

SDアクセスファブリックでのARP解決のトラブルシューティング

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はじめに

このドキュメントでは、SDアクセスファブリックのアドレス解決プロトコル(ARP)をトラブルシューティングする方法について説明します。

前提条件

要件

次の項目に関する知識があることが推奨されます。

- インターネットプロトコル(IP)転送
- Locator/ID Separation Protocol(LISP)
- アドレス解決プロトコル(ARP)

使用するコンポーネント

このドキュメントの情報は、次のソフトウェアとハードウェアのバージョンに基づいています。

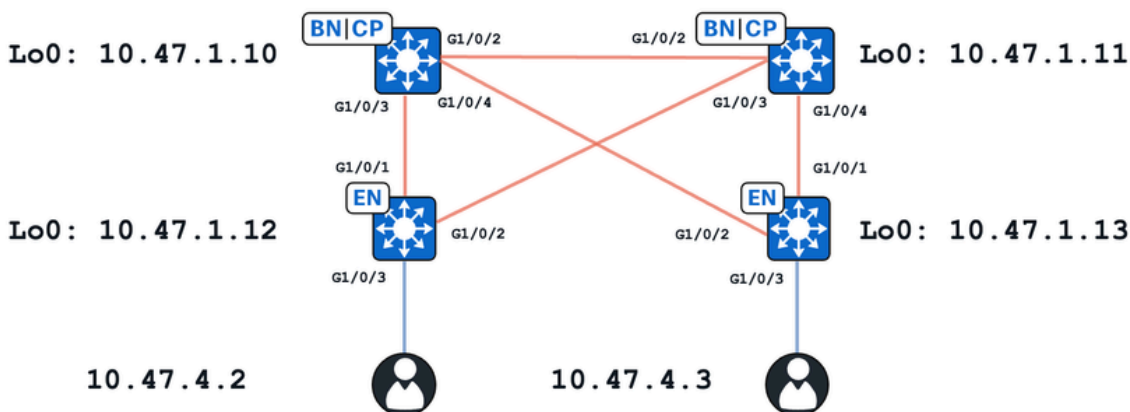
- Cisco IOS® XE 17.10.1上のC9000v
- SDA 1.0 (LISP PubSub以外)

このドキュメントの情報は、特定のラボ環境にあるデバイスに基づいて作成されました。このドキュメントで使用するすべてのデバイスは、クリアな (デフォルト) 設定で作業を開始しています。本稼働中のネットワークでは、各コマンドによって起こる可能性がある影響を十分確認してください。

このドキュメントは、次のバージョンのハードウェアとソフトウェアにも使用できます。

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

トポロジ



この演習では、次の操作を行います。

- 10.47.1.10と10.47.1.11は同じ場所に配置された境界
- 10.47.1.12と10.47.1.13はファブリックエッジノードです。
- 10.47.4.2および10.47.4.3はSDAファブリック内のエンドポイントであり、同じVLAN/サブネットおよび同じVN(red_vn)内にあります。

このドキュメントでは、主に次の2つの使用例を示します。

- ユニキャストパスによる10.47.4.2と10.47.4.3の間のARP解決
- フラディングパスを通じた10.47.4.2と10.47.4.3の間のARP解決

ユニキャストパスの初期状態

SDA内では、ファブリック内のARP解決に2つの主な方法があります。ユニキャストパスと呼ばれるものは、レイヤ2(L2)ARPフラッディングの設定がないか、問題のVLANに対応するLISP L2インスタンスID(IID)で「フラッディングarp nd」が設定されていないことを示します。この警告に加えて、ユニキャストARPパスの条件を満たすために、「IPローカルプロキシARP」の設定やレイヤ3専用プールの存在はありません。

上記の注意事項が満たされている場合、このトラブルシューティングのセクションに進みます。ここでは、両方のエンドポイント (10.47.4.2および10.47.4.3) がそれぞれのデフォルトゲートウェイ (10.47.4.1として存在するファブリックエッジスイッチ上に存在) に到達できると仮定します

```
<#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
```

 ヒント：エンドホストデバイス上のファイアウォールによって廃棄されているICMPパケットに関連する誤った結論を回避するために、エンドホストからエッジスイッチに向かってデフォルトゲートウェイにpingを実行することをお勧めします。その逆の方法は推奨しません。

。

次に、IPデバイストラッキング、(IPDT)LISP L2データベース、L2アドレス解決(AR)データベース、およびL3データベース内で、各ファブリックエッジノードがそれぞれのエンドポイントを持つことを確認します。

エッジ1:

IPDT内のエンドポイントを確認するには、show device-tracking database interface <interface connecting to endpoint>コマンドを使用します。

<#root>

Edge-1#

show device-tracking database interface g1/0/3

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 | prlvl | ag |
|-----------------------|--------------------|-----------|------|-------|----|
|-----------------------|--------------------|-----------|------|-------|----|

10.47.4.2

5254.0019.93e9

| | | | | | |
|---------|------|------|-----|-----------|---------------------|
| Gi1/0/3 | 1026 | 0024 | 15s | REACHABLE | 228 s try 0(6374 s) |
|---------|------|------|-----|-----------|---------------------|

LISP L2データベースのエンドポイントを確認するには、コマンドshow lisp eid-table vlan <vlan id> ethernet database <mac address>を使用して、前のコマンドで得たVLANとMACアドレスを使用します

<#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 |

L2 ARデータベースを確認するには、show lisp eid-table vlan <vlan-id> ethernet database address-resolution <mac address>コマンドを使用します。

<#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

LISP L3データベースを確認するには、コマンドshow lisp instance-id <L3 IID> ipv4 database <IPv4アドレス>/subnet maskを使用し、前のコマンドからLISP L3 IIDを使用します

<#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 |

エッジ2:

IPDT内のエンドポイントを確認するには、show device-tracking database interface <interface connecting to local endpoint>コマンドを使用します。

<#root>

Edge-2#

```
show device-tracking database interface g1/0/3
```

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) |

LISP L2データベースのエンドポイントを確認するには、コマンドshow lisp eid-table vlan <vlan id> ethernet database <mac address>を使用して、前のコマンドで得たVLANとMACアドレスを使用します

<#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
```

L2 ARデータベースを確認するには、コマンドshow lisp eid-table vlan <vlan-id> ethernet database address-resolution <mac address>を使用します。

<#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
```

LISP L3データベースを確認するには、コマンドshow lisp instance-id <L3 IID> ipv4 database <IPv4アドレス>/subnet maskを使用し、前のコマンドからLISP L3 IIDを使用します

```
<#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
```

併置された野線 :

L2 LISP、L2 AR、およびL3の観点からファブリックコントロールプレーン (Border-1とBorder-2) の両方に、理想的には両方のエンドポイントが登録されます。L2 LISP IDを取得するには、ファブリックエッジノードをチェックし、コマンド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 |
|---------|-----------|------|-------|
|---------|-----------|------|-------|

show lisp instance-id <L2 IID> ethernet server コマンドのL2 IIDを使用して、L2 LISPの観点からサーバを確認します

<#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

L2 ARサーバを確認するには、コマンドshow lisp instance-id <L2 IID> ethernet server address-resolutionを使用します。

<#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 |

L3サーバを確認するには、コマンド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 |

コントロールプレーンには、L3、L2、およびARエントリの登録イベントの短い履歴があります。これは、クライアントのローミングや、非常に短時間で複数のファブリックエッジによってクライアントが予期せず登録されるループの可能性をトラブルシューティングする際に役立ちます。

```
<#root>
```

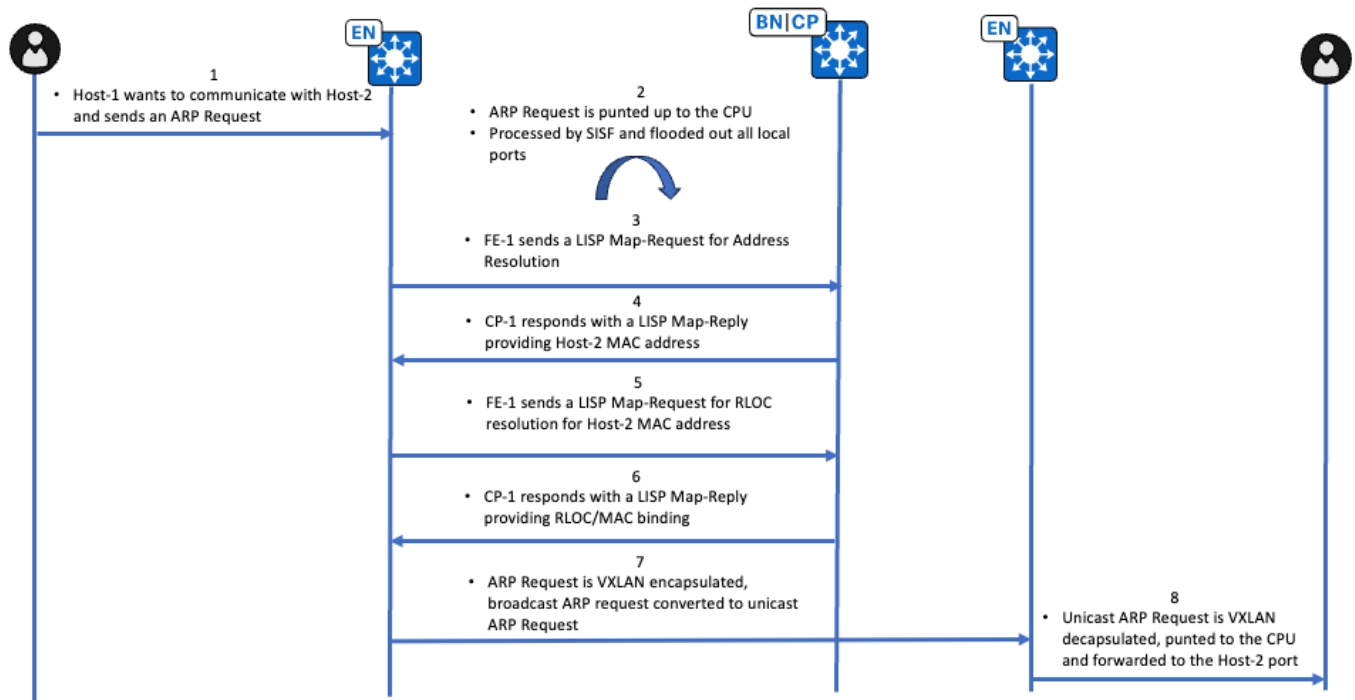
```
Border-1#
```

```
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
```

ユニキャストパスARP要求の高レベルワークフロー



ユニキャストパスARP要求の検証

IPアドレス10.47.4.2を所有するエンドポイントが、Edge-1のEmbedded Packet Capture(EPC)経由で確認したブロードキャストARP要求を送信します

エッジ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 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 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
```

このARP要求は、さらに処理するためにCPUにパントされます。FEDのPunject Captureを使用して、追加情報を取得します。

```
<#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], pa1:
```

```
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)
```

CPUキュー16を確認するには、show platform software fed switch active punt cpuq 16コマンドを使用します

<#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
```

理想的には、CPUポリサー（キュー16）のProtoスヌーピングキューでドロップが発生していないので、show platform hardware fed switch active qos queue stats internal cpu policerコマンドを使用します。

<#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
```

次に、パントされたARP要求がパントサービスによって処理されます。この動作は、debug、debug platform software infrastructure puntコマンドで確認できます。

<#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 MCP RP_PUNT_PAK_PROC_OK_DONE
```

 注意：このデバッグはチャタリングされるため、注意して使用してください。

パントサービスはパケットを処理した後、パケットをProto SnoopおよびProto ARP snoopプロセスに渡します。これにより、ARPスヌーピングテーブルにエントリが作成され、パケットがデバイストラッキング/SISFに送信されます。これを確認するには、debug arpとdebug platform fhs all

```
<#root>
```

```
Edge-1#
```


```
debug arp
```

```
Edge-1#
```

```
debug platform fhs all
```

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

```
ARP packet received from ARP snoop er(Gi1/0/3 10.47.4.2 (5254.0019.93e9) VLAN:1026)
```

 注意：これらのデバッグはチャットなので、注意して使用してください

show platform arpsnooping client <MACアドレス> コマンドを使用して、ARP要求がどうなるか確認します

```
<#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
```

IPDT/SISFがパケットを処理すると、ARP要求の内容が検証され、LISPによる解決を待っている間に一時エントリが作成されます。

```
<#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 sec1vl [guard], MAC 5254.0019.93e9: ARP::REQ,
[Tue Oct 24 14:37:13.000] VLAN 1026, From Gi1/0/3 sec1vl [guard], MAC 5254.0019.93e9: ARP::REQ,
```

debug device-trackingを使用すると、デバイストラッキングに0000.0000.00fdを指すエントリがあることがわかります。つまり、Gi1/0/3の背後にあるホストは、解決されていないホストを照会し、一時的な状態にあります（存在しないホストを照会する場合は永続的です。これは必ずしも悪いことではありません）

```
<#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
```

このLISPコントロールプレーンプロセスが引き継ぐことができるようになった後、SISFはLISP-AR-RELAY-VLANポリシーによりLISPを使用してARP解決をトリガーします。

```
<#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は、LISPコントロールプレーンを介してMACアドレス10.47.4.3を解決するためにLISPマップ要求を送信します

```
<#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 preference'.
```

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

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

Edge-1のCPU (コントロールプレーン) で実行される双方向のEmbedded Packet Capture(EPC)は、着信ARP要求とその後のLISPマップ要求を示します

```
<#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
```

LISPマップ要求のより詳細なビューを取得できます

<#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_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 15:20:08.948469000 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-RLLOC Count: 0
Record Count: 1
Nonce: 0xcffee30fb39a05b7
Source EID AFI: Reserved (0)
Source EID: not set
ITR-RLLOC 1: 10.47.1.12
  ITR-RLLOC AFI: IPv4 (1)
  ITR-RLLOC 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]

```

同じ場所に配置された境界 (10.47.1.10と10.47.1.11)

次に、LISPコントロールプレーンがLISPマップ応答でEdge-1に応答します。これは、デバッグとCPU EPCで確認できます。

```
<#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 (5
114 12.774428 10.47.1.11 -> 10.47.1.12 LISP 96 Map-Reply for Unknown LCAF Type (53)/32

```

パケットをより詳細に見ると、LISPマップ要求とそれに続くLISPマップ応答を確認できます

<#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: 0x000
.... .... .... .... ...0 0000 = ITR-RLLOC Count: 0
Record Count: 1
Nonce: 0x50c5f2b60b41ca1c
Source EID AFI: Reserved (0)
Source EID: not set
ITR-RLLOC 1: 10.47.1.12
    ITR-RLLOC AFI: IPv4 (1)
    ITR-RLLOC 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]

```

また、返信されるLISP Map-Replyも確認できます

<#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... = 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 = 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 Priority
  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 GigabitEthernet1/0/3
```

```
*Oct 24 16:02:17.854: LISP[TRNSP]-0: Processing received Map-Request(1) message on GigabitEthernet1/0/3
```

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

```
*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.
```

10.47.4.3が5254.001e.ad00であることを示すAddress Resolution (AR ; アドレス解決) 要求に対するLISP Map-ReplyをEdge-1が受信したので、Edge-1は別のLISP Map-Requestを生成して、エンドポイントのMACアドレスのRLOCを決定します

<#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

*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 prefix'

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

LISPコントロールプレーンは、MACアドレス10.47.4.3に対するLISPマップ要求を受信し、イーサネットサーバテーブルを参照してL2 LISP IID 8190を調べ、MAC-RLOCバインディングとともにLISPマップ応答を送信します

<#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

LISPマップ要求とマップ応答について詳しく見てみましょう

<#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_to_ts_pipe

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 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, Authority: 1440
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 Priority: 10
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は、Border-1からLISPマップ応答を受信します

```
<#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.
```

LISP/SISF交換を介したARP要求全体は、CPU EPCを介してEdge-1で表示できます

```
<#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
```

Edge-1のコントロールプレーンが収束すると、マップキャッシュエントリとSISFリモートエントリ(RMT)が表示されます

```
<#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, 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
```

```
RMT
```

```
10.47.4.3
```

```
5254.001e.ad00
```


L2LI0 1026 0005 7mn STALE try 0 731 s

次に、ユニキャストARP要求がCPUからインジェクトされます。物理インターフェイス上のEPCを使用して、CPU挿入パケットを出力方向でキャプチャすることはできません。VXLANカプセル化ユニキャストARP要求の受信の確認には、受信側ファブリックエッジノード上のSwitchport Analyzer(SPAN)または入力EPCを使用できます

Edge-2(10.47.1.13)

まず、LISPまたはトンネルインターフェイスがVLAN 1026のVLAN ID出力にリストされていることを確認します

<#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 |
|---------|-----------|------|-------|
|---------|-----------|------|-------|

ここで、Edge-2の入力EPCは、受信したVXLANカプセル化ARP応答を示します。ユニキャストARP要求はVXLANでカプセル化されるため、IP ACLを使用してエッジ2 RLOCに送信されるエッジ1 RLOC (それぞれ10.47.1.12から10.47.1.13に送信)と照合し、トラフィックをフィルタリングできます。

<#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
```

このARP要求をより詳しく調べると、ARPフレームが小さく、通常は60バイトであるため、VXLANカプセル化、UDPヘッダー、およびその他のヘッダーがあることがわかります。

```
<#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はVXLANカプセル化を取り除き、ユニキャストARP要求をさらに処理するためにCPUにパントします。これは、FEDパントキャプチャで確認できます。

```
<#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要求がARPスヌーププロセスに送信されます。

<#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, encaps 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：このデバッグはチャット形式なので、注意して使用してください。

このARP要求はL2 LISP/トンネルインターフェイスから送信されるため、Edge-2はLISPのダイナミックEIDのローカルエンドポイントとして10.47.4.2を学習しません

<#root>

Edge-2#s

```
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 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
```

ここで、ARP要求はCPUからVLAN 1026、特に10.47.4.3が接続されているGi1/0/3に注入されま
す。

<#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

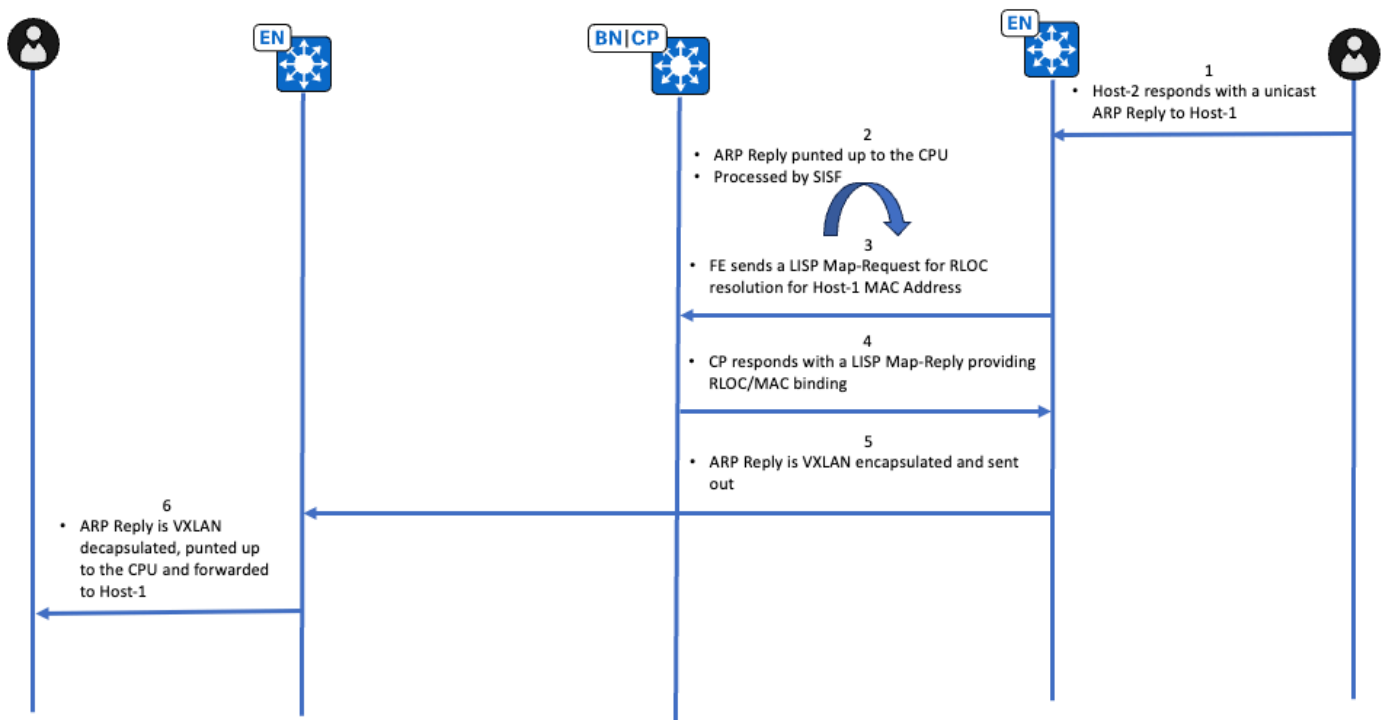
Edge-2#

```
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 |

ユニキャストパスARP応答の高レベルワークフロー



ユニキャストパスARP応答の検証

Edge-2(10.47.1.13)

10.47.4.3を所有するエンドポイントはユニキャストARP応答で応答し、ARP応答はIPDTの存在によりCPUにパントされます。最初の検証は、エンドポイントに面するインターフェイスでEPCを介して行われます。

<#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
```

次に、FEDパントを使用してパントアクションを確認します

<#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], pa1:

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)

次に、ARP応答がARPスヌーパとデバイストラッキングに渡されます

<#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 snooper(Gi1/0/3 10.47.4.3 (5254.001e.ad00) VLAN:10
```

 注意：これらのデバッグはおしゃべりなので、注意して使用してください。

```
<#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
```

ARP応答はすでに実際の宛先MACアドレス (Edge-1で一時的に確認されるプレースホルダとは異なる) を指しているため、Edge-2はLISPマップ要求をトリガーしてRLOC-MACの関連付けを解決できません。

```
<#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 prefix'
```

```
*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.
```

コマンドshow lisp instance-id <L2 IID> ethernet map-cache <宛先MACアドレス> を使用して、このARP応答がVXLANカプセル化を使用してどのRLOCに送信されるかを確認します

```
<#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)
```

LISPの解決後、ARP応答をCPUからアンダーレイの10.47.1.12 RLOCに挿入できます

```
<#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
```

フロー全体がEPC経路でEdge-2 CPUで確認できます。ARP応答とARP要求の違いは、このフローにはLISP AR解決がないことです。

```
<#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
```

 ヒント:FED Punjectキャプチャは、挿入されたARP応答をキャプチャしません。FED挿入の詳細トレースを使用してください。

show platform arpsnooping client <source MAC address>コマンドを使用すると、ARP応答に対してEdge-2で実行されたアクションを確認できます

```
<#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 | | | | | |

エッジ1(10.47.1.12)

Edge-1はVXLANカプセル化ARP応答を受信し、VXLANヘッダーをポップしてARP応答をCPUにパントし、さらに処理します。

```
<#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 MCRP_PUNT_PAK_PROC_OK_DONE
```

ARP応答がEdge-1でどのように処理されているかについての追加情報を取得するには、show platform arpsnooping client <source MAC address>コマンドを使用できます

<#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はパントされたARP応答を取得し、エンドポイント10.47.4.2が存在するポートにVLAN 1026にARP応答を送信します

<#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 |

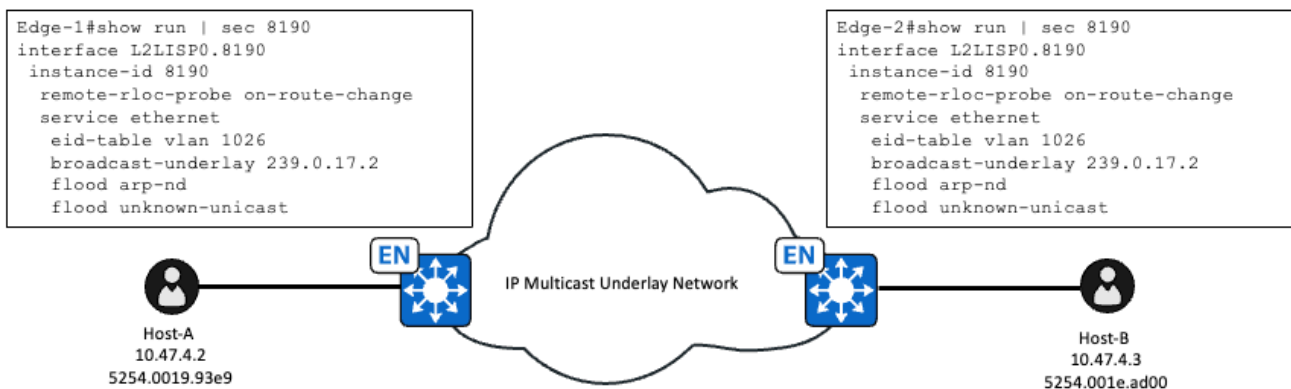
Total Mac Addresses for this criterion: 1

ARPフラッディング (L2フラッディング) パス

L2フラッディングを使用すると、ファブリック内のすべてのファブリックエッジノードと、L2ハ

ンドオブ/IPダイレクトブロードキャストが有効な境界が共通のアンダーレイマルチキャストグループに参加している場合にも、ARP解決が発生する可能性があります。フラッディングの対象となるパケット/フレームがエッジノードに到達するたびに、アンダーレイマルチキャストグループの宛先IPアドレスでVXLANがカプセル化されます。L2フラッディングは、特定のシナリオでARP解決に適用される可能性があります。

- flood arp-ndコマンドは、VLANのL2 LISPインスタンスで設定します。ブロードキャストARPフレームは、ブロードキャストアンダーレイマルチキャストグループを使用してすべてのファブリックエッジにフラッディングされます。
- プールでL2フラッディングが有効になっており、プールがワイヤレスプールとしてマークされていない場合、Cisco Catalyst Centerでflood arp-nd コマンドが設定されます
- アンダーレイマルチキャストは、LANオートメーションまたは手動設定を使用して設定する必要があります。ファブリックマルチキャストワークフローでは、アンダーレイマルチキャストは自動的に設定されません。



アンダーレイマルチキャストを設定し、flood arp-ndを有効にすると、ARP要求の処理方法が変更されます。この処理方法は、もともとLISP/SISFベースの解決を使用していました。L2 LISPインスタンスでflood arp-ndが設定されると、VLANのLISP-ARP-RELAY-VLAN IPDTポリシーが無効になり、使用されなくなります。

<#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 |

フラッディングパスARP要求の検証

エッジ1(10.47.1.12)

フラッディングarp-ndが設定されたL2フラッディング対応VLANでクライアントからARP要求を受信すると、ARPスヌーピングによって処理されなくなります。ARP要求は、IPDTラーニングの目的でCPUにパントされますが、転送の目的ではありません。

ARPスヌーパはARP要求を処理しません。これは、show platform arpsnooping client <MAC address>コマンドで確認できます。

<#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 | | | | | |

出力に示されているように、Edge-1はエンドポイント10.47.4.3のRMT IPDTエントリを作成しません

<#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 | prlvl | ag |
|-----------------------|--------------------|-----------|------|-------|----|
|-----------------------|--------------------|-----------|------|-------|----|

これで、ARP要求はVXLANでカプセル化され、ブロードキャストアンダーレイマルチキャストグループに追加されました。Edge-1には、送信元としてLoopback0を持つmrouteがあり、ブロード

キャストアンダーレイグループがグループ化されています。

<#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

```

実際には、フラッディングarp-ndは、自身をフラッディングするのではなく、IPDT/SISFを切り替えます。L2フラッディングはすでにブロードキャストをフラッディングしますが、テクニックはLISP ARポリシーをデバイストラッキングから無効にすることです。ARPの所有権が解放され、他のブロードキャストと同様にフラッディングできます。

L2フラッディングのハードウェアプログラミングを確認するには、show platform software dpidb l2lisp <L2 LISP IID>コマンドを使用します。

```
<#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
```

前のコマンドのdpidx値を、コマンドshow platform software fed switch active ifm if-id <dpidx value>で使用します。

```
<#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>

Gi1/0/2の出力方向でEPCを使用できます。このARP要求はCPUインジェクションを必要とせずに送受信が転送されるため、今回の出力決定ではEPCキャプチャを信頼できます。

<#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 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

110

Who has 10.47.4.3? Tell 10.47.4.2

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

VXLANでカプセル化されたARP要求を詳しく調べることができます

<#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はブロードキャストアンダーレイグループ239.0.17.2に参加し、Edge-1のS,Gを持ち、Gig1/0/1でVXLANカプセル化マルチキャストパケットを受信し、LISP0.8190サブインターフェイスが発信インターフェイスリストに含まれています。17.3以前のような以前のバージョンのコードは、LISP0サブインターフェイスの代わりにトンネルインターフェイスを使用します。

<#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はVXLANカプセル化パケットを受信し、VXLANヘッダーをポップしてパケットをVLAN 1026にフラッディングします。これは、着信インターフェイスのEPCや、エンドポイントに面するインターフェイスで確認できます。

<#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 exists 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
```

フラッディングパスARP応答の検証

ARP応答は、Gratuitous ARPでない限り、ほとんどの場合ユニキャストです。ユニキャストARP応答の場合、LISP/SISFに基づくユニキャストパスのワークフローとフラッディングarp-ndに基づくフラッディングパスのワークフローは区別されず、どちらもSISF/IPDT検出を含む同じユニキャストパスを使用します。「ユニキャストパスARP応答検証」セクションをトラブルシューティングに利用できます。

翻訳について

シスコは世界中のユーザにそれぞれの言語でサポート コンテンツを提供するために、機械と人による翻訳を組み合わせて、本ドキュメントを翻訳しています。ただし、最高度の機械翻訳であっても、専門家による翻訳のような正確性は確保されません。シスコは、これら翻訳の正確性について法的責任を負いません。原典である英語版（リンクからアクセス可能）もあわせて参照することを推奨します。