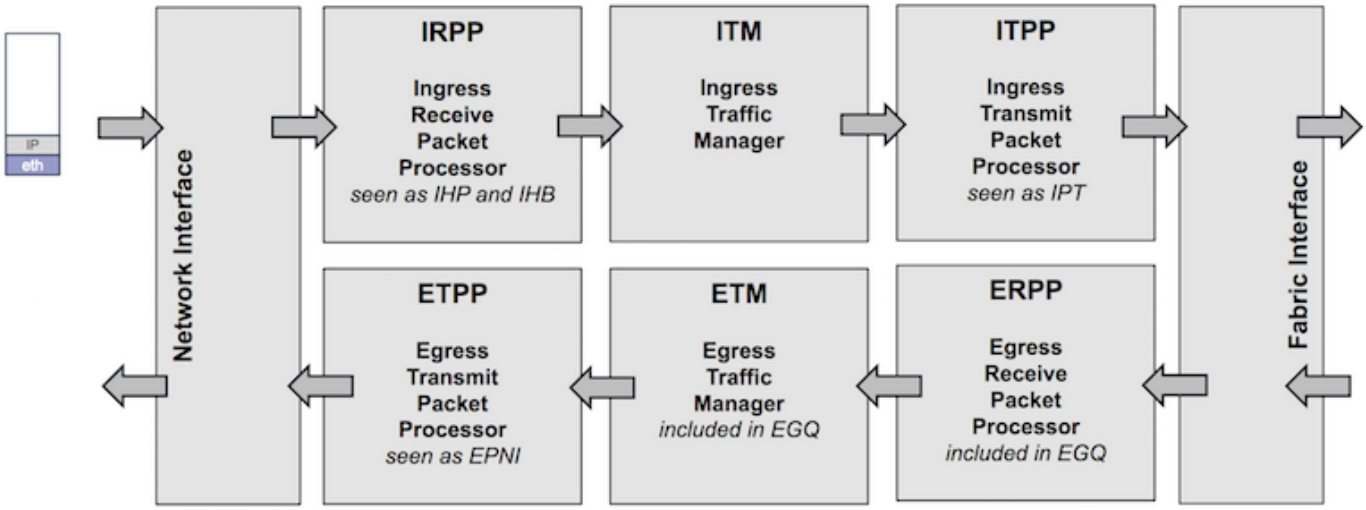
NCS5500: Vida útil de um pacote(trânsito, contagem/injeção, caminho do ping)

Contents

Introduction

Este documento descreve o caminho seguido pelos pacotes ICMP echo request/Echo Reply dentro da caixa NCS55xx(Fretta).

Vida útil de um pacote em ASIC de encaminhamento



IRPP

Um pacote é recebido em uma interface e transmitido ao IRPP, onde os primeiros 128 bytes serão extraídos e processados. Como resultado, o cabeçalho interno do sistema é precedido.

ITM

O pacote é armazenado na DRAM/OCB

ITPP

Se necessário, reescreva o cabeçalho do sistema (replicação multicast, espelhamento de portas, etc.)

Os pacotes são divididos em células e balanceados para a estrutura

ERPP

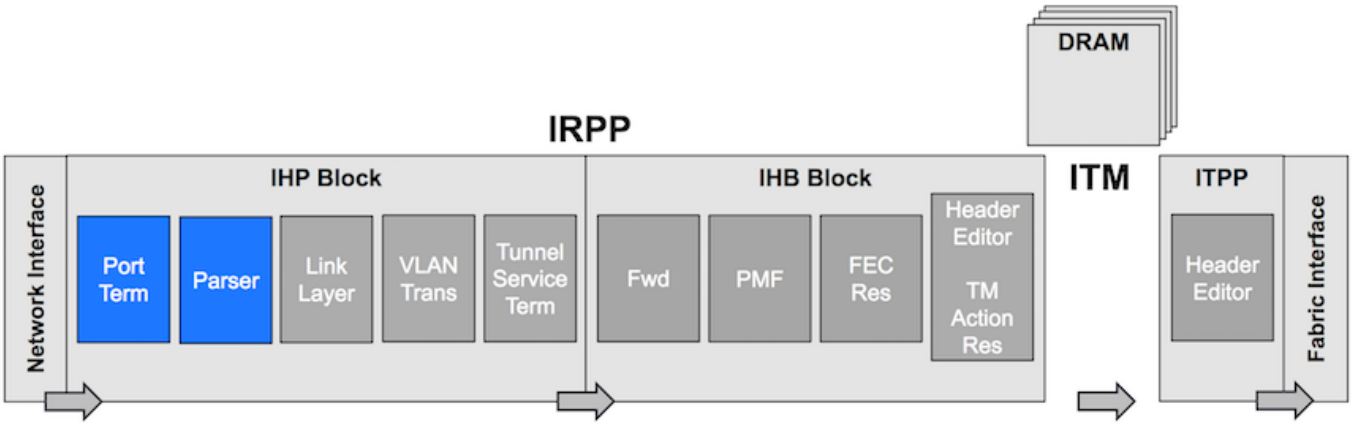
As células são recebidas e remontadas. Os primeiros 128 bytes são extraídos e aplicam todos os filtros da camada de enlace, ACL de saída, Replicação de saída (Multicast)

ETPP/ETM

O pacote inteiro é armazenado em um buffer até que o pacote de saída seja programado. Os cabeçalhos do sistema são removidos.

Encaminhamento de pipeline ASIC

IRPP (Port Term, Parser)

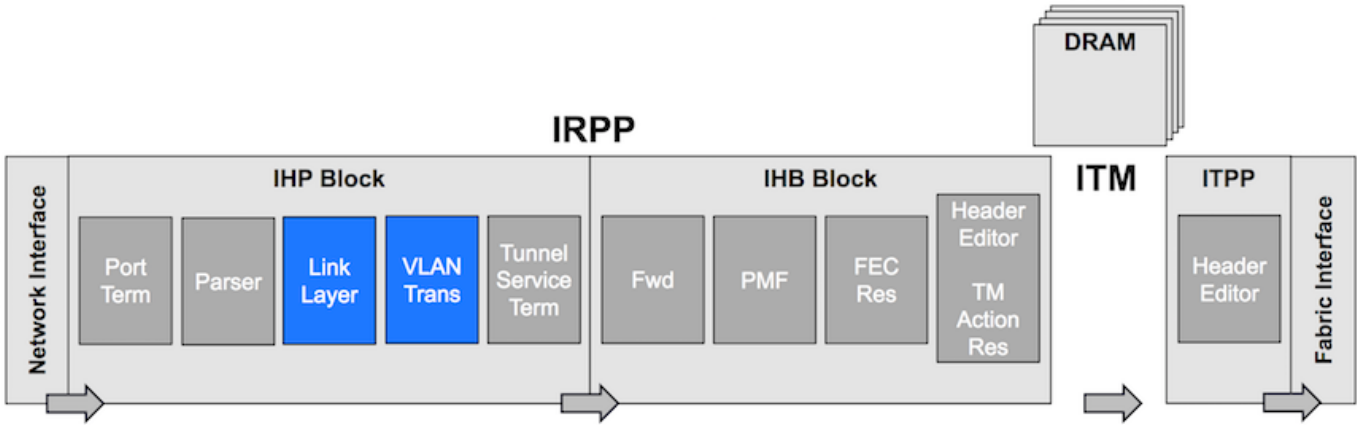


Terminação de porta: Pacotes recebidos da interface de rede/CPU/reciclagem

- Determine a porta de origem e marque o pacote com ela.
- Decida o programa inicial a ser usado no Analisador.
- Identificar onde o cabeçalho da rede é iniciado.

Analisador: Extraia Ethertype, MAC Addresses, Determine o deslocamento para os próximos estágios no pipeline.

IRPP(Line Layer, VLAN Trans)



Camada de enlace: Filtragem em L2 e autenticação de endereço de origem.

Tradução de VLAN: Mapeamos a interface lógica do pacote.

Caminho de busca

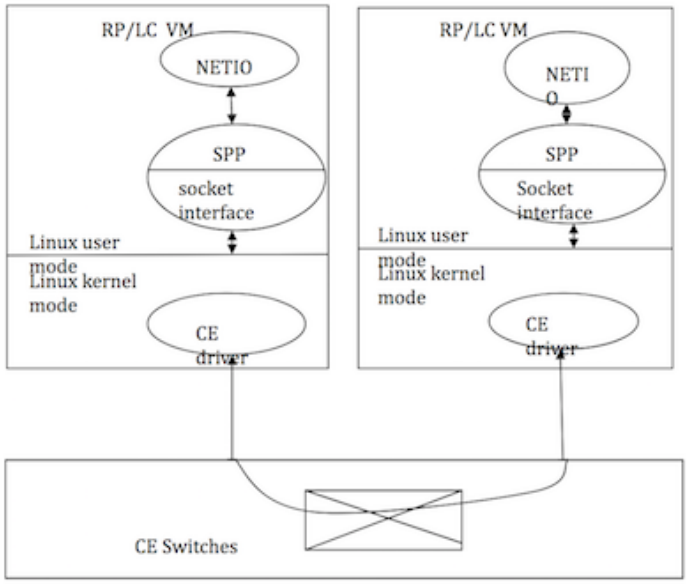
- Apenas algumas entradas LPTS TCAM estão disponíveis na NPU devido à falta de recursos TCAM.
- A pesquisa de LPTS principal é feita em SW LPTS Pre-IFIB em LC Netio
- Pacote punt LPTS de NPU para RP diretamente através da pesquisa de TCAM de PMF: OSPF, Mcast OSPFv3, os pacotes ISIS são direcionados para RP ativo e em standby diretamente
- Pacote punt LPTS da NPU para a CPU local via pesquisa de TCAM PMF: Qualquer protocolo que use TCP, UDP; ICMP, ND
- Os pacotes de protocolo L2 são direcionados para o LC através da armadilha de CPU BRCM: ARP, RARP, CDP, LACP, LLDP, EtherLink OAM, MACSec

- Os pacotes de exceção são direcionados para o LC através da armadilha de CPU BRCM. TTL0, TTL1, MTU Excedido, pacotes de opção

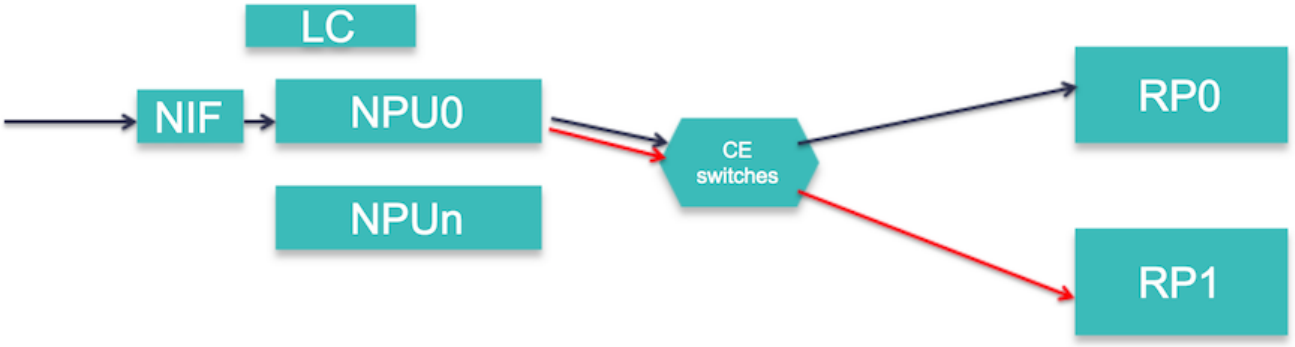
Caminho de busca entre dois nós da CPU

NetIO→SPP→CE switches→SPP→NETIO

CE switches: SC, FC, LC switches

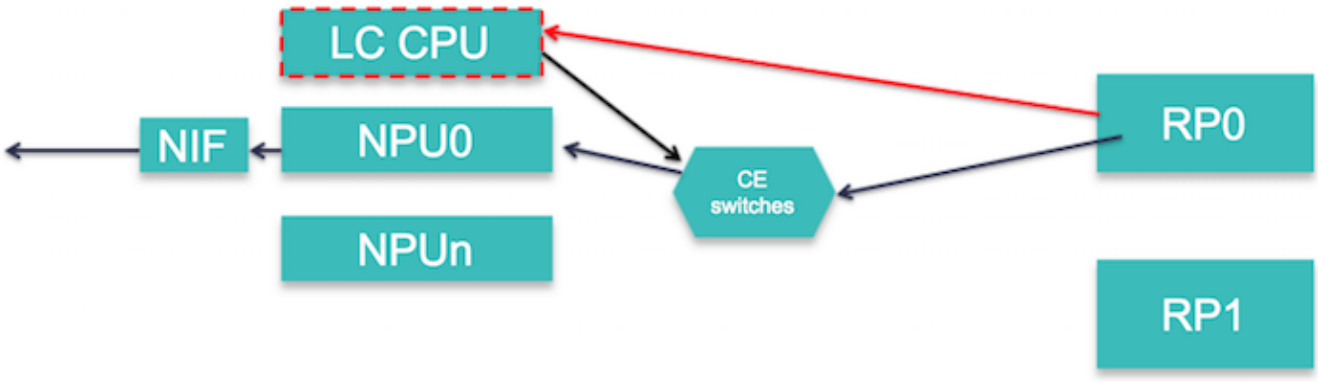


Caminho de busca da NPU para a CPU RP



Os pacotes RX Forus são replicados na NPU. Um é enviado para o RP ativo e outro para o RP standby

Injetar da CPU RP para a CPU NPU ou LC

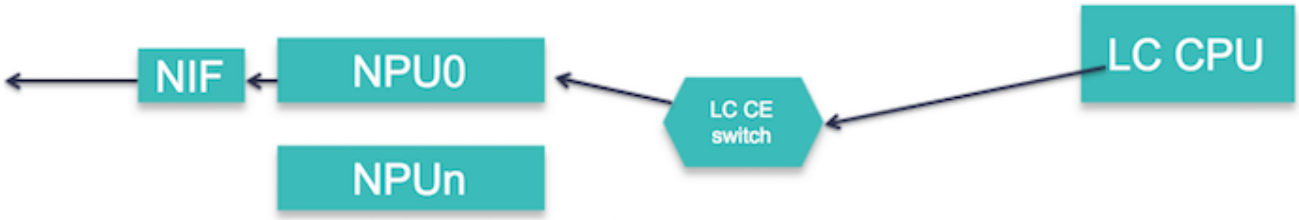


Os pacotes L3 são injetados diretamente na NPU se a adjacência de prefixo estiver completa ou se for um pacote de pré-roteamento

Os pacotes L3 são injetados na CPU do LC no caso:

- A adjacência de prefixo é GLEAN.
- pacote de roteamento prévio de MPLS
- O tamanho do pacote excede o MTU.

Caminho de injeção da CPU do LC para a NPU



Estes pacotes são injetados da CPU LC para a NPU:

- ARP, ND, Resposta de Eco ICMP, Pacotes Fragmentados
- Pacotes OAM de Ether-Link, CDP, LACP, LLDP

CLI para depuração de punt/injeção

```
Show SPP node counters location <>

show netio chain
```

```
show netio drop location <>

show ipv4/ipv6 traffic location <>

show fwd statistics location <>

show lpts pifib entry brief statistics location <>

show controllers fia diagshell
```

```
show interface <> location <>
```

Ping remoto

Caminho do pacote: Solicitação de eco

```
Local Node[ICMP(RP) -> IP I/O(RP) -> NetIO/Forwarder(RP) -> SPP(RP) -> NPU] -> wire ->
Remote[NPU -> LPTS(HW) -> SPP(LC) -> NetIO/Forwarder(LC) -> LPTS(SW)(LC) -> IP I/O (LC) -> ICMP
(LC)]
```

Caminho do pacote: Resposta de Eco

```
Remote Node[IPv4/ICMP (LC) -> FWD/NetIO (LC) -> SPP (LC) -> NPU] -> wire -> Local Node[LPTS(HW)
-> SPP(LC) -> NetIO/Forwarder(LC) -> NetIO(RP) -> IP I/O (RP) -> ICMP (RP)]
```

Ping local

Caminho do pacote: Solicitação de eco

```
RP(ICMP/IPv4 IO -> netio -> SPP -> CE) -> LC(SPP -> netio -> ICMP/ipv4 IO)
```

Caminho do pacote: Resposta de Eco

```
LC(IPv4 IO/ICMP -> Netio -> SPP -> CE) -> RP(SPP -> net -> ipv4 io/ICMP)
```

Debugs úteis:

```
debug icmp ipv4 location 0/0/CPU0

debug ipv4 packet location 0/0/CPU0

debug ipv4 ping events location 0/0/CPU0
```

Topologia

```
Fretta_1(GigabitEthernet0/0/0/16 ) <---->(GigabitEthernet0/0/0/16 ) Fretta_2


RP/0/RP0/CPU0:fretta_1#  ping 1.1.16.2 count 10000
```

Comandos para verificar o ping remoto

Solicitação de eco: RP local: TX

```
Path: ICMP(RP) -> IP I/O(RP) -> NetIO/Forwarder(RP) -> SPP(RP) -> NPU
```

1. E/S IP: Verifique se a solicitação de eco é gerada:

```
show ipv4 traffic brief
```

```
ICMP statistics:
  Sent: 0 admin unreachable, 0 network unreachable
        0 host unreachable, 0 protocol unreachable
        0 port unreachable, 0 fragment unreachable
        0 time to live exceeded, 0 reassembly ttl exceeded
        10000 echo request, 0 echo reply
        0 mask request, 0 mask reply
        0 parameter error, 0 redirects
        10000 total
```

2. NetIO

```
RP/0/RP0/CPU0:fretta_1#show netio clients location 0/rP0/CPU0

Counters                  Errors/Total
---------------------------------------
Output                     0/10019
Input                      0/11804
Puntback                   0/0
Jump                       0/0
Driver Output              0/10002

Mutex Bypass Counters        Total
---------------------------------------
Egress handled               0
Egress chainwalked           10006
Egress dropped               0
Ingress handled              10000
Ingress chainwalked          0
Ingress dropped              0



ClientID         Drop/Total        Drop/Total      Cur/High/Max    Cur/High/Max
-------------------------------------------------------------------------------
ipv6_icmp           0/0               0/0             0/0/1000        0/0/1000
icmp                0/10000           0/0             0/1/1000        0/0/1000




If ping is failing then check if it is getting dropped in Netio:

RP/0/RP0/CPU0:fretta_1#show netio drops location 0/rP0/CPU0
Thu Apr 20 20:28:09.577 UTC

Drops for interfaces on node 0/RP0/CPU0

No drops
```

3. SPP

```
RP/0/RP0/CPU0:fretta_1#show spp node-counters
Thu Apr 20 20:29:05.785 UTC
0/0/CPU0:
fretta/classify
     forwarded to spp clients:           10006
 forwarded NPU packet to NetIO:           10006
     dropped in classify node:              24
        Fwded to CoPP sampler:               1
                    PUNT ARP:                1
```

```
                  PUNT IFIB:           10006
              IFIB RAWIP4_FM:          10000
              IFIB RAWIP6_FM:              6
------------------------------
client/inject
       pkts injected into spp:         10002
 NetIO->NPU injected into spp:             2
 NetIO->CPU injected into spp:         10000
         NetIO->NPU PROTO ARP:             2
          NetIO->CPU PKT LPTS:         10000
------------------------------
socket/rx
               ether raw pkts:         10031
------------------------------
socket/tx
                     ce pkts:          10002
------------------------------
client/punt
             punted to client:         10007
------------------------------

0/RP0/CPU0:
socket/rx
               ether raw pkts:         10002
          mgmt interface pkts:          3204
------------------------------
socket/tx
                     ce pkts:          10000
          mgmt interface pkts:             5
------------------------------
fretta/classify
     forwarded to spp clients:         13204
 forwarded CPU packet to NetIO:         10000
forwarded Mgmt packet to NetIO:          3204
     dropped in classify node:              2
------------------------------
client/inject
       pkts injected into spp:         10005
 NetIO->NPU injected into spp:         10000
    MGMT_IF injected into spp:             5
NetIO->NPU PROTO IPV4_PREROUTE:         10000
------------------------------
client/punt
             punted to client:         13204
------------------------------
```

4. Verifique se a solicitação de eco é enviada para o cabeamento:

```
 RP/0/RP0/CPU0:fretta_1#show controllers gigabitEthernet 0/0/0/16 stats | be Egress
Thu Apr 20 21:17:28.176 UTC

Egress:
   Output total bytes          = 1140270
       Output good bytes           = 1140270

   Output total packets        = 10004
   Output 802.1Q frames        = 0
   Output pause frames         = 0
   Output pkts 64 bytes        = 1
   Output pkts 65-127 bytes    = 10003
   Output pkts 128-255 bytes   = 0
   Output pkts 256-511 bytes   = 0
   Output pkts 512-1023 bytes  = 0
```

```
   Output pkts 1024-1518 bytes = 0
   Output pkts 1519-Max bytes  = 0

   Output good pkts            = 10004
   Output unicast pkts         = 10000
   Output multicast pkts       = 3
   Output broadcast pkts       = 1

   Output drop underrun        = 0
   Output drop abort           = 0
   Output drop other           = 0

   Output error other          = 0
```

Solicitação de eco: LC remoto: RX

```
Path: NPU -> LPTS(HW) -> SPP(LC) -> NetIO/Forwarder(LC) -> LPTS(SW)(LC) -> IP I/O (LC) -> ICMP
(LC)
```

1. Verifique se o pacote é recebido do fio:

```
RP/0/RP0/CPU0:fretta_2#show controllers gigabitEthernet 0/0/0/16 stats
Thu Apr 20 20:44:22.115 UTC
Statistics for interface GigabitEthernet0/0/0/16 (cached values):

Ingress:
   Input total bytes           = 1140270
   Input good bytes            = 1140270

   Input total packets         = 10004
   Input 802.1Q frames         = 0
   Input pause frames          = 0
   Input pkts 64 bytes         = 1
   Input pkts 65-127 bytes     = 10003
```

2. Verifique o contador LPTS.

```
RP/0/RP0/CPU0:fretta_2#show lpts pifib hardware entry brief location 0/0/CPU0 | i ICMP
Thu Apr 20 20:45:54.687 UTC

DestIP               SrcIP               vrf   L4   LPort/Type   RPort  npu  Flowtype
DestNode     PuntPrio Accept Drop
0.0.0.0              0.0.0.0             0     1    ECHO         0      0    ICMP-local
Local LC     MEDIUM   10000  0
```

3. SPP

```
RP/0/RP0/CPU0:fretta_2#show spp node-counters location 0/0/CPU0

fretta/classify
     forwarded to spp clients:          10006
 forwarded NPU packet to NetIO:          10006
     dropped in classify node:              22
        Fwded to CoPP sampler:               2
                    PUNT ARP:                2
                   PUNT IFIB:            10006
              IFIB IPv4_STACK:           10000
               IFIB RAWIP6_FM:               6
------------------------------
client/inject
```

```
       pkts injected into spp:           10002
 NetIO->NPU injected into spp:           10002
         NetIO->NPU PROTO ARP:               2
        NetIO->NPU PROTO IPV4:           10000
------------------------------
socket/rx
                ether raw pkts:           10030
------------------------------
socket/tx
                      ce pkts:           10002
------------------------------
client/punt
             punted to client:           10008
------------------------------
```

4. Netio

```
show netio chains gigabitEthernet 0/0/0/16 location 0/0/cpu0

<12> (ipv4)   Stats IN: 10000 pkts, 1140000 bytes; OUT: 10000 pkts, 1140000 bytes

       Protocol        SAFI       Pkts In    Bytes In    Pkts Out   Bytes Out
---------------  ----------    ----------  ----------  ----------  ----------
           ipv4     Unicast          10000     1140000       10000     1000000
           ipv4   Multicast              0           0           0           0
           ipv4   Broadcast              0           0           0           0
           ipv6     Unicast              0           0           0           0
           ipv6   Multicast              0           0           0           0

RP/0/RP0/CPU0:fretta_2#show netio clients location 0/0/CPU0
Thu Apr 20 20:52:26.802 UTC

Counters                  Errors/Total
---------------------------------------
Output                        0/10002
Input                         0/10008
Puntback                      0/0
Jump                          0/0
Driver Output                 0/10002

XIPC queues              Dropped/Queued    Cur/High/Max
-------------------------------------------------------------
OutputL                       0/10000         0/1/6000
OutputH                       0/2             0/1/3000
Puntback                      0/0             0/0/6000

                  Input              Punt         XIPC InputQ      XIPC PuntQ
ClientID         Drop/Total        Drop/Total      Cur/High/Max    Cur/High/Max
-------------------------------------------------------------------------------
ipv6_icmp           0/0               0/0             0/0/1000        0/0/1000
icmp                0/10000           0/0             0/1/1000        0/0/1000
clns              L 0/0               0/0           L 0/0/1000        0/0/0
                  H 0/0                             H 0/0/1000
ipv6_io             0/0               0/0             0/0/1000        0/0/1000
ipv6_nd             0/0               0/0             0/0/1500        0/0/1000
l2snoop             0/0               0/0             0/0/1000        0/0/0
ether_sock          0/0               0/0
tp_oam              0/0               0/0             0/0/1000        0/0/1000
icmpv6_unreach_jump        0/0               0/0
arp                 0/2               0/0             0/1/1000        0/0/1000
```

```
mpls_io             0/0               0/0             0/0/1000        0/0/1000
ipv4                0/0               0/0             0/0/1000        0/0/1000
ipv6                0/0               0/0             0/0/1000        0/0/1000

Key:
 L = queue for lower priority packets
 H = queue for higher priority packets
```

5. estatísticas de FWD

```
RP/0/RP0/CPU0:fretta_2#show fwd statistics all location 0/0/cpu0
Thu Apr 20 20:51:50.347 UTC
RECEIVE STATISTICS SUMMARY:
rx_pkts: 10008
punt_pkts: 10008
ingress_total_drops: 0
TRANSMIT STATISTICS SUMMARY:
inject_pkts: 10002
tx_pkts: 10002
egress_total_drops: 0
RP/0/RP0/CPU0:fretta_2#
```

6. IOS IP

```
show ipv4 traffic brief location 0/0/CPU0

 Rcvd: 0 admin unreachable, 0 network unreachable
       0 host unreachable, 0 protocol unreachable
       0 port unreachable, 0 fragment unreachable
       0 time to live exceeded, 0 reassembly ttl exceeded
        10000 echo request, 0 echo reply
       0 mask request, 0 mask reply
       0 redirect, 0 parameter error
       0 source quench, 0 timestamp, 0 timestamp reply
       0 router advertisement, 0 router solicitation
       10000 total, 0 checksum errors, 0 unknown
```

Resposta de Eco: Nó remoto (LC): TX

```
Path: IPv4/ICMP (LC) -> FWD/NetIO (LC) -> SPP (LC) -> NPU
```

1. IP IO

```
RP/0/RP0/CPU0:fretta_2#show ipv4 traffic brief location 0/0/CPU0

ICMP statistics:
 Sent: 0 admin unreachable, 0 network unreachable
       0 host unreachable, 0 protocol unreachable
       0 port unreachable, 0 fragment unreachable
       0 time to live exceeded, 0 reassembly ttl exceeded
       0 echo request, 10000 echo reply
       0 mask request, 0 mask reply
       0 parameter error, 0 redirects
       10000 total
```

2. Netio

```
show netio chains gigabitEthernet 0/0/0/16 location 0/0/cpu0
```

```
<12> (ipv4)   Stats IN: 10000 pkts, 1140000 bytes; OUT: 10000 pkts, 1140000 bytes

       Protocol        SAFI       Pkts In    Bytes In    Pkts Out   Bytes Out
--------------  ----------    ----------  ----------  ----------  ----------
          ipv4     Unicast         10000     1140000       10000     1000000
          ipv4   Multicast             0           0           0           0
          ipv4   Broadcast             0           0           0           0
          ipv6     Unicast             0           0           0           0
          ipv6   Multicast             0           0           0           0

RP/0/RP0/CPU0:fretta_2#show netio clients location 0/0/CPU0
Thu Apr 20 20:52:26.802 UTC

Counters                  Errors/Total
---------------------------------------
Output                        0/10002
Input                         0/10008
Puntback                      0/0
Jump                          0/0
Driver Output                 0/10002

XIPC queues              Dropped/Queued    Cur/High/Max
-------------------------------------------------------
OutputL                       0/10000         0/1/6000
OutputH                       0/2             0/1/3000
Puntback                      0/0             0/0/6000
```

3. Estatísticas de FWD

```
 RP/0/RP0/CPU0:fretta_2#show fwd statistics all location 0/0/cpu0
Thu Apr 20 20:51:50.347 UTC
RECEIVE STATISTICS SUMMARY:
rx_pkts: 10008
punt_pkts: 10008
ingress_total_drops: 0
TRANSMIT STATISTICS SUMMARY:
inject_pkts: 10002
tx_pkts: 10002
egress_total_drops: 0
```

4. SPP

```
 show spp node-counters location 0/0/CPU0

fretta/classify
     forwarded to spp clients:           10006
 forwarded NPU packet to NetIO:           10006
     dropped in classify node:              22
        Fwded to CoPP sampler:               2
                    PUNT ARP:                2
                   PUNT IFIB:           10006
              IFIB IPv4_STACK:           10000
               IFIB RAWIP6_FM:               6
------------------------------
client/inject
       pkts injected into spp:           10002
 NetIO->NPU injected into spp:           10002
         NetIO->NPU PROTO ARP:               2
        NetIO->NPU PROTO IPV4:           10000
------------------------------
```

```
socket/rx
               ether raw pkts:           10030
------------------------------
socket/tx
                       ce pkts:            10002
------------------------------
client/punt
             punted to client:           10008
------------------------------
```

5. Verifique se o pacote é enviado para o cabeamento.

```
RP/0/RP0/CPU0:fretta_2#show controllers gigabitEthernet 0/0/0/16 stats
Thu Apr 20 21:20:22.593 UTC
Statistics for interface GigabitEthernet0/0/0/16 (cached values):
Egress:
   Output total bytes          = 1140270
   Output good bytes           = 1140270

   Output total packets        = 10004
   Output 802.1Q frames        = 0
   Output pause frames         = 0
   Output pkts 64 bytes        = 1
    Output pkts 65-127 bytes    = 10003
   Output pkts 128-255 bytes   = 0
   Output pkts 256-511 bytes   = 0
   Output pkts 512-1023 bytes  = 0
   Output pkts 1024-1518 bytes = 0
   Output pkts 1519-Max bytes  = 0

   Output good pkts            = 10004
   Output unicast pkts         = 10000
   Output multicast pkts       = 3
   Output broadcast pkts       = 1

   Output drop underrun        = 0
   Output drop abort           = 0
   Output drop other           = 0

   Output error other          = 0
```

6. Estatísticas da interface

```
RP/0/RP0/CPU0:fretta_2#show int gigabitEthernet 0/0/0/16
Thu Apr 20 21:21:37.942 UTC
GigabitEthernet0/0/0/16 is up, line protocol is up
 Interface state transitions: 1
 Hardware is GigabitEthernet, address is 008a.964a.7040 (bia 008a.964a.7040)
 Internet address is 1.1.16.2/24
 MTU 1514 bytes, BW 1000000 Kbit (Max: 1000000 Kbit)
    reliability 255/255, txload 0/255, rxload 0/255
 Encapsulation ARPA,
 Full-duplex, 1000Mb/s, link type is force-up
 output flow control is off, input flow control is off
 Carrier delay (up) is 10 msec
 loopback not set,
 Last link flapped 01:00:13
 ARP type ARPA, ARP timeout 04:00:00
 Last input 00:56:58, output 00:56:58
 Last clearing of "show interface" counters never
```

```
 5 minute input rate 0 bits/sec, 0 packets/sec
 5 minute output rate 0 bits/sec, 0 packets/sec
    10004 packets input, 1140270 bytes, 0 total input drops
    3 drops for unrecognized upper-level protocol
    Received 1 broadcast packets, 3 multicast packets
             0 runs, 0 giants, 0 throttles, 0 parity
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     10004 packets output, 1140270 bytes, 0 total output drops
    Output 1 broadcast packets, 3 multicast packets
    0 output errors, 0 underruns, 0 applique, 0 resets
    0 output buffer failures, 0 output buffers swapped out
    0 carrier transitions
```

Resposta de Eco: Nó local (LC): RX

```
LPTS(HW) -> SPP(LC) -> NetIO/Forwarder(LC) -> LPTS PreIFIB Lookup -> SPP(LC) -> CE(LC) ->
SPP(RP) -> NetIO(RP) -> IP I/O (RP) -> ICMP (RP)
```

1. Verifique se os pacotes estão vindo do fio.

```
RP/0/RP0/CPU0:fretta_1#show controllers gigabitEthernet 0/0/0/16 stats
Thu Apr 20 21:17:28.176 UTC
Statistics for interface GigabitEthernet0/0/0/16 (cached values):

Ingress:
   Input total bytes           = 1140270
   Input good bytes            = 1140270

   Input total packets         = 10004
   Input 802.1Q frames         = 0
   Input pause frames          = 0
   Input pkts 64 bytes         = 1
   Input pkts 65-127 bytes     = 10003
   Input pkts 128-255 bytes    = 0
   Input pkts 256-511 bytes    = 0
   Input pkts 512-1023 bytes   = 0
   Input pkts 1024-1518 bytes  = 0
   Input pkts 1519-Max bytes   = 0

   Input good pkts             = 10004
   Input unicast pkts          = 10000
   Input multicast pkts        = 3
   Input broadcast pkts        = 1

   Input drop overrun          = 0
   Input drop abort            = 0
   Input drop invalid VLAN     = 0
   Input drop invalid DMAC     = 0
   Input drop invalid encap    = 0
   Input drop other            = 0

   Input error giant           = 0
   Input error runt            = 0
   Input error jabbers         = 0
   Input error fragments       = 0
   Input error CRC             = 0
   Input error collisions      = 0
   Input error symbol          = 0
   Input error other           = 0

   Input MIB giant             = 0
   Input MIB jabber            = 0
```

```
   Input MIB CRC               = 0
```

2. Contadores LPTS

```
RP/0/RP0/CPU0:fretta_1#show lpts pifib hardware entry brief locatio 0/0/CPU0

0.0.0.0             0.0.0.0             0     1    ECHOREPLY    0      0    ICMP-app-default
Local LC     LOW      10000  0
```

3. SPP no LC

```
RP/0/RP0/CPU0:fretta_1#show spp node-counters location 0/0/CPU0
Thu Apr 20 21:01:31.974 UTC
fretta/classify
     forwarded to spp clients:           10006
 forwarded NPU packet to NetIO:           10006
     dropped in classify node:              24
        Fwded to CoPP sampler:               1
                    PUNT ARP:                1
                   PUNT IFIB:           10006
               IFIB RAWIP4_FM:           10000
               IFIB RAWIP6_FM:               6
------------------------------
client/inject
       pkts injected into spp:           10002
 NetIO->NPU injected into spp:               2
 NetIO->CPU injected into spp:           10000
         NetIO->NPU PROTO ARP:               2
          NetIO->CPU PKT LPTS:           10000
------------------------------
socket/rx
                ether raw pkts:           10031
------------------------------
socket/tx
                     ce pkts:           10002
------------------------------
client/punt
             punted to client:           10007
------------------------------
```

4. Netio no LC

```
RP/0/RP0/CPU0:fretta_1# show netio chains gigabitEthernet 0/0/0/16 location 0/0/cpu0

<12> (ipv4)   Stats IN: 10000 pkts, 1140000 bytes; OUT: 0 pkts, 0 bytes

Protocol SAFI counts:
--------------------

      Protocol        SAFI       Pkts In    Bytes In    Pkts Out   Bytes Out
--------------  ----------    ----------  ----------  ----------  ----------
           ipv4     Unicast         10000     1140000           0           0
          ipv4   Multicast             0           0           0           0
          ipv4   Broadcast             0           0           0           0
          ipv6     Unicast             0           0           0           0
          ipv6   Multicast             0           0           0           0
```

5. O FWD está no LC.

```
RP/0/RP0/CPU0:fretta_1#show fwd statistics all location 0/0/CPU0
Thu Apr 20 21:04:27.767 UTC
RECEIVE STATISTICS SUMMARY:
rx_pkts: 10007
punt_pkts: 10007
ingress_total_drops: 0
TRANSMIT STATISTICS SUMMARY:
inject_pkts: 10002
tx_pkts: 10002
egress_total_drops: 0
RP/0/RP0/CPU0:fretta_1#
```

5. SPP no LC para enviar ao SPP no RP.

```
RP/0/RP0/CPU0:fretta_1#show spp node-counters location 0/0/CPU0
Thu Apr 20 21:01:31.974 UTC
fretta/classify
     forwarded to spp clients:           10006
 forwarded NPU packet to NetIO:           10006
     dropped in classify node:              24
        Fwded to CoPP sampler:               1
                     PUNT ARP:               1
                    PUNT IFIB:           10006
                IFIB RAWIP4_FM:           10000
                IFIB RAWIP6_FM:               6
------------------------------
client/inject
       pkts injected into spp:           10002
 NetIO->NPU injected into spp:               2
 NetIO->CPU injected into spp:           10000
          NetIO->NPU PROTO ARP:              2
           NetIO->CPU PKT LPTS:           10000
------------------------------
socket/rx
               ether raw pkts:           10031
------------------------------
socket/tx
                       ce pkts:           10002
------------------------------
client/punt
             punted to client:           10007
------------------------------
```

6. SPP no RP

```
RP/0/RP0/CPU0:fretta_1#show spp node-counters location 0/rP0/CPU0
Thu Apr 20 21:06:33.045 UTC
socket/rx
                ether raw pkts:           10002
          mgmt interface pkts:            16651
------------------------------
socket/tx
                       ce pkts:           10000
          mgmt interface pkts:               14
------------------------------
fretta/classify
     forwarded to spp clients:           26651
 forwarded CPU packet to NetIO:           10000
forwarded Mgmt packet to NetIO:           16651
```

```
     dropped in classify node:               2
------------------------------
client/inject
       pkts injected into spp:           10014
 NetIO->NPU injected into spp:           10000
    MGMT_IF injected into spp:              14
NetIO->NPU PROTO IPV4_PREROUTE:           10000
------------------------------
client/punt
             punted to client:           26651
------------------------------
```

7. Netio no RP.

```
RP/0/RP0/CPU0:fretta_1#show netio clients location 0/RP0/CPU0
Thu Apr 20 21:05:05.977 UTC

Counters                  Errors/Total
---------------------------------------
Output                        0/10031
Input                         0/25872
Puntback                      0/0
Jump                          0/0
Driver Output                 0/10014

Mutex Bypass Counters        Total
---------------------------------------
Egress handled               0
Egress chainwalked           10018
Egress dropped               0
Ingress handled              10000
Ingress chainwalked          0
Ingress dropped              0

XIPC queues              Dropped/Queued    Cur/High/Max
-------------------------------------------------------------
OutputL                       0/10004         0/1/6000
OutputH                       0/14            0/1/3000
Puntback                      0/0             0/0/6000
PMutex_egressL                0/10004         0/1/6000
PMutex_egressH                0/14            0/1/1500
PMutex_ingressL               0/0             0/0/6000
PMutex_ingressH               0/0             0/0/1500

                  Input              Punt          XIPC InputQ      XIPC PuntQ
ClientID         Drop/Total        Drop/Total      Cur/High/Max    Cur/High/Max
-------------------------------------------------------------------------------
ipv6_icmp           0/0               0/0             0/0/1000        0/0/1000
icmp                0/10000           0/0             0/1/1000        0/0/1000
clns               L 0/0              0/0            L 0/0/1000       0/0/0
                   H 0/0                             H 0/0/1000
eth_mgmt            0/0               0/0
ipv6_io             0/0               0/4             0/0/1000        0/1/1000
ipv6_nd             0/4               0/0             0/1/1500        0/0/1000
l2snoop             0/0               0/0             0/0/1000        0/0/0
ether_sock          0/0               0/0
icmpv6_unreach_jump        0/0               0/0
raw                L 0/0              0/0            L 0/0/1600       0/0/0
                   H 0/0                             H 0/0/1600
tcp                L 0/0              0/0            L 0/0/1600       0/0/0
                   H 0/0                             H 0/0/1600
udp                L 0/307            0/0            L 0/1/1600       0/0/0
```

```
                H 0/0                           H 0/0/1600
arp                0/15565          0/0             0/4/1000        0/0/1000
mpls_io            0/0              0/0             0/0/1000        0/0/1000
lspv_server        0/0              0/0
ipv4               0/0              0/0             0/0/1000        0/0/1000
ipv6               0/0              0/0             0/0/1000        0/0/1000

Key:
 L = queue for lower priority packets
 H = queue for higher priority packets
```

8. IP IO

```
RP/0/RP0/CPU0:fretta_1#

RP/0/RP0/CPU0:fretta_1#show ipv4 traffic brief

  Rcvd: 0 admin unreachable, 0 network unreachable
        0 host unreachable, 0 protocol unreachable
        0 port unreachable, 0 fragment unreachable
        0 time to live exceeded, 0 reassembly ttl exceeded
        0 echo request, 10000 echo reply
        0 mask request, 0 mask reply
        0 redirect, 0 parameter error
        0 source quench, 0 timestamp, 0 timestamp reply
        0 router advertisement, 0 router solicitation
        10000 total, 0 checksum errors, 0 unknown
```

9. Estatísticas da interface:

```
RP/0/RP0/CPU0:fretta_1# show int gigabitEthernet 0/0/0/16
Thu Apr 20 21:22:12.822 UTC
GigabitEthernet0/0/0/16 is up, line protocol is up
 Interface state transitions: 1
 Hardware is GigabitEthernet, address is 008a.964b.7040 (bia 008a.964b.7040)
 Internet address is 1.1.16.1/24
 MTU 1514 bytes, BW 1000000 Kbit (Max: 1000000 Kbit)
    reliability 255/255, txload 0/255, rxload 0/255
 Encapsulation ARPA,
 Full-duplex, 1000Mb/s, link type is force-up
 output flow control is off, input flow control is off
 Carrier delay (up) is 10 msec
 loopback not set,
 Last link flapped 01:01:11
 ARP type ARPA, ARP timeout 04:00:00
 Last input 00:58:03, output 00:58:03
 Last clearing of "show interface" counters never
 5 minute input rate 0 bits/sec, 0 packets/sec
 5 minute output rate 0 bits/sec, 0 packets/sec
    10004 packets input, 1140270 bytes, 0 total input drops
    3 drops for unrecognized upper-level protocol
    Received 1 broadcast packets, 3 multicast packets
             0 runts, 0 giants, 0 throttles, 0 parity
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    10004 packets output, 1140270 bytes, 0 total output drops
    Output 1 broadcast packets, 3 multicast packets
    0 output errors, 0 underruns, 0 applique, 0 resets
    0 output buffer failures, 0 output buffers swapped out
    0 carrier transitions


RP/0/RP0/CPU0:fretta_1#
```

Ping local

<TBD>