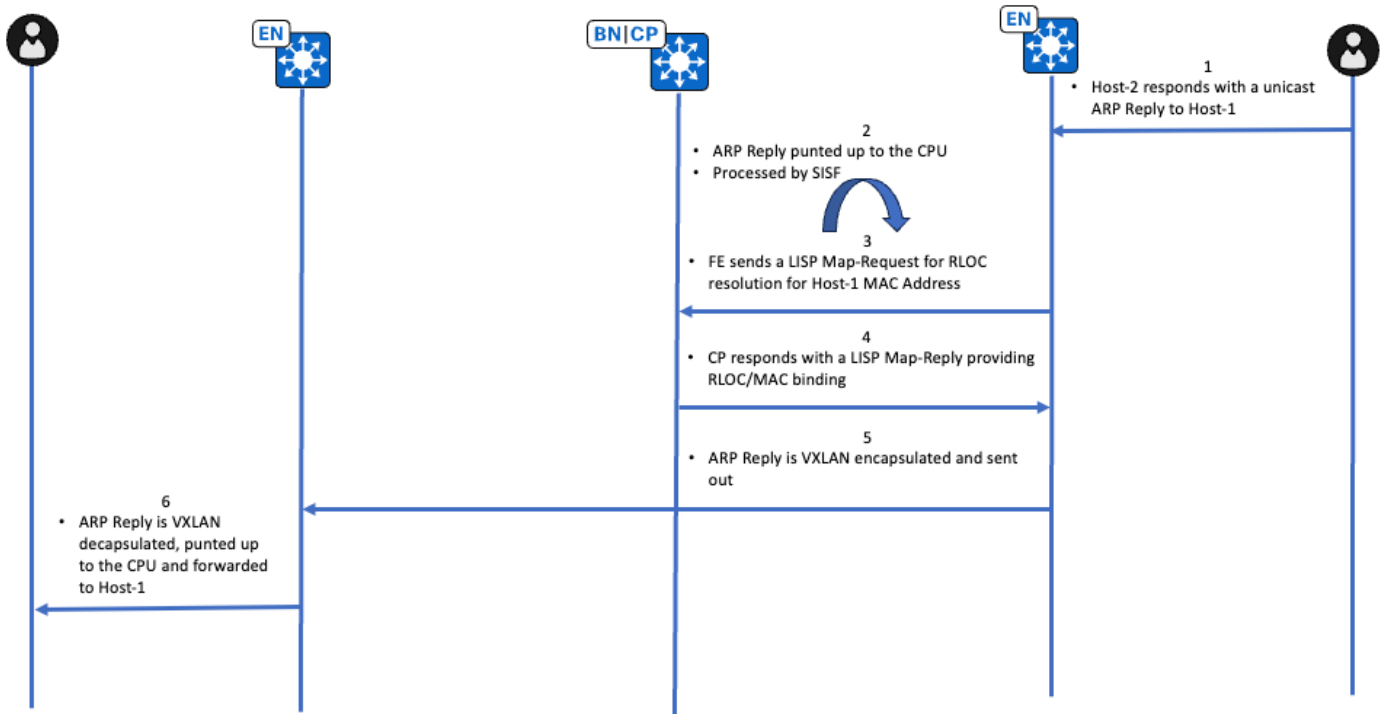
```

PLAT_DAI      : Platform DAI shim
FWDPLANE     : Dataplane forwarding
BRIDGE       : Packet to be bridged
ARPSN       : Arp Snooping
Packet Trace for client MAC 5254.001E.AD00:

```

Timestamp	Sender Mac	Sender IP	Target Mac	Target IP	Opcode
2023/10/24 15:57:01.129	5254.0019.93e9	10.47.4.2	0000.0000.0000	10.47.4.3	ARP_REQUEST
2023/10/24 15:57:01.129	5254.0019.93e9	10.47.4.2	0000.0000.0000	10.47.4.3	ARP_REQUEST

單播路徑ARP回覆高級 workflow



單點傳送路徑ARP回覆驗證

Edge-2(10.47.1.13)

擁有10.47.4.3的終端使用單播ARP應答進行響應，由於IPDT的存在，ARP應答會被傳送到CPU。初始驗證通過面向終端的介面上的EPC進行。

```
<#root>
```

```
Edge-2#
```

```
show monitor capture 1 buffer display-filter arp
```

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

```
2 88.712035
```

```
52:54:00:1e:ad:00 -> 00:00:0c:9f:f3:41 ARP 60 10.47.4.3 is at 52:54:00:1e:ad:00
```

接下來，使用FED Punject驗證punt操作

```
<#root>
```

```
Edge-2#
```

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

```
Punt packet capturing started.
```

```
Edge-2#
```

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

```
Punt packet capturing stopped. Captured 22 packet(s)
```

```
Edge-2#
```

```
show platform software fed sw active punt packet-capture display-filter "arp" brief
```

```
Punt packet capturing: disabled. Buffer wrapping: disabled
```

```
Total captured so far: 22 packets. Capture capacity : 4096 packets
```

```
----- Punt Packet Number: 6, Timestamp: 2023/10/24 20:32:35.634 -----
```

```
interface : physical: [if-id: 0x00000000], pal:
```

```
L2LISP0
```

```
[if-id: 0x00000017]
```

```
metadata : cause: 109 [
```

```
snoop packets]
```

```
, sub-cause: 1,
```

```
q-no: 16
```

```
, linktype: MCP_LINK_TYPE_IP [1]
```

```
<-- Punted for Snoop Packets to CPU queue 16
```

```
ether hdr :
```

```
dest mac: 5254.001e.ad00
```

```
,
```

```
src mac: 5254.0019.93e9
```

```
ether hdr : ethertype: 0x0806 (ARP)
```

接著，ARP回覆會傳遞到ARP監聽器和裝置追蹤

```
<#root>
```

```
Edge-2#
```

```
debug platform software infrastructure punt
```

```
*Oct 24 19:18:39.101: PUNT RX: mcprp_process_receive_packet: pak->vlan_id: 1026
```

```
*Oct 24 19:18:39.101: Punt: IP proto src 173.0.
```

```
10.47
```

```
, dst
```

```
4.3
```

```
.82.84, from table 0, intf Gi1/0/3, encap ARPA, size 60, cause snoop packets(L3)
```

```
<-- 10.47.4.3 is obscured
```

```
*Oct 24 19:18:39.101: punt cause:snoop packets invoking reg_invoke_mcprp_punt_feature_msg
```

```
*Oct 24 19:18:39.101: punt cause:snoop packets MCPRP_PUNT_PAK_PROC_OK_DONE
```

```
<#root>
```

```
Edge-2#
```

```
debug platform fhs
```

```
Edge-2#
```

```
debug platform fhs all
```

```
ARP packet received from ARP snoop(Gi1/0/3 10.47.4.3 (5254.001e.ad00) VLAN:10
```

 注意：這些調試是雜亂的，請謹慎使用。

```
<#root>
```

```
Edge-2#
```

```
debug device-tracking
```

```
*Oct 24 20:42:22.554: SISF[CLA]: Interest on target vlan 1026
```

```
*Oct 24 20:42:22.554: SISF[CLA]: feature Device-tracking
```

```
*Oct 24 20:42:22.554: SISF[CLA]: feature Address Resolution Relay
```

```
*Oct 24 20:42:22.555: SISF[SWI]:
```

```
Gi1/0/3 vlan 1026 Feature_0 Device-tracking priority 128
```



```

*Oct 24 20:42:22.555: SISF[SWI]:
Gi1/0/3 vlan 1026 Feature_1 Address Resolution Relay priority 81
*Oct 24 20:42:22.555: SISF[PRS]:
  ARP-REPLY target set to 10.47.4.2
*Oct 24 20:42:22.556: SISF[SWI]: Gi1/0/3 vlan 1026 Feature Device-tracking rc: OK
*Oct 24 20:42:22.556: SISF[ARR]: Gi1/0/3 vlan 1026 Receive a msg in AR
*Oct 24 20:42:22.557: SISF[ARR]:
  Gi1/0/3 vlan 1026 Not ARP Request or NS, return OK
*Oct 24 20:42:22.557: SISF[SWI]: Gi1/0/3 vlan 1026 Feature Address Resolution Relay rc: OK
*Oct 24 20:42:22.557: SISF[SWI]: Gi1/0/3 vlan 1026 Features execution OK

```

由於ARP應答已經指向實際目的MAC地址（與Edge-1上臨時看到的佔位符不同），Edge-2可以觸發LISP對映請求來解析RLOC-MAC關聯。

```
<#root>
```

```
Edge-2#
```

```
debug lisp control-plane all
```

```
Edge-2#
```

```
debug l2lisp all
```

```

*Oct 24 20:47:34.400: LISP[REMT ]-0 IID 8190: Schedule processing of Map-Requests from 'remote EID pref
*Oct 24 20:47:34.401: LISP[REMT ]-0:

```

```
  Map Request: Sending request for IID 8190 EID 5254.0019.93e9/48, requester 'remote EID prefix'.
```

```

*Oct 24 20:47:35.166: LISP[TRNSP]-0: Processing received Map-Reply(2) message on GigabitEthernet1/0/1 f
*Oct 24 20:47:35.166: LISP[REMT ]-0:

```

```
Received Map-Reply with nonce 0x5879579E-0xCAFC0AA5, 1 records.
```

```
*Oct 24 20:47:35.166: LISP[REMT ]-0:
```

```
Processing Map-Reply mapping record for IID 8190 MAC 5254.0019.93e9/48 LCAF 2, ttl 1440, action none, no
```

```
*Oct 24 20:47:35.166: LISP[REMT ]-0:
```

```
10.47.1.12
```

```
  pri/wei/dID/mID/met/si_type/si_id/si_flg/afn_id=10/10/0/0/4294967295/none/0/UNSPEC/UNSPEC 1pR.
```

使用命令show lisp instance-id <L2 IID> ethernet map-cache <destination MAC address> 驗證此ARP應答將通過VXLAN封裝傳送到哪個RLOC

```
<#root>
```

```
Edge-2#
```

```

show lisp instance-id 8190 ethernet map-cache 5254.0019.93e9

LISP MAC Mapping Cache for LISP 0 EID-table Vlan 1026 (IID 8190), 1 entries

5254.0019.93e9/48
, uptime: 00:03:45, expires: 23:56:15, via map-reply, complete
Sources: map-reply
State: complete, last modified: 00:03:45, map-source: 10.47.1.12
Active, Packets out: 6(0 bytes), counters are not accurate (~ 00:00:59 ago)
Encapsulating dynamic-EID traffic
Locator      Uptime      State  Pri/Wgt      Encap-IID
10.47.1.12
00:03:45 up      10/10      -
Last up-down state change:      00:03:45, state change count: 1
Last route reachability change: 2w0d, state change count: 1
Last priority / weight change:  never/never
RLOC-probing loc-status algorithm:
Last RLOC-probe sent:           00:03:45 (rtt 861ms)

```

在LISP解析之後，ARP回覆可以從CPU向底層中的10.47.1.12 RLOC注入

```

<#root>
Edge-2#
show ip cef 10.47.1.12

10.47.1.12/32
  nexthop 10.47.1.2 GigabitEthernet1/0/2
  nexthop 10.47.1.6 GigabitEthernet1/0/1

```

整個流可以通過EPC在Edge-2 CPU上看到，ARP回覆和ARP請求之間的區別在於，此流中沒有LISP AR解析。

```

<#root>
Edge-2#
show monitor capture 1 buffer display-filter "arp.src.proto_ipv4==10.47.4.3 or lisp"

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

 62  9.355185 52:54:00:1e:ad:00 -> 52:54:00:19:93:e9 ARP 60 10.47.4.3 is at 52:54:00:1e:ad:00
<-- ARP Reply punted up to the CPU

 63  9.355486      0.0.0.0 -> 0.0.0.0      LISP 176 Encapsulated Map-Request for [8190] 52:54:00:19:
<-- LISP Map-Request to resolve RLOC-MAC association

 88 12.058412 10.47.1.10 -> 10.47.1.13  LISP 96 Map-Reply for [8190] 52:54:00:19:93:e9/48

```

```
<-- LISP Map-Reply providing the RLOC-MAC association
```

```
90 12.072455 52:54:00:1e:ad:00 -> 52:54:00:19:93:e9 ARP 110 10.47.4.3 is at 52:54:00:1e:ad:00
```

```
<-- VXLAN Encapsulated ARP Reply that is injected by the CPU
```



提示:FED Punject捕獲不會捕獲注入的ARP應答，請使用FED注入詳細跟蹤

您可以使用show platform arpsnooping client <source MAC address> 指令檢視在Edge-2上執行的與ARP回覆相關的動作

```
<#root>
```

```
Edge-2#
```

```
show platform arpsnooping client 5254.001e.ad00
```

```
PLAT_DAI      : Platform DAI shim  
FWDPLANE     : Dataplane forwarding  
BRIDGE       : Packet to be bridged  
ARPSN        : Arp Snooping  
Packet Trace for client MAC 5254.001E.AD00:
```

Timestamp	Sender Mac	Sender IP	Target Mac	Target IP	Opcode
2023/10/24 20:47:38.151	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY
PLATF_DAI:RECEIVED INPUT					
2023/10/24 20:47:38.151	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY
2023/10/24 20:47:38.152	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY
PLATF_DAI:TO_ARPSND					
2023/10/24 20:47:38.152	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY
2023/10/24 20:47:38.152	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY
INJECT:INJ_VLAN_IFINPUT_TO_BDI					
2023/10/24 20:47:38.152	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY
INJECT:BD_DPIDX_TO_FWDPLANE					

```
Edge-1(10.47.1.12)
```

Edge-1接收VXLAN封裝的ARP應答，彈出VXLAN報頭，並將ARP應答推給CPU以進行進一步處理

。

```
<#root>
```

Edge-1#

```
debug platform software infrastructure punt
```

```
*Oct 24 21:42:11.303: PUNT RX: mcprp_process_receive_packet: pak->vlan_id: 1026
```

```
*Oct 24 21:42:11.303: Punt: IP proto src 173.0.
```

```
10.47
```

```
, dst
```

```
4.3
```

```
.82.84, from table 0,
```

```
intf L2LI0
```

```
, encaps LISP, size 60, cause snoop packets(L3)
```

```
<-- Can see 10.47.4.3 IP address that has been obscured
```

```
*Oct 24 21:42:11.303: punt cause:snoop packets invoking reg_invoke_mcprp_punt_feature_msg
```

```
*Oct 24 21:42:11.303: punt cause:snoop packets MCPRP_PUNT_PAK_PROC_OK_DONE
```

您可以使用show platform arpsnooping client <source MAC address> 指令取得有關Edge-1上如何處理ARP回覆的其他資訊

```
<#root>
```

Edge-1#

```
show platform arpsnooping client 5254.001e.ad00
```

```
PLAT_DAI      : Platform DAI shim
FWDPLANE      : Dataplane forwarding
BRIDGE        : Packet to be bridged
ARPSN         : Arp Snooping
Packet Trace for client MAC 5254.001E.AD00:
```

Timestamp	Sender Mac	Sender IP	Target Mac	Target IP	Opcode
2023/10/24 20:40:33.741	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY
2023/10/24 20:40:33.741	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY
2023/10/24 20:40:33.741	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY

```
PLATF_DAI:SHUNTED
```

2023/10/24 20:40:33.741	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY
2023/10/24 20:40:33.741	5254.001e.ad00	10.47.4.3	5254.0019.93e9	10.47.4.2	ARP_REPLY

```
INJECT:BD_DPIDX_TO_FWDPLANE
```

Edge-1採用轉發的ARP應答，並將ARP應答傳送到VLAN 1026，傳送到終端10.47.4.2所在的埠

```
<#root>
```

```
Edge-1#
```

```
show mac address-table address 5254.0019.93e9
```

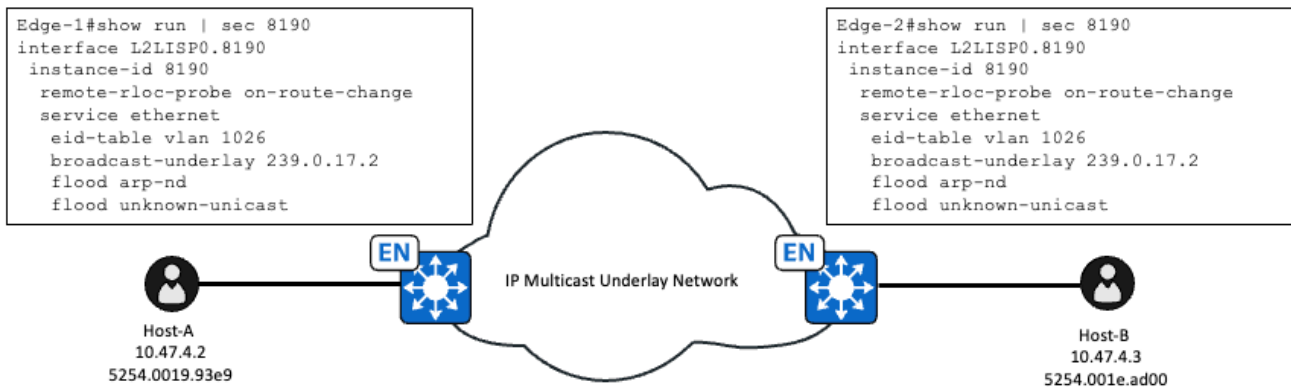
```
Mac Address Table
```

```
-----  
Vlan      Mac Address      Type      Ports  
-----  
1026     5254.0019.93e9   DYNAMIC   Gi1/0/3  
Total Mac Addresses for this criterion: 1
```

ARP泛洪 (L2泛洪) 路徑

使用L2泛洪時，當交換矩陣中的所有交換矩陣邊緣節點以及啟用了L2越區切換/IP定向廣播的邊界加入通用底層組播組時，也會發生ARP解析。每當符合泛洪條件的資料包/幀到達邊緣節點時，都會使用底層組播組的目標IP地址對它進行VXLAN封裝。在某些場景中，L2泛洪可應用於ARP解析：

- 命令flood arp-nd在VLAN的L2 LISP例項下配置，廣播ARP幀使用廣播底層組播組泛洪到所有交換矩陣邊緣。
- 當在池中啟用L2泛洪且池未標籤為無線池時，Cisco Catalyst Center上配置命令flood arp-nd
- 底層組播必須通過LAN自動化或手動配置進行配置。所有交換矩陣組播工作流都不會自動配置底層組播。



在配置了底層組播並啟用了泛洪arp-nd後，這改變了最初使用基於LISP/SISF的解析的ARP請求的處理方式。在L2 LISP例項下配置flood arp-nd後，這將禁用VLAN的LISP-ARP-RELAY-VLAN IPDT策略，並且不使用。

```
<#root>
```

```
Edge-1#
```

```
show device-tracking policies vlan 1026
```

Target	Type	Policy	Feature	Target range
vlan 1026	VLAN	DT-PROGRAMMATIC	Device-tracking	vlan all
vlan 1026	VLAN	LISP-DT-GLEAN-VLAN-MULTI-IP	Device-tracking	vlan all

泛洪路徑ARP請求驗證

Edge-1(10.47.1.12)

在已啟用泛洪arp-nd的L2泛洪的VLAN中，從客戶端收到ARP請求後，將不再由ARP監聽處理。將ARP請求轉發到CPU以進行IPDT學習，但不用於轉發。

ARP監聽器不會處理ARP請求，這可以通過show platform arpsnooping client <MAC address>命令看到

<#root>

Edge-1#

```
show platform arpsnooping client 5254.0019.93e9
```

```
PLAT_DAI      : Platform DAI shim
FWDPLANE     : Dataplane forwarding
BRIDGE       : Packet to be bridged
ARPSN        : Arp Snooping
Packet Trace for client MAC 5254.0019.93E9:
```

Timestamp	Sender Mac	Sender IP	Target Mac	Target IP	Opcode
Filtered entries counters:					
ARPSN_FILTER_SVI: 0					

Edge-1沒有為端點10.47.4.3建立RMT IPDT條目，如輸出所示

<#root>

Edge-1#

```
show monitor capture 1 buffer display-filter arp brief
```

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

```
1 0.000000 52:54:00:19:93:e9 -> ff:ff:ff:ff:ff:ff ARP 60 Who has 10.47.4.3? Tell 10.47.4.2
```

Edge-1#

```
show device-tracking database address 10.47.4.3
```

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

prlv1

ag

現在，ARP請求被VXLAN封裝到廣播底層組播組中。Edge-1有一個mroute，Loopback0作為源，組作為廣播底層組。

<#root>

Edge-1#

show run int lo0

Building configuration...

Current configuration : 135 bytes

!

interface Loopback0

ip address 10.47.1.12 255.255.255.255

no ip redirects

ip pim sparse-mode <-- PIM must be enabled

ip router isis

clns mtu 1400

end

<#root>

Edge-1#

show ip mroute 239.0.17.2

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

(* , 239.0.17.2), 5w1d/00:02:05, RP 10.47.1.14, flags: SJC

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

Outgoing interface list:

L2LISP0.8190, Forward/Sparse-Dense, 01:56:41/00:00:18, flags:

```
L2LISP0.8192, Forward/Sparse-Dense, 2w2d/00:00:58, flags:
L2LISP0.8188, Forward/Sparse-Dense, 5w1d/00:01:58, flags:
```

```
(
```

```
10.47.1.12
```

```
, 239.0.17.2), 00:02:53/00:00:06, flags: PFT
```

```
<-- Lo0 interface of Edge-1
```

```
    Incoming interface:
```

```
Null0
```

```
, RPF nbr 0.0.0.0,
```

```
<-- Incoming interface Null0 is expected
```

```
    Outgoing interface list:
```

```
GigabitEthernet1/0/2
```

```
, Forward/Sparse, 00:04:40/00:02:45, flags:
```

```
<-- Outgoing interface Gig1/0/2 faces the fabric underlay
```

實際上，泛洪arp-nd會切換IPDT/SISF，而不是泛洪本身。L2泛洪已泛洪廣播流量，但關鍵在於將LISP AR策略從裝置跟蹤中禁用，ARP的所有權現在被釋放，而且可以像任何其他廣播一樣泛洪。

要驗證L2泛洪的硬體程式設計，請使用命令show platform software dpidb l2lisp <L2 LISP IID>

```
<#root>
```

```
Edge-1#
```

```
show platform software dpidb l2lisp 8190
```

```
Instance Id:8190,
```

```
dpidx:25
```

```
, vlan:1026, Parent Interface:L2LISP0(if_id:23)
```

```
<-- dpidx value used in the next command
```

從上一個命令獲取dpidx值，然後在show platform software fed switch active if-id <dpidx value>命令中使用

```
<#root>
```

```
Edge-1#
```

```
show platform software fed switch active ifm if-id 25
```



```
Interface IF_ID      : 0x00000000000000019
Interface Name      : L2LISP0.8190
Interface Block Pointer : 0x7f65ec85ba78
Interface Block State : READY
Interface State     : Enabled
Interface Status    : ADD, UPD
Interface Ref-Cnt   : 2
Interface Type      : L2_LISP
Created Time       : 2023/09/19 17:57:32.046
Last Modified Time : 2023/10/25 17:59:09.265
Current Time       : 2023/10/25 20:15:44.624
  Is top interface  : FALSE
  Asic_num          : 0
  Switch_num        : 0
  AAL port Handle   : 7a00003a
  Parent interface id : 17
  Multicast Tunnel IP :
```

239.0.17.2

```
Mcast Tunnel Handle : 0x7f65ed356918
L2 Multicast Tunnel IP : 0.0.0.0
L2 Multicast Vlan Id   : 0
L2 Multicast Tunnel Hd1 : NULL
Vlan Id                : 1026
Instance Id            : 8190
Dest Port              : 4789
SGT                    : Enable
Underlay VRF (V4)     : 0
Underlay VRF (V6)     : 0
Flood Access-tunnel  : Disable
Flood unknown ucast  : Enable

Broadcast              : Enable

Multicast Flood       : Enable
L2 Multicast Flood   : Disable
Host Activity report: Enabled
<snip>
```

您可以在出口方向上使用Gi1/0/2上的EPC，因為此ARP請求被轉進和轉出，而不需要CPU注入，因此這一次，您可以在出口決策中信任EPC捕獲。

<#root>

Edge-1#

```
monitor capture 1 start
```

```
Started capture point : 1
```

Edge-1#

```
monitor capture 1 stop
```

Capture statistics collected at software:

```
Capture duration - 22 seconds
Packets received - 5
Packets dropped - 0
Packets oversized - 0
```

Number of Bytes dropped at asic not collected

Capture buffer will exist till exported or cleared

Stopped capture point : 1

Edge-1#

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

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

```
1 0.000000 52:54:00:19:93:e9 -> ff:ff:ff:ff:ff:ff ARP
```

110

Who has 10.47.4.3? Tell 10.47.4.2

<-- Size 110 because VXLAN, UDP, and other headers

您可以仔細檢視VXLAN封裝的ARP請求

<#root>

Edge-1#

```
show monitor capture 1 buffer display-filter frame.number==1 detailed
```

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

Frame 1: 110 bytes on wire (880 bits), 110 bytes captured (880 bits) on interface /tmp/epc_ws/wif_to_ts.

Interface id: 0 (/tmp/epc_ws/wif_to_ts_pipe)

Interface name: /tmp/epc_ws/wif_to_ts_pipe

Encapsulation type: Ethernet (1)

Arrival Time: Oct 25, 2023 20:44:36.578645000 UTC

[Time shift for this packet: 0.000000000 seconds]

Epoch Time: 1698266676.578645000 seconds

[Time delta from previous captured frame: 0.000000000 seconds]

[Time delta from previous displayed frame: 0.000000000 seconds]

[Time since reference or first frame: 0.000000000 seconds]

Frame Number: 1

Frame Length: 110 bytes (880 bits)

Capture Length: 110 bytes (880 bits)

[Frame is marked: False]

[Frame is ignored: False]

[Protocols in frame: eth:ethertype:ip:udp:vxlan:eth:ethertype:arp]

Ethernet II, Src: 00:00:00:00:00:00 (

00:00:00:00:00:00

), Dst: 00:00:00:00:00:00 (

00:00:00:00:00:00

)

<-- Ignore the all 0s MAC, not accurate

Destination: 00:00:00:00:00:00 (00:00:00:00:00:00)

Address: 00:00:00:00:00:00 (00:00:00:00:00:00)

```

    .... ..0. .... = LG bit: Globally unique address (factory default)
    .... ..0. .... = IG bit: Individual address (unicast)
Source: 00:00:00:00:00:00 (00:00:00:00:00:00)
Address: 00:00:00:00:00:00 (00:00:00:00:00:00)
    .... ..0. .... = LG bit: Globally unique address (factory default)
    .... ..0. .... = IG bit: Individual address (unicast)
Type: IPv4 (0x0800)
Internet Protocol Version 4,

Src: 10.47.1.12, Dst: 239.0.17.2 <-- Source is Edge-1 RLOC, Destination is the broadcast underlay group

0100 .... = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    0000 00.. = Differentiated Services Codepoint: Default (0)
    .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 96
Identification: 0x8dab (36267)
Flags: 0x4000, Don't fragment
    0... .... = Reserved bit: Not set
    .1.. .... = Don't fragment: Set
    ..0. .... = More fragments: Not set
Fragment offset: 0
Time to live: 255
Protocol: UDP (17)
Header checksum: 0xe2a3 [validation disabled]
[Header checksum status: Unverified]
Source: 10.47.1.12
Destination: 239.0.17.2
User Datagram Protocol, Src Port: 65280, Dst Port: 4789
Source Port: 65280
Destination Port: 4789
Length: 76
[Checksum: [missing]]
[Checksum Status: Not present]
[Stream index: 0]
[Timestamps]
    [Time since first frame: 0.000000000 seconds]
    [Time since previous frame: 0.000000000 seconds]
Virtual eXtensible Local Area Network
Flags: 0x8800, GBP Extension, VXLAN Network ID (VNI)
    1... .... = GBP Extension: Defined
    .... ..0.. .... = Don't Learn: False
    .... 1... .... = VXLAN Network ID (VNI): True
    .... .... 0... = Policy Applied: False
    .000 .000 0.00 .000 = Reserved(R): 0x0000
Group Policy ID: 0

VXLAN Network Identifier (VNI): 8190 <-- L2 LISP IID

Reserved: 0
Ethernet II, Src: 52:54:00:19:93:e9 (
52:54:00:19:93:e9
), Dst: ff:ff:ff:ff:ff:ff (
ff:ff:ff:ff:ff:ff
)
<-- SMAC and DMAC of the ARP Request
Destination: ff:ff:ff:ff:ff:ff (ff:ff:ff:ff:ff:ff)
Address: ff:ff:ff:ff:ff:ff (ff:ff:ff:ff:ff:ff)

```

```

    .... ..1. .... .. = LG bit: Locally administered address (this is NOT the factory d
    .... ..1 .... .. = IG bit: Group address (multicast/broadcast)
Source: 52:54:00:19:93:e9 (52:54:00:19:93:e9)
Address: 52:54:00:19:93:e9 (52:54:00:19:93:e9)
    .... ..1. .... .. = LG bit: Locally administered address (this is NOT the factory d
    .... ..0 .... .. = IG bit: Individual address (unicast)
Type: ARP (0x0806)
Trailer: 00000000000000000000000000000000
Address Resolution Protocol (request)
Hardware type: Ethernet (1)
Protocol type: IPv4 (0x0800)
Hardware size: 6
Protocol size: 4
Opcode: request (1)
Sender MAC address: 52:54:00:19:93:e9 (
52:54:00:19:93:e9
)
Sender IP address:
10.47.4.2
Target MAC address: 00:00:00:00:00:00 (
00:00:00:00:00:00
)
Target IP address:
10.47.4.3

```

Edge-2(10.47.1.13)

Edge-2加入廣播底層組239.0.17.2並具有Edge-1的S、G，它接收Gig1/0/1上的VXLAN封裝組播資料包，而LISP0.8190子介面位於傳出介面清單中。早期版本的代碼（如17.3或更早版本）使用隧道介面而不是LISP0子介面。

```
<#root>
```

```
Edge-2#
```

```
show ip mroute 239.0.17.2
```

```
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

(* , 239.0.17.2), 5w1d/stopped, RP 10.47.1.14, flags: SJC

Incoming interface: GigabitEthernet1/0/1, RPF nbr 10.47.1.6

Outgoing interface list:

L2LISP0.8190, Forward/Sparse-Dense, 02:28:57/00:01:02, flags:

L2LISP0.8192, Forward/Sparse-Dense, 2w2d/00:00:32, flags:

L2LISP0.8188, Forward/Sparse-Dense, 5w1d/00:02:54, flags:

(10.47.1.12, 239.0.17.2), 00:00:03/00:02:56, flags: JT

Incoming interface:

GigabitEthernet1/0/1

, RPF nbr 10.47.1.6

<-- Interface that faces the fabric underlay and the RPF interface towards 10.47.1.12

Outgoing interface list:

L2LISP0.8188, Forward/Sparse-Dense, 00:00:03/00:02:56, flags:

L2LISP0.8192, Forward/Sparse-Dense, 00:00:03/00:02:56, flags:

L2LISP0.8190, Forward/Sparse-Dense, 00:00:03/00:02:56, flags:

Edge-2接收VXLAN封裝的封包、彈出VXLAN標頭並將封包泛洪到VLAN 1026，這可在傳入介面以及面對端點的介面上的EPC中看到。

<#root>

Edge-2#

monitor capture 1 interface gig1/0/1 in match any

Edge-2#

monitor capture 1 int g1/0/3 out

Edge-2#

monitor capture 1 start

Started capture point : 1

Edge-2#

monitor capture 1 stop

Capture statistics collected at software:

Capture duration - 22 seconds

Packets received - 43

Packets dropped - 0

Packets oversized - 0

Number of Bytes dropped at asic not collected

Capture buffer will exist till exported or cleared

Stopped capture point : 1

Edge-2#

```
show monitor capture 1 buffer display-filter arp
```

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

```
10 6.230153 52:54:00:19:93:e9 -> ff:ff:ff:ff:ff:ff ARP
```

110

```
Who has 10.47.4.3? Tell 10.47.4.2
```

<-- Size 110 is the VXLAN encapsulated ARP Request

```
11 6.404781 52:54:00:19:93:e9 -> ff:ff:ff:ff:ff:ff ARP
```

60

```
Who has 10.47.4.3? Tell 10.47.4.2
```

<-- Size 60 is the original ARP Request

泛洪路徑ARP回複驗證

ARP應答幾乎總是單播，除非它們是無用的ARP。對於單播ARP應答，基於LISP/SISF的單播路徑的工作流程與基於泛洪arp-nd的泛洪路徑的工作流程之間沒有區別，二者使用包括SISF/IPDT檢測的同一單播路徑。您可以利用「單播路徑ARP應答驗證」部分進行故障排除。

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）。