# Troubleshooting Cisco Catalyst 9000 Series Switches

Michel Peters – Technical Leader Engineering
BRKTRS-3090

# Agenda

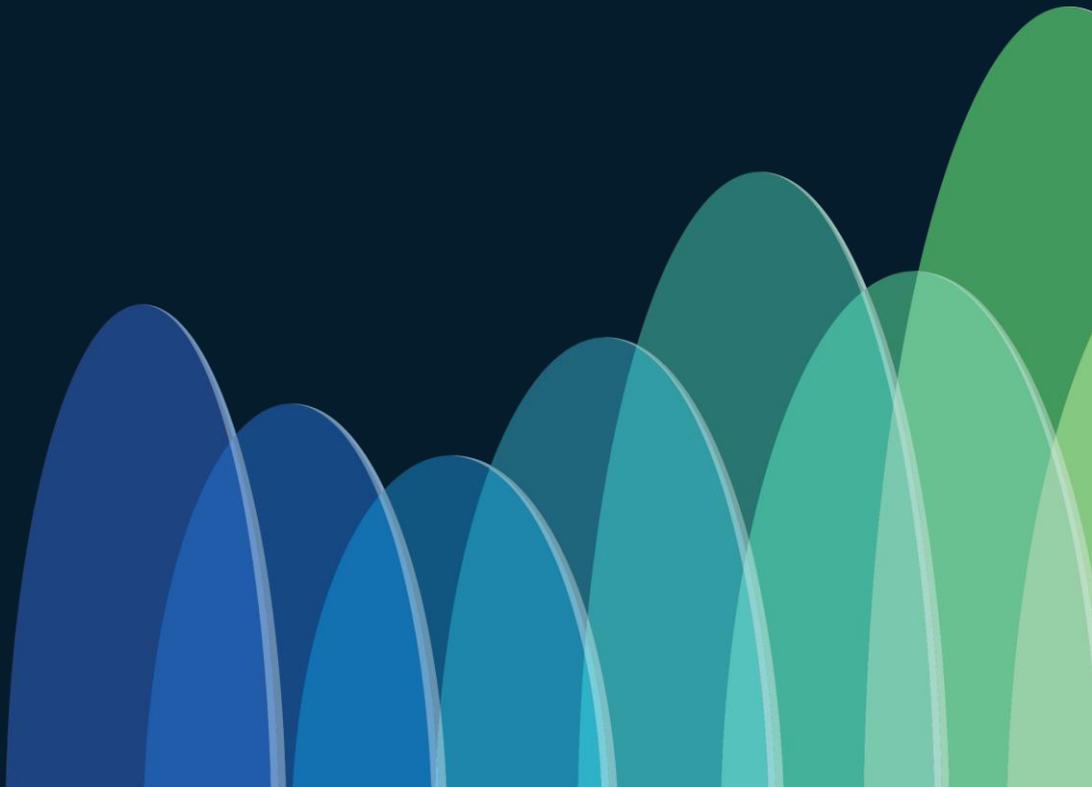- Introduction

- Memory and CPU

- Packet Drops

- Forwarding Verification

# Introduction

# Catalyst 9k family

Cisco Catalyst 9200 Series

Cisco Catalyst 9300 Series

Cisco Catalyst 9400 Series

Cisco Catalyst 9500 Series

Cisco Catalyst 9600 Series

|  | 9200/9200L | 9300/9300X | 9400/9400X | 9500/9500X | 9600/9600X |
|---|---|---|---|---|---|
| Format | Stackable | Stackale | Chassis | Standalone | Chassis |

9500X and 9600 Sup II based on Silicon One
All others based on UADP Asics

Different models designed for
different uses and performance

# Catalyst IOS-XE Software release schedule

| | Cupertino 17.9 | Dublin 17.12 | 17.14 | 17.15 | 17.16 |
|---|---|---|---|---|---|
| Next planned release | 17.9.7 | 17.12.5 | None | 17.15.3 | None |
| End of Software Maintenance | March 2025 | March 2026 | May 2025 | - | - |
| End of Vulnerability Security Support | Sept 2026 | Sept 2027 | May 2025 | - | - |
| Extended Maintenance Release | Yes | Yes | No | Yes | No |

Recommended releases:
https://www.cisco.com/c/en/us/support/docs/switches/catalyst-9300-series-switches/214814-recommended-releases-for-catalyst-9200-9.html

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# Software Maintenance Upgrade(SMU)

- SMU's provide patches on top of IOS-XE

- - Hitless , No reload needed to apply on top of IOS-XE
  - Reboot, Reload is performed to apply SMU

- Apply with the command:

  install add file <smu> activate commit

- Confirm with command :

  show install summary

- Remove with :
  install deactivate file <file>

- Do not just remove .bin from flash

| File Information | Release Date | Size |
|---|---|---|
| Hitless/Recommended SMU, LISP Address-Resolution entry randomly disappears on 17.9.5<br>cat9k_iosxe.17.09.05.CSCwm47533.SPA.smu.bin<br>Advisories 🗗 | 16-Oct-2024 | 0.03 MB |
| Hitless/Recommended SMU, Catalyst 9K Switches: Unexpected reload in FED due to SIGFPE Arithmetic exception<br>cat9k_iosxe.17.09.05.CSCwj55093.SPA.smu.bin<br>Advisories 🗗 | 26-Sep-2024 | 0.03 MB |
| Hitless/Recommended SMU, Hitless - September 2024 SMU PSIRT Bundle<br>cat9k_iosxe.17.09.05.CSCwm01146.SPA.smu.bin<br>Advisories 🗗 | 25-Sep-2024 | 0.16 MB |

# Install Summary

```
9400_21#sh install summary
[ R0 R1 ] Installed Package(s) Information:
State (St): I - Inactive, U - Activated & Uncommitted,
            C - Activated & Committed, D - Deactivated & Uncommitted
--------------------------------------------------------------------
Type  St    Filename/Version
--------------------------------------------------------------------
IMG   C     17.12.04.0.4826
PKG   C     bootflash:C9800-SW-iosxe-wlc.17.09.05.SPA.bin
SMU   C     bootflash:cat9k_iosxe.17.12.04.CSCwk22887.SPA.smu.bin
SMU   D     bootflash:cat9k_iosxe.2025-01-29_05.38.0.CSCwn37241.SSA.smu.bin
```
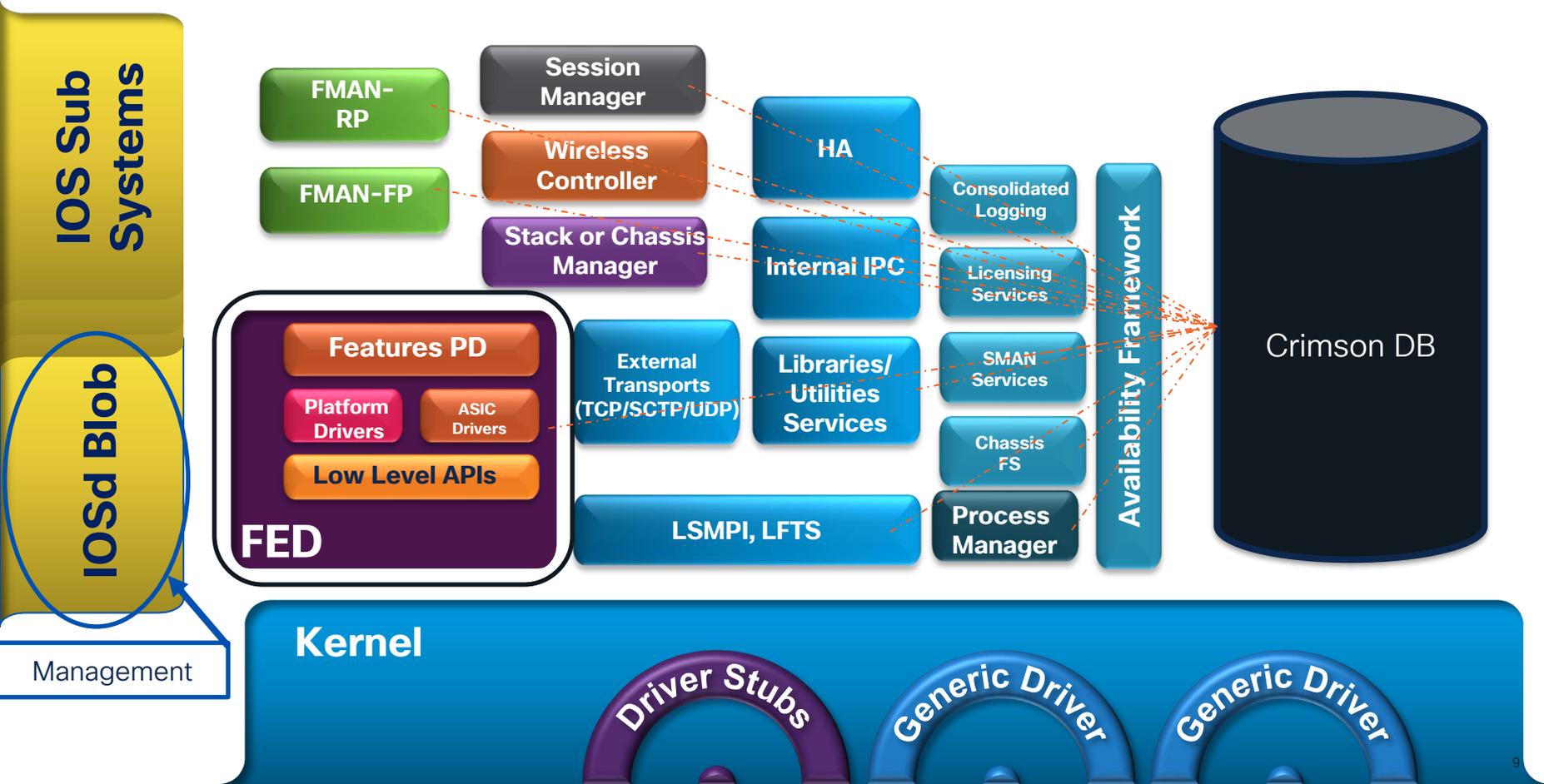
- SMU's should be Activated and Committed

- Show install summary also shows packages (ewlc) and base image (IMG)

# IOS-XE graphical overview

# Show and Debug Commands

- Many of the features run primarily on IOSd

- Those features provide the regular debugs and show commands

```
Switch#show ip route
Switch#show cdp neig
Switch#debug ip packet 101
```

- Note: Debugs/show commands shows IOSd's view of the system
  ex, debug ip packet shows ip packets IOSd has visibility on.

- Processes out of IOSd do communicate with IOSd,
  ex, show access-session gets access-session information from
  Session Manager Progress

# IOS-XE Specific Show Commands

- Many processes outside IOSd are non-platform specific
  Ex: Forwarding manager (fman) , WebUI (nginx), Wireless (wncd)

- Debug/show commands similar on all IOS-XE Devices

```
Switch#show platform software ip switch active R0 cef
ASR_1k#show platform software ip rp active cef
CSRv#show platform resources
```

- Specify location for command execution:
  - Active, Standby or switch number
  - RP/R0, Route Processor,
  - FP/F0 , Forwarding Processor

# Catalyst 9k Platform Specific Show Commands

- Forwarding Engine Driver(FED) is the Catalyst 9000 platform specific layer

- FED layer commands under software fed or software fed:
  show/set/debug platform hardware|software fed

```
9300#show platform software fed switch active ifm mappings
9300#show platform software fed switch 5 ifm mappings
9400#show platform software fed active ifm mappings
```

- Each Supervisor module and each switch in a stack runs its own Instance of FED.

# Debugging outside IOSd process

- To facilitate debugging/logging trace logs are available for all processes using always on tracing

- Tracing levels set with granularity (default notice). Always on tracing

- Common processes:  - smd, session manager
  - fed, forwarding engine driver
  - wncd, wireless process

```
Switch#set platform software trace smd switch active R0 dot1x-all verbose
Switch#show platform software trace level smd switch active R0 | inc dot1x
dot1x                          Notice
dot1x-all                      Verbose
dot1x-redun                    Notice
Switch#set platform software trace all notice ← set all back to default
```

# Displaying trace logs

- Tracelog files are stored in crashinfo:/logs in binary format.

- Analyzing traces:  show logging process <process>

- Bundle creation of binary traces:  "request platform software trace archive"

- Appending command with internal could provide more detail

```
Edge_1#sh logging process smd | inc RADIUS
2022/06/06 23:24:03.268912 {smd_R0-0}{1}: [radius] [24732]: (info): RADIUS: Send Accounting-Request to
10.48.91.222:1813 id 1813/184, len 850
2022/06/06 23:24:03.268937 {smd_R0-0}{1}: [radius] [24732]: (info): RADIUS:  authenticator e5 d1 b7 4d 8b e9 d5
06 - 14 b9 8d b6 8c 29 93 94
2022/06/06 23:24:03.268945 {smd_R0-0}{1}: [radius] [24732]: (info): RADIUS:  Vendor, Cisco        [26]   211
2022/06/06 23:24:03.268954 {smd_R0-0}{1}: [radius] [24732]: (info): RADIUS:   Cisco
AVpair       [1]    205  "cts-pac-opaque="
2022/06/06 23:24:03.268960 {smd_R0-0}{1}: [radius] [24732]: (info): RADIUS:  Vendor, Cisco        [26]    36
2022/06/06 23:24:03.268966 {smd_R0-0}{1}: [radius] [24732]: (info): RADIUS:   Cisco
AVpair       [1]     30  "dc-profile-name=Cisco-Device"
```

Make sure to enable traces in the
right places. Debugs on IOSd might
not be aware of full picture

# Memory and CPU

# Looking at the Kernel CPU information

- Kernel CPU utilization can be seen per switch/supervisor module

```
9300_54#show proc cpu platform sorted location switch active R0
CPU utilization for five seconds: 12%, one minute:  9%, five minutes:  5%
Core 0: CPU utilization for five seconds: 14%, one minute: 10%, five minutes:  5%
Core 7: CPU utilization for five seconds: 14%, one minute: 10%, five minutes:  6%
   Pid      PPid     5Sec     1Min     5Min  Status        Size  Name
--------------------------------------------------------------------------------
 14854    13498      51%      38%      22%  S           951436  linux_iosd-imag
 15322    15160      42%      30%      15%  S           313236  fed main event
  2960        2       8%       5%       2%  R                0  lsmpi-xmit
  2961        2       5%       4%       2%  S                0  lsmpi-rx
```

- linux_iosd-image process as seen on kernel is IOSd process
- Lsmpi  processes are part of Linux Shared Memory Punt Interface
- Not all processes run on all switches.
- Changing the location will display cpu for standby or member switches

# IOSd CPU utilization

```
9300_54#show proc cpu sort
CPU utilization for five seconds: 25%/1%; one minute: 22%; five minutes: 11%
 PID Runtime(ms)      Invoked      uSecs   5Sec    1Min    5Min TTY Process
  40    9474304      54714487       173 22.95% 16.12%   8.15%    0 ARP Input
  24      95502      12431773         7  0.07%  0.00%   0.00%    0 IPC Mcast Pendin
  41     152951      13280277        11  0.07%  0.00%   0.00%    0 ARP Background
  53     102409      12729984         8  0.07%  0.00%   0.00%    0 Dynamic ARP Insp
  83    4759850      48620416        97  0.07%  0.03%   0.02%    0 IOSD ipc task
 121    5602021      50896336       110  0.07%  0.04%   0.05%    0 Crimson config p
 136    5112131     792052381         6  0.07%  0.03%   0.02%    0 L2 LISP Punt Pro
```

- Inside IOSd process many functions and processes run
   Examples: BGP, RIP, CEF, ARP, UDLD, CDP, SSH, SNMP, Telnet
- CPU not involved in data plane forwarding
- Control Plane Policing enabled by default to throttle traffic

# CPU utilization in IOSd

- CPU history gives an overview of CPU history for last minute, hour and day

```
9300_54#show processor cpu history
              444      444      443      444      444      444      444      444      44
      1189111  18711  1188911  18821111883111  784111188711  1987111189
  100
   90
   50    **        **        **        **        **        **        ***       ***
   40    *#*       *#*       *#*       *#*       *#*       *#*       *#*       *#*
   30    ##*       ##*       ##*       ##*       ##*       ##*       ##*       ##*
   20    ##*       ##*       ##*       ##*       ##*       ##*       ##*       ##*
   10    ###       ###       ###       ###       ###       ###       ###       ###
     0....5....1....1....2....2....3....3....4....4....5....5....6
          0    5    0    5    0    5    0    5    0    5    0
              CPU% per minute (last 60 minutes)
            * = maximum CPU%   # = average
```

- Pattern of Interval and length of CPU spikes can point to trigger.
- Average high CPU more cause for concern then short spikes

# Catching CPU spikes in IOSd

- CPU spikes often occur when not actively watching the switch.

- IOS allows CPU monitoring :
  process cpu threshold type total rising <%> interval <s> falling <%> interval <s>

- When threshold are exceeded syslog is generated

- Syslog can be used by Embedded Event Manager to automate collection of data during time of failure

```
%SYS-1-CPURISINGTHRESHOLD: Threshold: Total CPU Utilization(Total/Intr): 48%/15%, Top 3
processes(Pid/Util):  40/32%, 94/0%, 105/0%

9300_54#show proc cpu | inc 40 | 94 | 105 | PID
 PID Runtime(ms)       Invoked        uSecs   5Sec    1Min    5Min TTY Process
  40     19640520      69264320         283 22.48% 20.61% 10.14%    0 ARP Input
  94       652410       6428606         101  0.07%  0.00%  0.00%    0 PuntInject Keepa
 105      3477489       6127722         567  0.00%  0.02%  0.02%    0 Crimson flush tr
```

Top 3 processes,
ARP input is highest

# Determining Cause of Inband traffic

```
9300_54#sh platform software fed switch active punt rates interfaces
Packets per second averaged over 10 seconds, 1 min and 5 mins
==============================================================================
                            |        | Recv | Recv | Recv | Drop | Drop | Drop
 Interface Name             | IF_ID  | 10s  | 1min | 5min | 10s  | 1min | 5min
==============================================================================
 GigabitEthernet1/0/11       0x00000013   5999   1707   2074    0      0      0
 Vlan192                     0x00000036   5999   1707   2074    0      0      0
9300_54#sh platform software fed switch active punt cpuq rates
Packets per second averaged over 10 seconds, 1 min and 5 mins
==============================================================================
 Q  |        Queue          | Rx   | Rx   | Rx   | Drop  | Drop  | Drop
 no |        Name           | 10s  | 1min | 5min | 10s   | 1min  | 5min
==============================================================================
 0   CPU_Q_DOT1X_AUTH               0      0      0       0       0       0
 1   CPU_Q_L2_CONTROL               0      0      0       0       0       0
 5   CPU_Q_FORUS_ADDR_RESOLUTION  6000   1874   2414     0       0       0
```

**Active interfaces sending to cpu**

**Per Queue Statistics**

**Queue information**

**Drops typically seen on Port Asic not in FED punt path**

# Using Embedded Packet Capture

- EPC provides packet capture on interface or control plane level

- Data capture in hardware, traffic copied to EPC process for capturing

- Packet capture rate limited to protect CPU , good for visibility, not for performance captures

```
9300_54#monitor capture CL interface GigabitEthernet 1/0/11 in
9300_54#monitor capture CL match any
9300_54#monitor capture CL start
9300_54#monitor capture CL stop
9300_54#monitor capture CL export location flash:cl.pcap
9300_54#sh monitor capture file flash:cl.pcap display-filter arp
Starting the packet display ........ Press Ctrl + Shift + 6 to exit
  352   57.9 00:00:ca:fe:ca:fe ff:ff:ff:ff:ff:ff ARP 60 Who has 192.168.5.1? Tell 192.168.2.8
  353   57.9 00:00:ca:fe:ca:fe ff:ff:ff:ff:ff:ff ARP 60 Who has 192.168.5.2? Tell 192.168.2.8
  354   57.9 00:00:ca:fe:ca:fe ff:ff:ff:ff:ff:ff ARP 60 Who has 192.168.5.3? Tell 192.168.2.8
  355   57.9 00:00:ca:fe:ca:fe ff:ff:ff:ff:ff:ff ARP 60 Who has 192.168.5.4? Tell 192.168.2.8
  356   57.9 00:00:ca:fe:ca:fe ff:ff:ff:ff:ff:ff ARP 60 Who has 192.168.5.5? Tell 192.168.2.8
```

Where and what to capture

Export capture to file

Displays capture from flash or buffer

# Determine packets hitting a specific CPU queue

- FED allows limited packet captures done in punt and inject path
- Allows filter to be setup to collect specific data.
- Use filter "fed.queue==<queue>" for collecting specific queue
- Detail and brief packet display. Detail contains internal forwarding information

```
9300_54#debug plat soft fed switch active punt packet-capture set-filter "fed.queue == 2"
9300_54#debug platform software fed switch active punt packet-capture [start|stop]
9300_54#show platform software fed switch active punt packet-capture brief
Punt packet capturing: disabled. Buffer wrapping: disabled
Total captured so far: 4096 packets. Capture capacity : 4096 packets
Capture filter : "fed.queue == 5"
------ Punt Packet Number: 3, Timestamp: 2023/05/31 13:14:45.888 ------
 interface : physical: GigabitEthernet1/0/11[if-id: 0x00000013], pal: Vlan192 [if-id: 0x00000036]
 metadata  : cause: 7 [ARP request or response], sub-cause: 1, q-no: 5, linktype: MCP_LINK_TYPE_IP
 ether hdr : dest mac: ffff.ffff.ffff, src mac: 0000.cafe.cafe
 ether hdr : ethertype: 0x0806 (ARP)
```

Metadata indicates why it was punted

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# Control Plane Policing HW stats

- Control plane policing drops frames on port asic's to protect CPU
- Do not modify defaults without clear understanding of the impact

```
9300_1#show plat hardware fed switch active qos queue stats internal cpu policer
                    CPU Queue Statistics
                                        (default) (set)    Queue         Queue
QId PlcIdx  Queue Name              Enabled  Rate      Rate      Drop(Bytes)   Drop(Frames)
------------------------------------------------------------------------------------
4    2      Routing Control         Yes      5400      5400      0             0
5    14     Forus Address resolution Yes     4000      65000     2212622868    345698644
                    CPU Queue Policer Statistics
Policer      Policer Accept    Policer Accept   Policer Drop    Policer Drop
  Index         Bytes             Frames         Bytes           Frames
------------------------------------------------------------------
12           0                 0                0              0
13           9562218           122704           453808601      7079824
                    CPP Classes to queue map
PlcIdx CPP Class                               :  Queues
------------------------------------------------------------------
0      system-cpp-police-data                  :  ICMP GEN/ BROADCAST/ ICMP Redirect/
14     system-cpp-police-forus                 :  Forus Address resolution/ Forus traffic/
```

**Control Plane policing drops**

**Rate changed from Default rate**

# Platform Memory

```
9600_SVL#sh processes memory platform sorted location switch 1 R0
System memory: 15993924K total, 6935004K used, 9058920K free,
Lowest: 9025140K
   Pid      Text        Data    Stack    Dynamic        RSS            Name
-----------------------------------------------------------------------------
   5373   256860     1488024      136        488     1488024     linux_iosd-imag
  31175      203      885528      136     132984      885528     fed main event
  26748     7236      295848      136       3808      295848          fman_rp
  15847     8158      263112      136       4692      263112        fman_fp_image
  27259      450      235088      136       4720      235088              dbm
  28641     2583      228456      164     101856      228456            confd
  30179       87      208392      136       7832      208392             pubd
  25903      336      193308      136        388      193308          ndbmand
   4272      790      177200      136      33732      177200            smand
  18087      178      176024      136      13104      176024          sessmgrd
```

IOSd

FED

Forwarding manager

SMD

- Kernel memory utilization is available per switch
- linux_iosd-image process is IOSd
- Resident Set Size(RSS), memory occupied by each Process

# Per process memory allocation

```
9300_54#show platform software memory smd switch active R0 brief
  module                  allocated     requested     allocs         frees
  ----------------------------------------------------------------------
  Summary                 10651060      10392132      461338         445155
  OBJ_SMTEST_EVENTLOG     6528072       6496040       2002           0
  AAA_CHUNK_ATTR_SUBLIST  1085842       1085762       5              0
  OBJ_DC                  625435        429323        12260          3
  chunk                   343897        342425        97             5
  OBJ_RCLSRV_SEND_BUF_CH  263045        262981        4              0
  smd                     213359        213295        4              0
  AAA_ATTR_LIST_HANDLE_I  133193        133145        3              0
  process                 133172        133124        3              0
  eventutil               120685        119757        2074           2016
  OBJ_EPM_CACHE_HASH_ELE  97688         97128         44             9
  AAA_CHUNK_ATTR_HEADER   78225         78145         5              0
  OBJ_EAP_ALLOC_HDL       65552         65536         1              0
  AAA_MLIST_ID            65552         65536         1              0
```

Detailed memory usage per process , details vary per process

# IOSd Memory

```
9600_SVL#sh processes memory sorted holding
Processor Pool Total: 2959189564 Used:   687714160 Free: 2271475404
reserve P Pool Total:     102404 Used:          88 Free:     102316
 lsmpi_io Pool Total:    6295128 Used:     6294296 Free:        832


 PID TTY  Allocated       Freed       Holding      Getbufs     Retbufs Process
   0   0  488208064    77059624    381785696            0           0 *Init*
 238   0  137113496     1017784    136266568            0           0 IP ARP Adjacency
  82   0   50195904     2966104     27577736            0           0 IOSD ipc task
 565   0  720962728   696333696     24623088            0           0 DHCPD Receive
   4   0   42371936    17822928     22358600            0           0 RF Slave Main Th
```

- IOSd runs as a process , but does still provides some kernel features like  memory management for all processes running inside IOSd
- Processor Pool: Pool for Processes on IOSd
- lsmpi_io :  Linux Shared Memory Punt Interface memory, IO buffers

# IOSd Memory Allocator

```
9600_SVL#sh processes memory 565
Trackey : 1#01327ced3d92c0f78c7959f154fa0114
Process ID: 565
Process Name: DHCPD Receive
Total Memory Held: 24623088 bytes

Processor memory Holding = 24623088 bytes
size =  10549344, count =  321, pc = :5644D0D8C000+934D623
size =  10450752, count =  318, pc = :5644D0D8C000+548EF85
size =   1478880, count =   45, pc = :5644D0D8C000+861423D
size =   1032040, count =  120, pc = :5644D0D8C000+8615EB3
size =    985920, count =   30, pc = :5644D0D8C000+8608243
```

- Allocator PC indicates what line of code allocated the memory
- Not all increased in memory are leaks, memory might get released again or functions might just need more memory
- Monitor over time and multiple boxes to determine possible pattern

# Packet Drops

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# Checking interface status

Err-disabled => check
show interface status errdisable
or show log for cause

Vlan column shows routed(L3) ,
trunk or base vlan

Half Duplex 1Gb/s, possible
duplex mismatch?

```
9500_1#show interfaces status | ex notc
Port            Name             Status        Vlan        Duplex  Speed Type
Twe1/0/7                         connected     routed      a-full  a-1000 10/100/1000BaseTX SFP
Twe1/0/12                        err-disabled  1           full     10G SFP-10GBase-CU1M
Twe1/0/15                        connected     routed      full     10G SFP-10GBase-CU3M
Twe1/0/20                        connected     4094        full     10G SFP-10GBase-CU1M
Twe1/0/21                        connected     routed      a-half  a-1000 10/100/1000BaseTX SFP
Twe1/0/22                        disabled      1           auto     auto 10/100/1000BaseTX SFP
Hu1/0/26                         connected     trunk       full     40G QSFP 40G CU3M
Hu1/0/27                         connected     4094        full     100G QSFP 100G CU2M
```

Show interface status command gives a quick overview of interface status

# Ethernet Statistics

```
Switch#show controllers ethernet-controller gi 5/0/48
Transmit                   GigabitEthernet5/0/48 Receive
    1562496684 Total bytes              2968958225 Total bytes
       5032561 Unicast frames              6004241 Unicast frames
     700808558 Unicast bytes            1807110661 Unicast bytes
       1269484 Multicast frames            2789759 Multicast frames
     861688062 Multicast bytes          1161847500 Multicast bytes
             1 Broadcast frames                  1 Broadcast frames
             0 Cos 0 Pause frames                0 Cos 0 Pause frames
       1236978 Minimum size frames          871517 Minimum size frames
       1892419 65 to 127 byte frames       2181611 65 to 127 byte frames
       1941967 128 to 255 byte frames      2712229 128 to 255 byte frames
        685594 256 to 511 byte frames      1260418 256 to 511 byte frames
         20261 512 to 1023 byte frames      900135 512 to 1023 byte frames
        524827 1024 to 1518 byte frames     868091 1024 to 1518 byte frames
             0 8192 to 16383 byte frames         0 8192 to 16383 byte frames
             0 16384 to 32767 byte frame          0 16384 to 32767 byte frame
             0 > 32768 byte frames               0 > 32768 byte frames
             0 Late collision frames             0 SymbolErr frames
             0 Excess Defer frames               0 Collision fragments
             0 Good (1 coll) frames              0 ValidUnderSize frames
             0 Good (>1 coll) frames             0 InvalidOverSize frames
             0 Deferred frames                   0 ValidOverSize frames
LAST UPDATE 361 msecs AGO
```

Ethernet controller statistics give more detailed port statistics

Frame size distribution

Error statistics

# Verifying link utilization

Input/output rates show average over 5 minutes (default). Traffic might be bursty in nature

```
Switch#show interfaces | inc line|rate
Vlan1 is up, line protocol is up , Autostate Enabled
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
GigabitEthernet0/0 is administratively down, line protocol is down
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
GigabitEthernet1/0/11 is up, line protocol is up (connected)
  30 seconds input rate 575000 bits/sec, 958 packets/sec
  30 seconds output rate 126975000 bits/sec, 10473 packets/sec
GigabitEthernet1/0/12 is down, line protocol is down (notconnect)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bit
GigabitEthernet1/0/13 is dow
  5 minute input rate 0 bits
  5 minute output rate 0 bit
```

load-interval has a range of 30-600 seconds

```
Switch#show controllers utilization
Port         Receive Utilization   Transmit Utilization
Gi1/0/1                0                    0
Gi1/0/11               0                    92
.
Gi1/0/24               0                    0
Te1/1/1                0                    0
Te1/1/4                9                    0
Total Ports : 33

Total Ports Receive Bandwidth Percentage Utilization  : 0
Total Ports Transmit Bandwidth Percentage Utilization : 0
Average Switch  Percentage Utilization : 0
```

Bandwidth in % Current load

# Tail Drops

```
9300_54#show interfaces gigabitEthernet 1/0/11 | inc output drops
  Input queue: 0/2000/0/0 (size/max/drops/flushes); Total output drops: 1277
9300_54#show controllers ethernet-controller gig 1/0/11 | inc Excess Def
        1277 Excess Defer frames                  0 Collision fragments
SNMP:
SNMPv2-SMI::enterprises.9.2.2.1.1.27.8 = INTEGER: 1277
```
ith.

- Buffer allocation per class can be changed inside service-policy

- Global multiplier to increase buffers up to 1200%
  qos softmax-queue-multiplier <percentage>
  Only adjust when needed, drops are not always a problem

- Ensure proper classification of traffic and apply correct policies,
  not all traffic is equal, file transfers don't mind buffering, voice does

# QoS Hardware configuration

```
9300_45#sh plat hard fed switch active qos queue config interface gi 1/0/11
Asic:0 Core:1 DATA Port:11 GPN:1 LinkSpeed:0x1
--------------------------------------------------------------
   DTS   Hardmax   Softmax    PortSMin   GlblSMin    PortStEnd
  -----  --------  --------   --------   --------    ---------
0   1  5   200  12  3200    5   500    0     0    6   9600
1   1  4     0  13  4800    5   750    2   300    6   9600
Priority       Shaped/shared       weight    shaping_step    sharpedWeight
--------       -------------       ------    ------------    -------------
0       0         Shared           50            0               0
1       0         Shared           75            0               0
Port           Port                Port      Port
Priority       Shaped/shared       weight    shaping_step
--------       -------------       ------    ------------
        2         Shaped           254           255
   Weight0 Max_Th0 Min_Th0 Weight1 Max_Th1 Min_Th1   Weight2 Max_Th2 Min_Th2
   ------- ------- ------- ------- ------- -------   ------- ------- ------
0       0    2709       0       0    3028       0         0    3400       0
1       0    3825       0       0    4275       0         0    4800       0
```

Hardmax : Reserved
Softmax : Global pool

Queue mode:
 shaped or shared
Queue limit for shaping
 Step/weight * speed

Drop thresholds for
queue/threshold
In Buffers (256 byte)

- QoS configured using service policies on interfaces
- Applied service-policy translated into Hardware settings that match HW capabilities

# QoS hardware statistics

```
9300_45#sh platform hardware fed switch active qos queue stats interface gigabitEthernet 1/0/11
----------------------------------------------------------------------------------------
AQM Global counters
GlobalHardLimit:  7976   |   GlobalHardBufCount: 0
GlobalSoftLimit: 11872   |   GlobalSoftBufCount: 0
----------------------------------------------------------------------------------------
High Watermark Soft Buffers:      429 <--- clear on read
----------------------------------------------------------------------------------------
Asic:0 Core:1 DATA Port:10 Hardware Enqueue Counters
----------------------------------------------------------------------------------------
 Q Buffers          Enqueue-TH0            Enqueue-TH1            Enqueue-TH2          Qpolicer
   (Count)             (Bytes)               (Bytes)               (Bytes)             (Bytes)
-- -------   -------------------   -------------------   -------------------   -------------------
 0     200                     0                385820              46085690                    0
 1       0                     0                     0                     0                    0
Asic:0 Core:1 DATA Port:0 Hardware Drop Counters
----------------------------------------------------------------------------------------------------------
 Q          Drop-TH0             Drop-TH1             Drop-TH2             SBufDrop             QebDrop           QpolicerDrop
            (Bytes)              (Bytes)              (Bytes)             (Bytes)             (Bytes)             (Bytes)
-- ------------------   ------------------   ------------------   ------------------   ------------------   ------------------
 0                  0                    0               412312                    0                    0                    0
 1                  0                    0                    0                    0                    0                    0
```

Highest number of buffers in use by interface since last issuing command

Current buffer count per queue

- At Asic level there are 8 Queues/3 Thresholds
- Enqueue/Drop Counters available per queue/per threshold
- Buffers (count) show currently assigned buffers to Queue (256 bytes)
- To enable high water mark counter monitoring.
  set platform hardware fed switch active qos port-monitor interface <if>
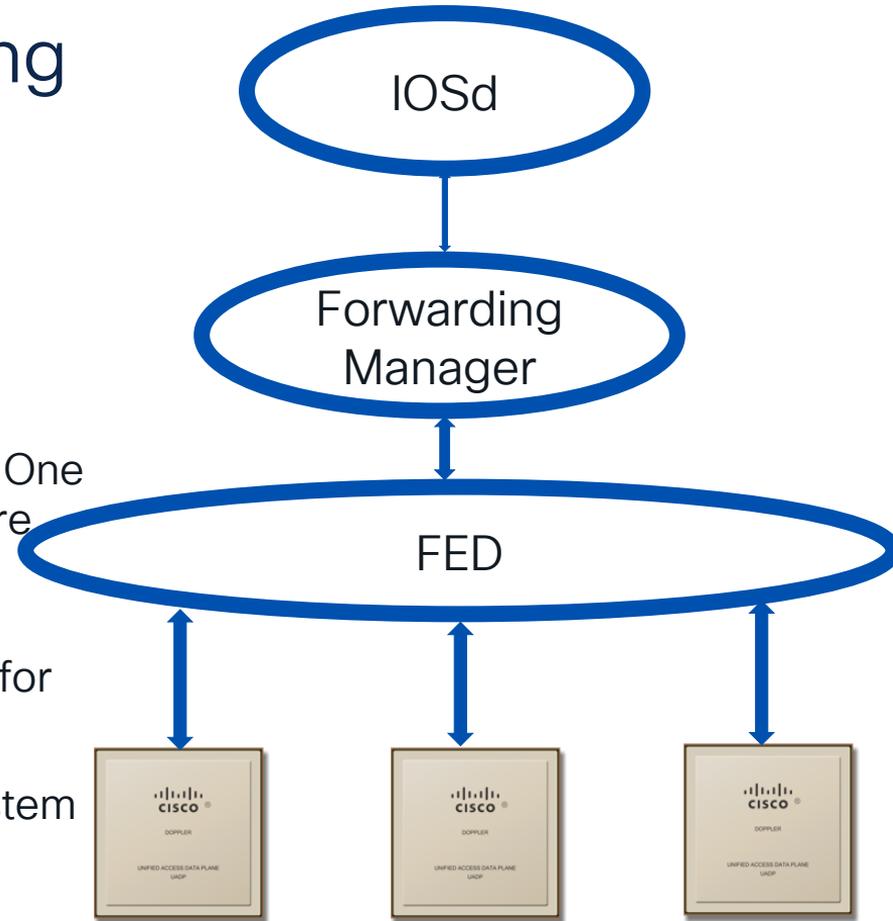
# Doppler ASIC packet forwarding drop counters

```
9300_45#sh platform hardware fed switch active fwd-asic drops exceptions
****EXCEPTION STATS ASIC INSTANCE 0 (asic/core 0/0)****
===========================================================================
 Asic/core |                    NAME                | prev   | current | delta
===========================================================================
0   0    NO_EXCEPTION                               35364016  35364108  92
0   0    IPV4_CHECKSUM_ERROR                        0         0         0
0   0    ROUTED_AND_IP_OPTIONS_EXCEPTION            2         2         0
0   0    CTS_FILTERED_EXCEPTION                     0         0         0
0   0    AUTH_DRIVEN_DROP                           0         0         0
0   0    PKT_DROP_COUNT                             0         3732      3732
0   0    ALLOW_DOT1Q_EXCEPTION_COUNT                0         0         0
0   0    ALLOW_PRIORITY_TAGGED_EXCEPTION_COUNT      0         0         0
0   0    IGR_EXCEPTION_L5_ERROR                     0         363       363
0   0    IP_UNICAST_TTL_REACHED_ZERO                0         0         0
0   0    MISC_FATAL_ERROR                           0         0         0
```

- Every packet passing through Port Asic gets parsed by the port-asic's on both receive and transmit side
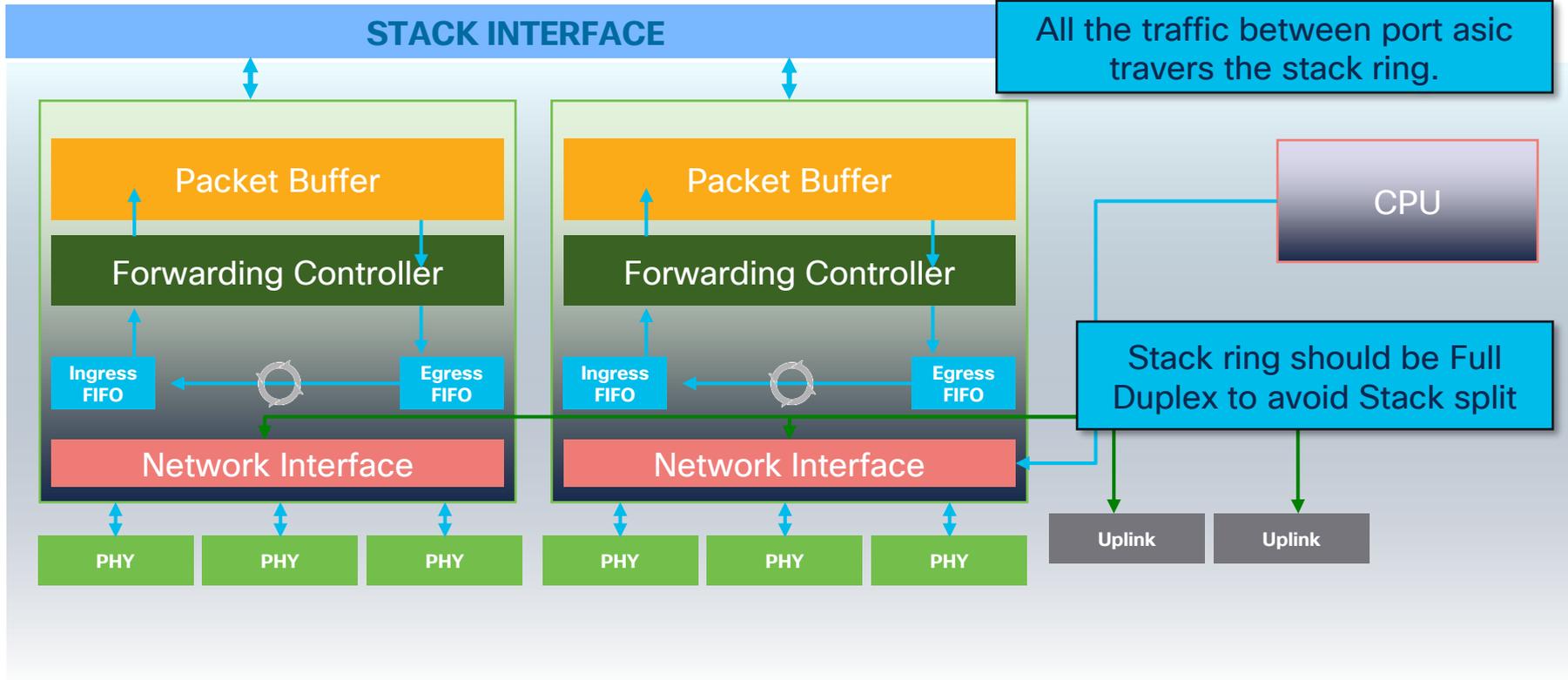- Exception drops are counted per Asic, not per port.

# Forwarding Verification

# Troubleshooting Forwarding

- Many layers are involved in forwarding

- Troubleshoot from top (IOSd) down toward the hardware layer

- 9500X and 9600 (Supervisor 2) use Silicon One All other models based on UADP architecture

- Packet processing happens on port asics.

- CPU only involved in programming the asic for forwarding.
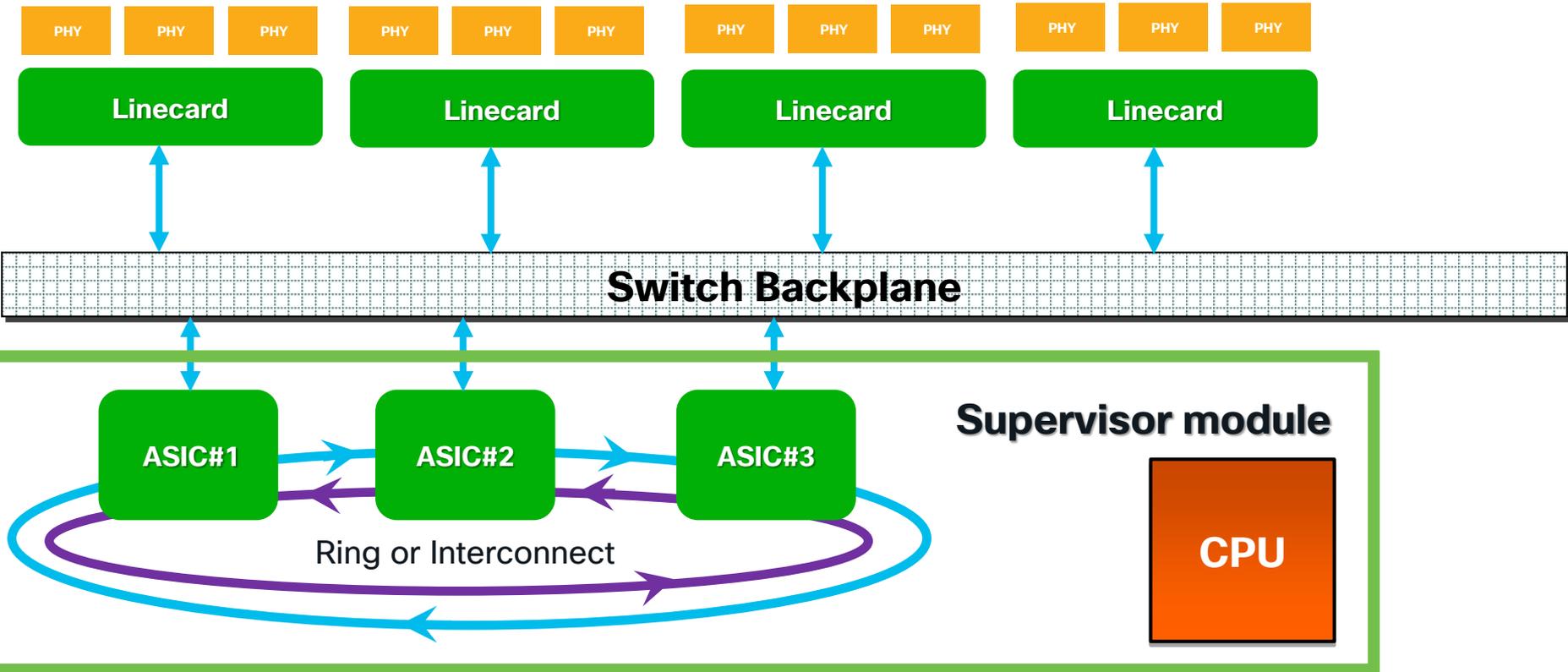
- Understand the packet flow through the system

IOSd

Forwarding Manager

FED

# Catalyst 9200/9300 Stackable Switches



**STACK INTERFACE**

All the traffic between port asic travers the stack ring.

Packet Buffer

Forwarding Controller

Ingress FIFO

Egress FIFO

Network Interface

Packet Buffer

Forwarding Controller

Ingress FIFO

Egress FIFO

Network Interface

CPU

Stack ring should be Full Duplex to avoid Stack split

Uplink

Uplink

PHY PHY PHY PHY PHY PHY

# Switch Stacks

```
9300_10#sh switch stack-ports summary
Sw#/Port#    Port Status   Neighbor/Port   Cable Length   Link OK    Link Active   Sync OK    #LinkOK   In Loopback
-----------------------------------------------------------------------------------------------------------------------
1/1          OK            4/2             100cm          Yes        Yes           Yes        1         No
1/2          OK            2/1             50cm           Yes        Yes           Yes        1         No
2/1          OK            1/2             50cm           Yes        Yes           Yes        2         No
2/2          OK            3/1             50cm           Yes        Yes           Yes        1         No
3/1          OK            2/2             50cm           Yes        Yes           Yes        1         No
3/2          OK            4/1             50cm           Yes        Yes           Yes        2         No
4/1          OK            3/2             50cm           Yes        Yes           Yes        1         No
4/2          OK            1/1             100cm          Yes        Yes           Yes        2         No
```

- Ensure all stack ports are connected and Link Ok to ensure stack is running with redundancy and full bandwith

- High Number of #linkOK or inability to read cable length might indicate bad cable/stack ports

- Show tech-support stack to gather useful commands

CISCO *Live!*

# Catalyst 9400/9600 Chassis based

# Catalyst 9500 Fixed Switches



**Internal High Speed Switch Stack Ring**

Core 0 ↔ Core 1 — ASIC 3
Core 0 ↔ Core 1 — ASIC 2
Core 0 ↔ Core 1 — ASIC 1
Core 0 ↔ Core 1 — ASIC 0

CPU

SDRAM

USB

Console/ Mgmt

PHY (×12)
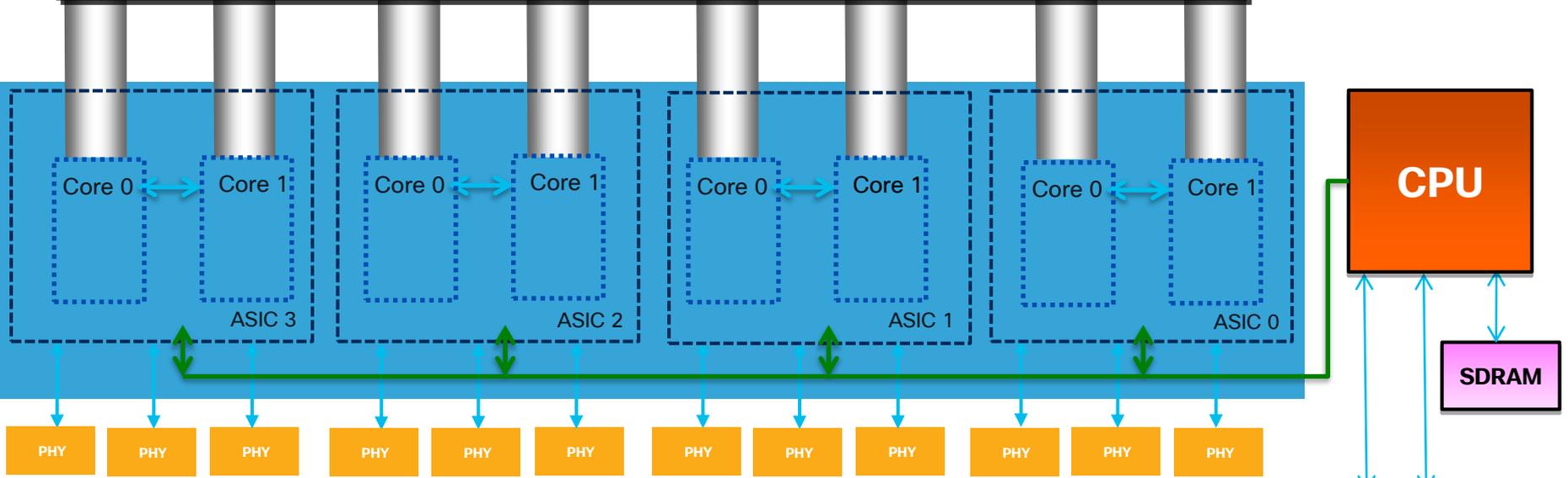
9500 does *not* support stack connectors.
Does support StackWise Virtual

CISCO *Live!*

# Interface Internal Mappings

Interface to ASIC mapping important to understand data flows

```
9300_1#show platform software fed switch active ifm mappings
Interface               IF_ID     Inst Asic Core Port SubPort Mac   Cntx LPN   GPN   Type Active
GigabitEthernet1/0/1    0x8        1    0    1    0    0       26    6    1     1     NIF  Y
GigabitEthernet1/0/2    0x4c       1    0    1    1    0       6     7    2     2     NIF  Y
GigabitEthernet1/0/3    0x4d       1    0    1    2    0       28    8    3     3     NIF  Y
```

Internally used interface addressing:
- LPN      : Local Port Number
- GPN      : Global Port Number
- IF_ID    : Interface Identification, used for many fed CLI
- Type     : Type of interface, NIF = Network Interface
- Inst     : Instance : ASIC + Core
- Port     : Asic Ports
- Active   : Is Interface Active

> Troubleshoot between ports on same ASIC when possible

# IFM Mappings logical interface

```
9600_SVL#show platform software fed switch active ifm interfaces vlan
Interface                           IF_ID           State
------------------------------------------------------------------
Vlan1                               0x0005ffff      READY
Vlan123                             0x00420012      READY
Vlan900                             0x00420010      READY
9600_SVL#show platform software fed switch active ifm interfaces svi
Interface                           IF_ID           State
------------------------------------------------------------------
Vlan123                             0x0000013b      READY
9600_SVL#show platform software fed switch active ifm interfaces tunnel
Interface                           IF_ID           State
------------------------------------------------------------------
Tunnel1                             0x00000143      READY
```

- An unique IF_ID is assigned to every logical and physical.
- Every type of interface has its unique IF_ID.
  Ex:Layer 2 Vlan has a different IF_ID as the Layer 3 SVI

# IF_ID more detail

```
9600_SVL#show platform software fed switch active ifm if-id 0x138
Interface IF_ID          : 0x0000000000000138
Interface Name           : FortyGigabitEthernet2/1/0/1
Interface Block Pointer  : 0x7f33b89fd918
Interface Block State    : READY
Interface State          : Enabled
Interface Status         : ADD, UPD
Interface Type           : ETHER
Port Type                : ROUTE PORT
Port Location            : LOCAL
Slot                     : 15
Unit                     : 0
Slot Unit                : 1
SNMP IF Index            : 148
GPN                      : 577
Port Handle              : 0xb7000104
IPv4 MTU                 : 9100
IPv6 MTU                 : 0
IPv4 VRF ID              : 0x0
IPv6 VRF ID              : 0x0
Protocol flags           : 0x0007 [ ipv4 ipv6 pim_ipv4 ]
```

Specifying the IF-ID gives verbose information

Information available varies depending on Interface Type

One VRF ID per VRF, VRF ID 0 is Global Routing Table

# Layer 2 Forwarding. Verifying HW STP state

- Show spanning tree gives IOSd view of Spanning Tree
- Hardware forwarding states can be checked *per switch* on FED layer
- Outputs will show what interface are in forwarding state and if traffic is tagged or untagged
- Flood list indicates what Ports will receive flooded traffic on this switch

```
9300_54#sh platform hardware fed switch active vlan 192 egress
VLAN STP State in hardware
vlan id is:: 192
Interfaces in forwarding state: : Gi1/0/11(Untagged), Te1/1/1(Untagged), Te1/1/4(Tagged)
9300_54#sh platform hardware fed switch active vlan 192 ingress
VLAN STP State in hardware
vlan id is:: 192
Interfaces in forwarding state: : Gi1/0/11(Untagged), Te1/1/1(Untagged), Te1/1/4(Tagged)
flood list: : Gi1/0/11, Te1/1/1, Te1/1/4
```

# Layer 2 Forwarding, IOSd mac address tables

```
9300_54#show mac address vlan 192
            Mac Address Table
Vlan     Mac Address          Type         Ports
----     -----------          --------     -----
 192     0000.cafe.cafe       DYNAMIC      Gi1/0/11
 192     0013.c3c1.0d89       DYNAMIC      Gi1/0/11
 192     0050.5693.5e70       DYNAMIC      Te1/1/4
 192     a0f8.4910.2dd3       STATIC       Vl192
 192     d0ec.35c9.d353       DYNAMIC      Te2/1/1
Total Mac Addresses for this criterion: 5
```

- Show mac address-table command shows overview of all mac addreses dynamic, static and system mac addresses.
- IOSd shows global view.
  Each FED maintains its own Mac Address Table

# FED MATM Mac Address Table

```
9300_1#sh platform software fed switch 1 matm macTable vlan 100
VLAN    MAC               Type    Seq#   EC_Bi  Flags  machandle   siHandle    diHandle    *a_time  *e_time  ports
--------------------------------------------------------------------------------------------------------------------------------
192     0000.cafe.cafe    0x1     71718    0      0     0x7f2348    0x7f2198    0x7f2478    300      112      GigabitEthernet1/0/11
192     d0ec.35c9.d353    0x101   71719    0      0     0x7f2328    0x7f2148    0x7f2588    300      14       TenGigabitEthernet2/1/1
192     0013.c3c1.0d89    0x1     71720    0      0     0x7f23d8    0x7f2378    0x7f4278    300      11       GigabitEthernet1/0/11
192     a0f8.4910.2dd3    0x8002    0      0      64    0x7f2308    0x7f21c8    0x5234      0        0        Vlan192
192     0050.5693.5e70    0x1     12772    0      0     0x7f23d8    0x7f2358    0x7f23e8    300      13       TenGigabitEthernet1/1/4

*a_time=aging_time(secs)   *e_time=total_elapsed_time(secs)
Type:
MAT_DYNAMIC_ADDR        0x1    MAT_STATIC_ADDR        0x2    MAT_CPU_ADDR          0x4    MAT_DISCARD_ADDR          0x8
MAT_ALL_VLANS           0x10   MAT_NO_FORWARD         0x20   MAT_IPMULT_ADDR       0x40   MAT_RESYNC                0x80
MAT_DO_NOT_AGE          0x100  MAT_SECURE_ADDR        0x200  MAT_NO_PORT           0x400  MAT_DROP_ADDR             0x800
MAT_DUP_ADDR            0x1000 MAT_NULL_DESTINATION   0x2000 MAT_DOT1X_ADDR        0x4000 MAT_ROUTER_ADDR           0x8000
MAT_WIRELESS_ADDR       0x10000 MAT_SECURE_CFG_ADDR   0x20000 MAT_OPQ_DATA_PRESENT 0x40000 MAT_WIRED_TUNNEL_ADDR    0x80000
MAT_DLR_ADDR            0x100000 MAT_MRP_ADDR         0x200000 MAT_MSRP_ADDR       0x400000 MAT_LISP_LOCAL_ADDR     0x800000
MAT_LISP_REMOTE_ADDR 0x1000000  MAT_VPLS_ADDR        0x2000000
```

- Type Field indicates the type of mac address using bitmap.
- Sequence number of an entry changing would indicate relearning
- Owning FED responsible for aging entries. MAT_DO_NOT_AGE bit set in type for non owning FED instances

# Layer 3 Forwarding. Routing protocols

```
9300_20#sh ip route 10.48.13.0
Routing entry for 10.48.13.0/24
  Known via "isis", distance 115, metric 30, type level-2
  Redistributing via isis
  Last update from 172.18.255.9 on TenGigabitEthernet1/0/47, 00:40:35 ago
  Routing Descriptor Blocks:
  * 172.18.255.9, from 172.31.254.18, 00:40:35 ago, via TenGigabitEthernet1/0/47
      Route metric is 30, traffic share count is 1

9300_20#show ip arp 172.18.255.9
Protocol   Address          Age (min)   Hardware Addr   Type    Interface
Internet   172.18.255.9            41   0072.78f8.aed6  ARPA    TenGigabitEthernet1/0/47
```

- Verify routing table and next hop information with known correct path
- Confirm the route shown is covered by the correct subnet and learned by the expected routing protocol.

# Cisco Express Forwarding

- CEF shows the Forwarding Information Base showing how traffic will be forwarded through the system.
- Sources show where the route is learned from.
  RIB(Routing Information Base)
- Use Detail or Internal keywords to get even more detail

```
9300_20#show ip cef 10.48.13.0 internal
10.48.13.0/24, epoch 4, RIB[I], refcnt 6, per-destination sharing
  sources: RIB
  feature space:
    IPRM: 0x00028000
    Broker: linked, distributed at 4th priority
  ifnums:
    TenGigabitEthernet1/0/47(144): 172.18.255.9
  path list 70C9760F41F0, 327 locks, per-destination, flags 0x4D [shble, hvsh, rif, hwcn]
    path 70C978450268, share 1/1, type attached nexthop, for IPv4
      nexthop 172.18.255.9 TenGigabitEthernet1/0/47, IP adj out of TenGigabitEthernet1/0/47,
addr 172.18.255.9 70C9761536E8
  output chain:
    IP adj out of TenGigabitEthernet1/0/47, addr 172.18.255.9 70C9761536E8
```

# Cisco Express Forwarding

```
9300_20#show adjacency 172.18.255.9 detail
Protocol Interface                Address
IP       TenGigabitEthernet1/0/47 172.18.255.9(174)
                                  0 packets, 0 bytes
                                  sourced in sev-epoch 9
                                  Encap length 14
                                  007278F8AED6007278F813550800
                                  L2 destination address byte offset 0
                                  L2 destination address byte length 6
                                  Link-type after encap: ip
                                  ARP
9300_20#sh ip arp TenGigabitEthernet 1/0/47
Protocol  Address          Age (min)  Hardware Addr   Type    Interface
Internet  172.18.255.10           -   0072.78f8.1355  ARPA    TenGigabitEthernet1/0/47
Internet  172.18.255.9          221   0072.78f8.aed6  ARPA    TenGigabitEthernet1/0/47
```

- CEF adjacency displays next hop information.
- Layer 2 rewrite information displayed to verify Destination and Source Mac Address of rewritten packet

# Forwarding Manager (FP/RP)

- Forwarding Manager should show the prefix on both Standby/Active RP and on all FP (stack members or supervisor modules)
- aom id shown with FP can be used to display prefix in object manager

```
9300_20#sh platform software ip switch active F0 cef prefix 10.48.13.0/24 detail
Forwarding Table
10.48.13.0/24 -> OBJ_ADJACENCY (0x4a), urpf: 81
Prefix Flags: unknown
aom id: 11562925, HW handle: (nil) (created)

9300_20#sh platform software object-manager switch active f0 object 11562925
Object identifier: 11562925
  Description: PREFIX 10.48.13.0/24 (Table id 0)
  Obj type id: 71
  Obj type: route-pfx
  Status: Done, Epoch: 0, Client data: 0x452c6ae8
```

# Forwarding Manager (FP/RP)

- Forwarding Manager should show the prefix on both Standby/Active RP and on all FP (stack members or supervisor modules)
- aom id shown with FP can be used to display prefix in object manager

```
9300_20#show platform software adjacency switch active f0 index 0x4a
Adjacency id: 0x4a (74)
  Interface: TenGigabitEthernet1/0/47, IF index: 144, Link Type: MCP_LINK_IP
  Encap: 0:72:78:f8:ae:d6:0:72:78:f8:13:55:8:0
  Encap Length: 14, Encap Type: MCP_ET_ARPA, MTU: 9100
  Flags: no-l3-inject
  Nexthop addr: 172.18.255.9
  IP FRR MCP_ADJ_IPFRR_NONE 0
  aom id: 8386846, HW handle: (nil) (created)
```

# Forwarding Manager (FP/RP)

- Looking at downlinks, parents or children of an object reveals related object

```
9300_20#show platform software object-manager switch active f0 object 8386846
Object identifier: 8386846
  Description: adj 0x4a, Flags None
  Obj type id: 40
  Obj type: adj
  Status: Done, Epoch: 0, Client data: 0x4546afd8
9300_20#sh plat soft object-manager switch active f0 object 8386846 downlinks
Object identifier: 987
  Description: PREFIX 0.0.0.0/0 (Table id 0)
  Status: Done
Object identifier: 11562925
  Description: PREFIX 10.48.13.0/24 (Table id 0)
  Status: Done
..
```

# Error Objects

- Error object that do not get cleared could suggest forwarding issues
- Lookup objects to verify relationship to potential issues

```
9600X_50#show platform software object-manager f0 statistics
Forwarding Manager Asynchronous Object Manager Statistics
Object update: Pending-issue: 2, Pending-acknowledgement: 0
Batch begin:   Pending-issue: 0, Pending-acknowledgement: 0
Batch end:     Pending-issue: 0, Pending-acknowledgement: 0
Command:       Pending-acknowledgement: 0
Total-objects: 1897
Stale-objects: 0
Resolve-objects: 0
Childless-delete-objects: 0
Backplane-objects: 0
Error-objects: 9
Number of bundles: 0
Paused-types: 0
```

# Error Objects

- Use keyword error-object, pending-* to see object id's
- Check objects  in error to confirm

```
9600X_50#sh platform software object-manager f0 error-object
Object identifier: 650830
  Description: LB 0x10000417
  Status: Modify/delete-failed
9600X_50#sh platform software object-manager f0 object 650830
Object identifier: 650830
  Description: LB 0x10000417
  Obj type id: 60
  Obj type: loadbalance
  Status: Modify/delete-failed, Epoch: 0, Client data: 0xad0635e8
```

# FED Routing tables

```
9300_20#show plat software fed switch active ip  route 10.48.13.0/24 detail
vrf    dest            htm             flags    SGT    DGID Last-modified           SecsSinceHit
---    ----            ---             -----    ---    ---- -----------------------  ------------
0      10.48.13.0/24   0x78bcb94983a8 0x0      0      0    2025/02/04 20:36:50.190              3
  FIB: prefix_hdl:0x2600007a, mpls_ecr_prefix_hdl:0, sgtOverWrite: 0
  ========== OCE chain =====
  ADJ:objid:74 {link_type:IP ifnum:0x90, adj:0x62000050, si: 0x78bcb9199178  IPv4:    172.18.255.9 }
[Output omitted]
Station Index (SI) [0xc3]
RI = 0x1f
DI = 0x53a8
Replication Bitmap: LD
Destination index   = 0x53a8
pmap                = 0x00000000 0x400000000000
pmap_intf : [TenGigabitEthernet1/0/47]
..
```

- FED layer output dependant on platform used (S1 vs Doppler)
- Replication Bitmap (per Asic/Core) shows if traffic is Local, Remote or to other Core.
- Bits in pmap are set if traffic would go out an interface

# FED Adjacency table

```
9300_20#sh platform software fed switch 1 ip adj 172.18.255.9 detail
IPV4 Adj entries
dest          if_name        dst_mac          si_hdl  ri_hdl  adj_id Last-modified
172.18.255.9  TenGiga1/0/47 0072.78f8.aed6    0x78178 0x78158 0x4a   2024/12/31 16:31:09
Asic          SI-Index                DI-Index
----          --------                -------
0             195                     0x53a8
Destination index   = 0x53a8
pmap                = 0x00000000 0x400000000000
pmap_intf : [TenGigabitEthernet1/0/47]
Rewrite info:
 ASIC#:0 RI:31 Rewrite_type:AL_RRM_REWRITE_L3_UNICAST_IPV4_SHARED(1)
Mapped_rii:L3_UNICAST_IPV4(9)
    MAC Addr: MAC Addr: 00:72:78:f8:ae:d6,
    L3IF LE Index 38
```

- Rewrites occur on destination Asic.
- Check Adj on Egress switch (when in stack)

# FED Tables, Silicon One

```
9600X_50#show plat software fed active ip  route 10.48.13.0/24
IPV4ROUTE_ID:id:0x5dd182def298 nobj:(IPNEXTHOP_ID,0x1000001d) 10.48.13.0/24 tblid:0 DA:0
  NPD: device:0 lspa_rec:0 api_type:route(3)
  SDK: is_host:0 l3_dest:0x7b8bedf76590 l3_dest:la_l3_fec_impl_base(oid=2851) vrf(gid/oid):0/0x267
 ADJ:objid:0x1000001d (IPv4: 172.31.250.218)  nh_type:NHADJ_NORMAL iif_id:0x4bc ether_type:0x8
#child:105
       srcmac:a453.0e46.22c5 dstmac:4ce1.75eb.0e82
     NPD: fec_oid:2851 was_nor_nh:1 cr_def:0 stale:0 l3port_valid:1
     NPD: device:0 nh_gid/oid:10/0xb1a old_gid/oid:0/0x0 parent_oid:2711
     SDK: cla_nhtype:0
9600X_50#show plat software fed active ip adj 172.31.250.218
Number of IPv4 Adjacency entries: 13
Adjacency ID        Adjacency IPAddress     Dest MacAddr       Nexthop Type   Interface
0x1000001d          172.31.250.218          4ce1.75eb.0e82     NORMAL         HundredGigE1/0/16
```

- Silicon One outputs differ from Doppler based platform on FED layer but can provide similar outputs
- Note : Not all FED commands work on both Doppler and S1.

# TCAM route utilization

```
9300_20#sh platform software fed switch active ip route summary
Total number of v4 fib entries = 11348
Total number succeeded in hardware = 8186

 Mask-Len 0 :-  Total-count 1  hw-installed count 1
 Mask-Len 4 :-  Total-count 1  hw-installed count 1
 Mask-Len 8 :-  Total-count 2  hw-installed count 2
 Mask-Len 24 :-  Total-count 10002  hw-installed count 8171
 Mask-Len 30 :-  Total-count 1331  hw-installed count 0
 Mask-Len 32 :-  Total-count 11  hw-installed count 11
```

- Hardware installed count should match Total-Count
- Routes not installed into Hardware mostly due to resource issues
- TCAM's use regions to install routes

# Verifying TCAM Utilization

```
9300_20#show platform hardware fed switch active fwd-asic resource tcam utilization
Codes: EM - Exact_Match, I - Input, O - Output, IO - Input & Output, NA - Not Applicable
CAM Utilization for ASIC  [0]
  Table                 Subtype      Dir    Max      Used    %Used       V4       V6     MPLS     Other
  -------------------------------------------------------------------------------------------------------
  Mac Address Table     EM           I      32768      97     0.30%       0        0        0        97
  Mac Address Table     TCAM         I       1024      21     2.05%       0        0        0        21
  L3 Multicast          EM           I       8192       0     0.00%       0        0        0         0
  L3 Multicast          TCAM         I        512       9     1.76%       3        6        0         0
  L2 Multicast          EM           I       8192       0     0.00%       0        0        0         0
  L2 Multicast          TCAM         I        512      11     2.15%       3        8        0         0
  IP Route Table        EM           I      24576      12     0.05%      11        0        1         0
  IP Route Table        TCAM         I       8192    8190    99.98%    8177       10        2         1
  QOS ACL               TCAM         IO      5120     181     3.54%      52       86        0        43
  Security ACL          TCAM         IO      5120     129     2.52%      26       58        0        45
  Netflow ACL           TCAM         I        256      42    16.41%      20       20        0         2
```

- TCAM Full situation can lead to performance issues
- Choose suitable SDM template to optimize TCAM allocation
- TCAM utilization can vary per ASIC
- Check syslog for error messages

# Verifing Hardware Forwarding

- Catalyst 9000 based switches allow for packets to be send through the system to verify hardware forwarding.

- Show Platform Hardware switch <id> fed forward command allows building packet from CLI of through pcap to verify hardware forwarding

- Using "exact-route" provides a faster response with less detailed outputs.

- Use packet parameters as it arives on the interface to see where and if it will be forwarded through the system

# Verifying Hardware Forwarding

```
9300_20#show platform hardware fed switch 1 forward exact-route interface te 1/0/1 0072.78f8.aed1
0072.78f8.1354 ipv4 10.48.91.151 10.48.13.151 tcp 10001 23  0
Ingress Packet Details:
ether hdr : dest mac: 0072.78f8.1354, src mac: 0072.78f8.aed1
ether hdr : ethertype: 0x0800 (IPv4)
ipv4  hdr : dest ip: 10.48.13.151, src ip: 10.48.91.151
ipv4  hdr : packet len: 40, ttl: 64, protocol: 6 (TCP)
tcp   hdr : dest port: 23, src port: 10001
Ingress Packet Hexdump (first 128 bytes):
007278F813550072  78F8AED608004500  0028000100004006  FD410A305B970A30
0D97271100170000  0000000000005000  2000EB2E00000000  0000000000000000
Egress Interface: TenGigabitEthernet1/0/47
Egress Packet Details:
ether hdr : dest mac: 0072.78f8.aed6, src mac: 0072.78f8.1355
ether hdr : ethertype: 0x0800 (IPv4)
ipv4  hdr : dest ip: 10.48.13.151, src ip: 10.48.91.151
ipv4  hdr : packet len: 40, ttl: 63, protocol: 6 (TCP)
tcp   hdr : dest port: 23, src port: 10001
Egress Packet Hexdump (first 128 bytes):
007278F8AED60072  78F8135508004500  0028000100003F06  FE410A305B970A30
0D97271100170000  0000000000005000  2000EB2E00000000  0000000000000000
```

Ingress packet

Egress packet

# Verifing Hardware Forwarding

```
9300_20#show platform hardware fed switch 1 forward  interface te 1/0/47 0072.78f8.aed1
0072.78f8.1354 ipv4 10.48.91.151 10.48.13.151 tcp 10001 23  0
Show forward is running in the background. After completion, syslog will be generated.
*Feb 10 14:52:48.864: %SHFWD-6-PACKET_TRACE_DONE: Switch 1 F0/0: fed: Packet Trace
Complete:  Execute (show platform hardware fed switch <> forward last summary|detail)
```

Using packet captures with show platform forward reduces  complexity

```
9300_20#show platform hardware fed switch active forward interface te 1/0/47 pcap
flash:inpacket.pcap number 2 data
```

Results:
- show platform hardware fed switch <id> forward last summary
- show platform hardware fed switch <id> forward last detail
- shfwd.log files in flash:

# Before needing to troubleshoot

- Get familiar with the CLI's

- Download this pdf for reference
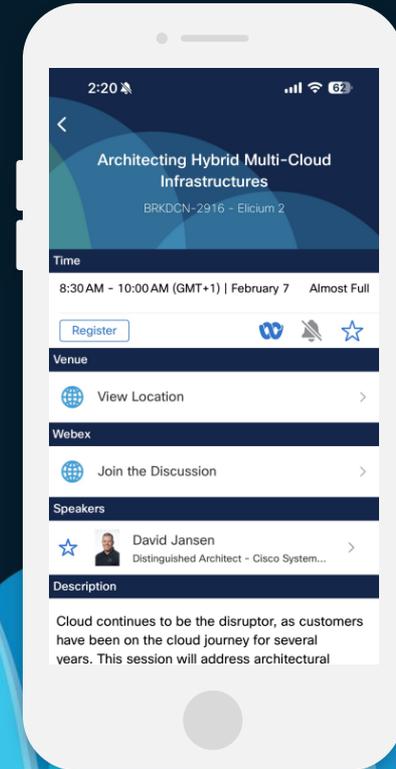
# Webex App

## Questions?
Use the Webex app to chat with the speaker after the session

## How

1. Find this session in the Cisco Events mobile app

2. Click "Join the Discussion"

3. Install the Webex app or go directly to the Webex space

4. Enter messages/questions in the Webex space

Webex spaces will be moderated by the speaker until February 28, 2025.

# Fill Out Your Session Surveys

Participants who fill out a minimum of 4 session surveys and the overall event survey will get a unique Cisco Live t-shirt.

(from 11:30 on Thursday, while supplies last)

All surveys can be taken in the Cisco Events mobile app or by logging in to the Session Catalog and clicking the 'Participant Dashboard'

Content Catalog

# Continue your education

- Visit the Cisco Showcase for related demos

- Book your one-on-one Meet the Engineer meeting

- Attend the interactive education with DevNet, Capture the Flag, and Walk-in Labs

- Visit the On-Demand Library for more sessions at ciscolive.com/on-demand. Sessions from this event will be available from March 3.
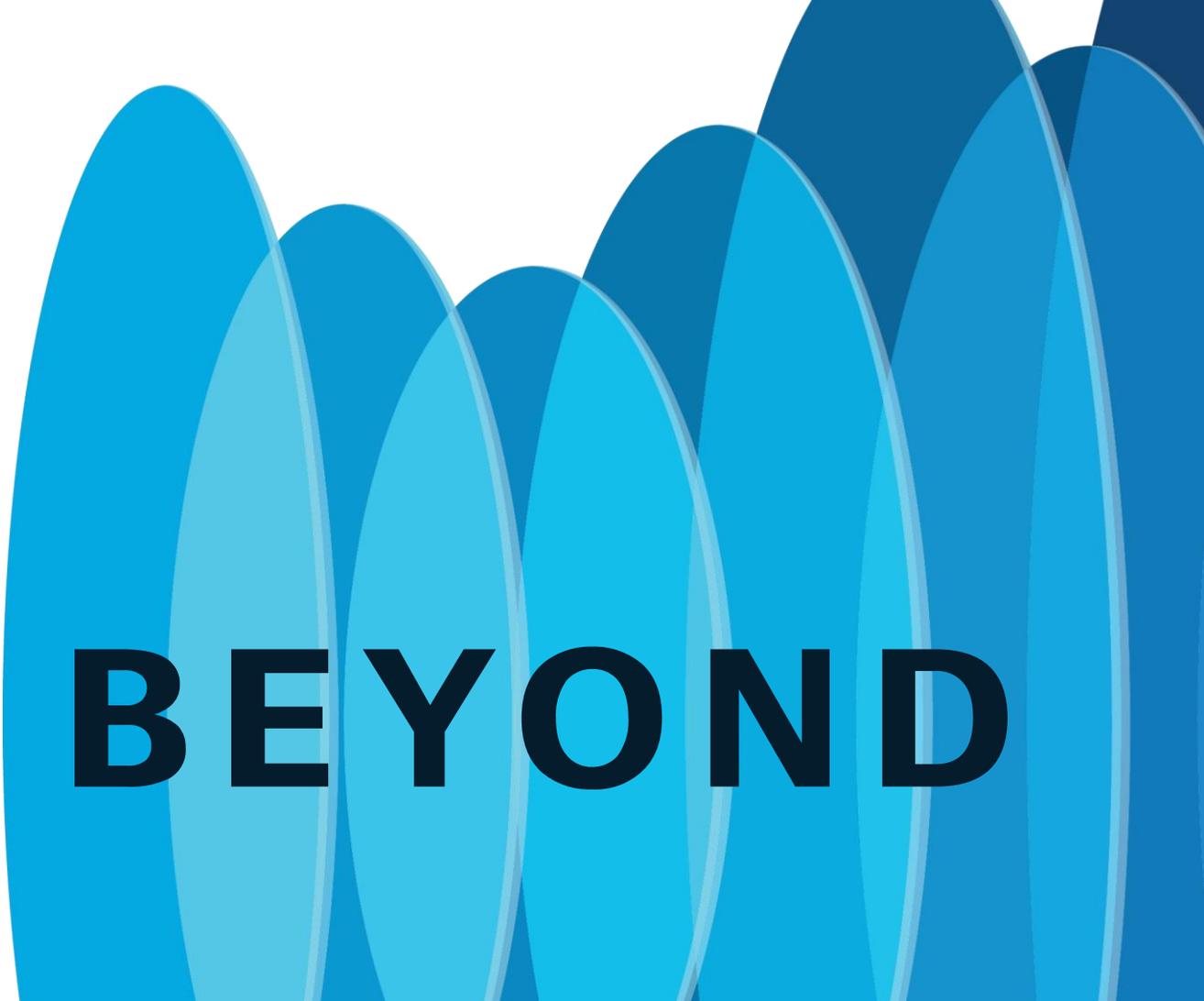
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