Troubleshooting Catalyst 4K and 6K

BRKRST-3067

TOMORROW
starts here.

Agenda
Troubleshooting Catalyst 4500

- Architecture

- Interface Packet Drops

- High CPU

- IOS and IOS-XE Crashes

- IOS-XE Licenses
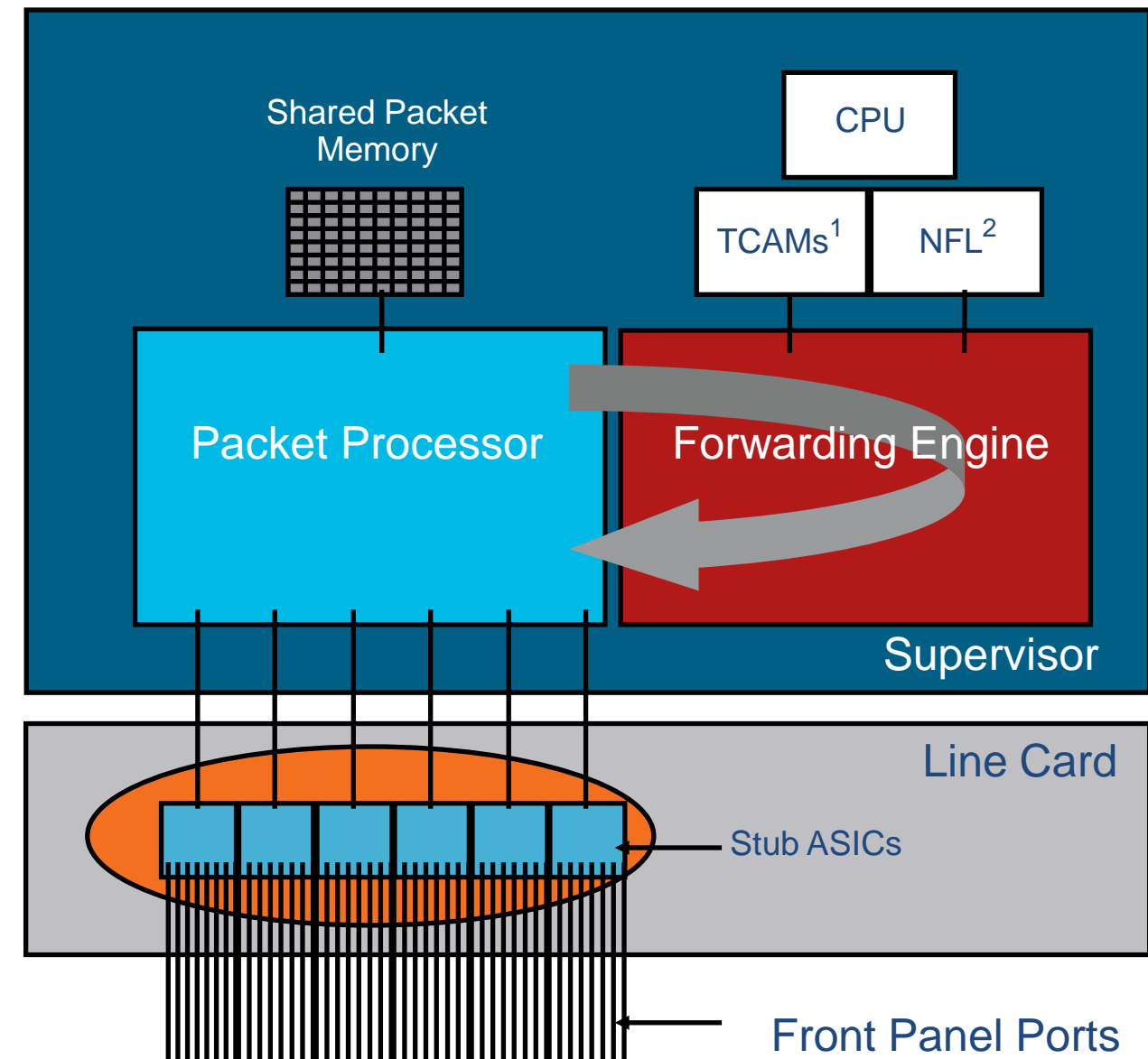
Catalyst 4500-E Series Switches

Catalyst 4500 Series Switches

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Architecture Overview

- ## **Intelligent** Supervisors
  - Supervisor Engine 7-E, 6-E, 6L-E, V-10GE, V, IV,
  - II-Plus-10GE, II-Plus, II-Plus
- ## Switching ASICs
  - Packet Processor
  - Forwarding Engine
- ## Specialised Hardware
  - TCAMs for ACLs, QoS, L3 forwarding
  - NetFlow (NFL) for statistics gathering
- ## Transparent Line Cards
  - Wire-rate, oversubscribed, PoE
  - 10/100, 10/100/1000, GE, 10GE

Shared Packet Memory

CPU

TCAMs[1]   NFL[2]

Packet Processor   Forwarding Engine

Supervisor

Line Card

Stub ASICs

Front Panel Ports

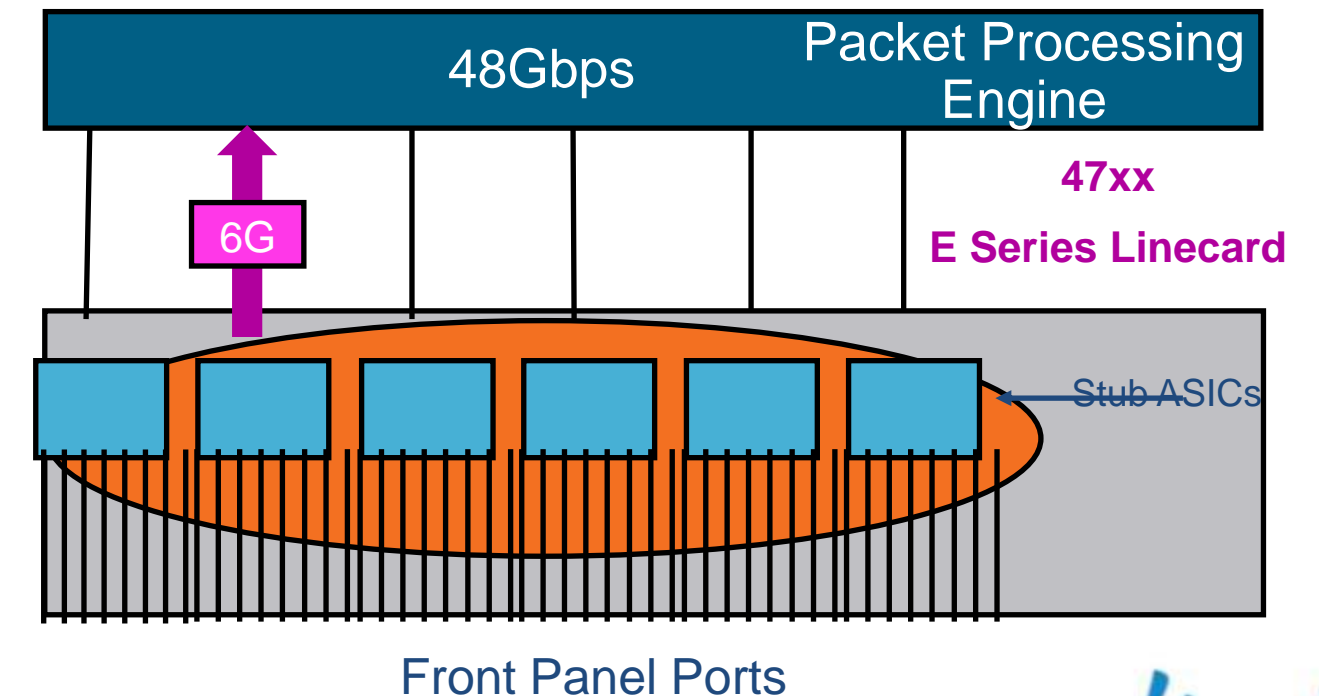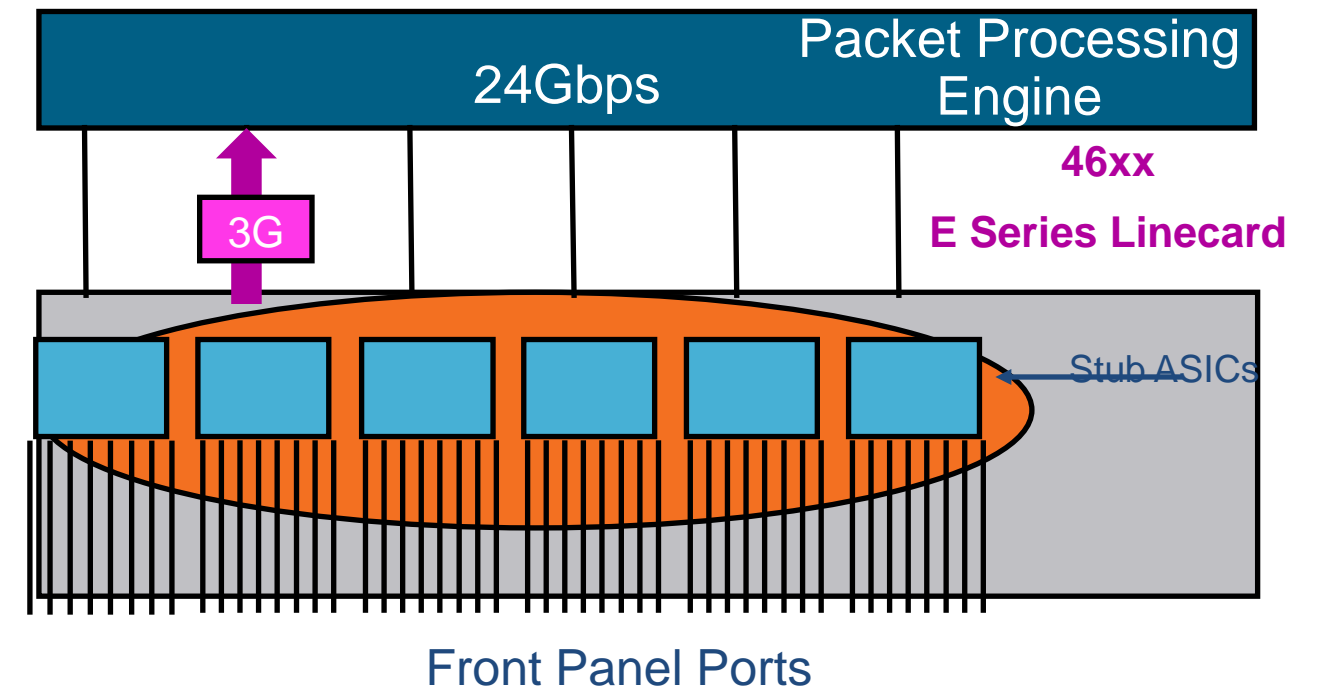**Supervisor and Blocking Line Card Block Diagram**

Next Generation Supervisors

- Supervisor 6L-E

- Supervisor 6-E

- Supervisor 7-E

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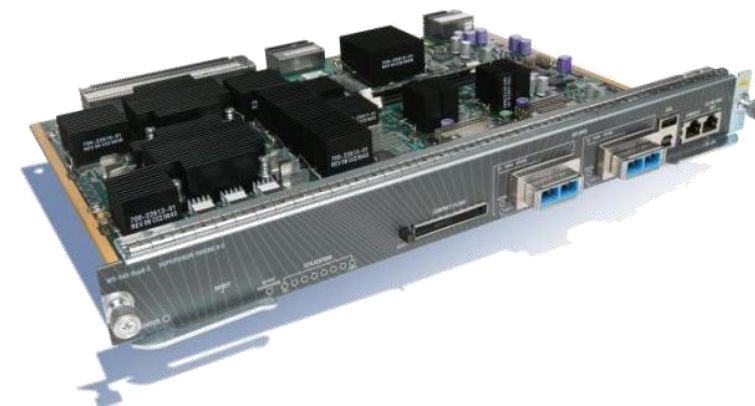
Troubleshooting Interface Drops

- Packet drops in transmit direction

  - TX queue is full

  - Oversubscription

  - Pause frames received

- Packet drops in receive direction

  - Minimal buffer on receiving queue

24Gbps | Packet Processing Engine

46xx

E Series Linecard

3G

Stub ASICs

Front Panel Ports

48Gbps | Packet Processing Engine

47xx

E Series Linecard

6G

Stub ASICs

Front Panel Ports

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Troubleshooting Interface Drops
TX Queue is Full

```
SUP6-E# show interfaces g2/47 counters detail | begin Drops
Port       Tx-Drops-Queue-1  Tx-Drops-Queue-2 Tx-Drops-Queue-3  Tx-Drops-Queue-4
Gi2/47                    0                 0                0                 0
Port   Tx-Drops-Queue-5  Tx-Drops-Queue-6 Tx-Drops-Queue-7  Tx-Drops-Queue-8
Gi2/47                0                 0                0         37748571

SUP6-E# show interfaces g2/47 counters detail | begin Drops
Port       Tx-Drops-Queue-1  Tx-Drops-Queue-2 Tx-Drops-Queue-3  Tx-Drops-Queue-4
Gi2/47
Port   Tx-Drops-Queue-5  Tx-Drops-Queue-6 Tx-Drops-Queue-7  Tx-Drops-Queue-8
Gi2/47                0                 0                0         37874327
```

Default queue 8 when QoS is disabled

- Next steps

  – Consider implementing a QoS policy to share traffic amongst queues

  – Increment default output queue-limit of 40 packets to allow for more buffer space

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Troubleshooting Interface Drops

Peer is Sending Pause Frames

```
SUP6-E# show interfaces g2/47 counters detail | begin RxPause
Port          Rx-No-Pkt-Buff      RxPauseFrames     TxPauseFrames     PauseFramesDrop
Gi2/47                     0                130                 0                   0

SUP6-E#show platform software interface g2/47 all | inc Busy
 Switch Phyport Gi2/7 BusyStatus : ON, PauseStatus : OFF
  BusyBitActivityCount      : 474
  Ignore Subport Busy       : False
```

BusyBit is activated when received pause frames exceed threshold.

```
%C4K_HWPORTMAN-4-BLOCKEDTXQUEUE: Blocked transmit queue HwTxQId7 on Switch Phyport Gi2/47,
   count=116
```

Error log displayed when BusyBit is set

Troubleshooting Interface Drops
Peer is Sending Pause Frames Continued

- Next steps
  - Disable flow control receive on the local interface
  - Disable flow control send on the peer

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Troubleshooting Interface Drops

Minimal buffer on receiving stub ASIC (applicable to linecards with oversubscription ratio)

- Next steps

  – Enable flow control send on the local interface

  – Enable flow control receive on the peer

```
Sup6-E# show interface gi1/13 | include overrun
     0 input errors, 0 CRC, 0 frame, 86432 overrun, 0 ignored
Sup6-E# show interface gi1/13 | include overrun
     0 input errors, 0 CRC, 0 frame, 206658 overrun, 0 ignored
```

```
Sup6-E# show interface gi1/13 counter all | begin Rx-No
Port           Rx-No-Pkt-Buff     RxPauseFrames     TxPauseFrames     PauseFramesDrop
Gi1/13              206658                    0                 0                   0
```
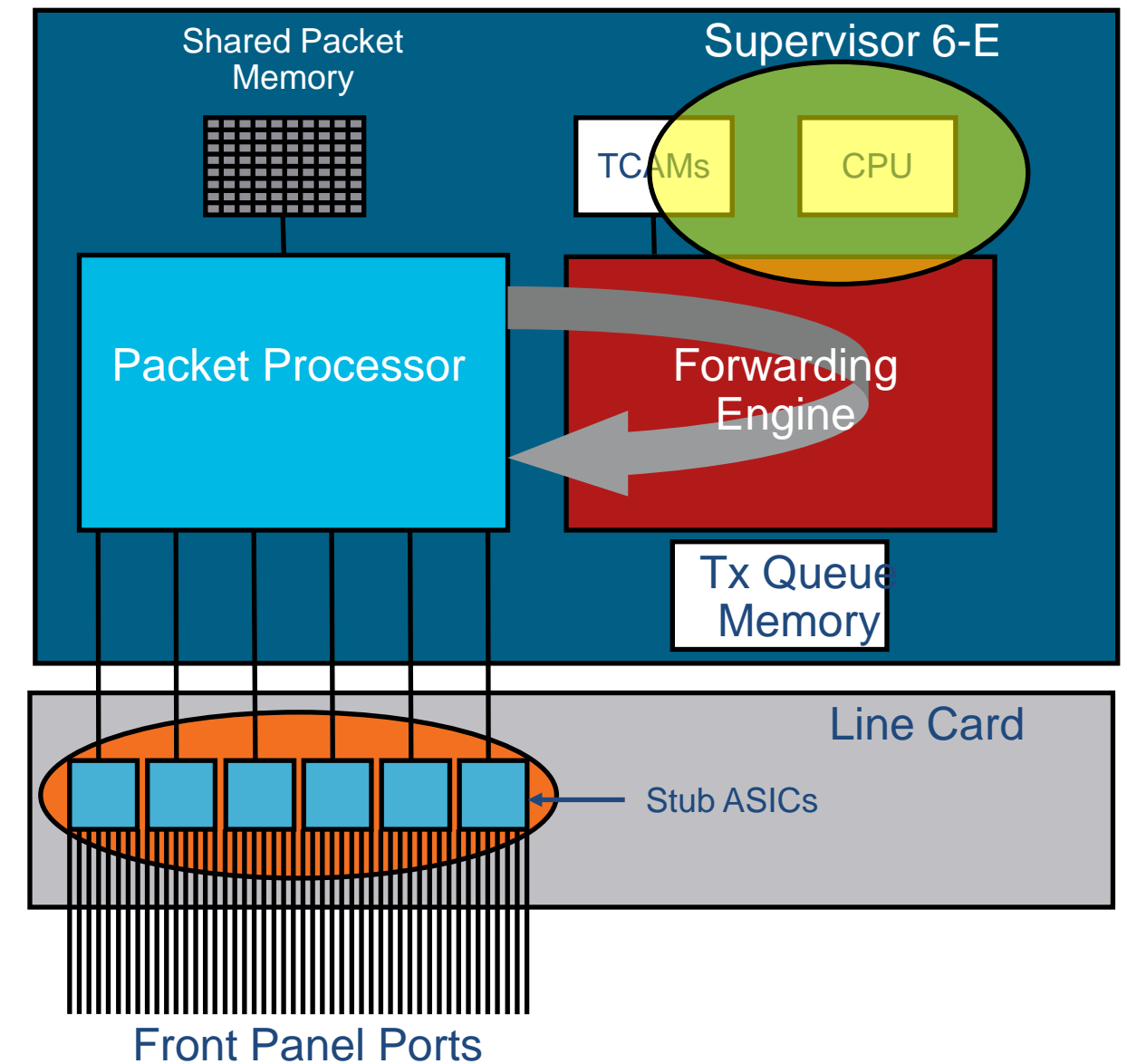
```
Sup6-E# show platform software interface g1/13 stub stat | in Overrun
OverrunPackets                    : 206658    (look for Rx Stats)
```

Troubleshooting High CPU

Functions of the 4500 CPU

- **Sends and receives control plane traffic**
  - STP, CDP, PAgP, VTP, DTP, routing protocols

- **Program dynamic entries into hardware**
  - ACLs, CEF entries

- **Manage access to the switch**
  - Telnet, SSH

- **Manage system components**
  - Fan tray, power supply, PoE

Shared Packet Memory

Supervisor 6-E

TCAMs   CPU

Packet Processor

Forwarding Engine

Tx Queue Memory

Line Card

Stub ASICs

Front Panel Ports

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Troubleshooting High CPU
Software-forwarded Data Traffic

- Packets copied to CPU but originally switched in hardware
  - Host mac address learning
- Packets punted to CPU for processing
  - Routing updates, BPDUS, flood of traffic
- Packets sent to the CPU for forwarding
  - AppleTalk, IPX

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Troubleshooting High CPU
Usage on IOS Threads

Dual core

Process breakdown

```
SUP7-E# show processes cpu sorted detail
Core 0: CPU utilization for five seconds: 4%; one minute: 2%; five minutes: 2%
Core 1: CPU utilization for five seconds: 6%; one minute: 3%; five minutes: 2%
PID     T C  TID      Runtime(ms) Invoked uSecs   5Sec        1Min       5Min      TTY    Process
                                                   (%)         (%)        (%)
9433    L             2946931     1131416 0       6.70605 A 4.39062  4.12207  0      iosd
9433    L 1  11383    984896      4669930 0       7.11    A 3.22     3.00     0      iosd
9433    L 1  9433     1961205     6644042 0       6.22    A 5.44     5.11     0      iosd
9433    L 1  11386    829         18630   0       0.00    A 0.00     0.00     0      iosd
71      I             55575       8787502 0       1.11    R 1.00     1.00     0      Cat4k Mgmt HiPri
52      I             4221576     2152734 0       0.33    R 0.33     0.33     0      IDB Work
72      I             1033445     1988579 0       0.33    R 0.33     0.33     0      Cat4k Mgmt LoPri
89      I             4           132     0       0.00    R 0.00     0.00     0      Exec
```

```
SUP6-E#sh proc cpu sorted
CPU utilization for five seconds: 6%/0%; one minute: 6%; five minutes: 6%
 PID Runtime(ms)      Invoked      uSecs    5Sec    1Min    5Min TTY Process
  51    12294972      8770348       1401   3.75%   3.78%   3.79%   0 Cat4k Mgmt LoPri
  50     2556152     16464011        155   2.47%   2.49%   2.47%   0 Cat4k Mgmt HiPri
  92           0        38032          0   0.07%   0.00%   0.00%   0 Ethchnl
 111          20          142        140   0.07%   0.00%   0.00%   0 Exec
  38        2044       380316          5   0.07%   0.06%   0.07%   0 IDB Work
  99       44600       106342        419   0.07%   0.04%   0.05%   0 CDP Protocol
```

Troubleshooting High CPU
Usage on platform dependent threads

- These processes use CPU under the Cat4K Mgmt HiPri and Cat4K Mgmt LoPri

- HiPri: within CPU target   LoPri: exceeds CPU target

```
SUP6-E#show platform health
                        %CPU    %CPU    RunTimeMax     Priority   Average %CPU     Total
                        Target  Actual  Target Actual   Fg    Bg  5Sec Min Hour    CPU
RkiosObflMan             0.50   0.00       4      0    100   500   0    0    0    0:15
GalChassisVp-review      3.00   0.09      10     33    100   500   0    0    0    5:34
S2w-JobEventSchedule    10.00   0.00      10      0    100   500   0    0    0    0:00
Stub-JobEventSchedul    10.00   0.50      10      5    100   500   0    0    0    13:58
Lj-poll                  1.00   0.01       2      0    100   500   0    0    0    1:18
StatValueMan Update      1.00   0.01       1      0    100   500   0    0    0    2:18
Pim-review               0.10   0.00       1      0    100   500   0    0    0    0:18
Ebm-host-review          1.00   0.00       8      0    100   500   0    0    0    0:05
Ebm-host-util-review     1.00   0.00      10      0    100   500   0    0    0    0:00
Ebm-port-review          0.10   0.00       1      0    100   500   0    0    0    0:01
Protocol-aging-revie     0.20   0.00       2      0    100   500   0    0    0    0:00
EbmHostRedundancyMan     2.00   0.00      20      0    100   500   0    0    0    0:00
Acl-Flattener            1.00   0.00      10      0    100   500   0    0    0    0:00
IrmFibThrottler Thro     2.00   0.00       7      0    100   500   0    0    0    0:26
```

Troubleshooting High CPU
Traffic in the CPU Queue

- Events that trigger packets to be sent to the CPU queue

```
SUP7-E# show platform cpu packet statistics
Packets Dropped In Processing Overall

Total                   5 sec avg 1 min avg 5 min avg 1 hour avg
-------------------- --------- --------- --------- ----------
          36802848          0         0         0          0

Packets Dropped In Processing by CPU event

Event            Total                5 sec avg 1 min avg 5 min avg 1 hour avg
---------------- -------------------- --------- --------- --------- ----------
Sa Miss                      36778332         0         0         0          0
Input Acl Fwd                      19         0         0         0          0
Input ACl Copy                  24497         0         0         0          0
```

Mac flap?

- Next steps

  – Identify the event that is dropping packets so that we know what type of packet to look for in further CPU debugging

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Troubleshooting High CPU - Tools
In-Built CPU Sniffer

- Packets that are punted to CPU are sent to a circular buffer
- Buffer retains 1024 packets at a time and does not occupy CPU cycles

```
SUP6-E# debug platform packet all buffer
platform packet debugging is on
SUP6-E# show platform cpu packet buffered
Total Received Packets Buffered: 1024
----------------------------------------
Index 0:
3 days 23:23:18:54927 - RxVlan: 1006, RxPort: Gi1/1
Priority: Normal, Tag: No Tag, Event: 11, Flags: 0x40, Size: 64
Eth: Src 00:00:0B:00:00:00 Dst 00:22:90:E0:D6:FF Type/Len 0x0800
Ip: ver:IpVersion4 len:24 tos:0 totLen:46 id:0 fragOffset:0 ttl:64 proto:tcp
    src: 10.10.10.100 dst: 172.16.100.100 hasIpOptions firstFragment lastFragment
Remaining data:
 0: 0x0  0x64 0x0  0x64 0x0  0x0  0x0  0x0  0x0  0x0
10: 0x0  0x0  0x50 0x0  0x0  0x0  0x8A 0x37 0x0  0x0
20: 0x0  0x1  0xB5 0x77 0x6A 0x7E
```

Ingress interface of packet

Source/destination address

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Troubleshooting High CPU - Tools
SPAN Capture for CPU

- ▪ **Monitor CPU bound traffic both in send and receive direction**

```
SUP6-E# show running-config | include monitor

monitor session 1 source cpu rx
monitor session 1 destination interface Gi1/48

SUP6-E# show monitor session 1
Session 1
---------
Type                     : Local Session
Source Ports             :
    RX Only              : CPU
Destination Ports        : Gi1/48
    Encapsulation        : Native
           Ingress       : Disabled
          Learning       : Disabled
```

Connect laptop with Wireshark

- ▪ **Next steps**

– Is there a pattern and is this legitimate traffic?

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IOS Process Crash

- ▪ Reasons for a crash
  - – Bus error, forced by software, address errors, watchdog timeouts
- ▪ All crashes generate a crashinfo
  - – Present in crashinfo or platform crashdump

```
----------------- show platform crashdump -----------------
Last powerfail: 03/09/2006 02:10:24
Current time: 02/19/2007 16:09:59
Last reload status: 00008800 038D0000
Last crash: 02/19/2007 15:44:40
Build: 12.2(31)SG ENTSERVICES
buildversion addr: 12288034
pc=112088A4 lr=11208824 msr=20029030 vector=00000300
cr=20000042 ctr=11207418 xer=00000000
r0=8000FBCE r1=13FFE680 r2=0000C000 r3=13FFE6C8 r4=13FFE620 r5=00000002 r6=00000000 r7=000000FF
    r8=FFFFFFFF r9=00000000 r10=00000002 r11=00000008
```
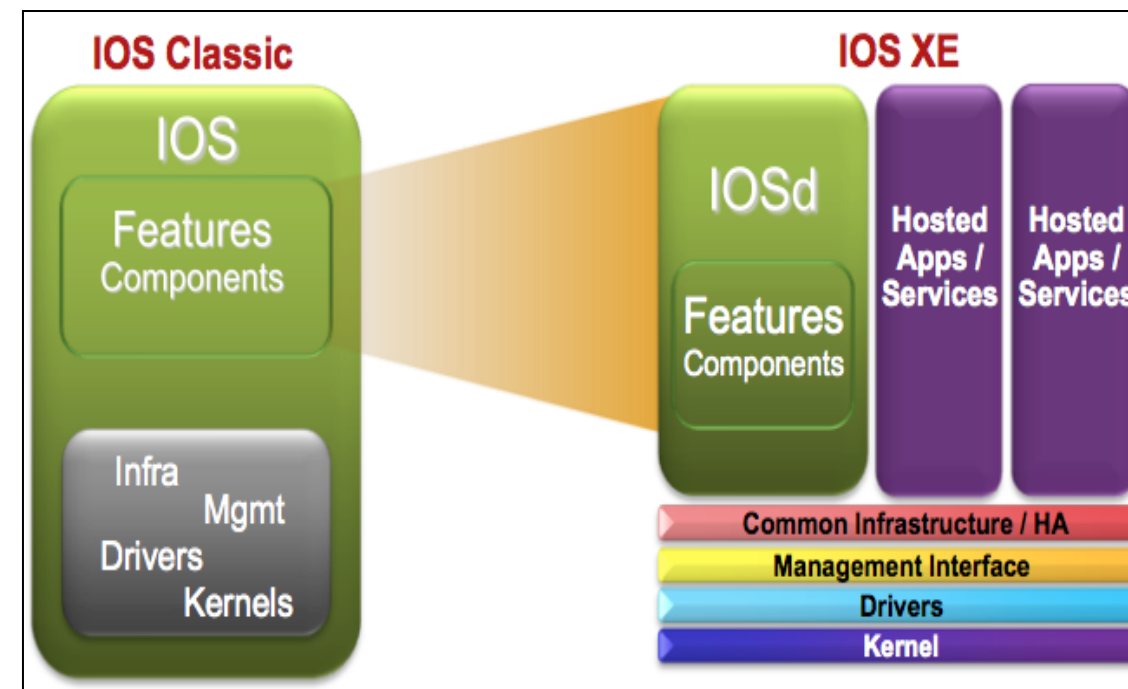
Verify time of outage

Tracebacks that need to be decoded

IOS-XE Process Crash
IOS-XE vs. IOS

- IOS-XE kernel is Linux

- Runs several different processes

  - IOSd, FFM, HA, licensing

- IOS runs as one process in a single unprotected memory space

- IOS-XE crash infrastructure collects crashinfo files for any failing process

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IOS-XE Process Crash

- Files generated upon a crash: system kernel info, crashinfo file and core file

- By default, crashinfo files are stored in the crashinfo directory (135MB partition of bootflash)

> Enables generation of process core dump file

```
Sup7-E(config)# exception coredump
```

- Generation of core files requires configuration

```
SUP7-E#show exception information
Exception configuration information
Coredump file - disabled,compressed
Maximum number of files
Core - 10 file(s)
Process crashinfo - 10 file(s)
Configured storage devices
1 - crashinfo:
2 - not assigned
3 - not assigned
Dump protocol - not configured        (not supported)
```

> Default – 10 crashinfo files and 10 core files saved

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IOS-XE Licensing (CSL)

Feature Set License

Feature Sets

Entservices

Ipbase

Lanbase

+

Entservices

IPbase

Lanbase

=

Entservices
Ipbase
Lanbase

Ipbase
Lanbase

Lanbase

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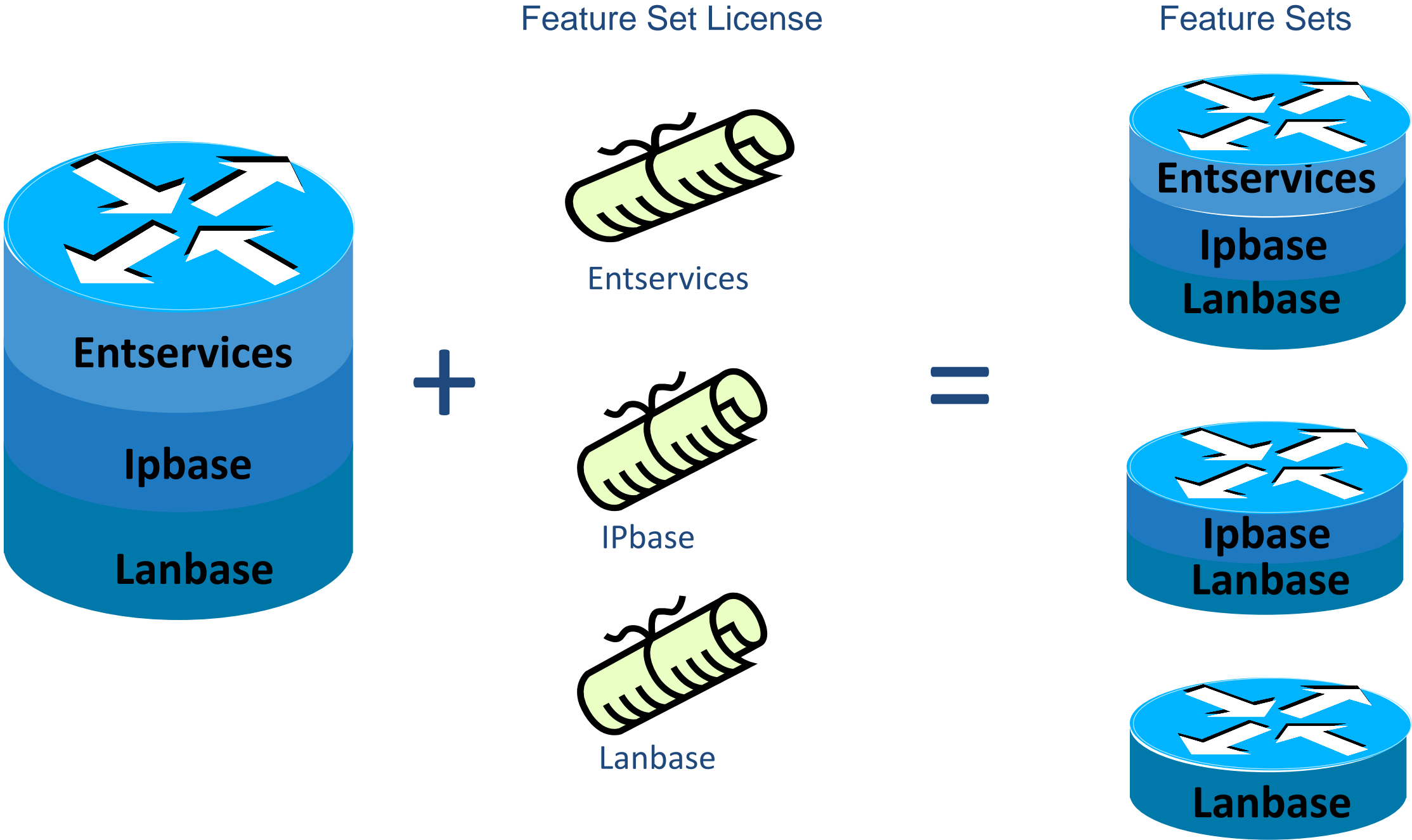
IOS-XE Licensing (CSL)

- Permanent license is node-locked

- License is for a chassis UDI (Universal Device Identifier), but stored on Supervisor bootflash

- License synced to hot standby supervisor

- No Product Activation Key (PAK) is generated for customer

License Show Commands

```
Sup7e# show license  all
License Store: Primary License Storage[1]
StoreIndex: 0 Feature: internal_service  Version: 1.0 License Type: Evaluation
        Evaluation period left: 23 hours 59 minutes        License State: Active, Not in Use, EULA
accepted[2]  …
StoreIndex: 2 Feature: entservices  Version: 1.0      License Type: Permanent
     License State: Active, In Use
     …
License Store: Dynamic License Storage
StoreIndex: 0 Feature: entservices  Version: 1.0      License Type: Evaluation
        Evaluation total period: 8 weeks 4 days        Evaluation period left: 4 weeks 3 days
     License State: Inactive
     …
```

Permanent node-locked license

Temporary License

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Troubleshooting License Installation
License must be installed and operational

- The system will boot up with default Lanbase license level if no licenses are installed

```
Sup7e# dir bootflash:
44268 … Jan 4 2011 21:46:41 …7slot_ent_FOX1418GEW0_20110103155106655.lic
```

```
Sup7e#license install bootflash:7slot_ent_FOX1418GEW0_20110103155106655.lic
Installing licenses from "bootflash:7slot_ent_FOX1418GEW0_20110103155106655.lic
Installing...Feature:entservices...Successful:Supported
1/1 licenses were successfully installed
0/1 licenses were existing licenses
0/1 licenses were failed to install
```

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Troubleshooting License Installation

- Is the license operational?

```
Sup7e#show license all
License Store: Primary License Storage
StoreIndex: 2 Feature: entservices   Version: 1.0
       License Type: Permanent
       License State: Active, Not in Use
       License Count: Non-Counted
       License Priority: Medium
```

- Reboot required to make the license operational

```
Sup7e# show version
Cisco IOS Software, IOS-XE Software, Catalyst 4500 L3 Switch Software (cat4500e-UNIVERSAL-M), Version
03.01.00.SG RELEASE SOFTWARE (fc4)
License Information for 'WS-X45-SUP7-E'
    License Level: lanbase   Type: Default. No valid license found
    Next reboot license Level: entservices
```

Troubleshooting License Installation
License Bootlevel: HA Upgrade

- Standby supervisor will always boot to the same license level as that of Active supervisor

- If running SSO and Active and Standby are running different license levels, need to manually set level.

```
Sup7e(config)#license boot level entservices
```

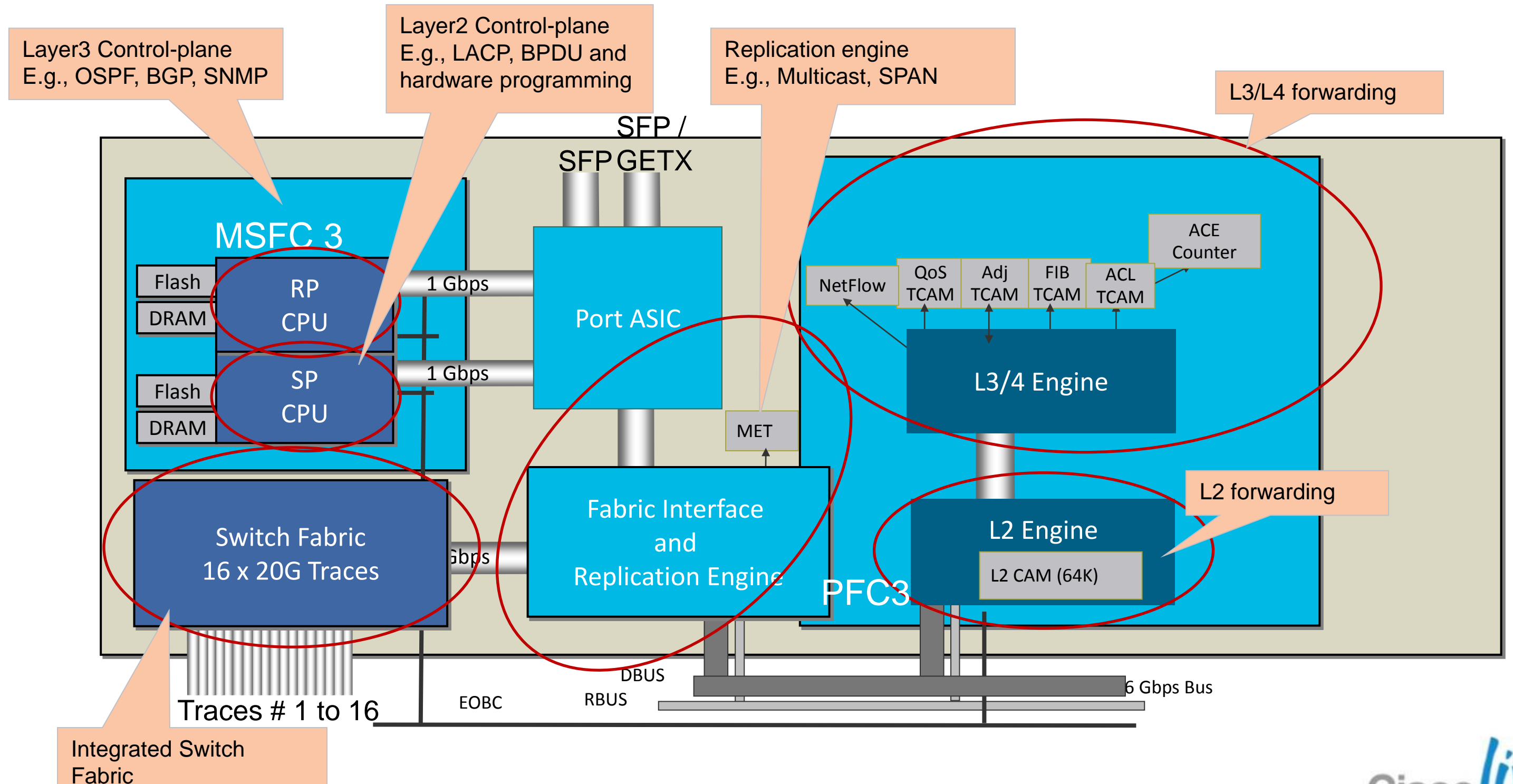# Troubleshooting Catalyst 6500 Series Switches

Agenda
Troubleshooting Catalyst 6500

- Sup720 Architecture

- Sup720 Layer 2 and Layer 3 Unicast Troubleshooting

- High CPU utilisation

- Virtual Switch System (VSS) Troubleshooting

- Sup2T Architecture

- Sup2T Layer 3 Unicast Troubleshooting

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Supervisor 720/PFC3 Architecture

Layer3 Control-plane
E.g., OSPF, BGP, SNMP

Layer2 Control-plane
E.g., LACP, BPDU and
hardware programming

Replication engine
E.g., Multicast, SPAN

L3/L4 forwarding

SFP /
SFP GETX

MSFC 3

Flash

DRAM

RP
CPU

Flash

DRAM

SP
CPU

1 Gbps

1 Gbps

Port ASIC

MET

ACE
Counter

NetFlow

QoS
TCAM

Adj
TCAM

FIB
TCAM

ACL
TCAM

L3/4 Engine

Switch Fabric
16 x 20G Traces

Fabric Interface
and
Replication Engine

Gbps

PFC3

L2 Engine

L2 CAM (64K)

L2 forwarding

Traces # 1 to 16

EOBC

DBUS
RBUS

6 Gbps Bus

Integrated Switch
Fabric

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L2 Packet Flow Troubleshooting

- Check the L2 forwarding engine counters
- Verify the channels used in the flow

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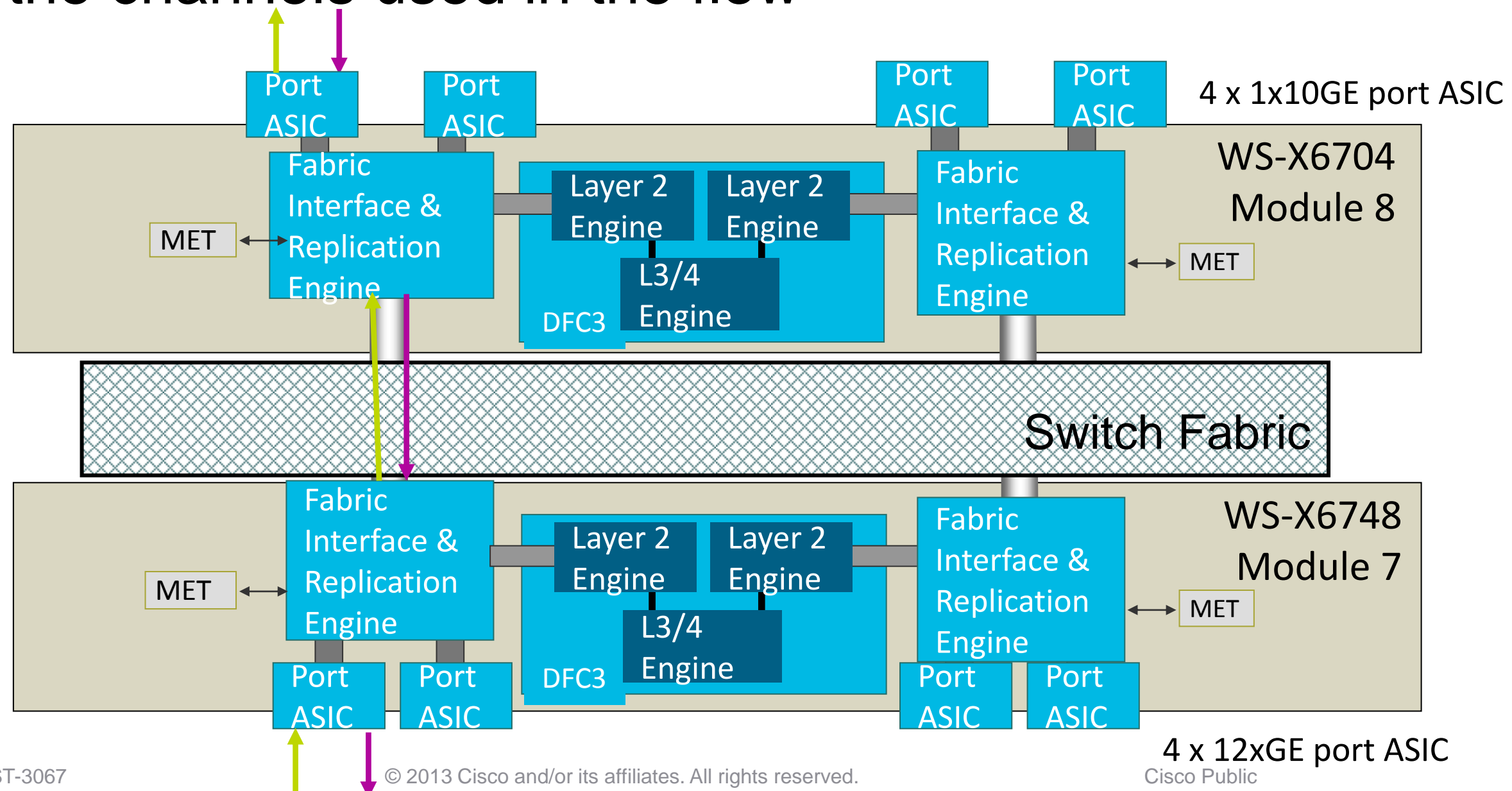
Layer 2 Learning and Forwarding

- **Layer 2 forwarding is based on {VLAN, MAC} pairs**
  - Entries are stored based on result of hash done on MAC and VLAN

- **MAC learning is done per PFC or DFC**
  - Each PFC/DFC maintains separate L2 CAM table

- **PFC and DFCs age entries independently**
  - Refreshing of entries based on "seeing" traffic from specific host
  - New learns on one forwarding engine communicated to other engines via MAC-Sync process

- **MAC table size:**
  - 64K entries on PFC3A / 3B / 3BXL and DFC3A / 3B / 3BXL
  - 96K entries on PFC3C / 3CXL and DFC3C / 3CXL

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L2 Unicast Traffic

- Verify that ARP entry is present for both hosts

```
Cat6K#show ip arp 7.0.1.1
Protocol  Address            Age (min)  Hardware Addr   Type    Interface
Internet  7.0.1.1               -        000b.fca2.fe0a  ARPA    Vlan700

Cat6K#show ip arp 7.0.1.2
Protocol  Address            Age (min)  Hardware Addr   Type    Interface
Internet  7.0.1.2               -        0011.bced.e400  ARPA    Vlan700
```

R2

Host2
7.0.1.2

Te8/1 Te8/3

Te8/1 Te8/3 **Po1**

Cat6K

Po2

Gig7/5 Gig7/3 Gig7/4

Gig8/3 Gig8/2 Gig8/1 **Po1**

R1

Host1
7.0.1.1

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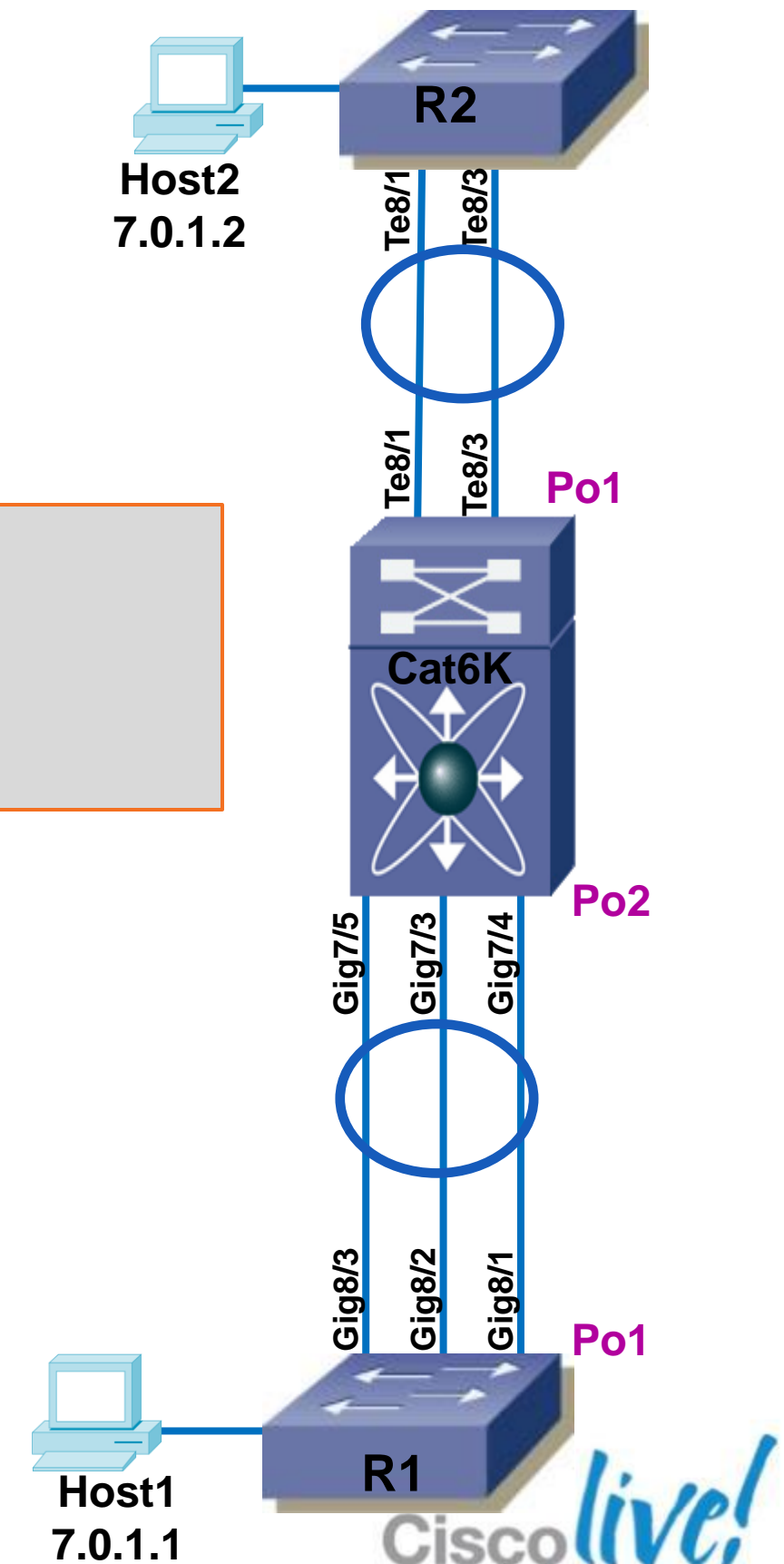
L2 Unicast Traffic

Verify the interface that both mac-addresses are learnt on

Host2
7.0.1.2

```
Cat6K#show mac-address-table address 000b.fca2.fe0a vlan 700
Legend: * - primary entry; age - seconds since last seen

  vlan   mac address      type     learn     age        ports
------+----------------+--------+-----+----------+--------------------

Module 7[FE 1]:
*  700  000b.fca2.fe0a   dynamic  Yes          50   Po2

Module 7[FE 2]:
*  700  000b.fca2.fe0a   dynamic  Yes         170   Po2


Cat6K#show mac-address-table address 0011.bced.e400 vlan 700
Legend: * - primary entry; age - seconds since last seen

  vlan   mac address      type     learn     age        ports

------+----------------+--------+-----+----------+--------------------
Module 8[FE 1]:
*  700  0011.bced.e400   dynamic  Yes         170   Po1

Module 8[FE 2]:
*  700  0011.bced.e400   dynamic  Yes         170   Po1
```

Two Forwarding Engines

R2

Te8/1 Te8/3

Te8/1 Te8/3 **Po1**

Cat6K

Po2

Gig7/5 Gig7/3 Gig7/4

Gig8/3 Gig8/2 Gig8/1 **Po1**

Host1
7.0.1.1

R1

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L2 Unicast Traffic
Verify that there is an entry for all fowarding engines (FE)

Host2
7.0.1.2

R2

Te8/1 Te8/3

Te8/1 Te8/3 **Po1**

Cat6K

Gig7/5 Gig7/3 Gig7/4 **Po2**

Gig8/3 Gig8/2 Gig8/1 **Po1**

R1

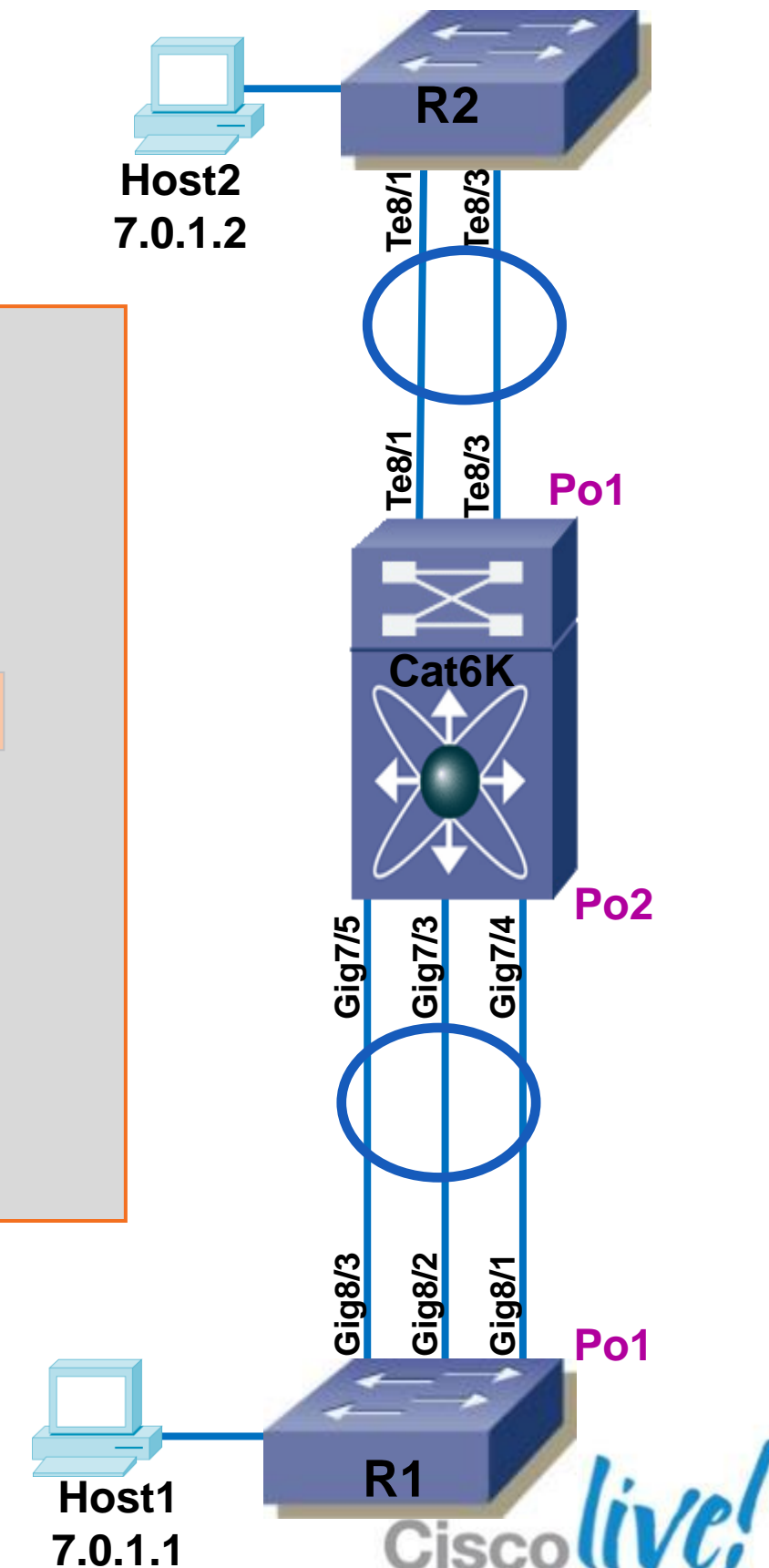**Host1**
7.0.1.1

```
Cat6K#show mac-address-table address 000b.fca2.fe0a vlan 700 all
Legend: * - primary entry; age - seconds since last seen
  vlan    mac address      type      learn      age            ports
------+---------------+--------+-----+----------+-------------------
Module 1:
   700  000b.fca2.fe0a   dynamic  Yes         170   Po2
Active Supervisor:
   700  000b.fca2.fe0a   dynamic  Yes         170   Po2
Standby Supervisor:
   700  000b.fca2.fe0a   dynamic  Yes         170   Po2
Module 7[FE 1]:
*  700  000b.fca2.fe0a   dynamic  Yes          50   Po2
Module 7[FE 2]:
*  700  000b.fca2.fe0a   dynamic  Yes         170   Po2
Module 8[FE 1]:
   700  000b.fca2.fe0a   dynamic  Yes         170   Po2
Module 8[FE 2]:
   700  000b.fca2.fe0a   dynamic  Yes         170   Po2
```

Primary
Entry
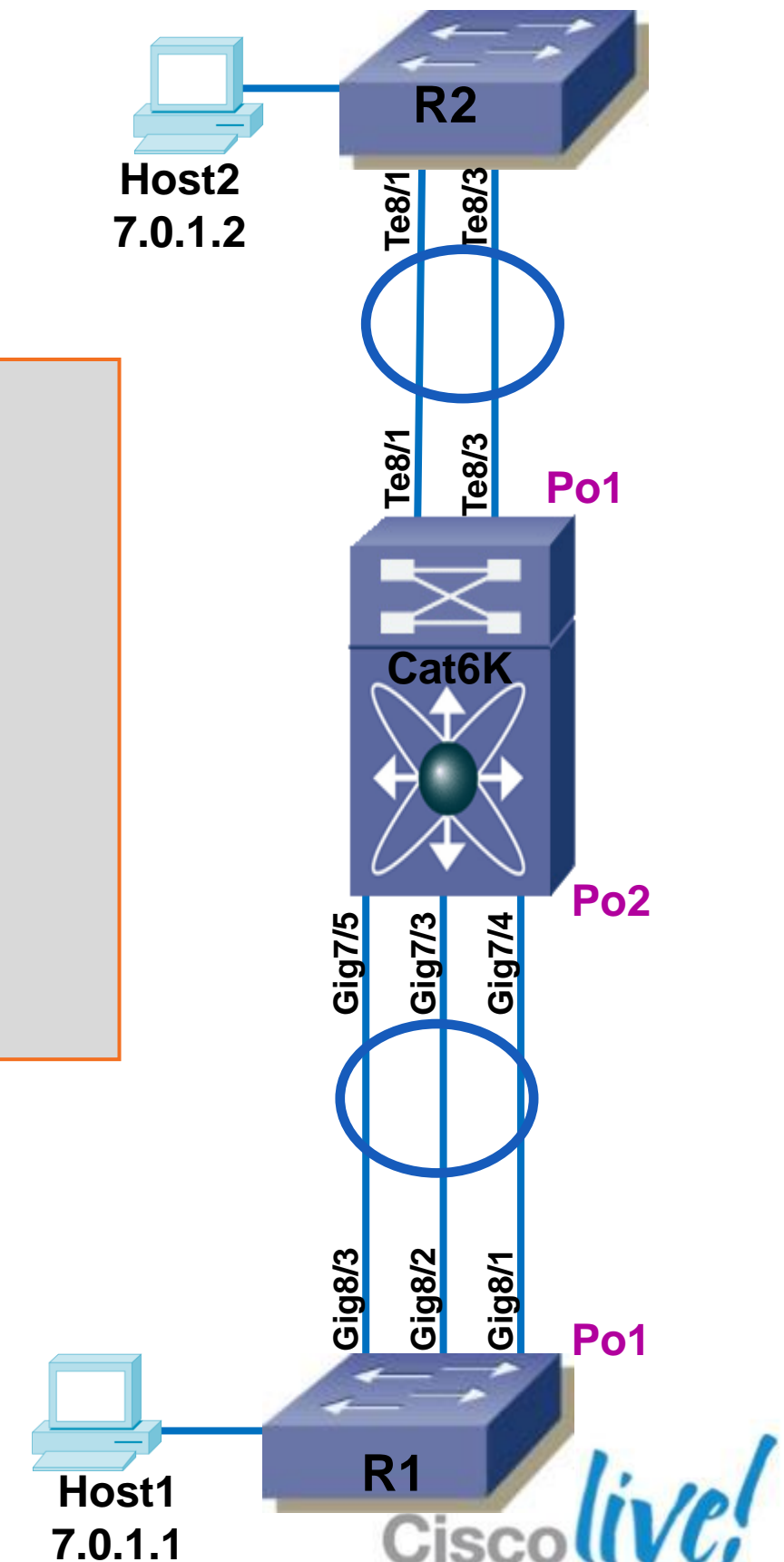
L2 Unicast Traffic

Check load balancing configuration. Use ingress Module number in command in case per-module load-balancing is configured (SXH images and later)

```
R1#show etherchannel load-balance module 1

EtherChannel Load-Balancing Configuration:

        dst-ip

        mpls label-ip

EtherChannel Load-Balancing Addresses Used Per-Protocol:

Non-IP: Destination MAC address

  IPv4: Destination IP address

  IPv6: Destination IP address

  MPLS: Label or IP

R1#show etherchannel load-balance hash-result interface po1 ip 7.0.1.2

Computed RBH: 0x1

Would select Gi8/1 of Po1
```

Mode is "dst-ip". Only use dest IP as argument. Prior to 12.2(33)SXH, use test etherchannel load-balance …(same arguments) on the SP

Link selected is Gi8/1 in Po1 of R1 for traffic to 7.0.1.2 leaving R1

Host2
7.0.1.2

R2

Te8/1   Te8/3

Te8/1   Te8/3   **Po1**

Cat6K

Gig7/5   Gig7/3   Gig7/4   **Po2**

Gig8/3   Gig8/2   Gig8/1   **Po1**

Host1
7.0.1.1

R1
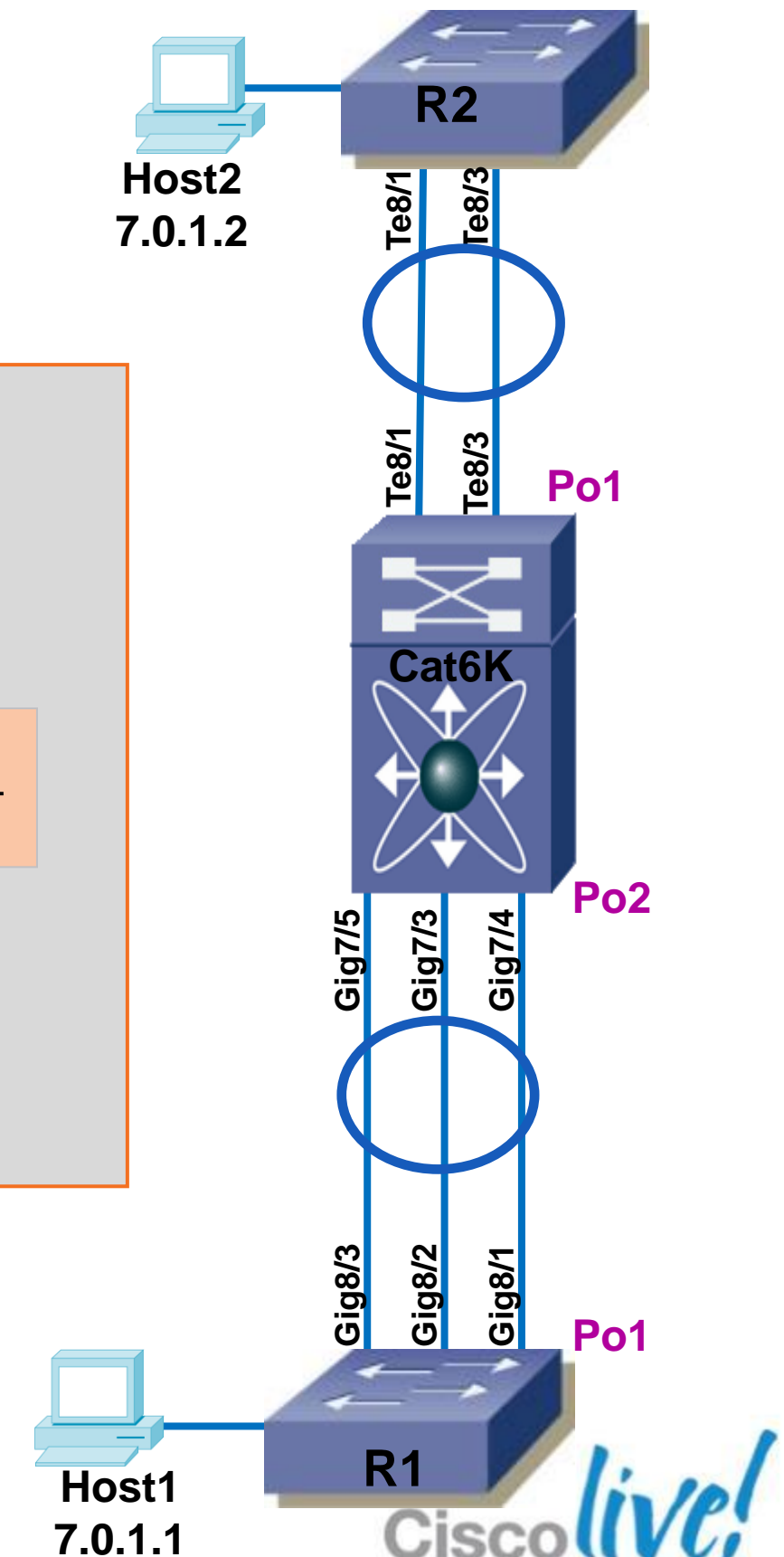
L3 Packet Flow Troubleshooting

- Check L3/L4 tables
- Confirm HW and SW forwarding tables are synchronised

4 x 1x10GE port ASIC

WS-X6704
Module 8

Port ASIC

Fabric Interface & Replication Engine

MET

Layer 2 Engine

Layer 2 Engine

L3/4 Engine

DFC3

Switch Fabric

WS-X6748
Module 7

4 x 12xGE port ASIC

L3 Unicast Traffic

Host2
9.0.1.2

R2

Te8/1 Te8/3

Te8/1 Te8/3

Cat6K

Gig7/5 Gig7/3 Gig7/4

Gig8/3 Gig8/2 Gig8/1

Host1
8.0.1.1

R1
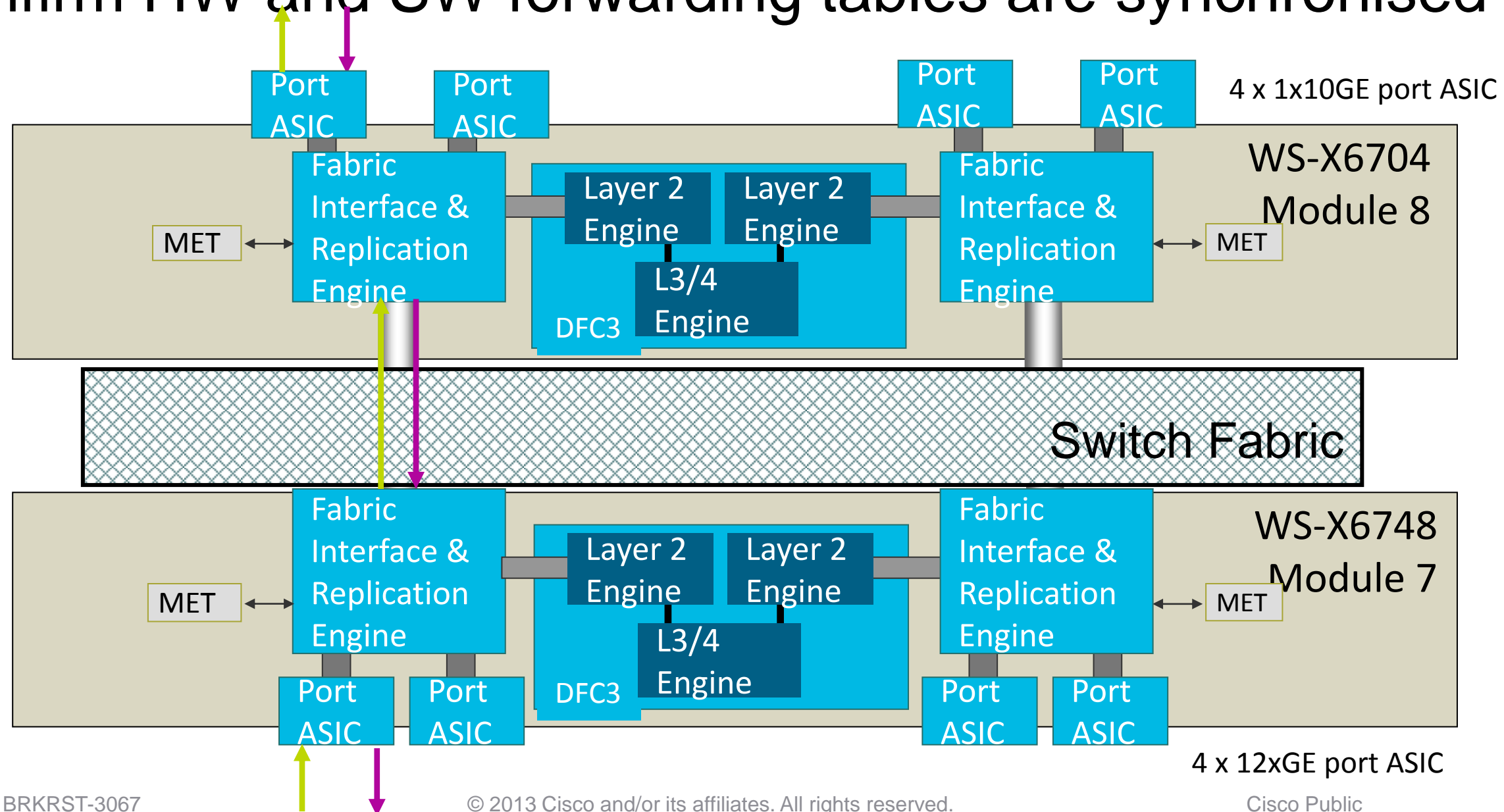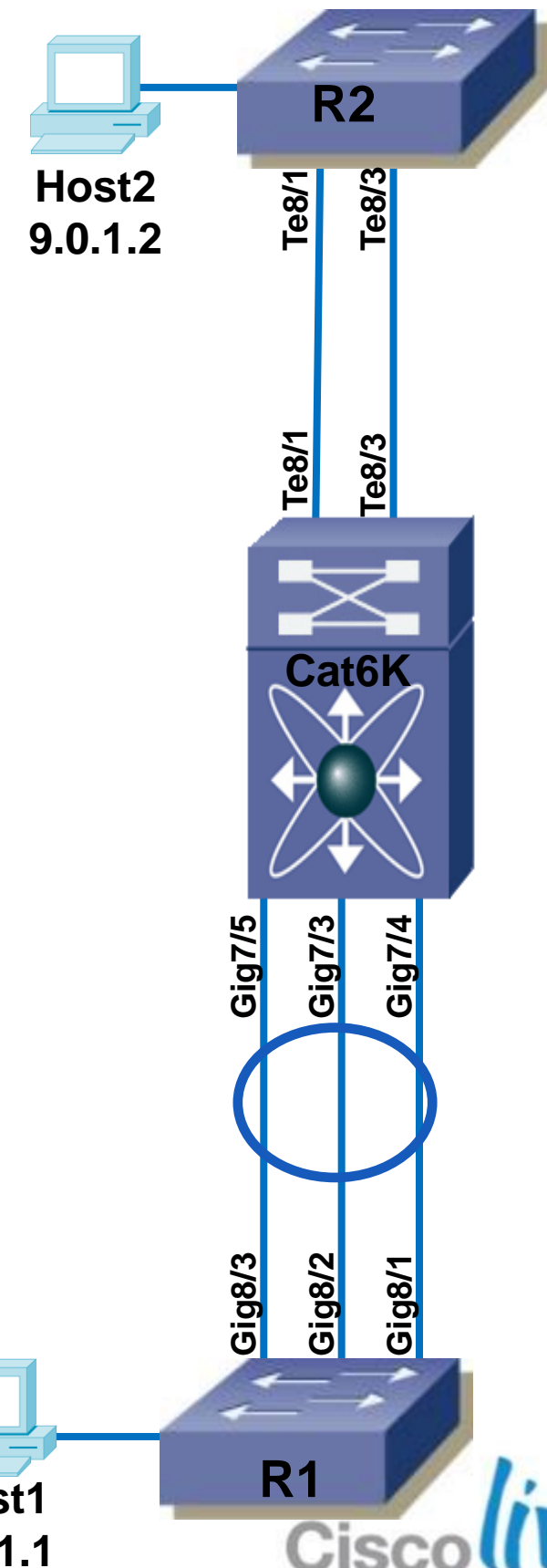
```
R1#show ip route 9.0.1.0 | include via                                    SW
  Known via "eigrp 700", distance 90, metric 3328, type internal
  Redistributing via eigrp 700
  * 7.2.1.2, from 7.2.1.2, 00:21:58 ago, via Vlan702
    7.5.1.2, from 7.5.1.2, 00:21:58 ago, via Vlan705
    7.4.1.2, from 7.4.1.2, 00:21:58 ago, via Vlan704
    7.3.1.2, from 7.3.1.2, 00:21:58 ago, via Vlan703
    7.1.1.2, from 7.1.1.2, 00:21:58 ago, via Vlan701

R1#show ip cef exact-route 8.0.1.1 9.0.1.2
8.0.1.1          -> 9.0.1.2          : Vlan701 (next hop 7.1.1.2)


R1#show mls cef exact-route 8.0.1.1 0 9.0.1.2 0                            HW
Interface: Vl705, Next Hop: 7.5.1.2, Vlan: 705, Destination Mac:
0050.f0f8.7400
```

Equal Cost Routes to the destination prefix

Next hop used for SW based CEF (SW forwarding data path)

Check which link between R1 and Cat6K is chosen.

Next hop used for HW based CEF (HW forwarding path). Note: "0" is used for both src and dest L4 port numbers as test flow was ICMP echo

FIB/Adjacency Tables
L3 FIB Table Programming Flow

Verify Layer 3

show ip route (RIB)

Verify Layer 2 rewrite

show ip arp

IOS® Routing Table (RP)

IOS ARP Cache Table (RP)

show ip cef

IOS FIB Table (RP)

IOS Adjacency Table (RP)

show ip cef adjacency

IOS FIB Table (SP/DFC)

IOS Adjacency Table (SP/DFC)

MLS FIB Table (SP/DFC)

MLS Adjacency Table (SP/DFC)

remote command module <mod> show adjacency detail

remote command module <mod> show ip cef

show mls cef lookup <ip address> <mod>

show mls cef adjacency entry

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L3 Unicast Traffic

```
Cat6K#show ip route 9.0.1.0 | i via
  Known via "eigrp 700", distance 90, metric 3072, type internal
  Redistributing via eigrp 700
  * 7.7.1.2, from 7.7.1.2, 00:07:33 ago, via TenGigabitEthernet8/3
    7.6.1.2, from 7.6.1.2, 00:07:33 ago, via TenGigabitEthernet8/1


Cat6K#show vlan internal usage
[snip]
1090 TenGigabitEthernet8/3
1091 TenGigabitEthernet8/1
[snip]
```

L3 Interface map internally to a "1-port" VLAN

Host2
9.0.1.2

R2

Te8/1   Te8/3

Te8/1   Te8/3

Cat6K

Gig7/5   Gig7/3   Gig7/4

Gig8/3   Gig8/2   Gig8/1

Host1
8.0.1.1

R1
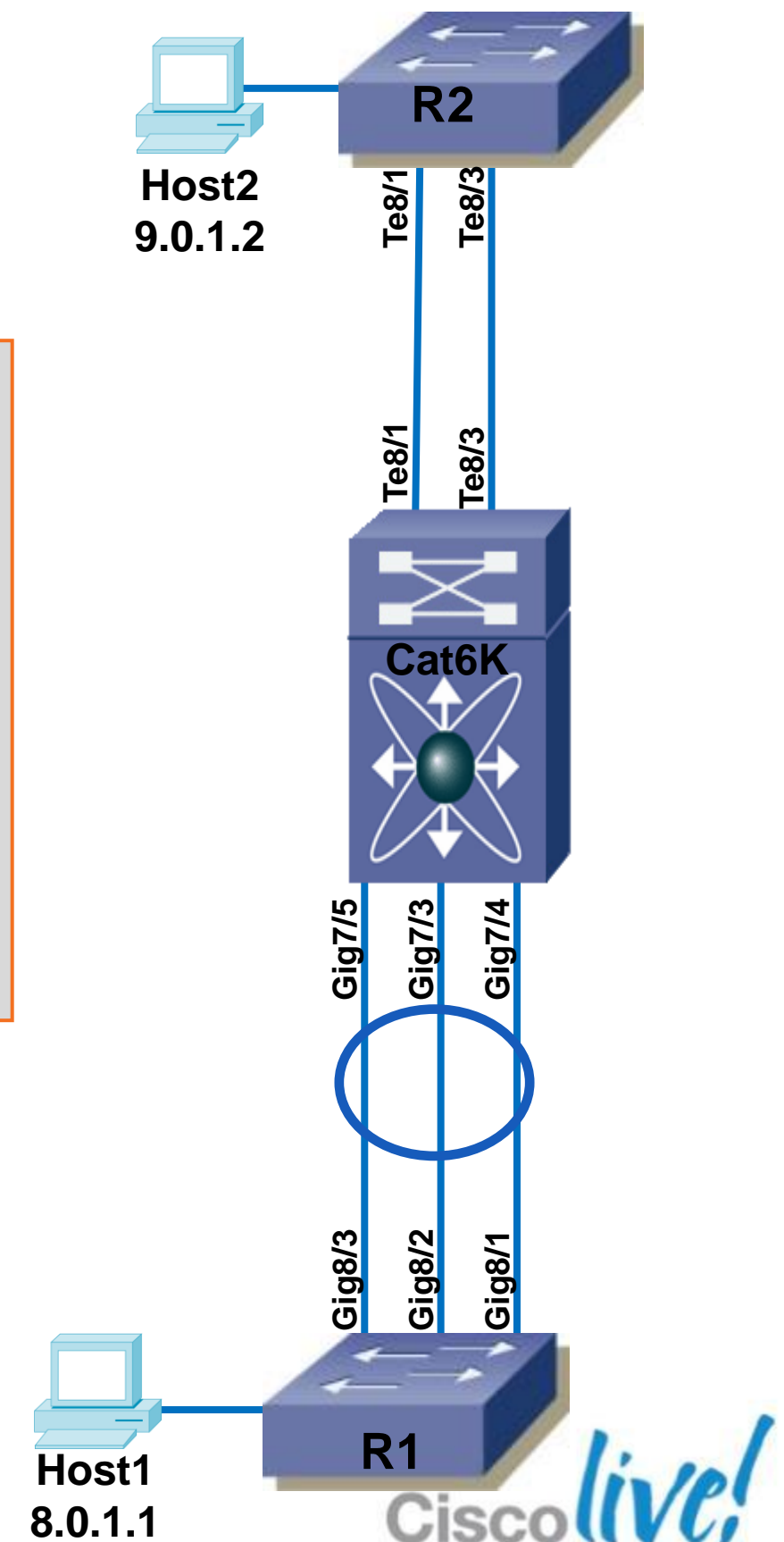
L3 Unicast Traffic

```
Cat6K#show ip cef 9.0.1.2                                    SW

9.0.0.0/8

  nexthop 7.6.1.2 TenGigabitEthernet8/1

  nexthop 7.7.1.2 TenGigabitEthernet8/3

Cat6K#show ip cef exact-route 8.0.1.1 9.0.1.2

8.0.1.1 -> 9.0.1.2 => IP adj out of TenGigabitEthernet8/1, addr 7.6.1.2

Cat6K#show ip cef adjacency TenGigabitEthernet 8/1 7.6.1.2

7.6.1.2/32

  attached to TenGigabitEthernet8/1

9.0.0.0/8

  nexthop 7.6.1.2 TenGigabitEthernet8/1
```

```
Cat6K#show mls cef lookup 9.0.1.2 mod 7

Codes: decap - Decapsulation, + - Push Label
                                                             HW
Index  Prefix                Adjacency

108749 9.0.0.0/8             Te8/1          , 000f.f8e4.d000 (Hash: 007F)

                             Te8/3          , 000f.f8e4.d000 (Hash: 7F80)

Cat6K#show mls cef exact-route 8.0.1.1 0 9.0.1.2 0 module 7

Interface: Te8/3, Next Hop: 7.7.1.2, Vlan: 1090, Destination Mac: 000f.f8e4.d000
```

Host2
9.0.1.2

Te8/1   Te8/3

R2

Te8/1   Te8/3

Cat6K

Gig7/5   Gig7/3   Gig7/4

Gig8/3   Gig8/2   Gig8/1

Host1
8.0.1.1

R1
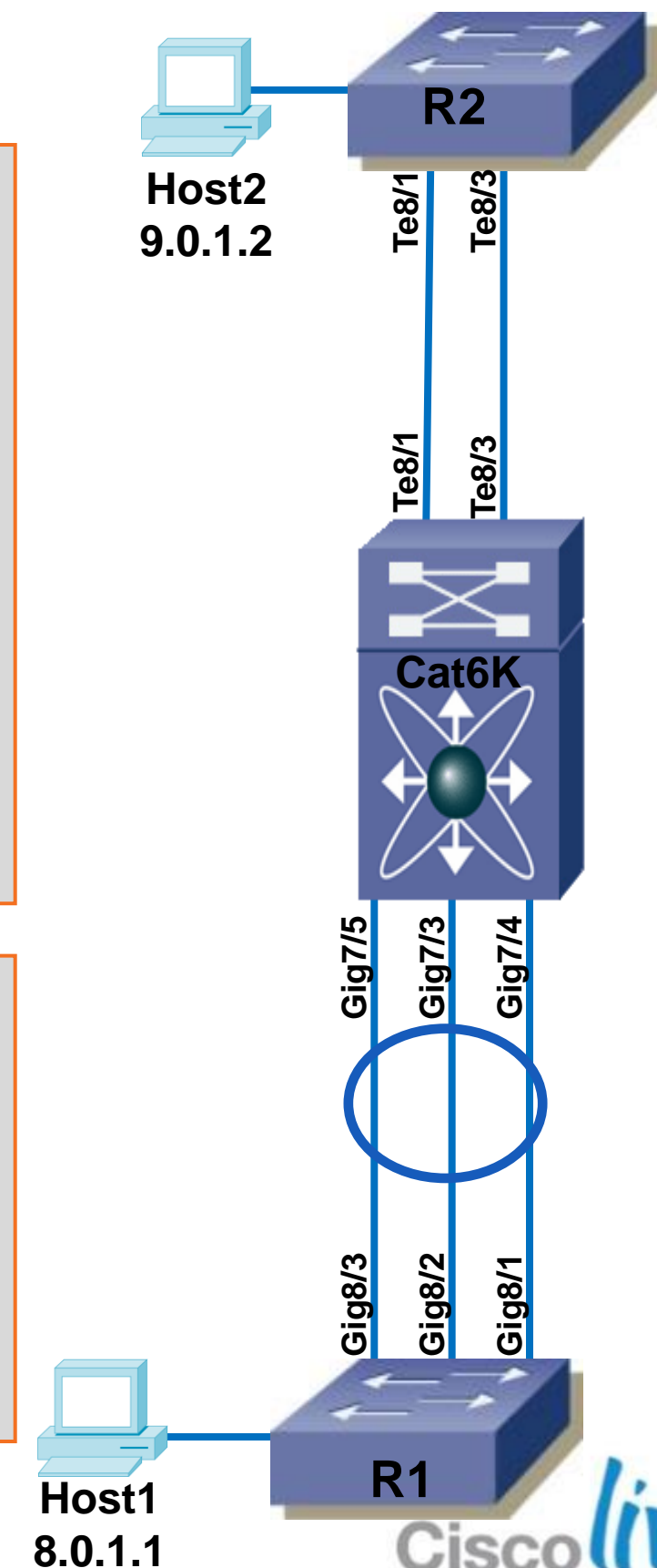
L3 Unicast Traffic

```
Cat6K#show adjacency ten 8/3 7.7.1.2 detail
Protocol Interface                      Address
IP          TenGigabitEthernet8/3       7.7.1.2(17)

                                        2001 packets, 228114 bytes

                                        epoch 0

                                        sourced in sev-epoch 774

                                        Encap length 14

                                        000FF8E4D0000050F0F874000800

                                        ARP

Cat6K#show mls cef lookup 9.0.1.2 detail mod 7
Codes: M - mask entry, V - value entry, A - adjacency index, P - priority bit

       D - full don't switch, m - load balancing modnumber, B - BGP Bucket sel

       V0 - Vlan 0,C0 - don't comp bit 0,V1 - Vlan 1,C1 - don't comp bit 1

       RVTEN - RPF Vlan table enable, RVTSEL - RPF Vlan table select
Format: IPV4_DA - (8 | xtag vpn pi cr recirc tos prefix)

Format: IPV4_SA - (9 | xtag vpn pi cr recirc prefix)

M(108749 ): E | 1 FFF  0 0 0 0   255.0.0.0

V(108749 ): 8 | 1 0    0 0 0 0   9.0.0.0       (A:294933 ,P:1,D:0,m:14,B:0)
```

Aggregate HW adjacency statistics (SW collects it from all DFC/PFC's for all prefixes linked to this adjacency)

Rewrite information (Dmac|Smac|0800): verify it is conform with next hop rewrite info

To get HW adjacency statistic for this prefix on this module

Start adjacency pointer is 294933, 14 + 1 = 15 adjacencies linked to the prefix

L3 Unicast Traffic

```
Cat6K#show mls cef adjacency entry 294933 to 294947 mod 7

Index: 294933   smac: 0050.f0f8.7400, dmac: 000f.f8e4.d000

                mtu: 9234, vlan: 1091, dindex: 0x0, l3rw_vld: 1

                packets: 0, bytes: 0

Index: 294947   smac: 0050.f0f8.7400, dmac: 000f.f8e4.d000

                mtu: 9234, vlan: 1090, dindex: 0x0, l3rw_vld: 1

                packets: 0, bytes: 0

Cat6K#show mls cef adjacency entry 294933 to 294947 mod 7 | i packets
```

294933 →	packets: 0, bytes: 0
294934 →	packets: 0, bytes: 0
294935 →	packets: 0, bytes: 0
294936 →	packets: 2001, bytes: 236118
294937 →	packets: 0, bytes: 0
294938 →	packets: 0, bytes: 0
294939 →	packets: 0, bytes: 0

```
Cat6K#show mls cef adjacency entry 294936 detail mod 7

Index: 294936   smac: 0050.f0f8.7400, dmac: 000f.f8e4.d000

                …

                packets: 0, bytes: 0
```

15 HW adjacencies linked to this prefix: which one is really used ?

Based on the packet counts, we see that the 4th adjacency (entry 294936) is being used.

Verify that the rewrite information is correct for the adjacency.

Note counter is cleared here; counter is cleared when adjacency is read.

Troubleshooting High CPU

Components Involved

RP: show process cpu

RP: show ibc

Uplink ports

MSFC 3

1 Gbps
Inband

Flash

RP
CPU

DRAM

C

RP: show ip traffic
RP: show interfaces

Flash

SP
CPU

DRAM

C

Port ASIC

1 Gbps
Inband

Sup720

SP: show process cpu

SP: show ibc

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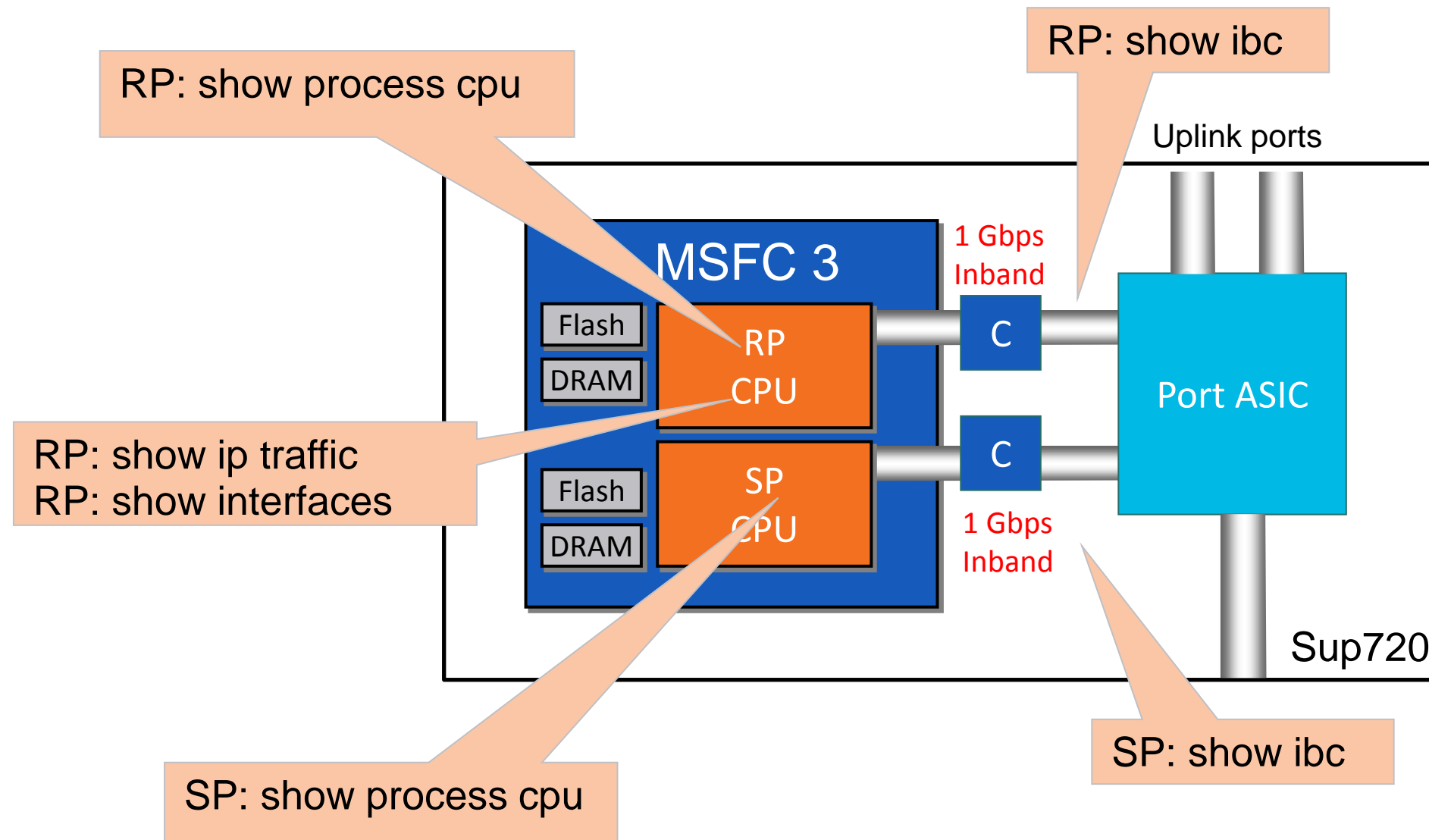
High CPU Utilisation - Process
Process: ARP Input

- Caused by ARP flooding
- Static route configured with next-hop interface instead of IP

Incrementing at very high rate

Look for abnormal input rate

```
Cat6K#show ip traffic | begin ARP
ARP statistics:
  Rcvd: 6512 requests, 2092 replies, 0 reverse, 0 other
  Sent: 258 requests, 707 replies (0 proxy), 0 reverse
  Drop due to input queue full: 20
<snip>
Cat6K#show interfaces | include line protocol|rate
Vlan501 is up, line protocol is up
  5 minute input rate 23013521 bits/sec, 2535 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
```

VLAN SVI is Virtual and counter gives only the amount/rate of process-switched or control-pane traffic

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High CPU Utilisation

- Identify if it is process driven or interrupts

Total CPU usage (Process + Interrupt)

CPU usage due to Interrupt

```
DUT# show process cpu
CPU utilization for five seconds: 99%/90%; one minute: 9%; five minutes: 8%
 PID  Runtime(ms)   Invoked   uSecs    5Sec    1Min   5Min TTY Process
   2         720        88    8181    9.12%   1.11%  0.23%  18 Virtual Exec
```

- Next Steps

  - Process: recurring events, control plane process etc.

  - Interrupts: incorrect switching path, system exceeding hardware resources

High CPU Utilisation - Process

Process: IP Input

- Caused by traffic that needs to be process switched or sent to the CPU

- Common Causes and Next Steps
  - Broadcast Storm
  - Traffic with IP-Options enabled
  - Traffic to which ICMP redirect or Unreachable required e.g., TTL=1, ACL Deny
  - Traffic that needs further CPU processing e.g., ACL Logging

Find the source host and isolate. Consider per-port broadcast storm-control

Find the source host and isolate. Consider HW Rate-limiters

Under VLAN SVIs configure:
no ip unreachables
no ip redirects
no ip proxy-arp
Consider HW Rate-limiters

Consider Optimised ACL Logging (OAL)

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High CPU Utilisation - Process

Process: Exec and Virtual Exec

```
Cat6K#show process cpu | include CPU|Virtual |Exec
CPU utilization for five seconds: 30%/0%; one minute: 8%; five minutes: 5%
 PID Runtime(ms)      Invoked       uSecs    5Sec    1Min    5Min TTY Process
   3         272          194        1402  29.00%   2.12%   1.89%   0 Exec
  54         180         1443         124   0.00%   0.00%   0.00%   1 Virtual Exec
```

Responsible for tty lines (console, auxiliary)

High CPU when too many messages sent to console/vty

Responsible for vty lines (telnet, SSH)

- **Next steps**
  - Check if any debug is enabled via "show debug". Issue "undebug all" if it is not needed
  - Disable logging by "no logging console" or "no logging terminal"

High CPU Utilisation - Traffic
Analyse Input Buffer

- Use when an input queue is oversubscribed

```
Cat6K#show buffers assigned
Header     DataArea  Pool Rcnt   Size Link   Enc     Flags   Input    Output
46FDBC14   8029784  Small   1     77   36     1        200    Vl100     None
46FE0010   802CBC4  Small   1     77   36     1        200    Vl100     None
. . .

Cat6K#show buffers input-interface vlan 100 dump
Buffer information for RxQ3 buffer at 0x378B3BC
  data_area 0x7C05EF0, refcount 1, next 0x0, flags 0x200
  linktype 7 (IP), enctype 1 (ARPA), encsize 14, rxtype 1
  if_input 0x46C7C68 (Vlan100), if_output 0x0 (None)
  inputtime 2d03h (elapsed 00:00:01.024)
  outputtime 00:00:00.000 (elapsed never), oqnumber 65535
  datagramstart 0x7C05F36, datagramsize 62, maximum size 2196
  mac_start 0x7C05F36, addr_start 0x7C05F36, info_start 0x0
  network_start 0x7C05F44, transport_start 0x7C05F58, caller_pc 0x6C1564

  source: 137.34.219.3, destination: 224.0.0.2, id: 0x0000, ttl: 1,
  TOS: 192 prot: 17, source port 1985, destination port 1985
```

Find the interface that's holding most of the buffers

Packet details

High CPU Utilisation - Traffic
Debug Netdr Capture

- Capture packets being received and sent by RP to buffer space

- Does not introduce extra CPU processing

```
Cat6K#debug netdr cap ?
  acl                    (11) Capture packets matching an acl
  and-filter             (3) Apply filters in an and function: all must match
  continuous             (1) Capture packets continuously: cyclic overwrite
  destination-ip-address (10) Capture all packets matching ip dst address
  dstindex               (7) Capture all packets matching destination index
  ethertype              (8) Capture all packets matching ethertype
  interface              (4) Capture packets related to this interface
  or-filter              (3) Apply filters in an or function: only one must
                         match
  rx                     (2) Capture incoming packets only
  source-ip-address      (9) Capture all packets matching ip src address
  srcindex               (6) Capture all packets matching source index
  tx                     (2) Capture outgoing packets only
  vlan                   (5) Capture packets matching this vlan number
  <cr>
```

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High CPU Utilisation - Traffic

Netdr Capture Output

```
Cat6K#show netdr cap
A total of 10 packets have been captured
The capture buffer wrapped 0 times
Total capture capacity: 4096 packets

------- dump of incoming inband packet -------
interface Vl10, routine draco2_process_rx_packet_inline
dbus info: src_vlan 0xA(10), src_indx 0xC0(192), len 0x76(118)
  bpdu 0, index_dir 0, flood 0, dont_lrn 0, dest_indx 0x380(896)
  08020401 000A0000 00C00000 76080000 00010428 0E000040 00000000 03800000
mistral hdr: req_token 0x0(0), src_index 0xC0(192), rx_offset 0x76(118)
  requeue 0, obl_pkt 0, vlan 0xA(10)
destmac 00.23.04.18.F8.80, srcmac 00.13.7F.8B.84.C1, protocol 0800
protocol ip: version 0x04, hlen 0x05, tos 0x00, totlen 100, identifier 13202
  df 0, mf 0, fo 0, ttl 255, src 10.10.10.1, dst 10.10.10.3
    icmp type 8, code 0

------- dump of incoming inband packet -------
interface Vl10, routine draco2_process_rx_packet_inline
dbus info: src_vlan 0xA(10), src_indx 0xC0(192), len 0x76(118)
  bpdu 0, index_dir 0, flood 0, dont_lrn 0, dest_indx 0x380(896)
```

Vlan

Ethertype

Source/Destination

Virtual Switch System (VSS)

- Virtual Switching System consists of two Cisco Catalyst 6500 Series switches connected through a special etherchannel called a Virtual Switch Link (VSL) to become one logical entity.

Virtual Switch Domain

Virtual Switch Link (VSL)

Switch 1   +   Switch 2   =   One Logical Switch

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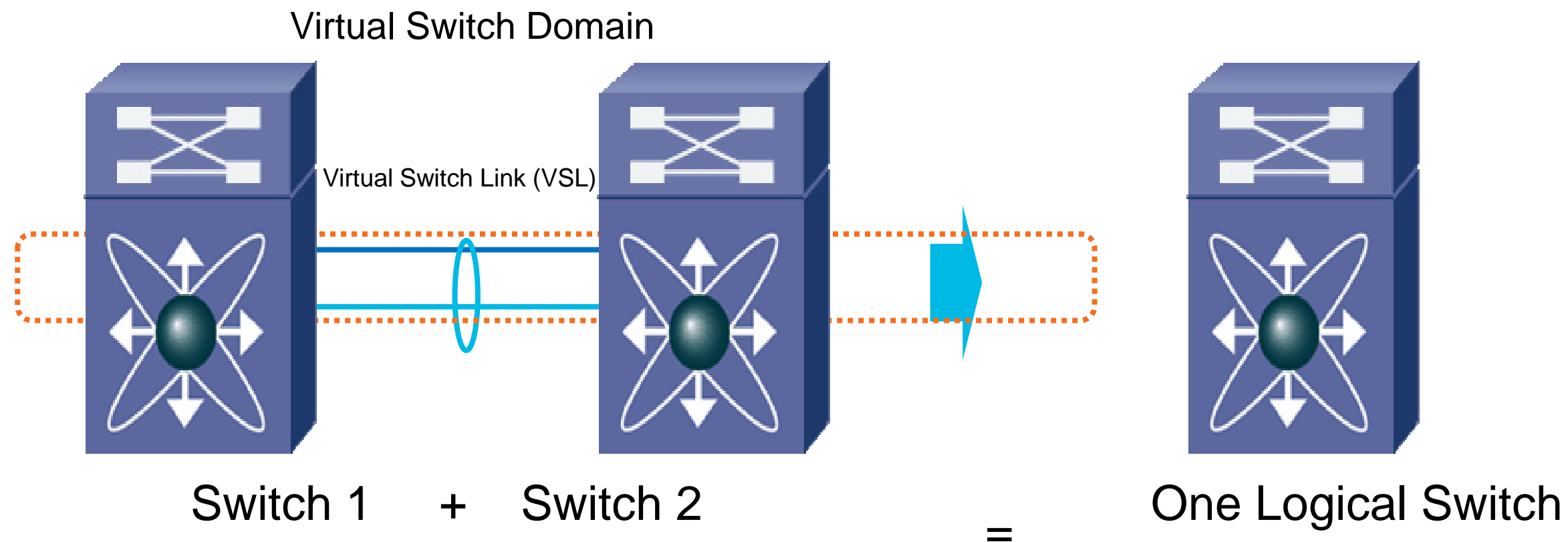
VSS Control Plane
VSS Specific Protocols

- VSL Protocol (VSLP) runs between active and standby switch over the VSL, and has two components:

  – LMP and RRP

- Link Management Protocol (LMP): Runs over each individual link in VSL

  – Bi-directionality; keepalives; connectivity (peer-to-peer)

- Role Resolution Protocol (RRP): Runs on each side (each peer) of the VSL port channel

  – HW/SW compatibility; role negotiation; control-link selection

VSS Control Plane

VSS Configuration Check

```
Cat6K#show switch virtual role
Switch    Switch Status  Preempt      Priority  Role      Session ID
          Number         Oper(Conf)   Oper(Conf)          Local  Remote
--------------------------------------------------------------------
LOCAL     1      UP      TRUE (Y*)    200(200)  ACTIVE    0      0
REMOTE    2      UP      TRUE (Y*)    100(100)  STANDBY   2977   3643
Standby configured preempt timer(switch 2): 5 minutes
Active configured preempt timer(switch 1): 5 minutes
In dual-active recovery mode: No
```

Switch 1 is active, switch 2 is standby, both are up

```
Cat6K#show switch virtual link port-channel
Flags:  D - down          P - bundled in port-channel
        . . .
Group   Port-channel  Protocol     Ports
------+------------+----------+--------------------
256     Po256(RU)     -          Te1/3/3(P)    Te1/3/4(P)    Te1/3/6(P)
                                 Te1/5/4(P)
255     Po255(RU)     -          Te2/2/3(P)    Te2/2/6(P)    Te2/2/8(P)
                                 Te2/5/4(P)
```

Interfaces are identified by [switch#]/[mod#]/[port#]

Switch 1 side of the VSL

Switch 2 side of the VSL

VSS Control Plane
VSS LMP Check

```
Cat6K#show switch virtual link
VSL Status : UP
VSL Uptime : 18 hours, 12 minutes
VSL SCP Ping : Pass
VSL ICC Ping : Pass
VSL Control Link : Te1/5/4
Cat6K#show switch virtual link port
  LMP summary
    Link info:      Configured: 4      Operational: 4

                          Peer Peer          Peer   Peer      Timer(s)running
Interface Flag State      Flag MAC           Switch Interface (Time remaining)
-------------------------------------------------------------------------
Te1/5/4   vfs  operational  vfs  0011.bc75.4400 2      Te2/5/4   T4(220ms)
                                                                 T5(175s)
Te1/3/3   vfs  operational  vfs  0011.bc75.4400 2      Te2/2/6   T4(220ms)
                                                                 T5(175s)
Te1/3/4   vfs  operational  vfs  0011.bc75.4400 2      Te2/2/8   T4(220ms)
                                                                 T5(175s)
Te1/3/6   vfs  operational  vfs  0011.bc75.4400 2      Te2/2/3   T4(768ms)
                                                                 T5(175s)
  Flags:  v - Valid flag set      f - Bi-directional flag set s - Negotiation flag set
```

Status and uptime of the VSL

Control link carries EOBC and IBC control messages (SCP and ICC/IPC)

Check LMP state and Flags (vf) of the links in the VSL bundle

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VSS Control Plane
VSS LMP Check

Indicates problem sending or receiving LMP packets from peer

Indicates problem sending LMP packet to the VSL peer

```
Cat6k#show vslp lmp counters
Instance #1:
  LMP counters

               Tx                          Rx

Interface    OK        Fail        Bidir   Uni     Fail      Bad
-----------------------------------------------------------------

Te1/5/4      12649     0           12675   1       0         0
Te1/3/3      12000     0           12024   0       0         0
Te1/3/4      11999     0           12024   0       0         0
Te1/3/6      12001     0           12025   0       0         0


                 Rx error details

Interface   My info     My info     Bad MAC     Bad switch   Domain id    Peer info
            mismatch    absent      Address     id           mismatch     mismatch
-----------------------------------------------------------------------------------

Te1/5/4     0           1           0           0            0            0
Te1/3/3     0           0           0           0            0            0
Te1/3/4     0           0           0           0            0            0
Te1/3/6     0           0           0           0            0            0
```

Packets received from VSL peer without our info, proving the link is unidirectional at that moment

These errors usually indicate a misconfiguration on one of the peers

1 unidirectional packet when first link in VSL came up

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VSS Control Plane
VSS RRP Check

```
Cat6K#show switch virtual role detail

Switch   Switch Status  Preempt      Priority  Role      Session ID
         Number                      Oper(Conf) Oper(Conf)          Local   Remote
-----------------------------------------------------------------------

LOCAL      1      UP      TRUE (Y*)   200(200)  ACTIVE    0       0
REMOTE     2      UP      TRUE (Y*)   100(100)  STANDBY   2977    3643
Standby configured preempt timer(switch 2): 5 minutes
Active configured preempt timer(switch 1): 5 minutes
 RRP Counters:
-----------------------------------------------------------------------

Inst. Peer Direction Req        Acc        Est        Rsugg       Racc
-----------------------------------------------------------------------
 1     1      Tx      0          2          0          2           6
 1     1      Rx      2          0          2          0           6
 RRP FSM info
-----------------------------------------------------------------------

sm(vslp_rrp RRP SM information for Instance 1, Peer 1), running yes, state role_res
Last transition recorded: (req)-> hold (srt_exp)-> hold (est)-> role_neg (srt_exp)-> role_neg (est)->
role_neg (racc)-> role_res (srt
_. . .

In dual-active recovery mode: No
```
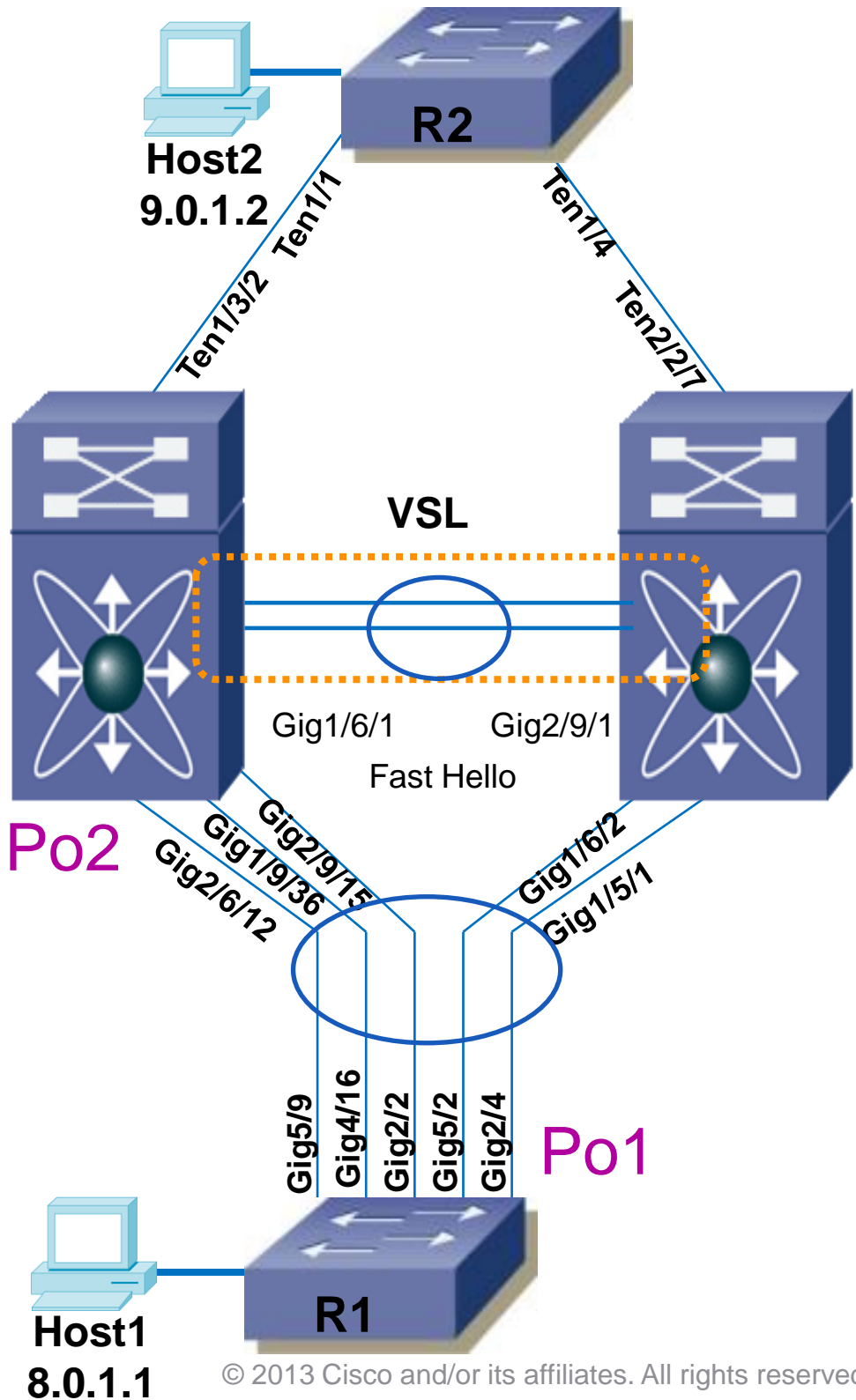
Check 1 is active, 2 is standby

State machine info on RRP protocol; current state is "role resolved"

Switch is not in dual active recovery mode

VSS L2/L3 Forwarding Path

Physical

Host2
9.0.1.2

R2

Ten1/1   Ten1/4

Ten1/3/2   Ten2/2/7

VSL

Gig1/6/1   Gig2/9/1

Fast Hello

Po2

Gig2/9/15
Gig1/9/36
Gig2/6/12
Gig1/6/2
Gig1/5/1

Po1

Gig5/9
Gig4/16
Gig2/2
Gig5/2
Gig2/4

Host1
8.0.1.1

R1

Logical

Host2
9.0.1.2

R2

Ten1/1   Ten1/4

Ten1/3/2   Ten2/2/7

Cat6K   Gig1/6/1

Po2

Gig2/6/12
Gig1/9/36
Gig2/9/15
Gig1/6/2
Gig1/5/1

Po1

Gig5/9
Gig4/16
Gig2/2
Gig5/2
Gig2/4

Host1
8.0.1.1

R1
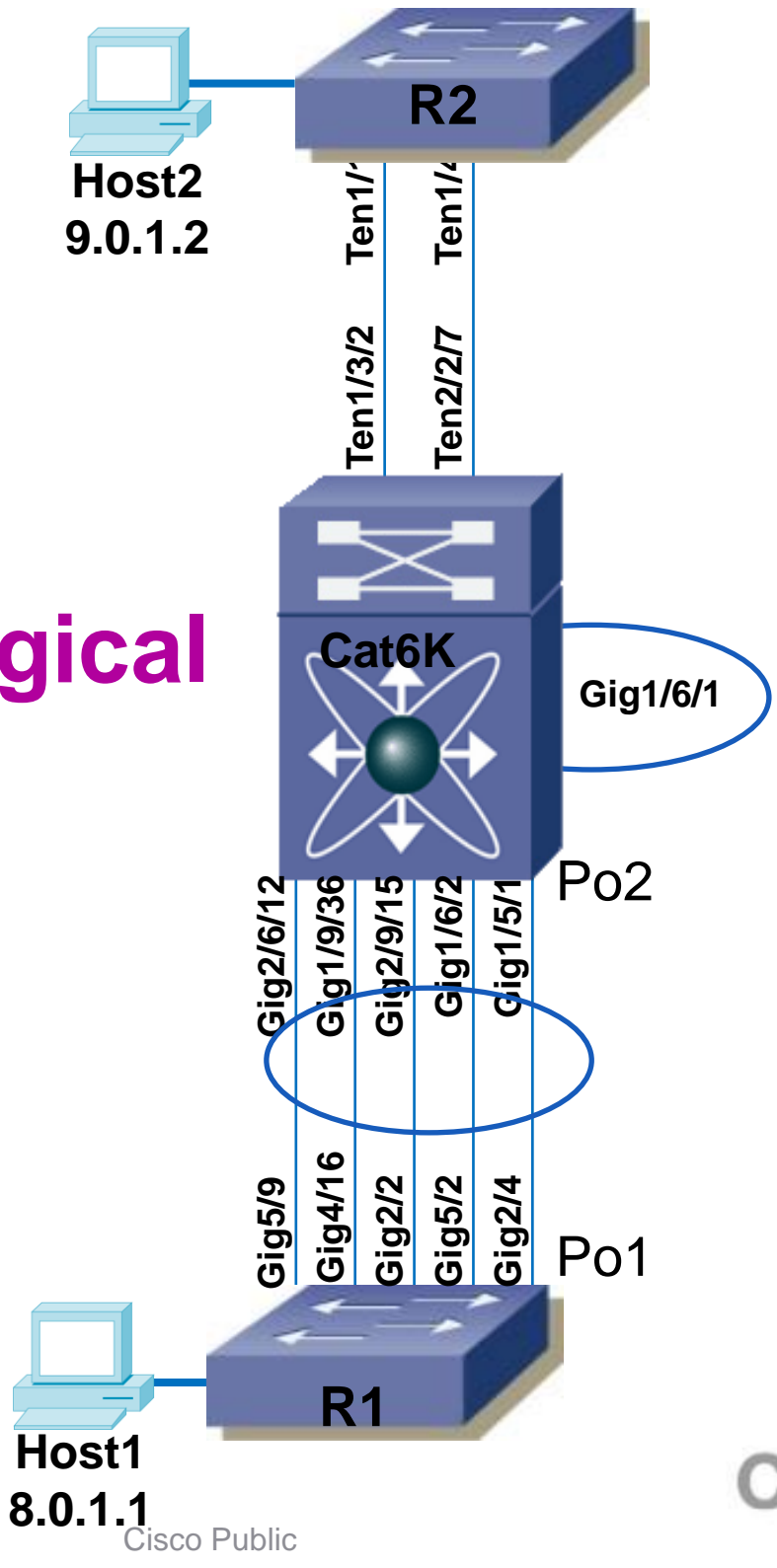
VSS Data Plane Forwarding Path

VSS Data Plane Design: Minimise Load on VSL
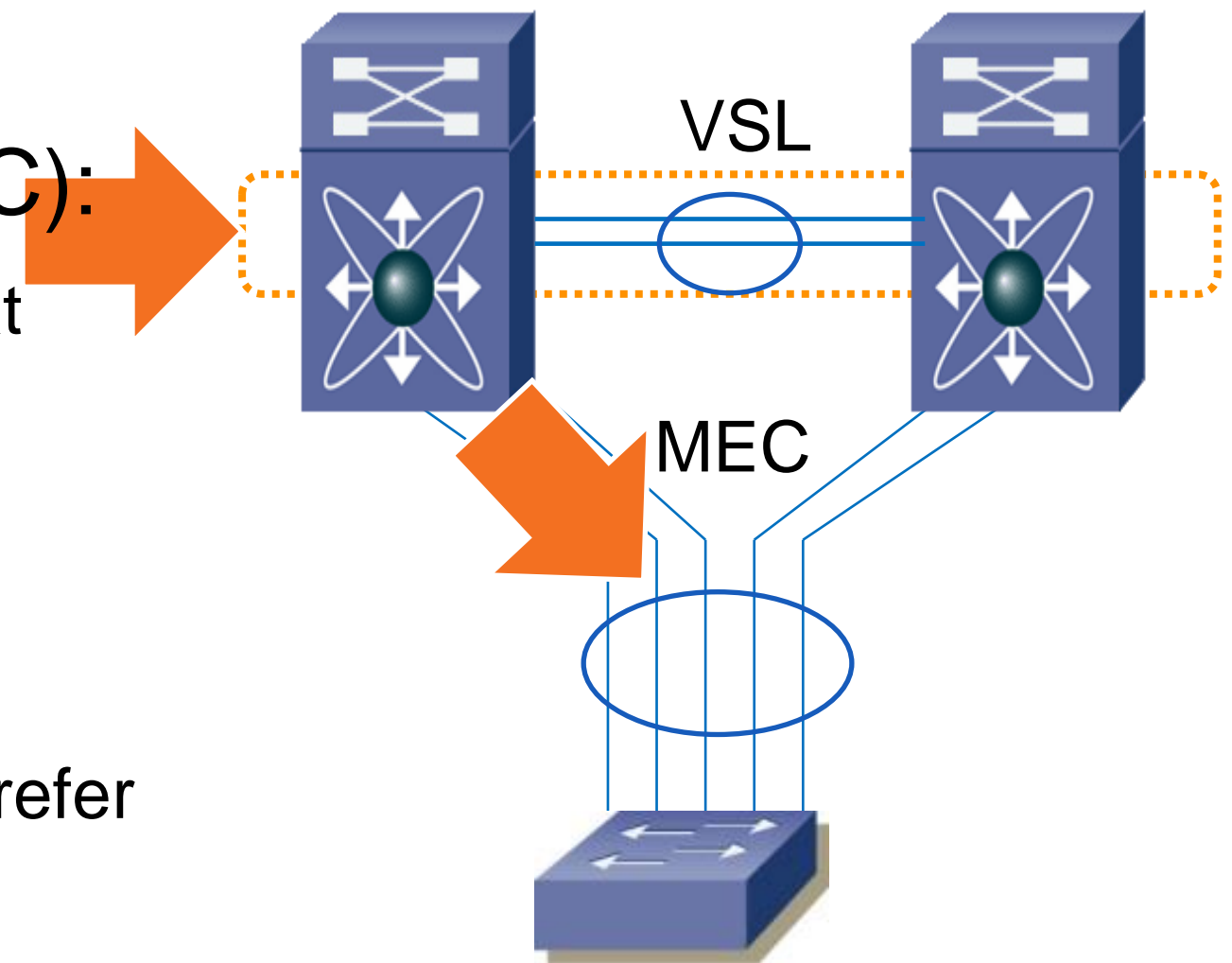
- ## Multi-chassis Ether Channel (MEC):
  - Channel hash is modified on VSS so that local links in the MEC are preferred over links on remote switch

- ## Equal Cost Multi Path (ECMP):
  - Adjacency table is modified on VSS to prefer next hops attached to local switch

VSL

MEC

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VSS L2/L3 Forwarding
VSS Data Plane Troubleshooting L2 MEC

- Verify the load-balancing algorithm used

> VSS specific commands augmented with switch id

```
Cat6K#show etherchannel load-balance switch 2 module 2
EtherChannel Load-Balancing Configuration:
        src-dst-ip enhanced
        mpls label-ip
EtherChannel Load-Balancing Addresses Used Per-Protocol:
Non-IP: Source XOR Destination MAC address
  IPv4: Source XOR Destination IP address
  IPv6: Source XOR Destination IP address
  MPLS: Label or IP
```

- Identify the physical path for flow from host 2 ➔ host 1

```
Cat6K#show etherchannel load-balance hash-result interface Port-channel 2 switch 1 ip 9.0.1.2  vlan 705
8.0.1.1
Computed RBH: 0x6
Would select Gi1/6/2 of Po2
Cat6K#show etherchannel load-balance hash-result interface Port-channel 2 switch 2 ip 9.0.1.2 vlan 705
8.0.1.1
Computed RBH: 0x6
Would select Gi2/9/15 of Po2
```

> **Important:** Only use parameters consistent with the configured load-balancing algorithm. Command uses all the specified arguments to calculate the hash.

VSS L2/L3 Forwarding

- ■ Routing table shows two equal cost paths to 9.0.0.0/8

```
Cat6K#show ip route 9.0.0.0 | i via
  Known via "eigrp 101", distance 90, metric 3072, type internal
  Redistributing via eigrp 101
    7.7.1.2, from 7.7.1.2, 1d00h ago, via TenGigabitEthernet2/2/7
  * 7.6.1.2, from 7.6.1.2, 1d00h ago, via TenGigabitEthernet1/3/2
```

- ■ Looking at the HW table shows next hop directly attached to local switch is preferred

```
Cat6K#show mls cef lookup 9.0.1.0 switch 1 mod 3
Codes: decap - Decapsulation, + - Push Label
Index  Prefix                 Adjacency
108775 9.0.0.0/8              Te1/3/2          , 000f.35ed.7c00
Cat6K#show mls cef lookup 9.0.1.0 switch 2 mod 2
Codes: decap - Decapsulation, + - Push Label
Index  Prefix                 Adjacency
108775 9.0.0.0/8              Te2/2/7          , 000f.35ed.7c00
Cat6K#show mls cef exact-route 8.0.1.1 0 9.0.1.2 0 switch 1 mod 3
Interface: Te1/3/2, Next Hop: 7.6.1.2, Vlan: 4064, Destination Mac: 000f.35ed.7c00
Cat6K#show mls cef exact-route 8.0.1.1 0 9.0.1.2 0 switch 2 mod 2
Interface: Te2/2/7, Next Hop: 7.7.1.2, Vlan: 4056, Destination Mac: 000f.35ed.7c00
```

> Packet coming in on switch 1 module 3, for 9.0.0.0/8 prefers next hop attached to local switch id 1

> Packet coming in on switch 2 module 2, for 9.0.0.0/8 prefers next hop attached to local switch id 2

live!

VSS Dual-Active Detection
VSL Failure

- Both switches assume the active role

- Leads to two independent routers with identical configurations

- Three methods for detection and recovery

  - VSLP Fast Hello

  - Enhanced Port Aggregation Protocol (ePAgP)

  - Bi-directional Forwarding Detection (BFD)

I'm active

I'm active

VSL

Active

Virtual Switch
Domain

Standby
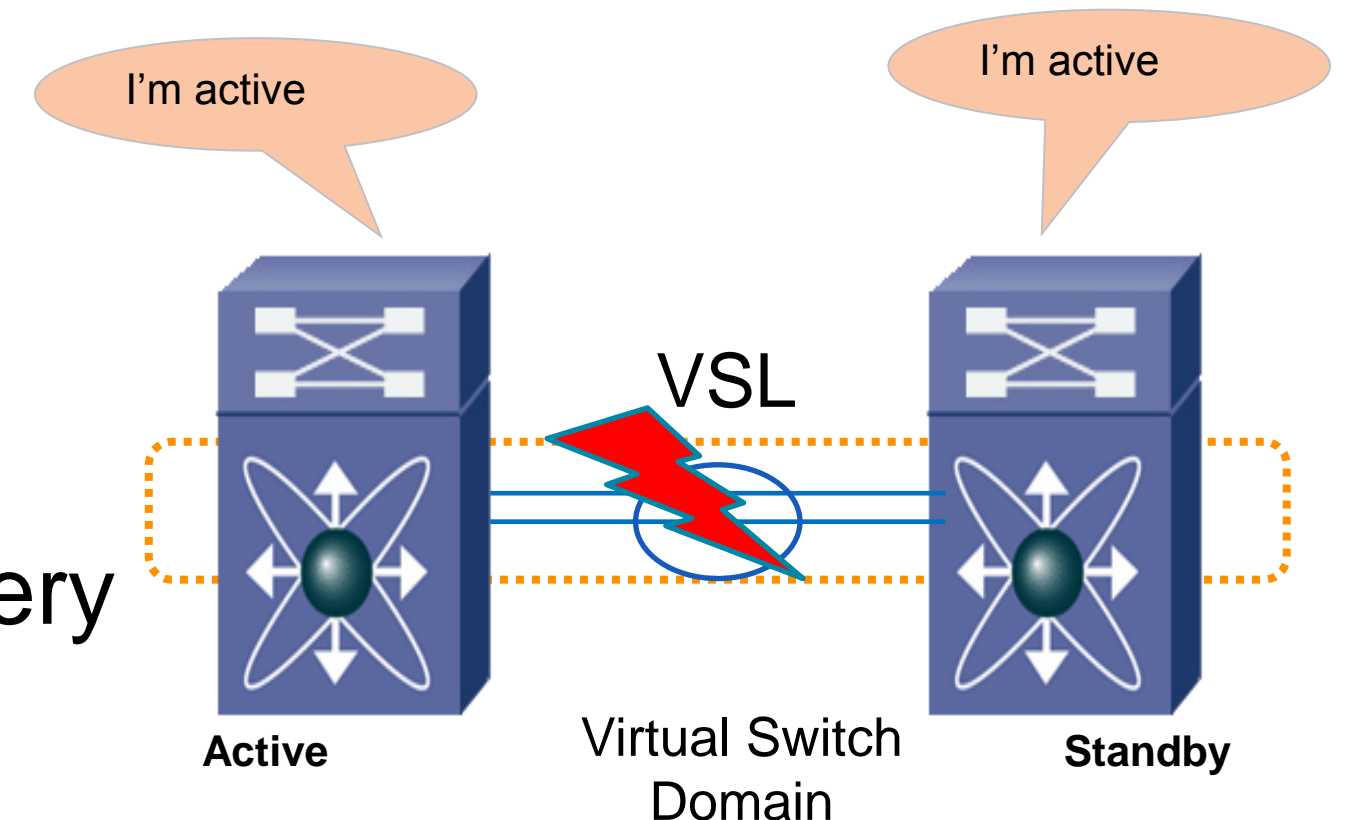
VSS Dual-Active Detection
VSS Dual Active Detection Methods

- VSLP Fast Hello: (available in 12.2(33)SXI onwards)
  - Uses a dedicated heartbeat link between the VSL peers to send periodic hellos
  - Received hellos contain remote VSL peer's current state and role
- Enhanced PAgP
  - Uses new Type-Length-Value (TLV) field in PAgP packets. contains the ID of the active switch
  - Requires Multi-chassis EtherChannel (MEC) switch support ePAgP
- BFD
  - Uses a dedicated connection between VSL peers
  - Requires IP addresses in different subnet on the interfaces in the BFD link

VSS Dual-Active Detection
VSS Dual Active Detection Setup

R2

Ten1/3/2 Ten1/1 Ten1/4 Ten2/2/7

Physical

VSL

Gig1/6/1   Gig2/9/1
Fast Hello

Gig2/9/15
Gig1/9/36
Gig2/6/12

Gig1/6/2
Gig1/5/1

Po2
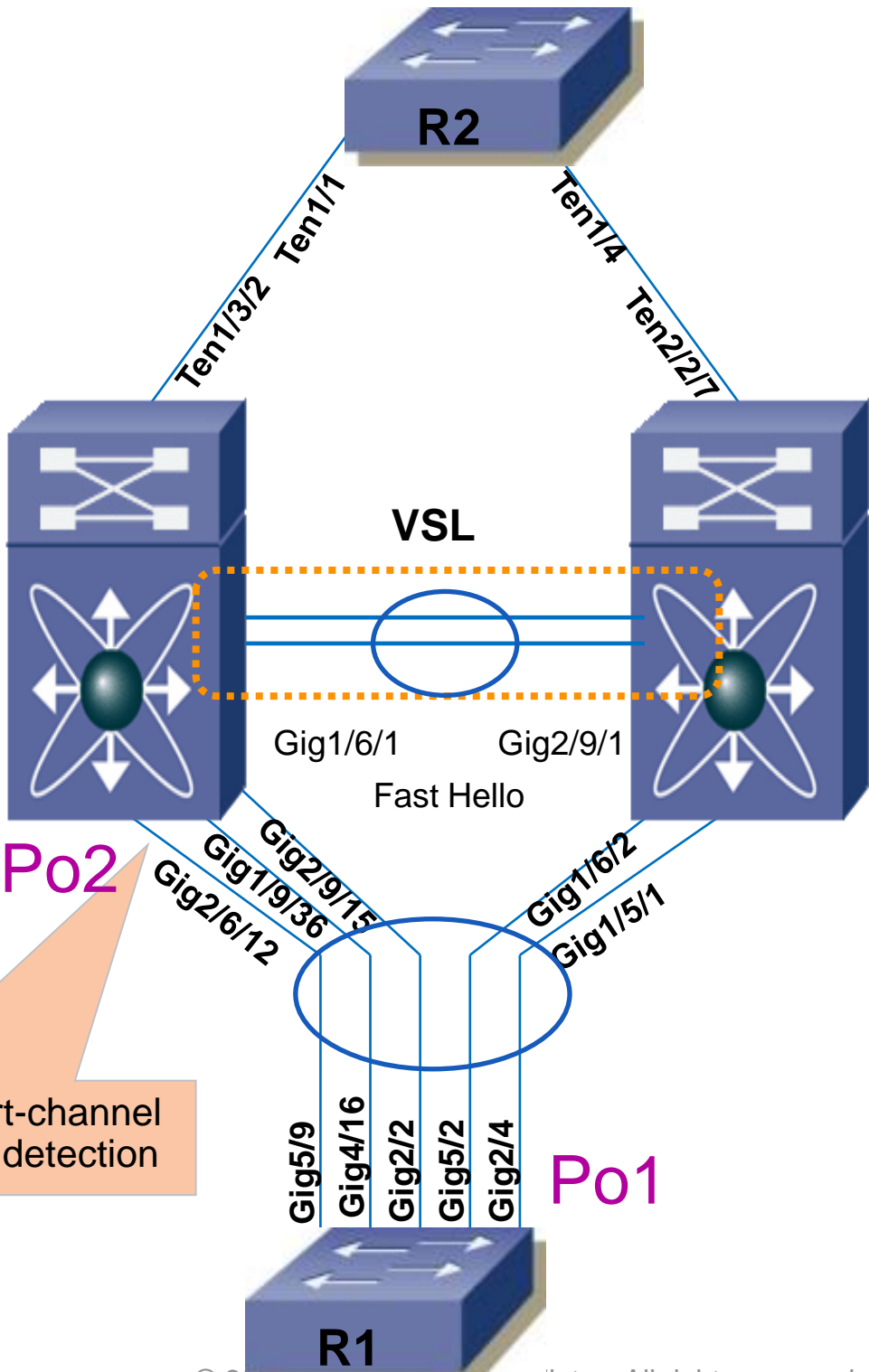
Port-Channel 2 is the only port-channel trusted for ePAgP dual-active detection

Gig5/9 Gig4/16 Gig2/2 Gig5/2 Gig2/4

Po1

R1

Logical

R2

Ten1/3/2 Ten2/2/7

Ten1/ Ten1/4

Cat6K

Gig1/6/1

Po2

Gig2/6/12 Gig1/9/36 Gig2/9/15 Gig1/6/2 Gig1/5/1

Gig5/9 Gig4/16 Gig2/2 Gig5/2 Gig2/4

Po1

R1

Cisco live!
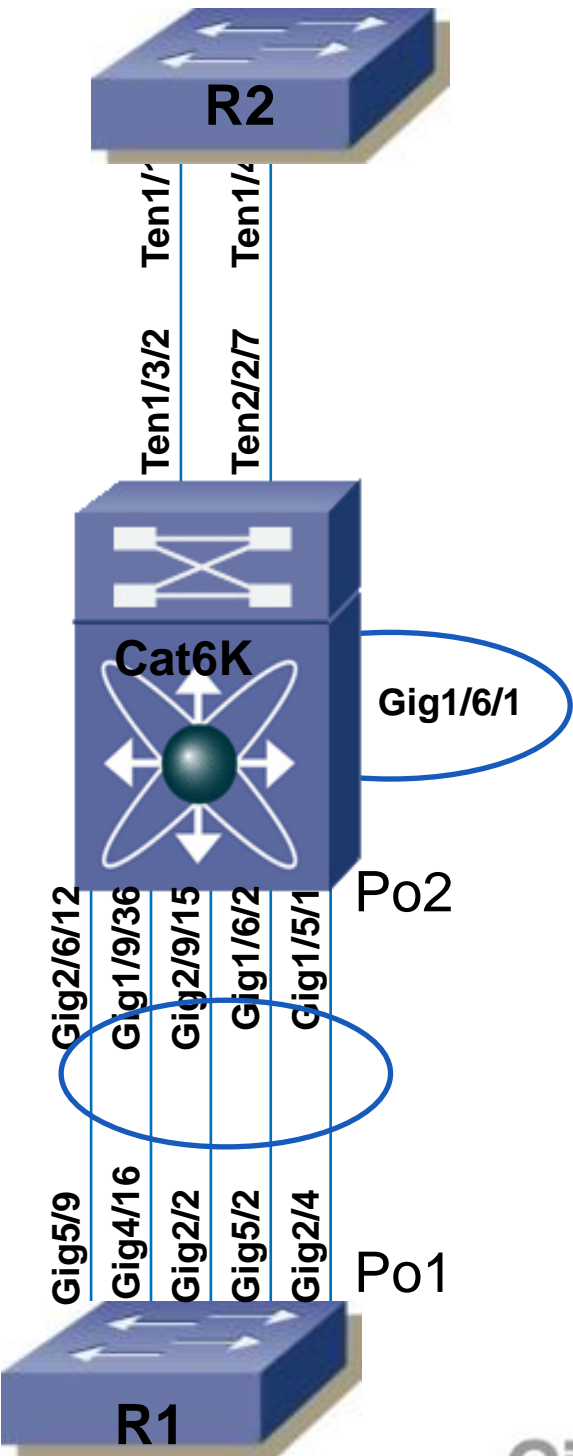
VSS Dual-Active Detection
VSS Dual Active Detection Troubleshooting

```
Cat6K#show startup-config | begin switch virtual
switch virtual domain 1
 switch mode virtual
 ...
 no dual-active detection bfd
 dual-active detection pagp trust channel-group 2
 dual-active exclude interface GigabitEthernet1/5/3
 dual-active exclude interface GigabitEthernet2/5/3
!
...
interface GigabitEthernet1/6/1
 no switchport
 no ip address
 dual-active fast-hello
...
interface GigabitEthernet2/9/1
 no switchport
 no ip address
 dual-active fast-hello
```

BFD Dual Active detection is explicitly disabled

Enhanced PAgP messages are only sent on channels configured in trust mode

Interfaces can be excluded from recovery mode. They will not go down when the switch goes into recovery mode

Cisco live!

VSS Dual-Active Detection

VSS Dual Active Detection Troubleshooting

```
Cat6K#show switch virtual dual-active summary

Pagp dual-active detection enabled: Yes

Fast-hello dual-active detection enabled: Yes

Interfaces excluded from shutdown in recovery mode:

  Gi1/5/3

  Gi2/5/3

In dual-active recovery mode: No

Cat6K#show switch virtual dual-active pagp

PAgP dual-active detection enabled: Yes

PAgP dual-active version: 1.1

Channel group 2 dual-active detect capability w/nbrs

Dual-Active trusted group: Yes

          Dual-Active     Partner           Partner   Partner

Port      Detect Capable  Name              Port      Version

Gi1/5/1   Yes             R1                Gi2/4     1.1

Gi1/6/2   Yes             R1                Gi5/2     1.1

.........
```

Shows that both enhanced PAgP and fast hello methods of dual active detection are enabled

Port channel 2 is trusted for Enhanced PAGP dual active detection … at least 1 trusted port channel needed !!

Check that the neighbour runs a SW version that supports Enhanced PAGP … if not, no dual active detection !!

VSS Dual-Active Detection

VSS Dual Active Detection Troubleshooting

- Recovery Mode: all non-VSL and all non-excluded ports will be internally shutdown

VSL

SW1

Active

Gig1/6/1   Gig2/9/1

Fast Hello

SW2

Standby

Po2

Gig2/9/15
Gig1/9/36
Gig2/6/12

Gig1/6/1
Gig1/5/1

Looks like my peer
is still there and
becoming Active.
Let me go to
Recovery Mode!

I lost my VSL.
Let me take over as Active!

ePAgP

Gig5/9
Gig4/16
Gig2/2
Gig5/2
Gig2/4

Po1

R1

Cisco live!

VSS Dual-Active Detection

VSS Dual Active Detection Troubleshooting
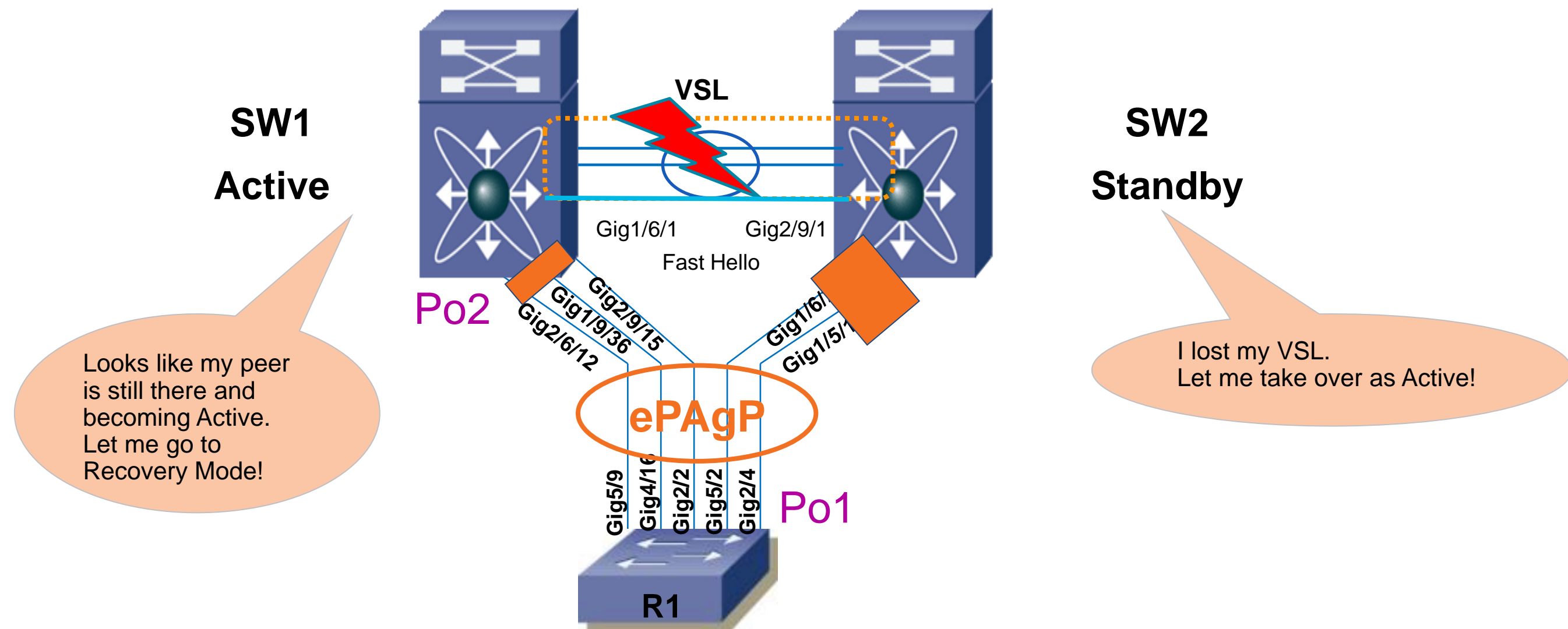
Enhanced PAGP detected both switch ids were active at the same time

- Trigger dual active situation by bringing down the VSL

```
*Apr  1 12:40:22.885 CET: %PAGP_DUAL_ACTIVE-SW1_SP-1-RECOVERY: PAgP running on Gi1/5/1 triggered dual-
    active recovery: active id 0011.bc75.4400 received,  expected 0011.5d54.6800

*Apr  1 12:40:22.945 CET: %DUAL_ACTIVE-SW1_SP-1-DETECTION: Dual-active condition detected: all non-VSL and
    non-excluded interfaces have been shut down
```

Original active switch (switch 1 in example) goes into recovery mode

- On switch in recovery mode, do "show ip interface brief | inc up" to check the interfaces that are up

```
Apr  1 12:40:20.096 CET: %VSLP-SW2_SPSTBY-2-VSL_DOWN: All VSL links went down while switch is in Standby
    role

*Apr  1 12:40:20.096 CET: %DUAL_ACTIVE-SW2_SPSTBY-1-VSL_DOWN: VSL is down switchover, or possible dual-
    active situation has occurred

*Apr  1 12:40:20.100 CET: %PFREDUN-SW2_SPSTBY-6-ACTIVE: Initializing as Virtual Switch ACTIVE processor
```

Original Standby switch goes into Active mode

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VSS Dual-Active Detection
VSS Dual Active Detection Troubleshooting

```
Cat6K#show switch virtual role

Switch   Switch Status  Preempt       Priority  Role      Session ID
         Number                       Oper(Conf) Oper(Conf)          Local  Remote
         -----------------------------------------------------------------

LOCAL    1      UP      TRUE (Y*)     200(200)  ACTIVE    0      0
Active configured preempt timer(switch 1): 5 minutes

In dual-active recovery mode: Yes

Triggered by: PAgP detection

Triggered on interface: Gi1/5/1

  <snip>
```

On switch id 1: originally active, now in recovery mode

Does not see switch 2 (as VSL is still down)

Mechanism that detected dual active was Enhanced PAgP, via link 1/5/1

```
Cat6K#show switch virtual role

Switch   Switch Status  Preempt       Priority  Role      Session ID
         Number                       Oper(Conf) Oper(Conf)          Local  Remote
         -----------------------------------------------------------------

LOCAL    2      UP      TRUE (Y*)     100(100)  ACTIVE    0      0
Active configured preempt timer(switch 2): 5 minutes
In dual-active recovery mode: No
```

Switch id 2 is now the "real" active switch, and doesn't see switch id 1 as long as the VSL is down

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VSS Dual-Active Detection
Bringing up the VSL

```
*Apr  1 12:49:29.513 CET: %DUAL_ACTIVE-1-VSL_RECOVERED: VSL has    recovered during dual-active situation:
   Reloading switch 1

*Apr  1 12:49:29.513 CET: %VS_GENERIC-5-VS_CONFIG_DIRTY: Configuration  has changed. Ignored reload request
   until configuration is saved

*Apr  1 12:49:32.781 CET: %LINK-SW2_SP-3-UPDOWN: Interface TenGigabitEthernet2/5/4 changed state to up

*Apr  1 12:49:49.128 CET: %VSLP-SW2_SP-5-VSL_UP:  Ready for Role Resolution with Switch=1,
   MAC=0011.5d54.6800 over Te2/2/6

*Apr  1 12:49:50.320 CET: Initializing as Virtual Switch ACTIVE processor

*Apr  1 12:49:52.140 CET: %VSLP-SW2_SP-5-RRP_MSG: Peer Switch with unsaved configurations needs to be
   reloaded. Please save relevant configurations on the peer switch and reload it.
```

- Configuration deemed "DIRTY" since configuration mode was entered and configuration was not written. Do NOT change configuration when the switch is in Recovery mode.

- Configuration must be saved MANUALLY and reloaded to bring the switch back up into the VSS

Supervisor 2T/PFC4 Architecture

MSFC5 Complex contains single (combined SP/RP) CMP CPU

Fabric interface / Replication engine to interface with fabric & bus, and for multicast/SPAN replication

NetFlow Hash & Data tables for stats & features

CL1 TCAM contains Security & Feature ACL entries

FIB contains IPv4 / IPv6 prefixes and MPLS entries

ADJ contains Rewrite info

CL2 TCAM contains QoS ACL entries

LIF Map contains port mappings

Reverse Path Forwarding info

Hardware for ACL TCAM counters

L2 CAM contains MAC entries

Logical Interface (LIF) Table contains entries

Logical Interface Statistics

Switch Fabric

MSFC 5

Central Management Processor CPU

DRAM Flash

Switch Fabric 26 x 40G Traces

2 x 1 Gbps

40 Gbps

1GE / 10GE Uplinks

Port ASIC

MET

Fabric Interface & Replication Engine

PFC

NetFlow CL1 TCAM ADJ TCAM FIB TCAM CL2 TCAM

LIF MAP **L3/4 Engine** RPF Table

LIF Table LIF Stats **L2 Engine** ACE Counter

L2 CAM (128K)

Traces # 1 to 26

EOBC

DBUS RBUS

Cisco live!

Sup720 vs. Sup2T Overview

Sup720

Sup2T

Control-Plane

Route Processor (RP)

Switch Processor (SP)

Dual Core Processor

MSFC 3

MSFC 5

Data-Plane

Policy Feature Card

Policy Feature Card

PFC3

PFC4

 　Cisco Public
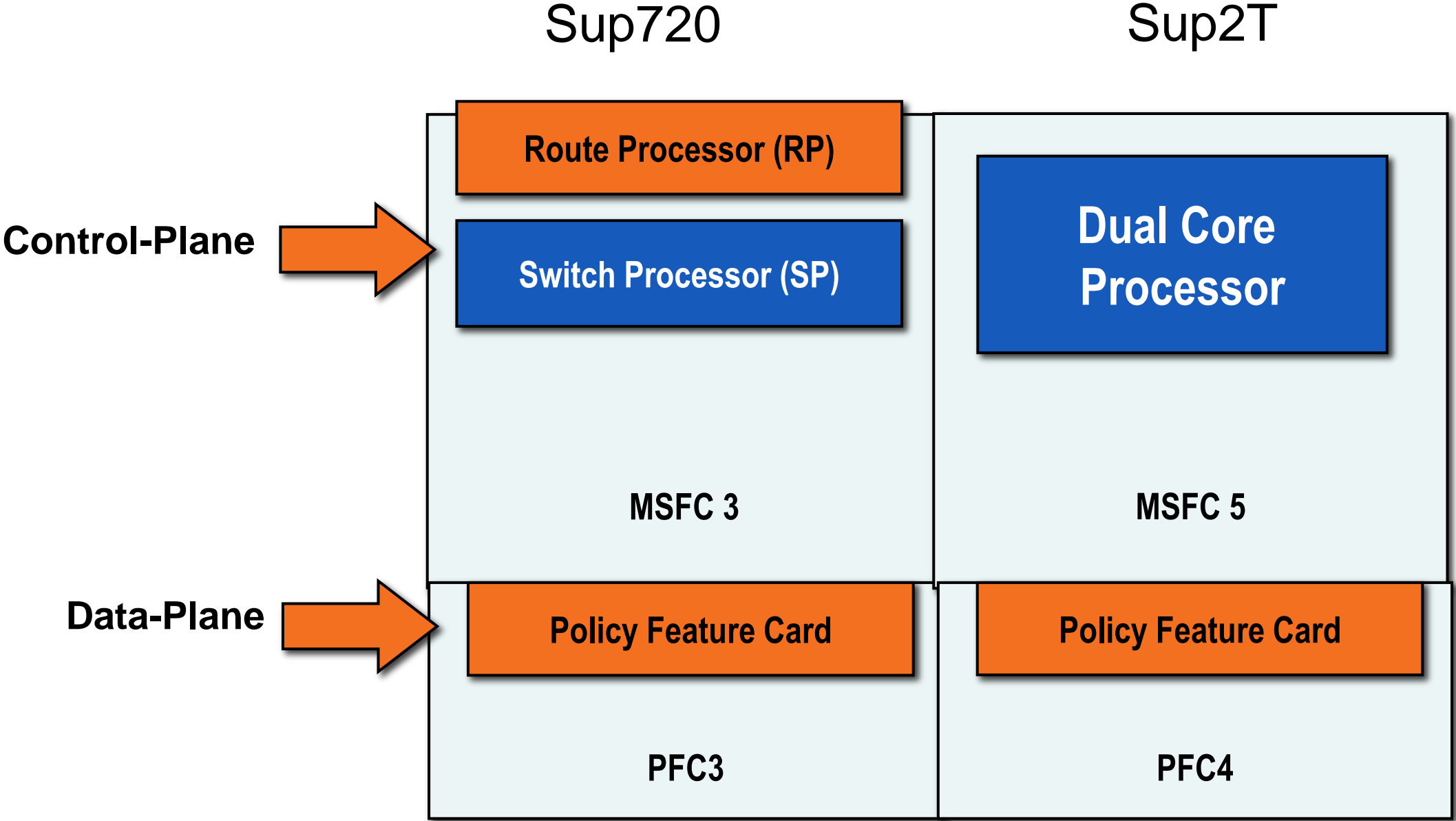
Sup2T Overview

- Integrated with Control Management Processor (CMP)

- USB-based console and flash support

- Key improvement: Single-Cycle Input & Output Processing

- Has superior Control-Plane protection

- Supports all Sup720 features, including VSS

 Cisco Public

L3 Packet Flow Troubleshooting
Verify IP Route

```
Sup2T#show ip route 192.168.200.5
 Routing entry for 192.168.200.4/30
  Known via "static", distance 1, metric 0
  Routing Descriptor Blocks:
    192.168.25.5
      Route metric is 0, traffic share count is 1
  * 192.168.25.1
      Route metric is 0, traffic share count is 1


Sup2T#show ip route 192.168.200.9
 Routing entry for 192.168.200.8/30
  Known via "static", distance 1, metric 0
  Routing Descriptor Blocks:
    192.168.100.5
      Route metric is 0, traffic share count is 1
  * 192.168.100.1
      Route metric is 0, traffic share count is 1
```

R2

Host2
192.168.200.9

Gig3/2   Gig3/1

.1   .5

192.168.100.0/30   192.168.100.4/30

.2   .6

Gig3/25   Gig3/26

Sup2T

Gig1/25   Gig1/26

.2   .6

192.168.25.0/30   192.168.25.4/3

.1   .5

Gig3/1   Gig3/2

R1

Host1
192.168.200.5
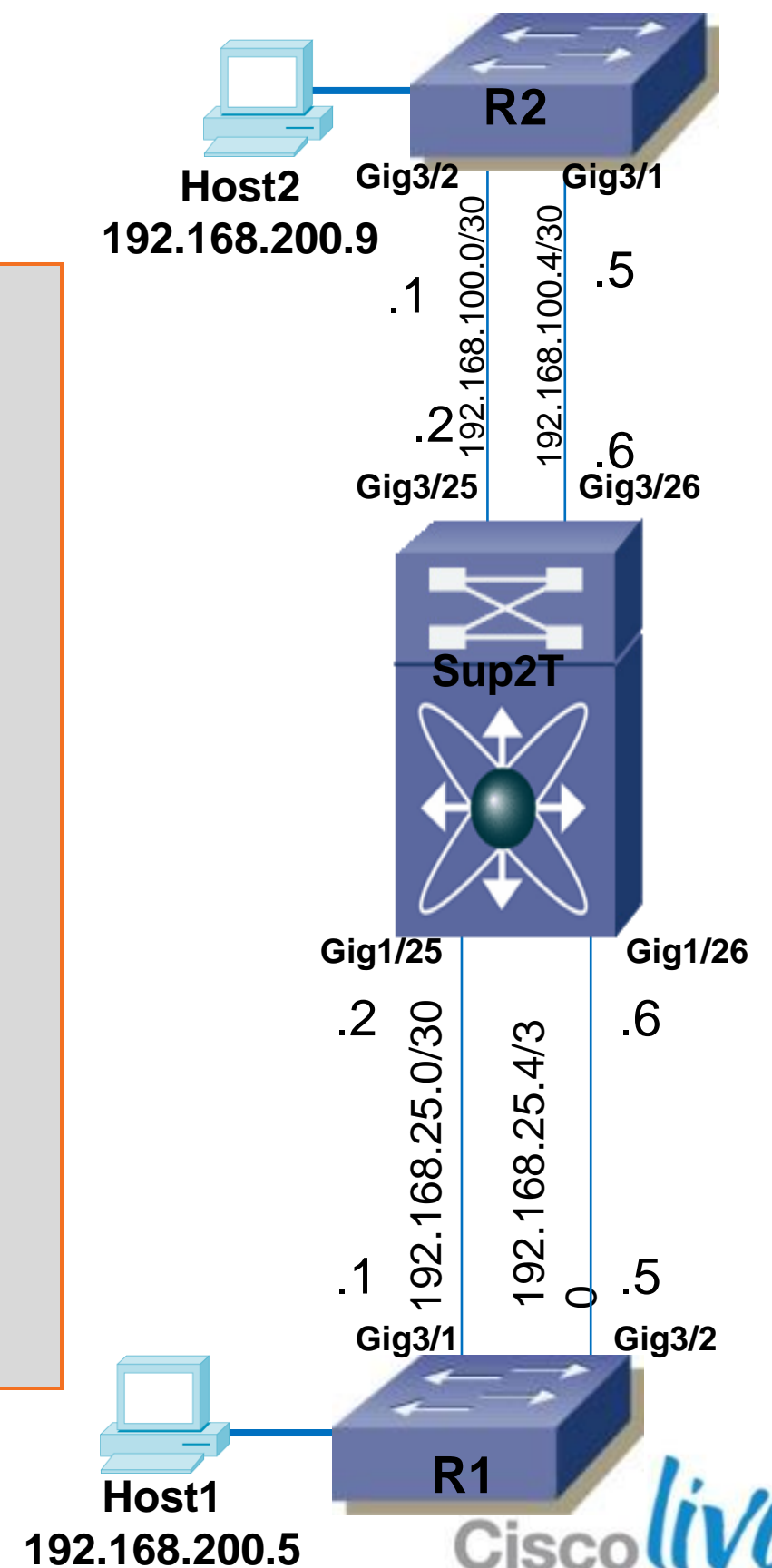
L3 Packet Flow Troubleshooting

```
Sup2T#show ip cef 192.168.200.9
192.168.200.8/30
  nexthop 192.168.100.1 GigabitEthernet3/25
  nexthop 192.168.100.5 GigabitEthernet3/26
Sup2T#show ip cef exact-route 192.168.200.5 192.168.200.9
192.168.200.5 -> 192.168.200.9 => IP adj out of GigabitEthernet3/25, addr 192.168.100.1
Sup2T#show ip cef adjacency GigabitEthernet 3/25 192.168.100.1
192.168.100.1/32
  attached to GigabitEthernet3/25
192.168.200.8/30
  nexthop 192.168.100.1 GigabitEthernet3/25
```
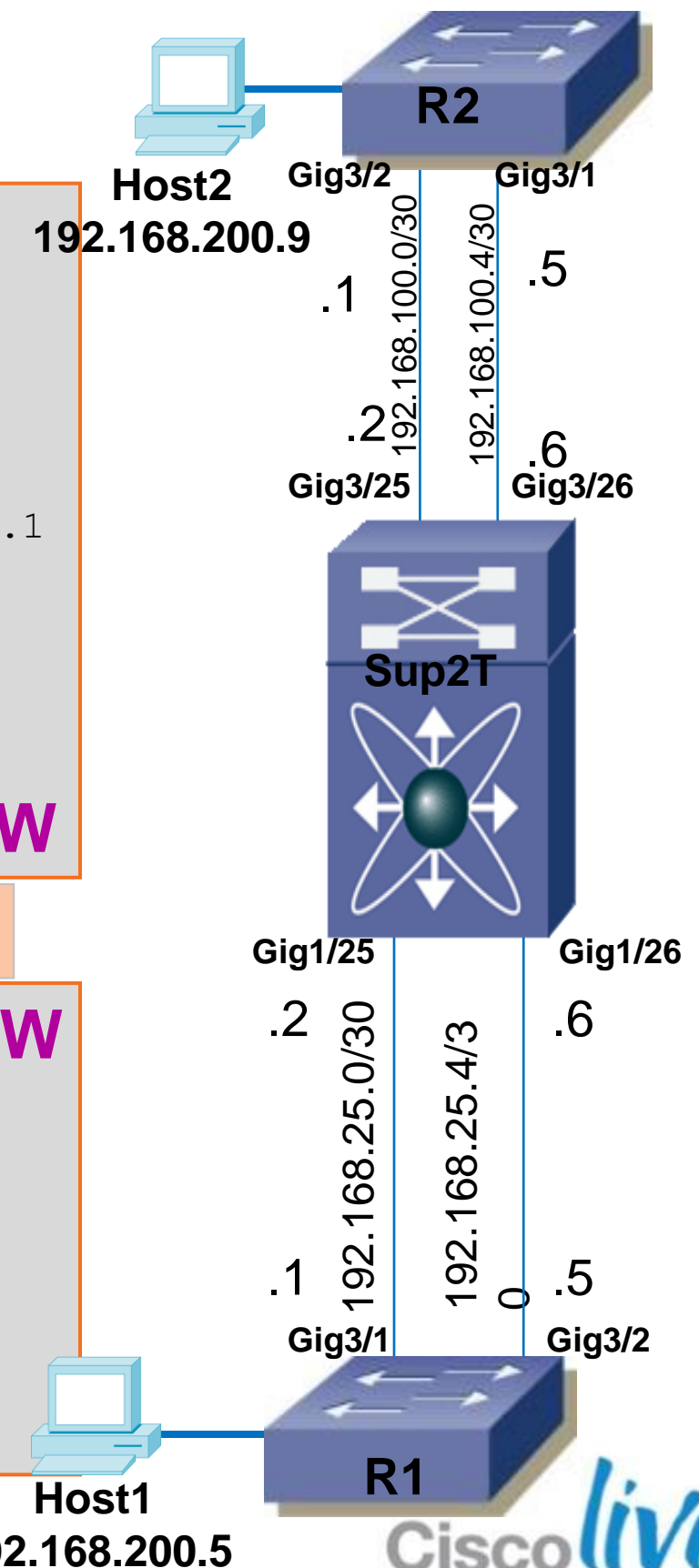
SW

No more MLS. Use "platform hardware".

HW

```
Sup2T#show platform hardware cef lookup 192.168.200.9
Codes: decap - Decapsulation, + - Push Label
Index  Prefix                  Adjacency
219265 192.168.200.8/30   Gi3/25            ,001d.e656.cc00 (Hash: 007F)
                          Gi3/26            ,001d.e656.cc00 (Hash: 7F80)
Sup2T#show platform hardware cef exact-route 192.169.200.5 0 192.168.200.9 0
Interface: Gi3/26, Next Hop: 192.168.100.5, ifnum: 0x7E, Destination Mac:
    001d.e656.cc00   LIF: 0x2000411B
```

Host2
192.168.200.9

R2

Gig3/2   Gig3/1

.1   192.168.100.0/30   192.168.100.4/30   .5

.2   .6

Gig3/25   Gig3/26

Sup2T

Gig1/25   Gig1/26

.2   192.168.25.0/30   192.168.25.4/3   .6

.1   .5

Gig3/1   Gig3/2

Host1

R1

192.168.200.5
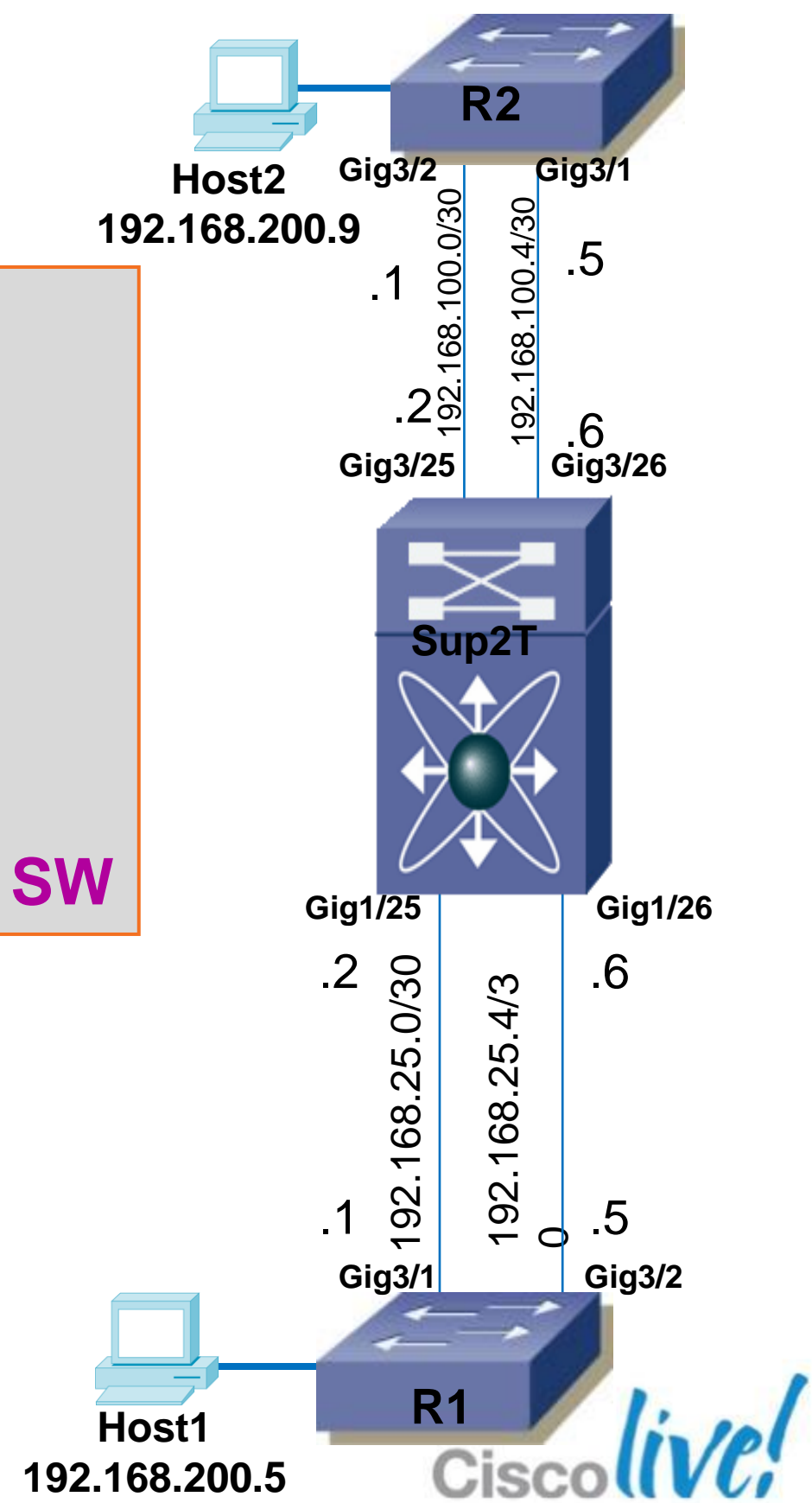
L3 Packet Flow Troubleshooting
L3 FIB Counters and Tables

```
Sup2T#show adjacency Gig3/25 192.168.100.1 detail
Protocol Interface                 Address
IP       GigabitEthernet3/25       192.168.100.1(13)
                                   2001 packets, 11682 bytes
                                   epoch 2
                                   sourced in sev-epoch 29
                                   Encap length 14
                                   001DE656CC00001DE65828000800
                                   L2 destination address byte offset 0
                                   L2 destination address byte length 6
                                   Link-type after encap: ip
                                   ARP                                      SW
```

Rewrite information (Dmac|Smac|0800): verify it is conform with next hop rewrite info

R2

Host2
192.168.200.9

Gig3/2   Gig3/1

.1   192.168.100.0/30   192.168.100.4/30   .5

.2   .6

Gig3/25   Gig3/26

Sup2T

Gig1/25   Gig1/26

.2   192.168.25.0/30   192.168.25.4/3   .6

.1   0   .5

Gig3/1   Gig3/2

Host1
192.168.200.5

R1

L3 Packet Flow Troubleshooting
L3 FIB Counters and Tables

HW

```
Sup2T#show platform hardware cef ip 192.168.100.5 detail

Codes: M - mask entry, V - value entry, A - adjacency index, NR- no_route bit
       LS - load sharing count, RI - router_ip bit, DF: default bit
       CP - copy_to_cpu bit, AS: dest_AS_number, DGTv - dgt_valid bit
       DGT: dgt/others value

Format:IPV4 (valid class vpn    prefix)
M(54794  ):    1      F     3FFF 255.255.255.255
V(54794  ):    1      0     0    192.168.100.5
                          (A:376833, LS:0, NR:0, RI:0, DF:0 CP:0 DGTv:1, DGT:0)
```
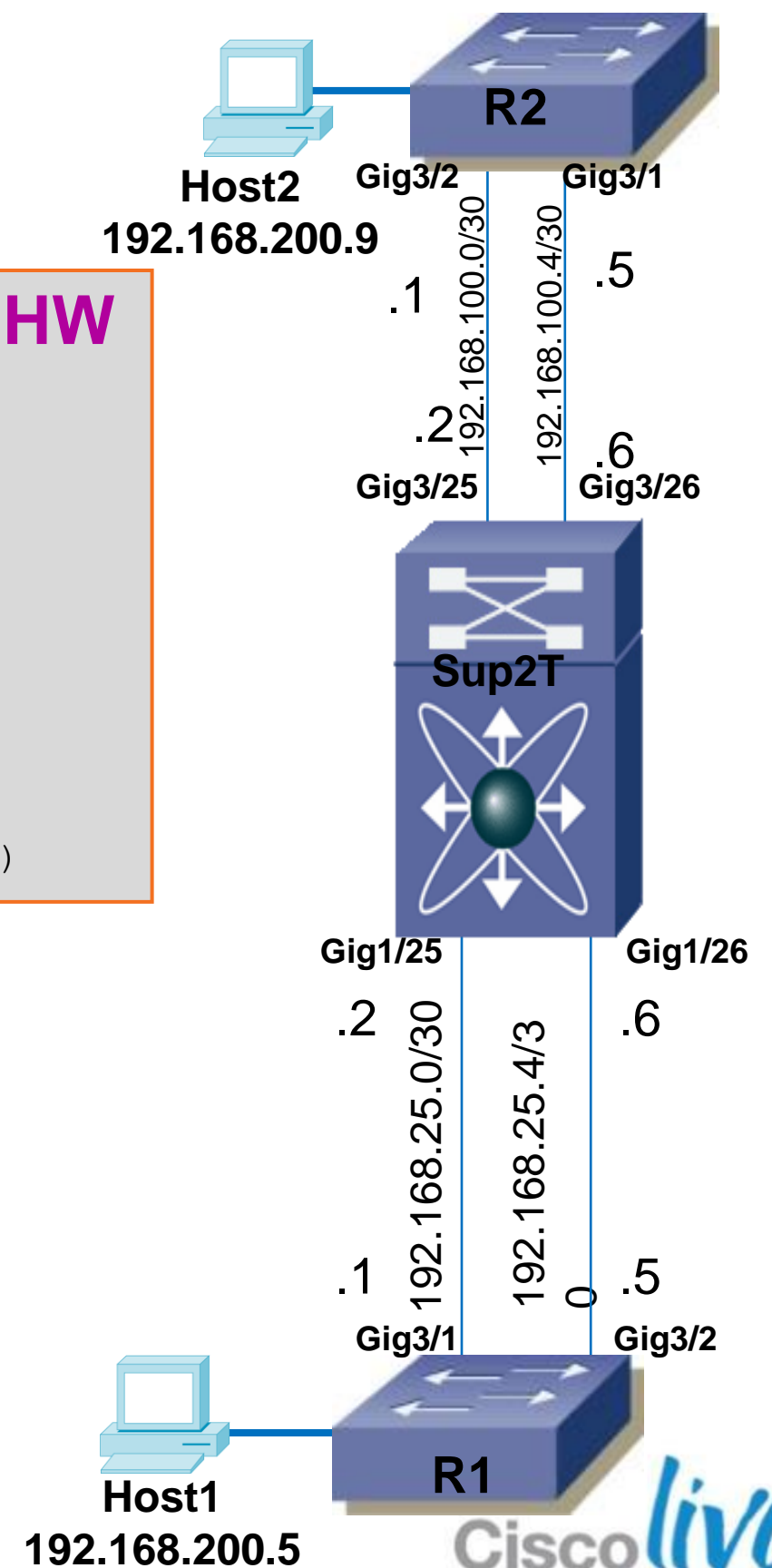
Start adjacency pointer is 376833

Host2
192.168.200.9

R2

Gig3/2   Gig3/1

.1   192.168.100.0/30   192.168.100.4/30   .5

.2   .6

Gig3/25   **Gig3/26**

Sup2T

Gig1/25   **Gig1/26**

.2   192.168.25.0/30   192.168.25.4/3   .6

.1   0   .5

Gig3/1   **Gig3/2**

R1

Host1
192.168.200.5

    Cisco Public

L3 Packet Flow Troubleshooting
L3 FIB Counters and Tables

R2

Host2
192.168.200.9

Gig3/2   Gig3/1

.1   192.168.100.0/30   192.168.100.4/30   .5
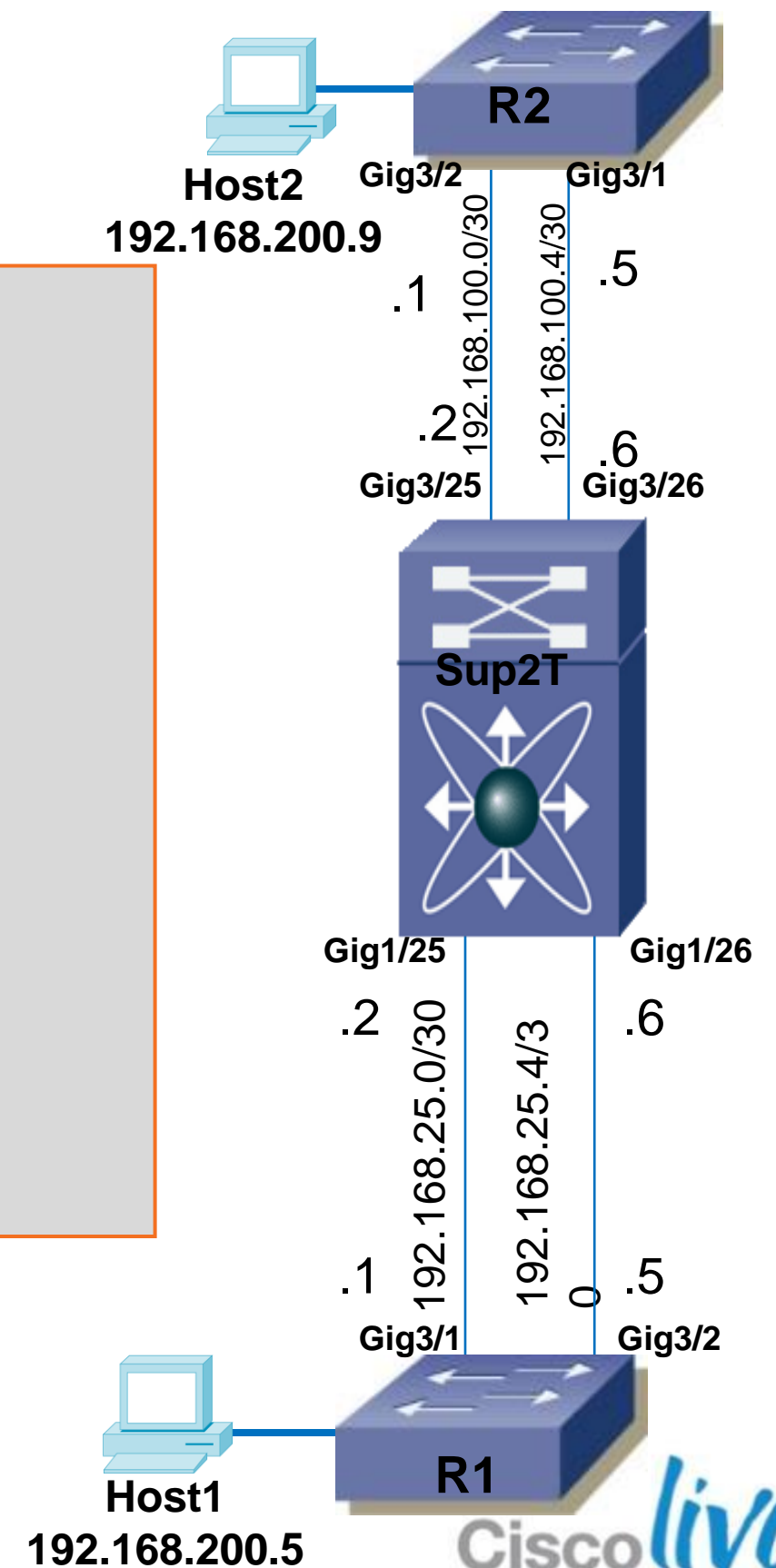
```
Sup2T#show platform hardware cef adjacencies entry 376833 detail
Index: 376833 -- Valid entry (valid = 1) –
  Adjacency fields:
  _____
   |adj_stats =  EN  | fwd_stats =  EN  | trig = 0
   |_____|_____|_____
   |l3_enable = ON (classify as Layer3) | age = 0
   |_____|_____|_____
   |format = IP      | rdt = ON         | ignr_emut = 0
   |_____|_____|_____
   |vpn = 0x3FFF     | elif = 0x411B    | ri = 3
   |_____|_____|_____
   |top_sel = 0      | zone_enf = OFF   | fltr_en = OFF
   |_____|_____|_____
   |frr_te = OFF     | idx_sel = 0      | tnl_encap = 0
   |_____|_____|_____
   |rw_hint = 0      | ttl_control = 4  |
   |_____|_____|_____

. . . Continued . . .
```
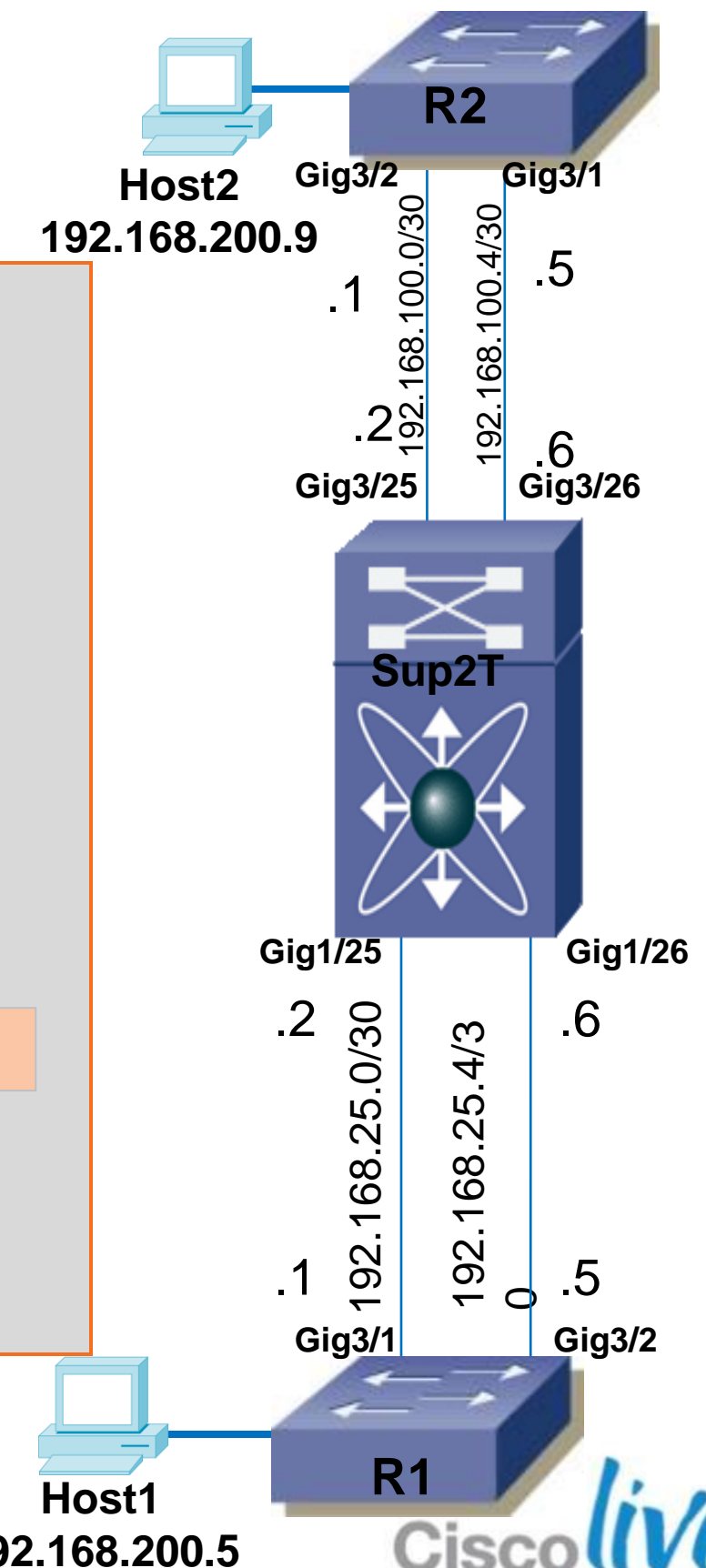
.2 192.168.100.0/30   .6

Gig3/25   Gig3/26

Sup2T

Gig1/25   Gig1/26

.2   192.168.25.0/30   192.168.25.4/3   .6

.1   0   .5

Gig3/1   Gig3/2

Host1
192.168.200.5

R1

L3 Packet Flow Troubleshooting
L3 FIB Counters and Tables

```
. . . Continued . . .

  RIT fields: The entry has a Layer2 Format

  _____
  |decr_ttl = YES   | pipe_ttl = 0       | utos = 0
  |_____|_____|_____
  |l2_fwd = 0       | rmac = 0           | ccc = L3_REWRITE
  |_____|_____|_____
  |rm_null_lbl = YES| rm_last_lbl = YES  | pv = 0
  |_____|_____|_____
  |add_shim_hdr= NO | rec_findex = N/A   | rec_shim_op = N/A
  |_____|_____|_____
  |rec_dti_type = N/A                    | rec_data = N/A
  |_____|_____
  |modify_smac = YES| modify_dmac = YES  | egress_mcast = NO
  |_____|_____|_____
  |ip_to_mac = NO
  |_____
  |dest_mac = 001d.e656.cc00   | src_mac = 001d.e658.2800
  |_____|_____
  |
Statistics: Packets = 1138
            Bytes   = 569016
```

Rewrite MAC info

Statistics

Host2
192.168.200.9

R2

Gig3/2 Gig3/1

.1   .5

192.168.100.0/30   192.168.100.4/30

.2   .6

Gig3/25   Gig3/26

Sup2T

Gig1/25   Gig1/26

.2   .6

192.168.25.0/30   192.168.25.4/3

.1   .5

Gig3/1   Gig3/2

R1

Host1
192.168.200.5

Summary

- Troubleshooting Catalyst 4500

- Troubleshooting Catalyst 6500

- Sup-720 and Sup-2T

- Troubleshooting High CPU

- Troubleshooting VSS

 Cisco Public

Q & A

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