EX硬體：ACI資料包轉發深入分析。

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簡介

本文檔介紹在應用中心基礎設施(ACI)中使用基於「EX」的ACI交換機的不同轉發方案。它將說明如何驗證硬體是否已正確程式設計，以及我們正在將資料包轉發到相應終端組(EPG)中的正確目標終端(EP)。

必要條件

需求

本文件沒有特定需求。

採用元件

本檔案中的資訊是根據以下硬體和軟體版本：

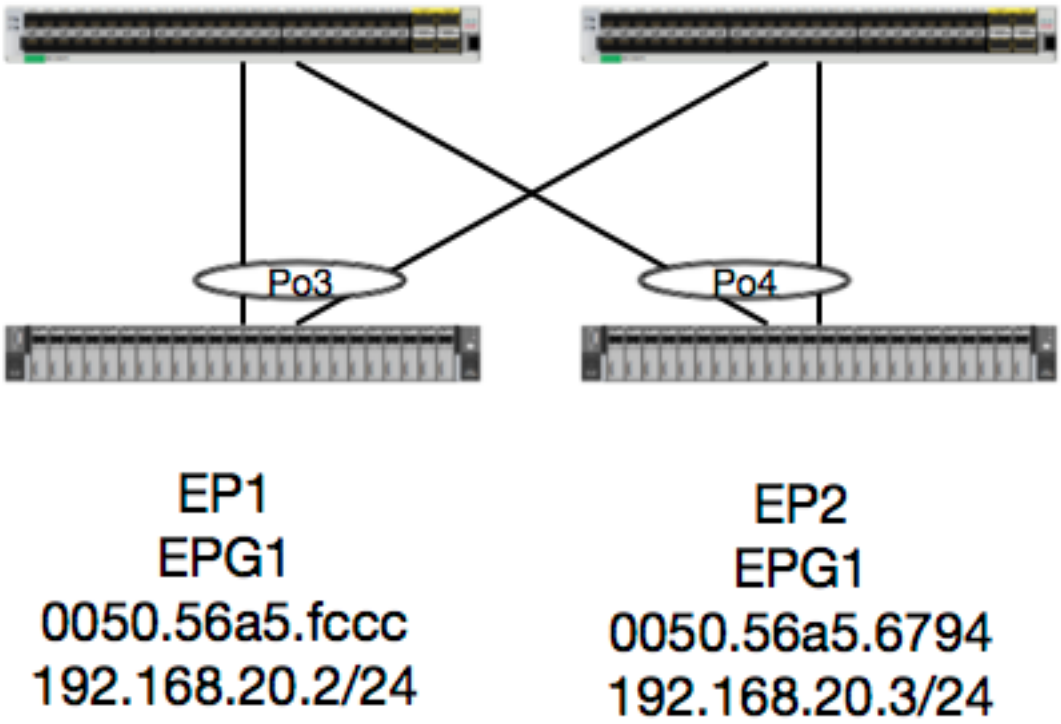
- ACI交換矩陣，包括使用EX硬體的兩個主幹交換機和兩個枝葉交換機
- 一台帶有兩個上行鏈路的ESXi主機，分別連線到每台枝葉交換機
- 充當路由器的Nexus 5000裝置。
- 用於初始設定的應用策略基礎設施控制器(APIC)

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。如果您的網路正在作用，請確保您已瞭解任何指令可能造成的影響。

案例

2個EP位於同一EPG/相同枝葉 — 交換幀中

拓撲



根據此拓撲，從EP1到EP2的流是L2流，應在源流量進入的任何枝葉上本地交換。 要檢查第2層(L2)資料流，首先要檢查mac地址表，以確定交換機是否接收幀以及在何處收到幀：

```
leaf4# show mac address-table | grep fccc
* 30       0050.56a5.fccc    dynamic      -       F    F    po3
leaf4# show mac address-table | grep 6794
* 30       0050.56a5.6794    dynamic      -       F    F    po4
```

若要檢視封裝VLAN，您還可以檢查EP資料庫：

```
leaf4# show endpoint mac 0050.56a5.fccc
Legend:
 O - peer-attached    H - vtep             a - locally-aged     S - static
 V - vpc-attached     p - peer-aged        L - local            M - span
 s - static-arp       B - bounce
```

```
+----------------------------------+--------------+-----------------+-------------+----------
---+
      VLAN/                          Encap           MAC Address       MAC Info/
Interface
      Domain                         VLAN            IP Address        IP Info
+----------------------------------+--------------+-----------------+-------------+----------
---+
30                                      vlan-2268    0050.56a5.fccc LV
po3
Joey-Tenant:Joey-Internal               vlan-2268      192.168.20.2 LV
po3


calo2-leaf4# show endpoint mac 0050.56a5.6794
Legend:
 O - peer-attached    H - vtep             a - locally-aged     S - static
 V - vpc-attached     p - peer-aged        L - local            M - span
 s - static-arp       B - bounce
+----------------------------------+--------------+-----------------+-------------+----------
---+
      VLAN/                          Encap           MAC Address       MAC Info/
Interface
      Domain                         VLAN            IP Address        IP Info
+----------------------------------+--------------+-----------------+-------------+----------
---+
30                                      vlan-2268    0050.56a5.6794 LV
po4
Joey-Tenant:Joey-Internal               vlan-2268      192.168.20.3 LV
po4
```

我們知道FD_VLAN 30匹配，但我們可以始終在軟體中驗證對映：

```
leaf4# show vlan extended | grep 2268
 30   enet  CE         vlan-2268
```

當然，我們可以檢查硬體，以確保VLAN 30對映到作為前面板封裝的VLAN 2268。

```
leaf4# vsh_lc
module-1# show system internal eltmc info vlan 30


            vlan_id:             30   :::      hw_vlan_id:             22
          vlan_type:        FD_VLAN   :::         bd_vlan:             28
   access_encap_type:         802.1q   :::    access_encap:           2268
   fabric_encap_type:          VXLAN   :::    fabric_encap:          11960
              sclass:          32778   :::           scope:             11
           untagged:               0
     acess_encap_hex:          0x8dc   :::  fabric_enc_hex:         0x2eb8
     pd_vlan_ft_mask:            0x8
    fd_learn_disable:              0
        qos_class_id:              0   :::      qos_pap_id:              0
          qq_met_ptr:             25   :::      ipmc_index:              0
   ingressBdAclLabel:              0   ::: ingBdAclLblMask:              0
    egressBdAclLabel:              0   ::: egrBdAclLblMask:              0
         qos_map_idx:              0   :::     qos_map_pri:              0
        qos_map_dscp:              0   :::      qos_map_tc:              0
        vlan_ft_mask:          0xe30
           hw_bd_idx:              0   :::      hw_epg_idx:          11267
         intf_count:               2   ::: glbl_scp_if_cnt:              2

<SNIPPED>
```

鑑於已經從軟體中學習了電子產品，我們還可以驗證硬體是否也對這些電子產品的二級資訊進行程

式設計。 在新硬體中，硬體抽象層(HAL)是硬體的軟體狀態。 HAL的工作是接受軟體程式設計請求，並將其推送到硬體上。

為了檢視有關終端的L2硬體資訊，我們可以檢視HAL中給定mac地址的L2表：

```
leaf4# vsh_lc
module-1# show platform internal hal ep l2 mac 0050.56a5.fccc
LEGEND:
-------
BDId:              BD Id                                                 BD Name:        BD
Name
T:                 EP Type (Pl: Physical Vl: Virtual Xr: Remote          EP Mac:         Mac
L2 IfId:           L2 Interface                                          L2 IfName:      L2
IfName
FDId:              FD Id                                                 FD Name:        FD
Name
S Class:           S Class                                               Age Intvl:      Age
Interval
P A:               Packet Action (F: Forward, T: Trap to CPU,
                                  L: Log & Forward, D: Drop, N: None)
S T:               Static Ep                                             S E:
Secure EP
L D:               Learn Disable                                         B N D:          Bind
Notify Disable
E N D:             Epg Notify Disable                                    B E:
Bounce Enable
I D L:             IVxlan Dont Learn                                     SPI:
Source Policy Incomplete
DPI:               Dest Policy Incomplete                                SPA:
Source Policy Applied
DPA:               Dest Policy Applied                                   DSS:            Dest
Shared Service
IL:                Is Local                                              VUB:            Vnid
Use Bd
SO:                SA Only

 L2 EP Count: 1

================================================================================================
======================
                                                                                          B E
I S D S D D   V
     BD           EP               L2       L2               FD        S     Age   P S S L N N
B D P P P P S I U S
BdId Name      T  Mac              IfId     Ifname      FDId Name      Class Intvl A T E D D D
E L I I A A S L B O
================================================================================================
======================
1c   BD-28     Pl 00:50:56:a5:fc:cc 16000002 Po3         1e   FD-30     800a  29f   F 0 0 0 1 0
0 0 0 0 0 0 0 1 0 0


module-1# show platform internal hal ep l2 mac 0050.56a5.6794
================================================================================================
======================
                                                                                          B E
I S D S D D   V
     BD           EP               L2       L2               FD        S     Age   P S S L N N
B D P P P P S I U S
BdId Name      T  Mac              IfId     Ifname      FDId Name      Class Intvl A T E D D D
E L I I A A S L B O
```

```
================================================================================================
======================
1c   BD-28     Pl 00:50:56:a5:67:94 16000003 Po4         1e   FD-30     800a  29f   F 0 0 0 1 0
0 0 0 0 0 0 0 1 0 0
```

現在我們已經規劃了硬體，讓我們來執行ELAM並檢視資料包應該傳送到哪裡。

伊拉姆語

```
leaf4# vsh_lc
module-1# debug platform internal tah elam asic 0
module-1(DBG-TAH-elam)# trigger reset
module-1(DBG-TAH-elam)# trigger init in-select 6 out-select 0
module-1(DBG-TAH-elam-insel6)# set outer l2 src_mac 0050.56a5.fccc dst_mac 0050.56a5.6794
module-1(DBG-TAH-elam-insel6)# start
module-1(DBG-TAH-elam-insel6)# stat
ELAM STATUS
===========
Asic 0 Slice 0 Status Armed
Asic 0 Slice 1 Status Triggered

module-1(DBG-TAH-elam-insel6)# report | grep ovec
  sug_elam_out_sidebnd_no_spare_vec.ovector_idx: 0x9E
```

很好，因此Leaf4在Asic 0片1上收到該幀。在新硬體上使用ELAM時，出現了一個在故障排除時非常重要的新的欄位：ovector_idx。 此索引是轉發幀/資料包時應使用的物理埠索引。 收到ovector_idx後，我們可以使用此命令查詢它對映到的埠：

```
module-1(DBG-TAH-elam-insel6)# show platform internal hal l2 port gpd
Legend:
-------
IfId:       Interface Id                                IfName:      Interface Name
I P:        Is PC Mbr                                   IfId:           Interface Id
Uc PC Cfg:      UcPcCfg Idx                             Uc PC MbrId:    Uc Pc Mbr Id
As:             Asic                                    AP:             Asic Port
Sl:             Slice                                   Sp:             Slice Port
Ss:             Slice SrcId                             Ovec:           Ovector (slice |
srcid)
L S:            Local Slot                              Reprogram:
L3:             Is L3
    P:    PifTable                                      Xla Idx:        Xlate Idx
    RP:   Rw PifTable                                   Ovx Idx:        OXlate Idx
    IP:   If Profile Table                              N L3:           Num. of L3 Ifs
    RS:   Rw SrcId Table                                NI L3:          Num. of Infra L3 Ifs
    DP:   DPort Table                                   Vif Tid:        Vif Tid
    SP:   SrcPortState Table                            RwV Tid:        RwVif Tid
    RSP:  RwSrcPortstate Table                          Ing Lbl:        Ingress Acl Label
    UC:   UCPcCfg                                       Egr Lbl:        Egress Acl Label
    UM:   UCPcMbr                                       Reprogram:
PROF ID:        Lport Profile Id
    VS:   VifStateTable                                 HI:             LportProfile Hw
Install
    RV:   Rw VifTable
Num. of Sandboxes: 1

Sandbox_ID: 0, BMP: 0x0
 Port Count: 8

================================================================================================
=========================================
                        Uc   Uc                          |       Reprogram       |
```

```
| Rep |
                    I PC   Pc                          L |   R I R D    R  U U X | L Xla Ovx N
NI Vif    RwV    Ing  Egr  | V R | PROF H
IfId     Ifname      P Cfg  MbrID As AP Sl Sp Ss Ovec S | P P P S P Sp Sp C M L | 3 Idx Idx L3
L3 Tid    Tid    Lbl  Lbl  | S V | ID   I
================================================================================================
==========================================
1a004000 Eth1/5      1 0    1d     0  d  0  c  18 18   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      800  0      0 1   0    0
1a005000 Eth1/6      1 0    b      0  e  0  d  1a 1a   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      800  0      0 1   0    0
1a006000 Eth1/7      0 26   5      0  f  0  e  1c 1c   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
D-256  -      800  0      0 1   e    0
1a007000 Eth1/8      0 2e   7      0  10 0  f  1e 1e   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
D-84   -      800  0      0 1   30   0
1a01e000 Eth1/31     1 0    2d     0  37 1  e  1c 9c   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      0    0      0 1   0    0
1a01f000 Eth1/32     1 0    3d     0  38 1  f  1e 9e   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      0    0      0 1   0    0
1a030000 Eth1/49     0 2    1      0  49 1  20 38 b8   1   0 0 0 0 0 0  0  0 0 0   1 8   6   2  2
D-24d  -      400  0      0 0   1    0
1a031000 Eth1/50     0 3    3      0  29 1  0  0  80   1   0 0 0 0 0 0  0  0 0 0   1 9   7   2  2
D-350  -      400  0      0 0   1    0
```

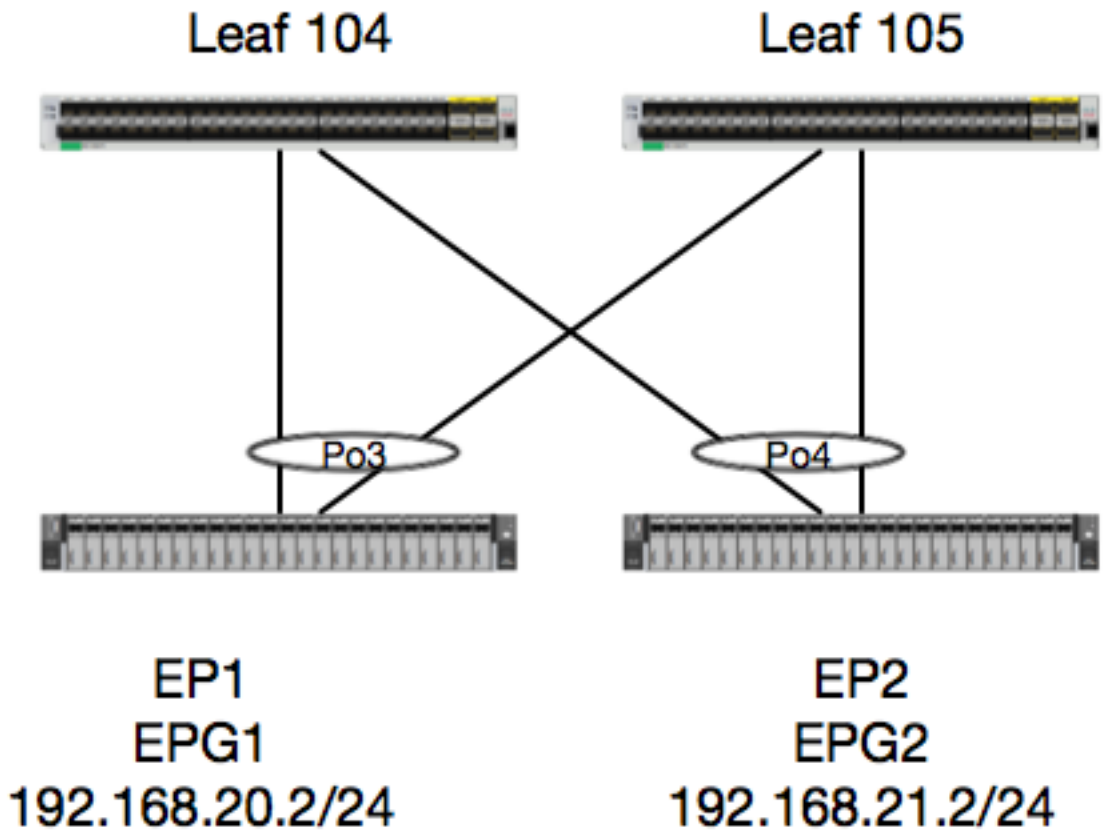
交換器認為封包應該從介面Ethernet 1/32轉送。是在得知MAC位址的PO4嗎？

```
leaf4# show port-channel summary
Flags:  D - Down        P - Up in port-channel (members)
        I - Individual  H - Hot-standby (LACP only)
        s - Suspended   r - Module-removed
        S - Switched    R - Routed
        U - Up (port-channel)
        M - Not in use. Min-links not met
        F - Configuration failed
------------------------------------------------------------------------------
Group Port-       Type     Protocol  Member Ports
      Channel
------------------------------------------------------------------------------
1     Po1(SU)     Eth      LACP      Eth1/5(P)
2     Po2(SU)     Eth      LACP      Eth1/6(P)
3     Po3(SU)     Eth      LACP      Eth1/31(P)
4     Po4(SU)     Eth      LACP      Eth1/32(P)
```

會，因此封包會從介面1/32轉送到目的地主機。

不同EPG/相同枝葉中的2個EP — 路由資料包

拓撲



在本示例中，我們將跟蹤資料包從EP1到EP2的流量，其中資料包存在於同一個vPC枝葉對中。 兩個EP使用不同的BD位於不同的EPG中。

首先要始終檢查EP資料庫，看我們是否學習了EP:

```
leaf4# show endpoint ip 192.168.20.2
Legend:
 O - peer-attached    H - vtep             a - locally-aged     S - static
 V - vpc-attached     p - peer-aged        L - local            M - span
 s - static-arp       B - bounce
+------------------------------------+--------------+-----------------+--------------+----------
---+
      VLAN/                           Encap           MAC Address       MAC Info/
Interface
      Domain                          VLAN            IP Address        IP Info
+------------------------------------+--------------+-----------------+--------------+----------
---+
30                                        vlan-2268     0050.56a5.fccc LV
po3
Joey-Tenant:Joey-Internal                 vlan-2268       192.168.20.2 LV
po3


calo2-leaf4# show endpoint ip 192.168.21.2
Legend:
 O - peer-attached    H - vtep             a - locally-aged     S - static
 V - vpc-attached     p - peer-aged        L - local            M - span
 s - static-arp       B - bounce
+------------------------------------+--------------+-----------------+--------------+----------
---+
      VLAN/                           Encap           MAC Address       MAC Info/
Interface
```

```
      Domain                            VLAN            IP Address        IP Info
+-----------------------------------+--------------+-----------------+-------------+----------
---+
8                                       vlan-2200     0050.56a5.0c11 LV
po4
Joey-Tenant:Joey-Internal               vlan-2200       192.168.21.2 LV
po4
```

由於我們已經學習了EP並瞭解了IP資訊，因此我們應當能夠檢視硬體中的EP學習資訊：

```
leaf4# vsh_lc
module-1# show platform internal hal ep l3 all
LEGEND:
-------
VrfName:           Vrf Name                                                  T:              Type
(Pl: Physical, Vl: Virtual, Xr: Remote)
EP IP:             Endpoint IP
S Class:           S Class                                                   Age Intvl:      Age
Interval
S T:               Static Ep                                                 S E:
Secure EP
L D:               Learn Disable                                             B N D:          Bind
Notify Disable
E N D:             Epg Notify Disable                                        B E:
Bounce Enable
I D L:             IVxlan Dont Learn                                         SPI:
Source Policy Incomplete
DPI:               Dest Policy Incomplete                                    SPA:
Source Policy Applied
DPA:               Dest Policy Applied                                       DSS:            Dest
Shared Service
IL:                Is Local                                                  VUB:            Vnid
Use Bd
SO:                SA Only                                                   EP NH L3IfName: EP
Next Hop L3 If Name
NHT:               Next Hop Type (L2: L2 Entry L3: L3 Next Hop)              BD Name:        L2 NH
BD Name
EP Mac:            EP Mac                                                    L3 IfName:      L3 NH
If Name
L2 IfName:         L2 If Name                                                FD Name:        L2
Entry FD Name
IP:                L3 NH IP

 L3 EP Count: 12

================================================================================================
==========================================================================
                                                                  B E   I S D S D D   V   EP-NH
N  |
Vrf              EP                              S     Age   S S L N N B D P P P P S I U S L3
H  | BD        EP                L3           L2          FD
Name          T  IP                             Class Intvl T E D D D E L I I A A S L B O
IfName       T  | Name      Mac                IfName       Ifname      Name      IP
================================================================================================
==========================================================================
common*rewall Pl 10.6.112.1                     1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -           -         0.0.0.0
common*rewall Pl 10.6.114.1                     1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -           -         0.0.0.0
common*rewall Pl 10.6.114.129                   1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -           -         0.0.0.0
common*efault Pl 100.100.101.1                  1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
```

```
L3   -         00:00:00:00:00:00 -           -           -         0.0.0.0
Joey-T*ternal Pl 192.168.1.1                  1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -           -         0.0.0.0
Joey-T*ternal Xr 192.168.1.100                8013  128   0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 -
L3   -         00:0c:0c:0c:0c:0c Tunnel2     Tunnel2     -         0.0.0.0
Joey-T*ernal2 Pl 192.168.3.1                  1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -           -         0.0.0.0
Joey-T*ternal Pl 192.168.20.1                 1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -           -         0.0.0.0
Joey-T*ternal Pl 192.168.20.2                 800a  0     0 0 0 0 0 0 0 0 0 0 0 1 0 0 -
L2   BD-28     00:50:56:a5:fc:cc -           Po3         FD-30     -
Joey-T*ternal Pl 192.168.21.1                 1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -           -         0.0.0.0
Joey-T*ternal Pl 192.168.21.2                 800c  0     0 0 0 0 0 0 0 0 0 0 0 1 0 0 -
L2   BD-7      00:50:56:a5:0c:11 -           Po4         FD-8      -
Joey-T*ternal Pl 2001:0:0:100::1              1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -           -         0.0.0.0
```

HAL第3層(l3)表非常有用，因為它為我們提供了第3層獲知EP的VLAN/埠資訊。 我們知道目的地是Po4，因此應該將封包從Po4中的任何連線埠轉送。

我們運行一個ELAM並檢視結果！

伊拉姆語

```
leaf4# vsh_lc
module-1# debug platform internal tah elam asic 0 module-1(DBG-TAH-elam)# trigger init in-select
6 out-select 0
module-1(DBG-TAH-elam-insel6)# set outer ipv4 src_ip 192.168.20.2 dst_ip 192.168.21.2
module-1(DBG-TAH-elam-insel6)# start
module-1(DBG-TAH-elam-insel6)# stat
ELAM STATUS
===========
Asic 0 Slice 0 Status Armed
Asic 0 Slice 1 Status Armed

module-1(DBG-TAH-elam-insel6)# stat
ELAM STATUS
===========
Asic 0 Slice 0 Status Armed
Asic 0 Slice 1 Status Triggered

module-1(DBG-TAH-elam-insel6)# report | grep ovec
  sug_elam_out_sidebnd_no_spare_vec.ovector_idx: 0x9E
```

很好，所以我們觸發了資料包，我們發現「ovector_idx」是0x9E。ovector索引是應該將資料包轉發出來的傳出物理介面索引。 讓我們看看哪個連線埠具有此索引：

```
module-1(DBG-TAH-elam-insel6)# show platform internal hal l2 port gpd
Legend:
-------
IfId:       Interface Id                                IfName:      Interface Name
I P:        Is PC Mbr                                   IfId:           Interface Id
Uc PC Cfg:      UcPcCfg Idx                             Uc PC MbrId:    Uc Pc Mbr Id
As:             Asic                                    AP:             Asic Port
Sl:             Slice                                   Sp:             Slice Port
Ss:             Slice SrcId                             Ovec:           Ovector (slice |
srcid)
L S:            Local Slot                              Reprogram:
```

```
L3:             Is L3
    P:    PifTable                                          Xla Idx:        Xlate Idx
    RP:   Rw PifTable                                       Ovx Idx:        OXlate Idx
    IP:   If Profile Table                                  N L3:           Num. of L3 Ifs
    RS:   Rw SrcId Table                                    NI L3:          Num. of Infra L3 Ifs
    DP:   DPort Table                                       Vif Tid:        Vif Tid
    SP:   SrcPortState Table                                RwV Tid:        RwVif Tid
    RSP:  RwSrcPortstate Table                              Ing Lbl:        Ingress Acl Label
    UC:   UCPcCfg                                           Egr Lbl:        Egress Acl Label
    UM:   UCPcMbr                                           Reprogram:
PROF ID:        Lport Profile Id
    VS:   VifStateTable                                     HI:             LportProfile Hw
Install
    RV:   Rw VifTable
Num. of Sandboxes: 1

Sandbox_ID: 0, BMP: 0x0
 Port Count: 8

================================================================================================================
=========================================
                        Uc   Uc                            |       Reprogram       |
| Rep |
                     I PC   Pc                         L |   R I R D    R  U U X | L Xla Ovx N
NI Vif    RwV    Ing  Egr  | V R | PROF H
IfId     Ifname      P Cfg  MbrID As AP Sl Sp Ss Ovec S | P P P S P Sp Sp C M L | 3 Idx Idx L3
L3 Tid    Tid    Lbl  Lbl  | S V | ID   I
================================================================================================================
=========================================
1a004000 Eth1/5      1 0    1d    0  d  0  c  18 18   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      800  0      0 1   0    0
1a005000 Eth1/6      1 0    b     0  e  0  d  1a 1a   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      800  0      0 1   0    0
1a006000 Eth1/7      0 26   5     0  f  0  e  1c 1c   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
D-256  -      800  0      0 1   c    0
1a007000 Eth1/8      0 2f   7     0  10 0  f  1e 1e   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
D-199  -      800  0      0 1   2e   0
1a01e000 Eth1/31     1 0    2d    0  37 1  e  1c 9c   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      0    0      0 1   0    0
1a01f000 Eth1/32     1 0    3d    0  38 1  f  1e 9e   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      0    0      0 1   0    0
1a030000 Eth1/49     0 2    1     0  49 1  20 38 b8   1   0 0 0 0 0 0  0  0 0 0   1 6   4   2  2
D-24d  -      400  0      0 0   1    0
1a031000 Eth1/50     0 3    3     0  29 1  0  0  80   1   0 0 0 0 0 0  0  0 0 0   1 5   3   2  2
D-350  -      400  0      0 0   1    0
```

似乎應該從埠1/32傳送它，對嗎？

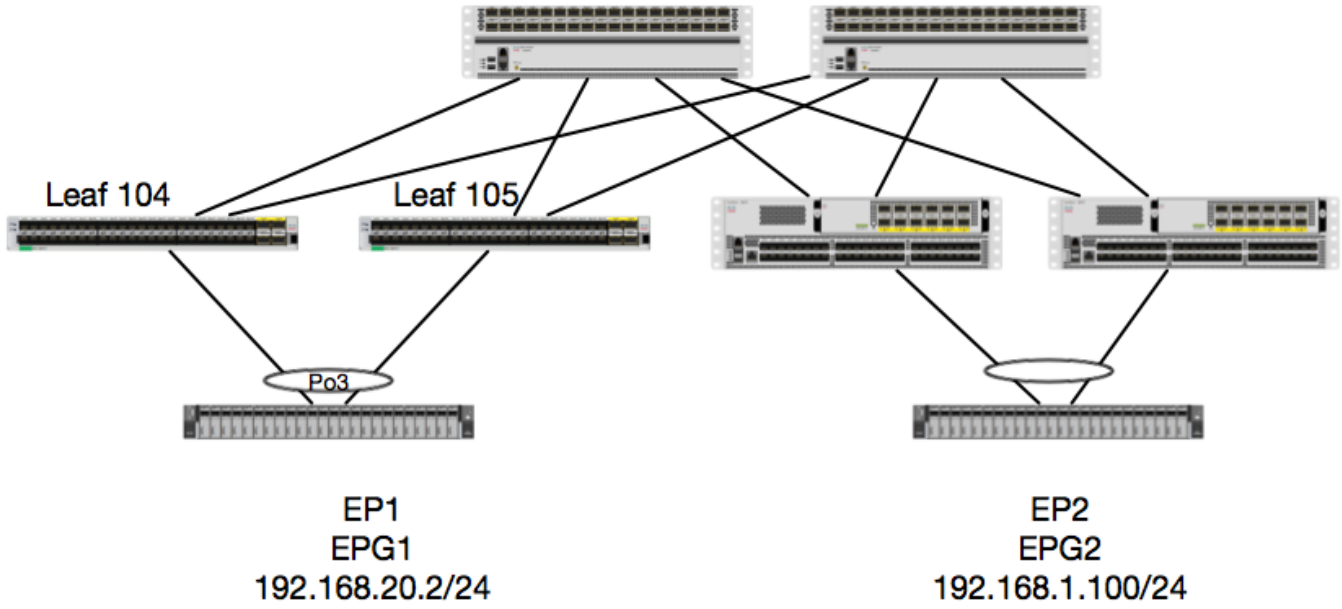
```
leaf4# show port-channel summary
Flags:  D - Down        P - Up in port-channel (members)
        I - Individual  H - Hot-standby (LACP only)
        s - Suspended   r - Module-removed
        S - Switched    R - Routed
        U - Up (port-channel)
        M - Not in use. Min-links not met
        F - Configuration failed
--------------------------------------------------------------------------------
Group Port-       Type     Protocol  Member Ports
      Channel
--------------------------------------------------------------------------------
1     Po1(SU)     Eth      LACP      Eth1/5(P)
2     Po2(SU)     Eth      LACP      Eth1/6(P)
3     Po3(SU)     Eth      LACP      Eth1/31(P)
```

```
4      Po4(SU)     Eth       LACP       Eth1/32(P)
```

是的，這是正確的。

不同EPG/不同枝葉中的2個EP — 路由資料包

拓撲



在本示例中，我們將跟蹤資料包從EP1到EP2的資料包流，其中EP1存在於EX vPC對上，EP2存在於遠端第1代vPC枝葉對上。 兩個EP使用不同的BD位於不同的EPG中。

再來，我們看看環保部門從哪裡學到：

```
leaf4# show endpoint ip 192.168.20.2
Legend:
 O - peer-attached    H - vtep             a - locally-aged     S - static
 V - vpc-attached     p - peer-aged        L - local            M - span
 s - static-arp       B - bounce
+-----------------------------------+--------------+-----------------+--------------+----------
---+
      VLAN/                          Encap           MAC Address       MAC Info/
Interface
      Domain                         VLAN            IP Address        IP Info
+-----------------------------------+--------------+-----------------+--------------+----------
---+
30                                      vlan-2268     0050.56a5.fccc LV
po3
Joey-Tenant:Joey-Internal               vlan-2268       192.168.20.2 LV
po3


calo2-leaf4# show endpoint ip 192.168.1.100
Legend:
 O - peer-attached    H - vtep             a - locally-aged     S - static
 V - vpc-attached     p - peer-aged        L - local            M - span
 s - static-arp       B - bounce
+-----------------------------------+--------------+-----------------+--------------+----------
---+
```

```
      VLAN/                            Encap           MAC Address       MAC Info/
Interface
      Domain                           VLAN            IP Address        IP Info
+--------------------------------+--------------+-----------------+-------------+----------
---+
Joey-Tenant:Joey-Internal                                 192.168.1.100
tunnel2
```

現在，讓我們驗證硬體已程式設計：

```
leaf4# vsh_lc
module-1# show platform internal hal ep l3 all
LEGEND:
-------
VrfName:           Vrf Name                                                T:              Type
(Pl: Physical, Vl: Virtual, Xr: Remote)
EP IP:             Endpoint IP
S Class:           S Class                                                 Age Intvl:      Age
Interval
S T:               Static Ep                                               S E:
Secure EP
L D:               Learn Disable                                           B N D:          Bind
Notify Disable
E N D:             Epg Notify Disable                                      B E:
Bounce Enable
I D L:             IVxlan Dont Learn                                       SPI:
Source Policy Incomplete
DPI:               Dest Policy Incomplete                                  SPA:
Source Policy Applied
DPA:               Dest Policy Applied                                     DSS:            Dest
Shared Service
IL:                Is Local                                                VUB:            Vnid
Use Bd
SO:                SA Only                                                 EP NH L3IfName: EP
Next Hop L3 If Name
NHT:               Next Hop Type (L2: L2 Entry L3: L3 Next Hop)            BD Name:        L2 NH
BD Name
EP Mac:            EP Mac                                                  L3 IfName:      L3 NH
If Name
L2 IfName:         L2 If Name                                              FD Name:        L2
Entry FD Name
IP:                L3 NH IP

 L3 EP Count: 12

================================================================================================
================================================================================
                                                                  B E   I S D S D D   V   EP-NH
N  |
Vrf              EP                                 S     Age   S S L N N B D P P P P S I U S L3
H  | BD        EP                L3           L2          FD
Name          T  IP                                 Class Intvl T E D D D E L I I A A S L B O
IfName       T  | Name      Mac                IfName       Ifname      Name      IP
================================================================================================
================================================================================
common*rewall Pl 10.6.112.1                        1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -          -         0.0.0.0
common*rewall Pl 10.6.114.1                        1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -          -         0.0.0.0
common*rewall Pl 10.6.114.129                      1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -          -         0.0.0.0
common*efault Pl 100.100.101.1                     1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -           -          -         0.0.0.0
```

```
Joey-T*ternal Pl 192.168.1.1                    1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -            -           -         0.0.0.0
Joey-T*ternal Xr 192.168.1.100                  8013  128   0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 -
L3   -         00:0c:0c:0c:0c:0c Tunnel2      Tunnel2     -         0.0.0.0
Joey-T*ernal2 Pl 192.168.3.1                    1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -            -           -         0.0.0.0
Joey-T*ternal Pl 192.168.20.1                   1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -            -           -         0.0.0.0
Joey-T*ternal Pl 192.168.20.2                   800a  0     0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 -
L2   BD-28     00:50:56:a5:fc:cc -            Po3         FD-30     -
Joey-T*ternal Pl 192.168.21.1                   1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -            -           -         0.0.0.0
Joey-T*ternal Pl 192.168.21.2                   800c  0     0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 -
L2   BD-7      00:50:56:a5:0c:11 -            Po4         FD-8      -
Joey-T*ternal Pl 2001:0:0:100::1                1     0     1 0 0 0 0 0 1 1 0 0 0 0 1 0 0 -
L3   -         00:00:00:00:00:00 -            -           -         0.0.0.0
```

硬體認為EP存在於通道2上。通道2的目的地是什麼？

```
module-1# show system internal eltmc info interface tunnel2
           IfInfo:
          interface:        Tunnel2   :::          ifindex:      402718722
                iod:              66   :::            state:             up
                Mod:               0   :::             Port:              0
       Tunnel Index:               0   :::   Tunnel Dst ip:     0xc0a87843
       Tunnel Encap:          ivxlan   ::: Tunnel VPC Peer:              0
  Tunnel Dst ip str: 192.168.120.67   :::      Tunnel ept:            0x1

         [SDK Info]:
         tunnl_name:
             vrf_id:               2   :::        if_index:     0x18010002
         hwencapidx:               0   :::       encaptype:              1
          mac_proxy:               0   :::        v4_proxy:              0
           v6_proxy:               0   :::    ip_addr_type:              0
       ipv4_address:      0xc0a87843

[SDB INFO]:
                iod:              66
         pc_if_index:               0
        fab_if_index:               0
               sv_if:               0
             src_idx:               0
            int_vlan:               0
          encap_vlan:               0
     mod_port_status:      0x41620003
           v6_tbl_id:      0x80000002
           v4_tbl_id:             0x2
         router_mac:00.00.00.00.00.00
         unnumbered:               0
           trunk_id:               0
         tunnel_mod:               0
        tunnel_port:               0
             tep_ip:      0xc0a87843
         ip_if_mode:               0
         sdk_vrf_id:               2
                mtu:            9366   :::        ipmtu_id:              0
      is_fex_fabric:               0
```

由於目標位於vPC之外，因此該目標IP應該是遠端枝葉的vPC虛擬IP。 讓我們檢查遠端枝葉並檢視：

```
leaf1# show system internal epm vpc
```

```
Local TEP IP                  : 192.168.160.95
Peer TEP IP                   : 192.168.160.93
vPC configured                : Yes
vPC VIP                       : 192.168.120.67
MCT link status               : Up
Local vPC version bitmap      : 0x7
Peer vPC version bitmap       : 0x7
Negotiated vPC version        : 3
Peer advertisement received   : Yes
Tunnel to vPC peer            : Up
```

非常好，因此它從遠端vPC對獲取了目標EP。 我們來看看ELAM看到什麼並驗證我們是否正確轉發資料包：

伊拉姆語

```
module-1# debug platform internal tah elam asic 0
module-1(DBG-TAH-elam)# trigger init in-select 6 out-select 0
module-1(DBG-TAH-elam-insel6)# set outer ipv4 src_ip 192.168.20.2 dst_ip 192.168.1.100
module-1(DBG-TAH-elam-insel6)# start
module-1(DBG-TAH-elam-insel6)# stat
ELAM STATUS
===========
Asic 0 Slice 0 Status Armed
Asic 0 Slice 1 Status Triggered
```

現在，對於EX硬體上的遠端目標，有2個ELAM值在排除資料包流故障時非常重要。 與之前類似的ovector_idx和encap_idx:

```
module-1(DBG-TAH-elam-insel6)# report | grep ovec
  sug_elam_out_sidebnd_no_spare_vec.ovector_idx: 0xB8
module-1(DBG-TAH-elam-insel6)# report | grep encap
  sug_lurw_vec.encap_l2_idx: 0x0
  sug_lurw_vec.encap_pcid: 0x0
  sug_lurw_vec.encap_idx: 0x6
  sug_lurw_vec.encap_vld: 0x1
```

在EX硬體上，我們確實能夠驅動應轉發資料包的目的埠。 以前，我們通常只檢查封裝idx並驗證目標idx是否是正確的隧道。 在此我們可以驗證哪些埠對映到8B:

```
module-1(DBG-TAH-elam-insel6)# show platform internal hal l2 port gpd
Legend:
-------
IfId:       Interface Id                                IfName:      Interface Name
I P:        Is PC Mbr                                   IfId:           Interface Id
Uc PC Cfg:      UcPcCfg Idx                             Uc PC MbrId:    Uc Pc Mbr Id
As:             Asic                                    AP:             Asic Port
Sl:             Slice                                   Sp:             Slice Port
Ss:             Slice SrcId                             Ovec:           Ovector (slice |
srcid)
L S:            Local Slot                              Reprogram:
L3:             Is L3
    P:    PifTable                                      Xla Idx:        Xlate Idx
    RP:   Rw PifTable                                   Ovx Idx:        OXlate Idx
    IP:   If Profile Table                              N L3:           Num. of L3 Ifs
    RS:   Rw SrcId Table                                NI L3:          Num. of Infra L3 Ifs
    DP:   DPort Table                                   Vif Tid:        Vif Tid
```

```
    SP:   SrcPortState Table                                    RwV Tid:        RwVif Tid
    RSP:  RwSrcPortstate Table                                  Ing Lbl:        Ingress Acl Label
    UC:   UCPcCfg                                               Egr Lbl:        Egress Acl Label
    UM:   UCPcMbr                                               Reprogram:
PROF ID:        Lport Profile Id
    VS:   VifStateTable                                         HI:             LportProfile Hw
Install
    RV:   Rw VifTable
Num. of Sandboxes: 1

Sandbox_ID: 0, BMP: 0x0
 Port Count: 8

================================================================================================================
=========================================
                       Uc   Uc                          |       Reprogram       |
| Rep |
                     I PC   Pc                       L |   R I R D    R  U U X | L Xla Ovx N
NI Vif    RwV    Ing  Egr  | V R | PROF H
IfId     Ifname      P Cfg  MbrID As AP Sl Sp Ss Ovec S | P P P S P Sp Sp C M L | 3 Idx Idx L3
L3 Tid    Tid    Lbl  Lbl  | S V | ID   I
================================================================================================================
=========================================
1a004000 Eth1/5      1 0    1d    0  d  0  c  18 18   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      800  0      0 1   0    0
1a005000 Eth1/6      1 0    b     0  e  0  d  1a 1a   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      800  0      0 1   0    0
1a006000 Eth1/7      0 26   5     0  f  0  e  1c 1c   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
D-256  -      800  0      0 1   c    0
1a007000 Eth1/8      0 2f   7     0  10 0  f  1e 1e   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
D-199  -      800  0      0 1   2e   0
1a01e000 Eth1/31     1 0    2d    0  37 1  e  1c 9c   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      0    0      0 1   0    0
1a01f000 Eth1/32     1 0    3d    0  38 1  f  1e 9e   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-      -      0    0      0 1   0    0
1a030000 Eth1/49     0 2    1     0  49 1  20 38 b8   1   0 0 0 0 0 0  0  0 0 0   1 6   4   2  2
D-24d  -      400  0      0 0   1    0
1a031000 Eth1/50     0 3    3     0  29 1  0  0  80   1   0 0 0 0 0 0  0  0 0 0   1 5   3   2  2
D-350  -      400  0      0 0   1    0
```

Switch認為它應該將其轉發到介面Eth1/49上的主幹。但我們如何驗證封裝是否正確？

我們首先需要檢視有關隧道的硬體資訊。 可通過運行以下HAL命令執行此操作：

```
module-1(DBG-TAH-elam-insel6)# show platform internal hal tunnel rtep pi
Non-Sandbox Mode
LEGEND:
-------
Tun Ifid:  Tunnel Ifid                                          IfName:     Tunnel If Name
Lid:       Logical Id                                           ET:         Encap Type V:
Vxlan I: IVxlan N: NVGRE
VrfId:     Vrf Id                                               Vrf Name: Vrf Name
IP:        Tunnel's IP
Hw Enc:    Hw Encap Idx                                         IVP:        Is VPC Peer
IL:        Is Local                                             P4:         Proxy for v4
P6:        Proxy for V6                                         PM:         Proxy for Mac
II:        Is Ingress Only                                      IC:         Is Copy Service
C OBd:     Copy Service Outer Bd                                U D:        Use DF
NBT:       Next Base Type E: ECMP N: Next-Hop                   NB Id:      Next Base Id
NH cnt:    Next Hop Count                                       VrfId:      Vrf Id
Vrf Name:  Vrf Name                                             IP:         IP Address
Mac:       Mac                                                  L3 IfId:    L3 IfId
L3IfName:  L3 If Name                                           L2 IfId:    L2 IfId
```

```
L2IfName:  L2 If Name

Num. of Sandboxes: 1

Sandbox_ID: 0, BMP: 0x0
 Remote Tep Count: 15

================================================================================================
================================================================================================
=======
                                                                    I                   N N
|

                      E             Vrf                         Hw   V I P P P I I C   U B B
NH  |        Vrf                                          L3       L3           L2       L2

IfId     Ifname       T Lid  VrfId  Name         IP            Enc  P L 4 6 M I C OBd D T Id
Cnt | VrfId  Name         IP            Mac               IfId     IfName       IfId     IfName

================================================================================================
================================================================================================
=======
18010002 Tunnel2      I 3005 2      overlay-1    192.168.120.670    0 0 0 0 0 0 0 1   0 E 2
2     2      overlay-1    0.0.0.0       0d:0d:0d:0d:0d:00 1a030001 Eth1/49.1    1a030000 Eth1/4
9

2      overlay-1    0.0.0.0       0d:0d:0d:0d:0d:00 1a031002 Eth1/50.2    1a031000 Eth1/5
0
```

此輸出提供我們關心的幾個值：

IfId — 分配給通道的介面ID

IP — 目的地的IP。 這應該與ELTMC相符。

L3 IfId — 交換器可用來轉送到適當目的地的第3層介面。

得知IfId後，我們可以驗證在群組中取得的封包是否與通道目的地相符：

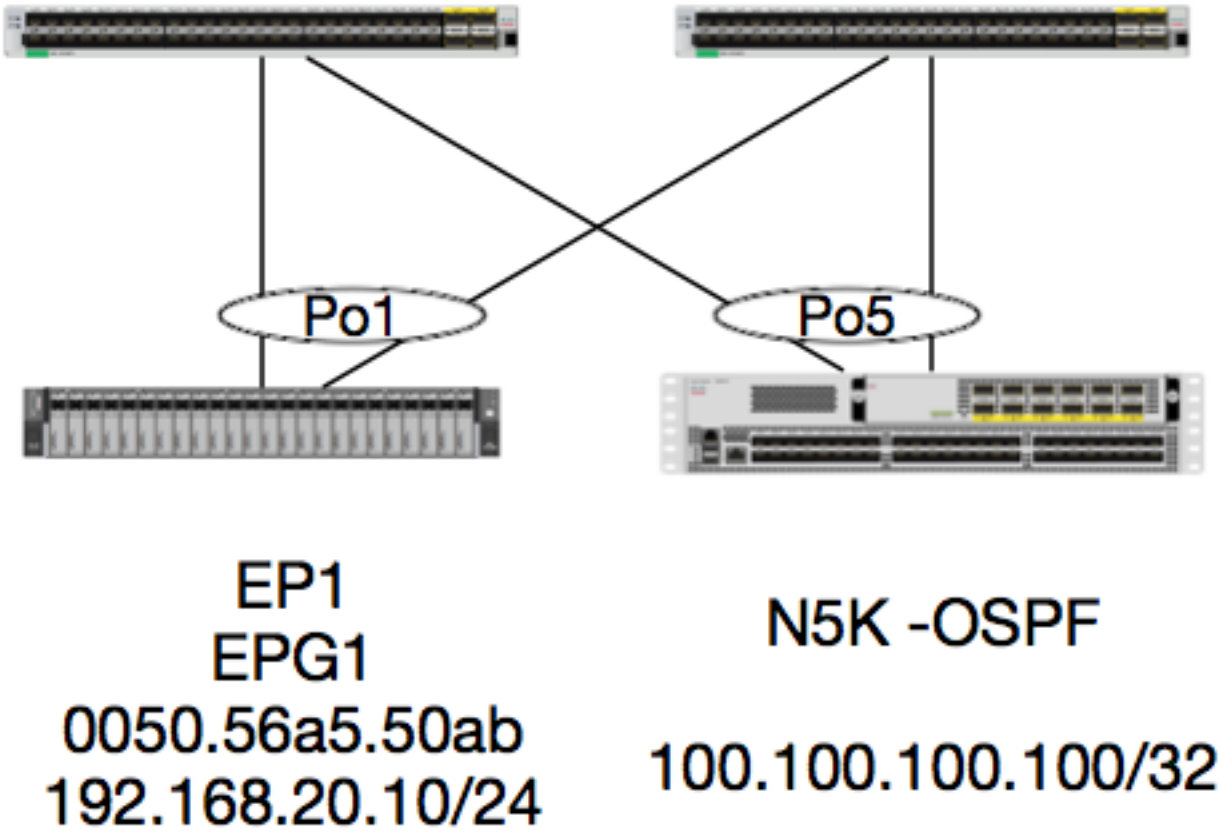
```
module-1(DBG-TAH-elam-insel9)# show platform internal hal tunnel rtep apd
Non-Sandbox Mode
LEGEND:
-------
ifId:         Interface Id                                IP:           IP address
HwVrfId:      Hardware Vrf Id                             SrcTepIdx:    Source Tep Index
BDXlate:      Egress BDXlate                              DstInfoIdx:   Destination info index
RwEncapIdx:   Rw Encap Index                              ECMPIdx:      ECMP Index
Num:          Number of hops                              ECMPMbrIdx:   ECMP member Index
L2 Index:     L2 Index                                    RwDmacIdx:    Rw Dmax Index

Num. of Sandboxes: 1

Sandbox_ID: 0, BMP: 0x0
 Remote Tep Count: 15

================================================================================================
==============================
ifId     IP             HwVrfId BDXlate SrcTepIdx DstInfoIdx RwEncapIdx ECMPIdx  ECMPMbrIdx Num
L2Index  RwDmacIdx
================================================================================================
==============================
```

```
18010002 192.168.120.67 2       1       3a9a      3005       6          0        0          2
1a030000 0         <---- RwEncapIdx is 6!  Same as the "encap_idx" in the ELAM Report.

1a031000 1
```

此隧道的RwEncapIdx（重寫封裝索引）為6，這是在elam中顯示的內容。

1 EP —> L3輸出 — 路由流

拓撲



在本示例中，我們將跟蹤資料包的流量，該資料包從EP1傳送ICMP到運行OSPF的N5K上的環回。N5K通過同一對EX交換機上的L3Out連線。

由於我們已經在本文檔開頭驗證了本地EP程式設計，因此假定在硬體中正確學習了EP，然後繼續路由驗證。

首先檢查OSPF狀態和路由表：

```
leaf6# show ip ospf neighbors vrf jr:sb
 OSPF Process ID default VRF jr:sb
 Total number of neighbors: 2
 Neighbor ID     Pri State            Up Time  Address         Interface
 27.27.27.1        1 FULL/BDR         00:22:39 10.10.27.1      Vlan28    <---- Leaf5
 27.27.27.3        1 FULL/DROTHER     00:22:37 10.10.27.3      Vlan28    <----  N5K

leaf6# show ip route vrf jr:sb 100.100.100.100
IP Route Table for VRF "jr:sb"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
```

```
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

100.100.100.100/32, ubest/mbest: 1/0
    *via 10.10.27.3, vlan28, [110/5], 00:16:58, ospf-default, intra
```

因此，我們知道路由表在10.10.27.3上將下一跳顯示為5K。這算是良好的開端，但我們如何驗證哪些硬體有呢？

首先檢查硬體中的鄰接表，確保ARP解析為10.10.27.3，並且已使用正確的介面進行程式設計：

```
leaf6# vsh_lc
module-1# show forwarding adjacency

IPv4 adjacency information, adjacency count 20

next-hop        rewrite info   interface       phy i/f
--------------  -------------- --------------- ---------------
10.10.27.1      0022.bdf8.19ff Vlan28          Tunnel3
10.10.27.3      8c60.4f02.88fc Vlan28          port-channel5
```

MAC地址與5K:

```
ACI-5548-B# show interface vlan 3117
Vlan3117 is up, line protocol is up
  Hardware is EtherSVI, address is  8c60.4f02.88fc
  Internet Address is 10.10.27.3/29
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec
```

在EX平台上，有一個分配給VRF的「hw_vrf_idx」。在我們驗證硬體程式設計時，將引用此索引。讓我們找到索引：

```
module-1# show system internal eltmc info vrf jr:sb
VRF-TABLE: jr:sb
            vrf_type:         tenant   :::      context_id:              6
       overlay_index:              0   :::            vnid:        2129921
               scope:              5   :::          sclass:          16386
         v4_table_id:            0x5   :::     v6_table_id:     0x80000005
          intf_count:              5   :::   intrn_vlan_id:              0
            VRF Intf:         Vlan11   ::: src_plcy_incomp:              0
            vnid_hex:       0x208001   :::  ingress_policy:            0x1
       vrf_intf_list: Vlan28,Vlan16,Vlan9,Vlan11,loopback2,
          hw_vrf_idx:           4612   ::: nb_egr_outer_bd:              0
     sb_egr_outer_bd:              0
         vrf_bd_list: 28,16,11,9,
     sb_egr_outer_bd:              0   :::      sdk_vrf_id:              5

          [SDK Info]:
            vrf_name:          jr:sb
              vrf_id:              5   :::      hw_vrf_idx:           4612
            vrf_vnid:        2129921   :::        is_infra:              0
      tornbinfrahwbd:              0   :::  torsbinfrahwbd:              0
   ingressBdAclLabel:              0   ::: ingBdAclLblMask:              0
    egressBdAclLabel:              0   ::: egrBdAclLblMask:              0
            sg_label:              5   :::          sclass:          16386
       sp_incomplete:              1   :::      sclassprio:              3

[SDB INFO]:
v4 table
            vrf type:              1
              vrf id:              5
```

```
               vnid:        2129921
 internal infra vlan:              0
 external router mac:00:22:bd:f8:19:ff
v6 table
            vrf type:              1
              vrf id:              5
               vnid:        2129921
 internal infra vlan:              0
 external router mac:00:22:bd:f8:19:ff
::::
```

在檢測到鄰接關係後，HAL應該對路由進行程式設計。 我們可以使用以下命令檢查這一點：

```
module-1# show platform internal hal l3 routes | head

----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------
LEGEND:
|
----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------
LID: Logical ID           RID: Route ID               PID: Physical ID       NB-ID:Next-Base ID
HIT IDX: Next-Hop HitIndex   CLP : Class Priority       TBI: Trie Base Index             |
SC : Sup-Copy             SSR: Src Sup-Redirect       DSR: Dst Sup-Redirect  TDD  :TTL Disable
NB: NextBaseType             SDC : Src Direct Connect   TRO: Trie Offset                 |
SPI: Src Policy Inc       DPI: Dst Policy Inc         DR : Default Route     LE   :Learn Enable
[E:Ecmp/A:Adj]              ILL : Is Link Local        ISS: Is Shared Services          |
RT : Route Type           FWD: Forwarding             HR : Host Routes       EP   :Ext Prefixes
DLR: Default Lpm Route       CLSS: Class Id             RDEL: Route in Deletion          |
BNE: Bind Notify Enable   SNE: Sclass Notify Enable   BE : Bounce Enable     IDL  :Ivxlan
DoNotLearn  DL : Dest Local              SA  : Src Only             AI : Age Interval
|
SF : Static Flag          SH : Src Hit                DH: Dest Hit
|
module-1# show platform internal hal l3 routes

----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------
LEGEND:
|
----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------
LID: Logical ID           RID: Route ID               PID: Physical ID       NB-ID:Next-Base ID
HIT IDX: Next-Hop HitIndex   CLP : Class Priority       TBI: Trie Base Index             |
SC : Sup-Copy             SSR: Src Sup-Redirect       DSR: Dst Sup-Redirect  TDD  :TTL Disable
NB: NextBaseType             SDC : Src Direct Connect   TRO: Trie Offset                 |
SPI: Src Policy Inc       DPI: Dst Policy Inc         DR : Default Route     LE   :Learn Enable
[E:Ecmp/A:Adj]              ILL : Is Link Local        ISS: Is Shared Services          |
RT : Route Type           FWD: Forwarding             HR : Host Routes       EP   :Ext Prefixes
DLR: Default Lpm Route       CLSS: Class Id             RDEL: Route in Deletion          |
BNE: Bind Notify Enable   SNE: Sclass Notify Enable   BE : Bounce Enable     IDL  :Ivxlan
DoNotLearn  DL : Dest Local              SA  : Src Only             AI : Age Interval
|
SF : Static Flag          SH : Src Hit                DH: Dest Hit
|
----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------
|     |                                          |   |     |          | LID |<-----------------
- Trie ------------>|<Dleft Trie>|                                                                |
| VRF |                Prefix/Len                | RT| RID |    LID   | Type| PID | FPID/| HIT
|N|  NB-ID  |  NB Hw | PID | FPID/|   TBI   |TRO|Ifindex|CLSS|CLP| AI |SH|DH| Flags            |
|-----|-----------------------------------------|---|-----|----------|-----|     | TID  | IDX
|B|         |  Idx   |     |  TID |---------|---|-------|----|---|----|--|--|------------------|
```

```
|-----|-----------------------------------------|---|-----|----------|-----|<-----------------
- DLEFT ------------>|-----|------|---------|---|-------|----|---|----|--|--|------------------|
|     |                                         |   |     |          |     | PID | FPID/| HIT
|N|  NB-ID  |  NB Hw |     |      |         |   |       |    |   |    |  |  |                  |
|     |                                         |   |     |          |     |     |  TID | IDX
|B|         |  Idx   |     |      |         |   |       |    |   |    |  |  |                  |
|     |                                         |   |     |          |     |<-----------------
- TCAM ------------->|     |      |         |   |       |    |   |    |  |  |                  |
|     |                                         |   |     |          |     | PID | TCAM | HIT
|N|  NB-ID  |  NB Hw |     |      |         |   |       |    |   |    |  |  |                  |
|     |                                         |   |     |          |     |     |  ID  | IDX
|B|         |  Idx   |     |      |         |   |       |    |   |    |  |  |                  |
-------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------
|Sandbox_ID: 0  Asic Bitmap: 0x0
-------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------
```

```
module-1# show platform internal hal l3 routes | egrep 100.100.100.100
| 4612|                        100.100.100.100/ 32| UC|   e4|      4a04| TRIE|   10| 5/  0|
6010|A|     7567|    802e| 186a| 1/  2|       10|  0|      0|   f|  3|   0| 0| 0|spi,dpi
```

此輸出提供下一跳路由的相關資訊。 4612是jr:sb VRF的hw_vrf_idx。為了驗證下一跳，我們將使用TCAM中的「NB硬體Idx」來驗證下一表：

```
module-1# show platform internal hal l3 nexthops
Non-Sandbox Mode
LEGEND:
-------
NHOP ID       : Nhop Identifier (Hex)            CONS          : H/W S/W info Consistency
TYPE          : Nexthop Type                     ACTN          : Nexthop Action
Vrf           : L3 Vrf of the Nhop               L3 INTF       : L3 interface index (Hex)
L2 INTF       : L2 interface index (Hex)         BDID Or RwVRF : Bridge Domain Id Or Rewrite
Vrfid (Hex)
INFR          : ACI Infra valid                  PVRF          : Preserve VRF
LRN           : Learn Enabled                    VRFR          : VRF Rewrite
PID           : Physical ID                      FPID          : FP of this nexthop
TLID          : Tile Id within FP                HIT IDX       : Location of this Nhop (Hex)

Mac Entry:
TYP         : Type                      INTF        : Interface related Info (Hex)
LRN         : Learn Info                DL          : Destination Local
MLD         : Unused                    VNB         : Vnid use BD
DFL         : Default Entry             VLD         : MacKey Valid
FT          : FID Type                  FV          : FID Valid
FID         : FID value (Hex)           Mac         : L2 MAC Address
L2 Ifabric Info:
CLSS        : Source Class                          CLP         : Source Class Priority
EPG         : EndPoint Group                        BNE         : Bind Notification Enabled
SNE         : Source Address Notification Enabled CNE         : Source class Notification
Enabled
DL          : iVxlan DL                             SPI         : Source Policy Incomplete
DPI         : Dest Policy Incomplete
IP Address  : IP address

Sandbox_ID: 0  Asic Bitmap: 0x0
Summary info for 31 L3 Nexthop objects
         C T A                       BDID  I P   V         T    |--------------------Mac Entry-
-----------------|----L2 Ifabric Info----|
 NHOP    O Y C         L3       L2    Or   N V L R         L HIT|T       L   M V D V|----------
----Mac Key-------|     C      B S C   S D|
  ID     N P T        INTF     INTF  RwVRF F R R F      FP I IDX|Y  INTF  R D L N F L|F F  FID
|     L      N N N D P P|
```

```
 (Hex)   S E N Vrf    (H)       (H)   (H)  R F N R PID  ID D (H)|P  (H)   N L D B L D|T V  (H)
Mac          |CLSS P EPG  E E E L I I| IP Address
--------+-+-+-+----+--------+--------+----+-+-+-+-+----+--+-+----+-+-----+-+-+-+-+-+-+-+-----
-+-----------------+----+-+----+-+-+-+-+-+-+--------------------------
```

```
module-1# show platform internal hal l3 nexthops | grep 802e
    7567 N I F    5  901001c 16000004   1c 0 0 0 0   2e  9 0 802e 0     22 0 0 0 0 0 1 1 1
1214 8c:60:4f:02:88:fc    0 0 2c0d 0 0 0 0 0 0 10.10.27.3
```

這裡，我們選擇「NB硬體IDX」並將其對映到「HIT IDX」。這將向我們顯示與下一跳MAC/IP對應的條目。這相當於檢視第1代ACI枝葉交換機上Broadcom中的「l3 defip show」和「l3 egress show」。

我們可以看到，該表包含正確的資訊：

L2 INTF:0x16000004 —> Port-channel 5的ifIndex

命中IDX: Hal l3路由中Nb硬體IDX驅動的索引

MAC:8c:60:4f:02:88:fc —> 5K上下一跳SVI的MAC

EPG: L3 EPG的SCLASS

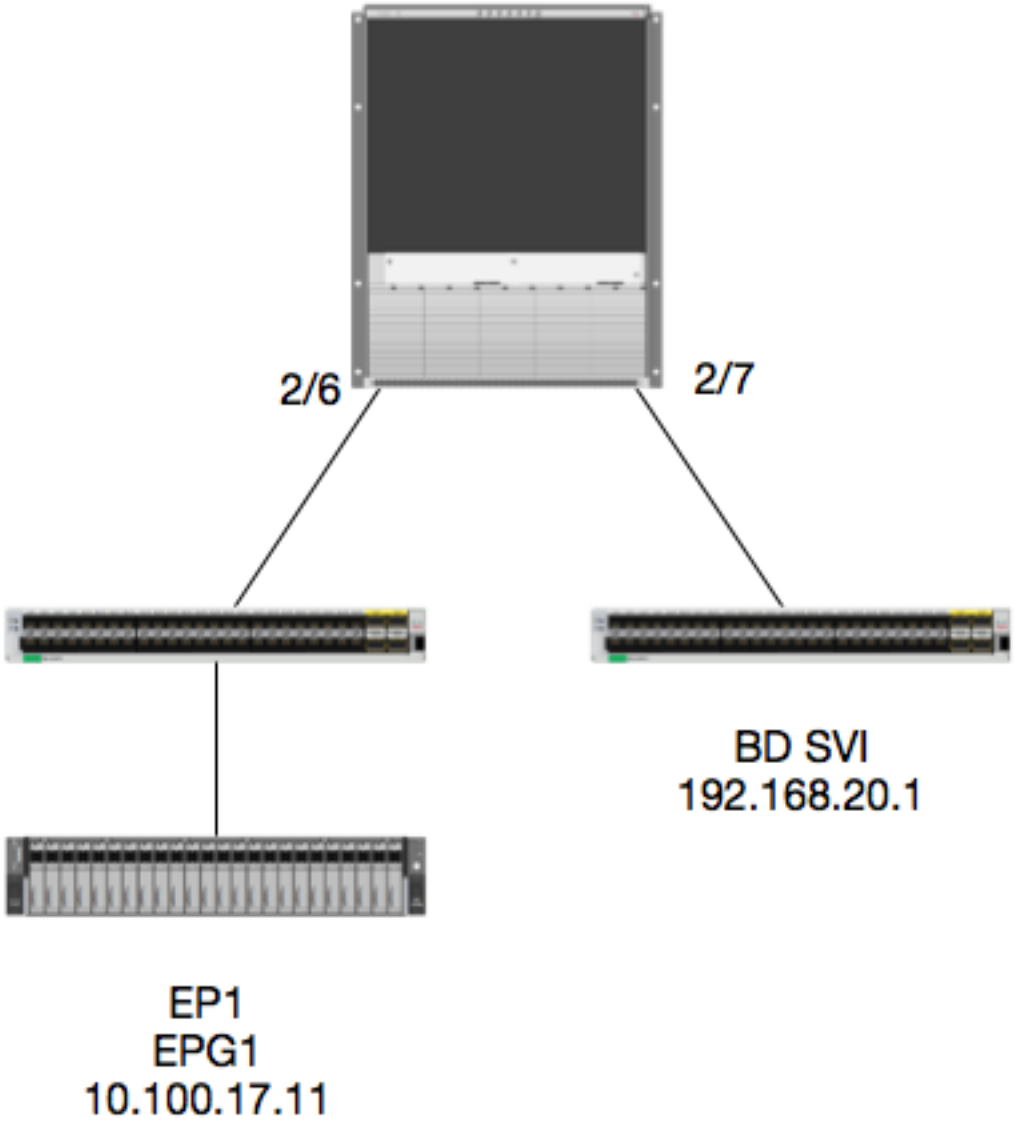
IP 位址:10.10.27.3 —> 5K上SVI的下一跳IP

伊拉姆語

```
leaf6# pwd
/var/sysmgr/tmp_logs

leaf6# cat elam_report.txt | grep ip.da
    sug_pr_lu_vec_l3v.ip.da: 0x00000000000000000064646464
leaf6# cat elam_report.txt | grep ip.sa
    sug_pr_lu_vec_l3v.ip.sa: 0x00000000000000000C0A8140A

leaf6# cat elam_report.txt | grep adj
    sug_lurw_vec.dst_addr.adj: 0x8C604F0288FC
      sug_lurw_vec.dst_addr.adj.padfield: 0x04F0288FC
      sug_lurw_vec.dst_addr.adj.idx: 0x2318
  sug_lurw_vec.adj_vld: 0x0

leaf6# cat elam_report.txt | grep macdarslt.hit_idx
        sug_fpc_lookup_vec.fplu_vec.rslt.macdarslt.hit_idx: 0x802E
```

1 EP —>遠端EP或SVI — 主幹驗證

拓撲



邏輯

在本示例中，我們將跟蹤從EP1發往遠端BD交換虛擬介面(SVI)的資料包流。本示例的目的是驗證主幹轉發，以確保將該資料包傳送到正確的枝葉。 讓我們假設封包已傳送到輸入枝葉上的主幹代理。

在骨幹上，我們首先驗證目的地IP的Council of Oracles Protocol(COOP)，因為封包已傳送到骨幹代理進行查詢：

```
calo1-spine1# show coop internal info ip-db | grep -A 10 192.168.20.1
IP address : 192.168.20.1
Vrf : 2129921
Flags : 0
EP vrf vnid : 2129921
EP IP :  192.168.20.1
Publisher Id : 10.0.224.88
Record timestamp : 11 04 2016 16:41:16 422062712
Publish timestamp : 11 04 2016 16:41:16 424633605
Seq No: 0
Remote publish timestamp: 01 01 1970 00:00:00 0
URIB Tunnel Info
Num tunnels : 1
Tunnel address : 10.0.224.88    <---- REMOTE LEAF
```

```
Tunnel ref count : 1
```

讓我們驗證哪個枝葉具有該TEP地址：

```
spine1# acidiag fnvread | grep 10.0.224.88
     105        1          calo1-leaf5      FDO20160TPS     10.0.224.88/32    leaf
active   0
```

由於我們知道資料包進入模組2上的骨幹（埠6），因此我們可以連線到模組2並檢視埠佈局。

```
spine1# vsh
Cisco iNX-OS Debug Shell
This shell should only be used for internal commands and exists
for legacy reasons. User should use ibash infrastructure as this
will be deprecated.
calo1-spine1# attach module 2
Attaching to module 2 ...
To exit type 'exit', to abort type '$.'
No directory, logging in with HOME=/
Bad terminal type: "xterm-256color". Will assume vt100.
Cisco iNX-OS Debug Shell
This shell should only be used for internal commands and exists
for legacy reasons. User should use ibash infrastructure as this
will be deprecated.
Loading parse tree (LC). Please be patient...
module-2#

module-2# show platform internal hal l2 port gpd
Legend:
-------
IfId:       Interface Id                                    IfName:      Interface Name
I P:        Is PC Mbr                                       IfId:           Interface Id
Uc PC Cfg:      UcPcCfg Idx                                 Uc PC MbrId:    Uc Pc Mbr Id
As:             Asic                                        AP:             Asic Port
Sl:             Slice                                       Sp:             Slice Port
Ss:             Slice SrcId                                 Ovec:           Ovector (slice |
srcid)
L S:            Local Slot                                  Reprogram:
L3:             Is L3
    P:    PifTable                                          Xla Idx:        Xlate Idx
    RP:   Rw PifTable                                       Ovx Idx:        OXlate Idx
    IP:   If Profile Table                                  N L3:           Num. of L3 Ifs
    RS:   Rw SrcId Table                                    NI L3:          Num. of Infra L3 Ifs
    DP:   DPort Table                                       Vif Tid:        Vif Tid
    SP:   SrcPortState Table                                RwV Tid:        RwVif Tid
    RSP:  RwSrcPortstate Table                              Ing Lbl:        Ingress Acl Label
    UC:   UCPcCfg                                           Egr Lbl:        Egress Acl Label
    UM:   UCPcMbr                                           Reprogram:
PROF ID:        Lport Profile Id
    VS:   VifStateTable                                     HI:             LportProfile Hw
Install
    RV:   Rw VifTable
Num. of Sandboxes: 1

Sandbox_ID: 0, BMP: 0x0
 Port Count: 7

================================================================================================
=========================================
                        Uc   Uc                          |       Reprogram       |
| Rep |
                     I PC   Pc                       L |   R I R D    R  U U X | L Xla Ovx N
```

```
NI Vif    RwV    Ing  Egr  | V R | PROF H
IfId     Ifname      P Cfg  MbrID As AP Sl Sp Ss Ovec S | P P P S P Sp Sp C M L | 3 Idx Idx L3
L3 Tid    Tid    Lbl  Lbl  | S V | ID   I
=============================================================================================
==========================================
1f5      SpInBndMgmt 0 9de  1a    0  0  0  0  0  0    0   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
D-2d4  D-3e1  0    0      0 0   1    0
1a080000 Eth2/1      0 9a   1c    0  11 0  10 20 20   1   0 0 0 0 0 0  0  0 0 0   1 b   b   1  1
D-f3   D-61   100  0      0 0   1    0
1a081000 Eth2/2      0 9b   22    0  d  0  c  18 18   1   0 0 0 0 0 0  0  0 0 0   1 c   c   1  1
D-1ee  D-30b  100  0      0 0   1    0
1a084000 Eth2/5      0 9e   1e    0  3d 1  14 28 a8   1   0 0 0 0 0 0  0  0 0 0   1 1   1   1  1
D-19a  D-2ee  100  0      0 0   1    0
1a085000 Eth2/6      0 9f   24    0  39 1  10 20 a0   1   0 0 0 0 0 0  0  0 0 0   1 e   e   1  1
D-87   D-184  100  0      0 0   1    0
1a086000 Eth2/7      0 a0   26    0  35 1  c  18 98   1   0 0 0 0 0 0  0  0 0 0   1 d   d   1  1
D-1d0  D-357  100  0      0 0   1    0
1a088000 Eth2/9      0 a2   20    1  d  0  c  18 18   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
D-3ea  D-1a9  100  0      0 0   1    0
```

Ethernet 2/6是連線到枝葉6的介面位於ASIC 0 SLICE 1上

現在我們知道哪個ASIC運行我們的ELAM。 ASIC 0.

```
module-2# debug platform internal tah elam asic 0
module-2(DBG-TAH-elam)# trigger reset
module-2(DBG-TAH-elam)# trigger init in-select 13 out-select 0
module-2(DBG-TAH-elam-insel13)# set inner ipv4 src_ip 10.100.17.11 dst_ip 192.168.20.1
module-2(DBG-TAH-elam-insel13)# start
stat
module-2(DBG-TAH-elam-insel13)# stat
ELAM STATUS
===========
Asic 0 Slice 0 Status Armed
Asic 0 Slice 1 Status Armed

module-2(DBG-TAH-elam-insel13)# stat
ELAM STATUS
===========
Asic 0 Slice 0 Status Triggered   <---- Packet triggered from FM
Asic 0 Slice 1 Status Triggered   <---- Packet triggered from Front Panel
```

通過ELAM可以找到向量索引：

```
Front Panel ELAM drove sug_elam_out_sidebnd_no_spare_vec.ovector_idx: 0xB8
```

現在，如何將0xb8對映到埠？ 由於我們知道資料包應該傳送到交換矩陣模組(FM)進行查詢，因此我們可以檢視內部埠對映以查詢目的FM:

```
module-2# show platform internal hal l2 internal-port pi
Num. of Sandboxes: 1
Legend:
-------
IfId:      Interface Id               IfName:     Interface Name
As:        Asic                       AP:         Asic Port
Sl:        Slice                      SP:         Slice Port
Ss:        Slice SrcId                Ovec:       Ovector
UcPcCfgId: Uc Pc CfgId                Lb Mbrid:   LB MbrId

Sandbox_ID: 0, BMP: 0x0
 Internal Port Count: 32
```

```
=====================================================================
                                                        UcPc   Lb
IfId     IfName                        As AP Sl SP Ss Ovec CfgId MbrId
=====================================================================
7d       -                             0  21 0  20 38 38   0     4
7e       -                             0  29 1  0  0  80   0     8
7f       -                             1  21 0  20 38 38   0     c
80       -                             1  29 1  0  0  80   0     10
81       -                             2  21 0  20 38 38   0     14
82       -                             2  29 1  0  0  80   0     18
83       -                             3  21 0  20 38 38   0     1c
84       -                             3  29 1  0  0  80   0     20
95       -                             0  19 0  18 30 30   0     3
96       -                             0  49 1  20 38 b8   0     7
97       -                             1  19 0  18 30 30   0     b
98       -                             1  49 1  20 38 b8   0     f
99       -                             2  19 0  18 30 30   0     13
9a       -                             2  49 1  20 38 b8   0     17
9b       -                             3  19 0  18 30 30   0     1b
9c       -                             3  49 1  20 38 b8   0     1f
ad       -                             0  25 0  24 40 40   0     1
ae       -                             0  41 1  18 30 b0   0     6
af       -                             1  25 0  24 40 40   0     9
b0       -                             1  41 1  18 30 b0   0     e
b1       -                             2  25 0  24 40 40   0     11
b2       -                             2  41 1  18 30 b0   0     16
b3       -                             3  25 0  24 40 40   0     19
b4       -                             3  41 1  18 30 b0   0     1e
dd       -                             0  15 0  14 28 28   0     2
de       -                             0  4d 1  24 40 c0   0     5
df       -                             1  15 0  14 28 28   0     a
e0       -                             1  4d 1  24 40 c0   0     d
e1       -                             2  15 0  14 28 28   0     12
e2       -                             2  4d 1  24 40 c0   0     15
e3       -                             3  15 0  14 28 28   0     1a
e4       -                             3  4d 1  24 40 c0   0     1d
```

使用ASIC0/Ovc B8時，我們得到MbrId 0x7,Slice並不重要。

此MbrId是USD上對映到FM上的介面的介面。 請記住，此MbrId以十六進位制表示，必須轉換為十進位制。

通過檢視USD介面並檢查埠7，我們可以找到哪個FM:

```
module-2# show platform internal usd port info | grep -A 3 "Int 7"(if the interface has multiple
digits, will be "Int##" with no space)

Port  73.0 (Int 7) : Admin UP Link UP Remote slot22.asic0
                slice:1 slice port:32 lcl srcid:56 gbl srcid:184
                asic mrl:0xd07c010, mac mrl:0x12c84010, mac:16, chan:0
                speed 106G serdes: 0x328 0x329 0x32a 0x32b
```

「slot」以0為基礎，而FM編號以1為基礎，因此我們需要將1新增到此處列出的數字中。 這意味著資料包應傳送到FM 23。

合成IP

與Alpine一樣，有一個合成IP用作外部IP地址，用於確定COOP查詢的雜湊。 若要尋找此內容，您需要對內部DST IP運行此命令和grep:

```
module-2(DBG-TAH-elam-insel7)# show forwarding route synthetic vrf all | grep 192.168.20.1
SYNTH-88        1.203.211.185/32    0x208001          192.168.20.1
```

這表明1.203.211.185是我們的合成IP。基於此，我們還可以將FM鏈路上的「外部DST IP」設定為此。 我們應該在FM上觸發：

光纖模組ELAM

```
module-23(DBG-TAH-elam-insel7)# trigger reset
module-23(DBG-TAH-elam)# trigger init in-select 13 out-select 0
module-23(DBG-TAH-elam-insel13)# set outer ipv4 dst_ip 1.203.211.185   <----- DST IP IS THE
SYNTHETIC IP
module-23(DBG-TAH-elam-insel13)# set inner ipv4 src_ip 10.100.17.11 dst_ip 192.168.20.1
module-23(DBG-TAH-elam-insel13)# start
stat
module-23(DBG-TAH-elam-insel13)# stat
ELAM STATUS
===========
Asic 0 Slice 0 Status Armed
Asic 0 Slice 1 Status Armed
Asic 0 Slice 2 Status Armed
Asic 0 Slice 3 Status Armed
Asic 0 Slice 4 Status Armed
Asic 0 Slice 5 Status Armed

module-23(DBG-TAH-elam-insel13)# stat
ELAM STATUS
===========
Asic 0 Slice 0 Status Armed
Asic 0 Slice 1 Status Armed
Asic 0 Slice 2 Status Triggered    <---- Triggered on SLICE 2
Asic 0 Slice 3 Status Armed
Asic 0 Slice 4 Status Armed
Asic 0 Slice 5 Status Armed
```

顯然，請轉儲完整的報告，但讓我們看一下我們觸發的此資料包的ovector_idx:

lac_elam_out_sidebnd_no_spare_vec.ovector_idx:**0x20 <**以下-----令中使用的向量索引

我們如何確定哪個介面具有此向量？ 在FM上運行以下命令：

****錯誤CSCvf42796 ，附加所有FM命令，並加上「|不更多」。 否則，某些表條目可能不會顯示在最終輸出中。**

```
module-23(DBG-TAH-elam-insel13)# show platform internal hal l2 port gpd | no-more
Legend:
-------
IfId:       Interface Id                                    IfName:      Interface Name
I P:        Is PC Mbr                                       IfId:           Interface Id
Uc PC Cfg:      UcPcCfg Idx                                 Uc PC MbrId:    Uc Pc Mbr Id
As:             Asic                                        AP:             Asic Port
Sl:             Slice                                       Sp:             Slice Port
Ss:             Slice SrcId                                 Ovec:           Ovector (slice |
srcid)
L S:            Local Slot                                  Reprogram:
L3:             Is L3
    P:    PifTable                                          Xla Idx:        Xlate Idx
    RP:   Rw PifTable                                       Ovx Idx:        OXlate Idx
```

```
    IP:   If Profile Table                                  N L3:           Num. of L3 Ifs
    RS:   Rw SrcId Table                                    NI L3:          Num. of Infra L3 Ifs
    DP:   DPort Table                                       Vif Tid:        Vif Tid
    SP:   SrcPortState Table                                RwV Tid:        RwVif Tid
    RSP:  RwSrcPortstate Table                              Ing Lbl:        Ingress Acl Label
    UC:   UCPcCfg                                           Egr Lbl:        Egress Acl Label
    UM:   UCPcMbr                                           Reprogram:
PROF ID:        Lport Profile Id
    VS:   VifStateTable                                     HI:             LportProfile Hw
Install
    RV:   Rw VifTable
Num. of Sandboxes: 1

Sandbox_ID: 1, BMP: 0x1
 Port Count: 8

================================================================================================
=========================================
                        Uc   Uc                          |       Reprogram       |
| Rep |
                      I PC   Pc                        L |   R I R D    R  U U X | L Xla Ovx N
NI Vif    RwV    Ing   Egr  | V R | PROF H
IfId      Ifname      P Cfg  MbrID As AP Sl Sp Ss Ovec S | P P P S P Sp Sp C M L | 3 Idx Idx L3
L3 Tid    Tid    Lbl   Lbl  | S V | ID   I
================================================================================================
=========================================
ae        fc0-lc1:0-0 1 0    3     0 11 0 10 20 20 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 - - 0 0 0 0 0
0
af        fc0-lc1:0-1 1 0    4     0  3d 2  c  18 98   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-       -       0    0      0 0   0    0
b0        fc0-lc1:1-0 1 0    13    0  d  0  c  18 18   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-       -       0    0      0 0   0    0
b1        fc0-lc1:1-1 1 0    14    0  39 2  8  10 90   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-       -       0    0      0 0   0    0
b2        fc0-lc1:2-0 1 0    23    0  5d 3  14 28 e8   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-       -       0    0      0 0   0    0
b3        fc0-lc1:2-1 1 0    24    0  21 1  8  10 50   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-       -       0    0      0 0   0    0
b4        fc0-lc1:3-0 1 0    33    0  51 3  8  10 d0   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
-       -       0    0      0 0   0    0
```

該向量對映到ASIC 0/SLICE 0上的LC1（插槽2中的線卡，因為它基於0）。我們從最初在LC上運行的ELAM中得知，我們在此片上觸發：

```
module-2# debug platform internal tah elam asic 0
module-2(DBG-TAH-elam)# trigger reset
module-2(DBG-TAH-elam)# trigger init in-select 13 out-select 0
module-2(DBG-TAH-elam-insel13)# set inner ipv4 src_ip 10.100.17.11 dst_ip 192.168.20.1
module-2(DBG-TAH-elam-insel13)# start
stat
module-2(DBG-TAH-elam-insel13)# stat
ELAM STATUS
===========
Asic 0 Slice 0 Status Armed
Asic 0 Slice 1 Status Armed

module-2(DBG-TAH-elam-insel13)# stat
ELAM STATUS
===========
Asic 0 Slice 0 Status Triggered   <---- Packet triggered from FM
Asic 0 Slice 1 Status Triggered   <---- Packet triggered from Front Panel
```

此ELAM上的向量是sug_elam_out_sidebnd_no_spare_vec.ovector_idx:0x98(我們通過「hal l2埠

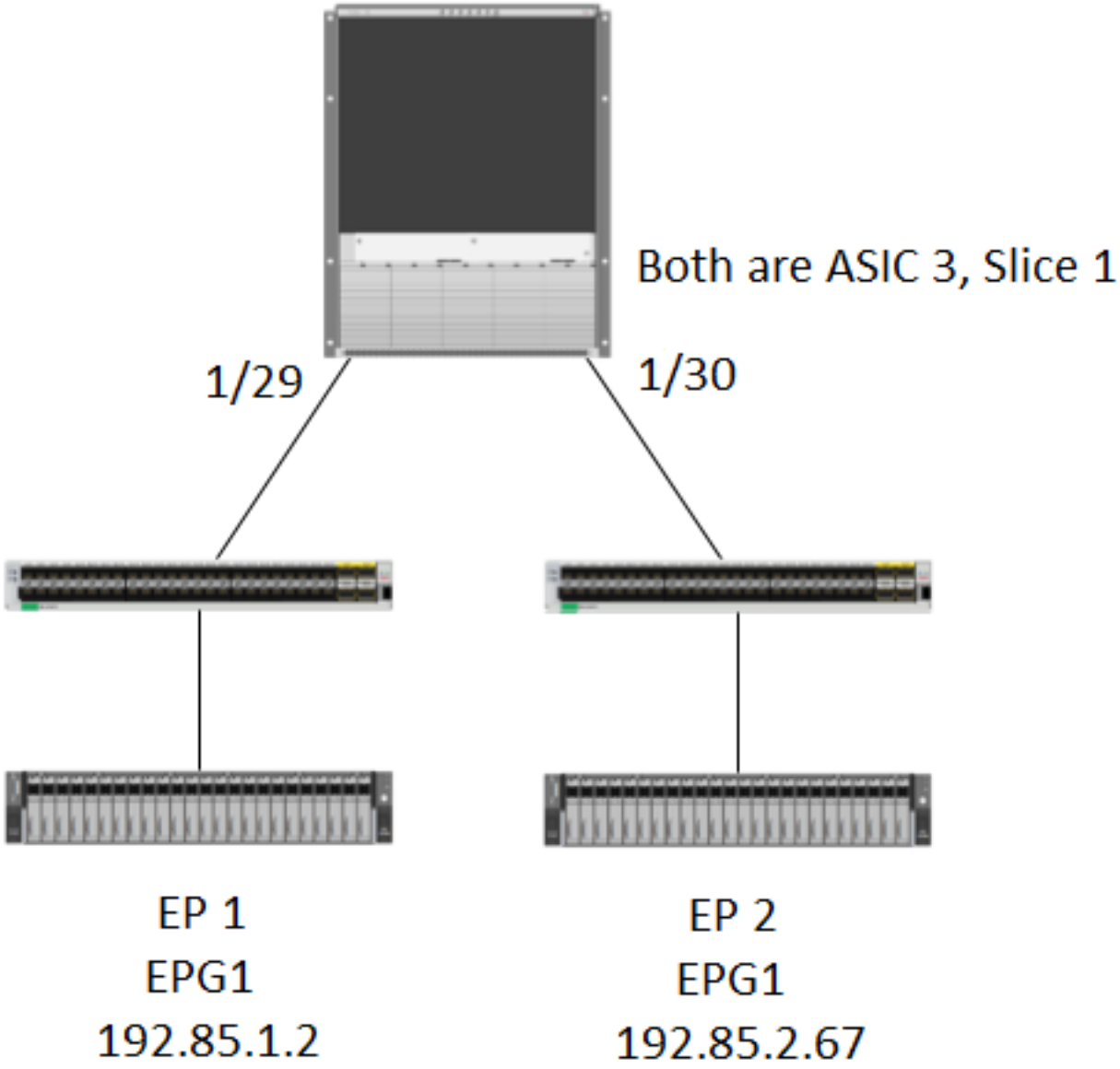
gpd」得知)對映到LC上的正確介面：

```
================================================================================================================
=========================================
                       Uc   Uc                              |       Reprogram       |
| Rep |
                     I PC   Pc                          L |   R I R D    R  U U X | L Xla Ovx N
NI Vif    RwV    Ing  Egr  | V R | PROF H
IfId      Ifname      P Cfg  MbrID As AP Sl Sp Ss Ovec S | P P P S P Sp Sp C M L | 3 Idx Idx L3
L3 Tid    Tid    Lbl  Lbl  | S V | ID   I
================================================================================================================
=========================================
1f5       SpInBndMgmt 0 9de  1a    0  0  0  0  0  0    0   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
D-2d4  D-3e1  0    0       0 0   1    0
1a080000 Eth2/1       0 9a   1c    0  11 0  10 20 20   1   0 0 0 0 0 0  0  0 0 0   1 b   b   1  1
D-f3   D-61   100  0       0 0   1    0
1a081000 Eth2/2       0 9b   22    0  d  0  c  18 18   1   0 0 0 0 0 0  0  0 0 0   1 c   c   1  1
D-1ee  D-30b  100  0       0 0   1    0
1a084000 Eth2/5       0 9e   1e    0  3d 1  14 28 a8   1   0 0 0 0 0 0  0  0 0 0   1 1   1   1  1
D-19a  D-2ee  100  0       0 0   1    0
1a085000 Eth2/6       0 9f   24    0  39 1  10 20 a0   1   0 0 0 0 0 0  0  0 0 0   1 e   e   1  1
D-87   D-184  100  0       0 0   1    0
1a086000 Eth2/7       0 a0   26    0  35 1  c 18 98    1   0 0 0 0 0 0  0  0 0 0   1 d   d   1  1  D-
1d0  D-357  100  0       0 0   1    0
1a088000 Eth2/9       0 a2   20    1  d  0  c  18 18   1   0 0 0 0 0 0  0  0 0 0   0 0   0   0  0
D-3ea  D-1a9  100  0       0 0   1    0
```

Ethernet 2/7是連線到枝葉5的介面。

額外方案：獲取不在「hal internal-port pi」輸出中的Ovector

拓撲



邏輯

在某些情況下，我們會在「**show platform internal hal2 internal-port pi**」**表中捕獲沒有Ovector的**資料包。 在下面的場景中，我們實際上捕獲的是從FM傳回的資料包，因此我們需要檢視不同的表格，以檢視資料包選擇的前面板埠。

請注意，上面的拓撲是學習傳輸流量的完全不同的環境（無代理路由）。 模組是N9K-X9732C-EX。

```
@module-1# debug platform internal tah elam asic 3
@module-1(DBG-elam)# trigger reset
@module-1(DBG-elam)# trigg init in-select 13 out-select 0
@module-1(DBG-elam-insel13)# set inner ipv4 src_ip 192.85.1.2 dst_ip 192.85.2.67
@module-1(DBG-elam-insel13)# star
@module-1(DBG-elam-insel13)# stat
ELAM STATUS
===========
Asic 3 Slice 0 Status Armed
Asic 3 Slice 1 Status Triggered
```

```
@module-1(DBG-elam-insel13)# report | grep ovector
 sug_elam_out_sidebnd_no_spare_vec.ovector_idx: 0xA0 <<<<<<<<<<<<<<<< now we look for this in
the "hal internal-port pi" command


@module-1# show platform internal hal l2 internal-port pi
No sandboxes exist
Num. of Sandboxes: 1
Legend:
-------
IfId:      Interface Id               IfName:     Interface Name
As:        Asic                       AP:         Asic Port
Sl:        Slice                      SP:         Slice Port
Ss:        Slice SrcId                Ovec:       Ovector
UcPcCfgId: Uc Pc CfgId                Lb Mbrid:   LB MbrId

Sandbox_ID: 0, BMP: 0x0
 Internal Port Count: 24

=====================================================================
                                                      UcPc  Lb
IfId     IfName                       As AP Sl SP Ss Ovec CfgId MbrId
=====================================================================
7d       -                            0  21 0  20 38 38   0     4
7e       -                            0  29 1  0  0  80   0     8
7f       -                            1  21 0  20 38 38   0     c
80       -                            1  29 1  0  0  80   0     10
81       -                            2  21 0  20 38 38   0     14
82       -                            2  29 1  0  0  80   0     18
83       -                            3  21 0  20 38 38   0     1c
84       -                            3  29 1  0  0  80   0     20
ad       -                            0  25 0  24 40 40   0     1
ae       -                            0  41 1  18 30 b0   0     6
af       -                            1  25 0  24 40 40   0     9
b0       -                            1  41 1  18 30 b0   0     e
b1       -                            2  25 0  24 40 40   0     11
b2       -                            2  41 1  18 30 b0   0     16
b3       -                            3  25 0  24 40 40   0     19
b4       -                            3  41 1  18 30 b0   0     1e
dd       -                            0  15 0  14 28 28   0     2
de       -                            0  4d 1  24 40 c0   0     5
df       -                            1  15 0  14 28 28   0     a
e0       -                            1  4d 1  24 40 c0   0     d
e1       -                            2  15 0  14 28 28   0     12
e2       -                            2  4d 1  24 40 c0   0     15
e3       -                            3  15 0  14 28 28   0     1a
e4       -                            3  4d 1  24 40 c0   0     1d  <<<<<<<  we cant find an
entry that matches 0xA0


@module-1# show platform internal hal l2 port gpd
Legend:
-------
<snip>

Sandbox_ID: 0, BMP: 0x0
 Port Count: 6

=============================================================================================================
=============================================
                      Uc   Uc                          |       Reprogram
|                                          | Rep |
                    I PC   Pc                       L |   R I R D    R  U U X | L Xla Ovx N  NI
Vif    RwV    Ing  Egr  | V R | PROF H
```

```
IfId     Ifname      P Cfg  MbrID As AP Sl Sp Ss Ovec S | P P P S P Sp Sp C M L | 3 Idx Idx L3
L3 Tid    Tid    Lbl  Lbl  | S V | ID   I
=============================================================================================
==========================================
1f5      SpInBndMgmt 0 9de  1a    0  0  0  0  0  0    0   0 0 0 0 0 0  0  0 0 0   0 0   0   0
0  D-2d4  D-3e1  0    0      0 0   1    0
1a000000 Eth1/1      0 1b   1c    0  11 0  10 20 20   1   0 0 0 0 0 0  0  0 0 0   1 1   1   1
1  D-13b  D-33b  500  0      1 0   3    0
1a01c000 Eth1/29     0 37   1e    3  3d 1  14 28 a8   1   0 0 0 0 0 0  0  0 0 0   1 8   8   1
1  D-3f2  D-7a   100  0      0 0   2    0
1a01d000 Eth1/30     0 38   20    3  39 1  10 20 a0   1   0 0 0 0 0 0  0  0 0 0   1 5   5   1
1  D-36e  D-362  100  0      0 0   2    0
1a01e000 Eth1/31     0 39   22    3  35 1  c  18 98   1   0 0 0 0 0 0  0  0 0 0   1 9   9   1
1  D-273  D-8    100  0      0 0   2    0
1a01f000 Eth1/32     0 3a   24    3  31 1  8  10 90   1   0 0 0 0 0 0  0  0 0 0   1 a   a   1
1  D-154  D-5d   100  0      0 0   2    0
```

1/30是連線到枝葉102的phy介面，由拓撲、ASIC 3、片1驗證