Cisco ASR 9000 Architecture and Troubleshooting

CSC-ASR9000

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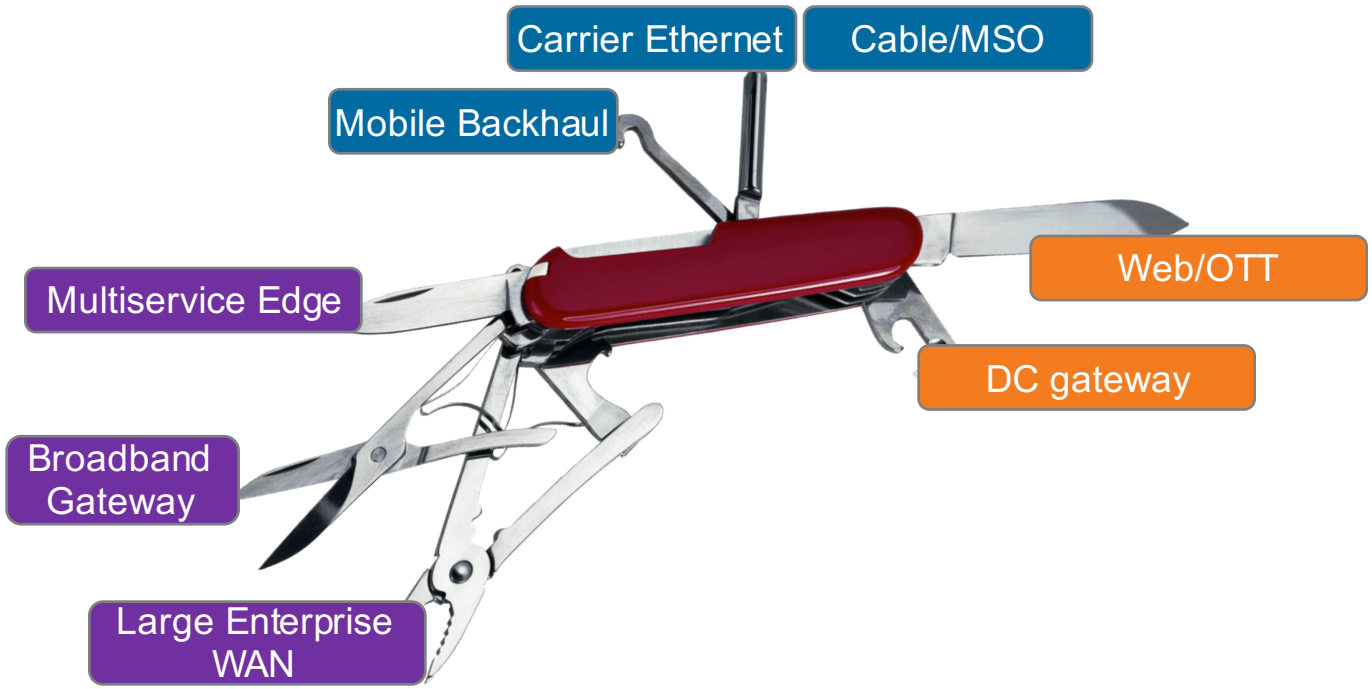
Swiss Army Knife Built for Edge Routing World

- Cisco ASR9000 Market Roles



1. High-End Aggregation & Transport

1. Mobile Backhaul
2. L2/Metro Aggregation
3. CMTS Aggregation
4. Video Distribution & Services

2. DC Gateway Router

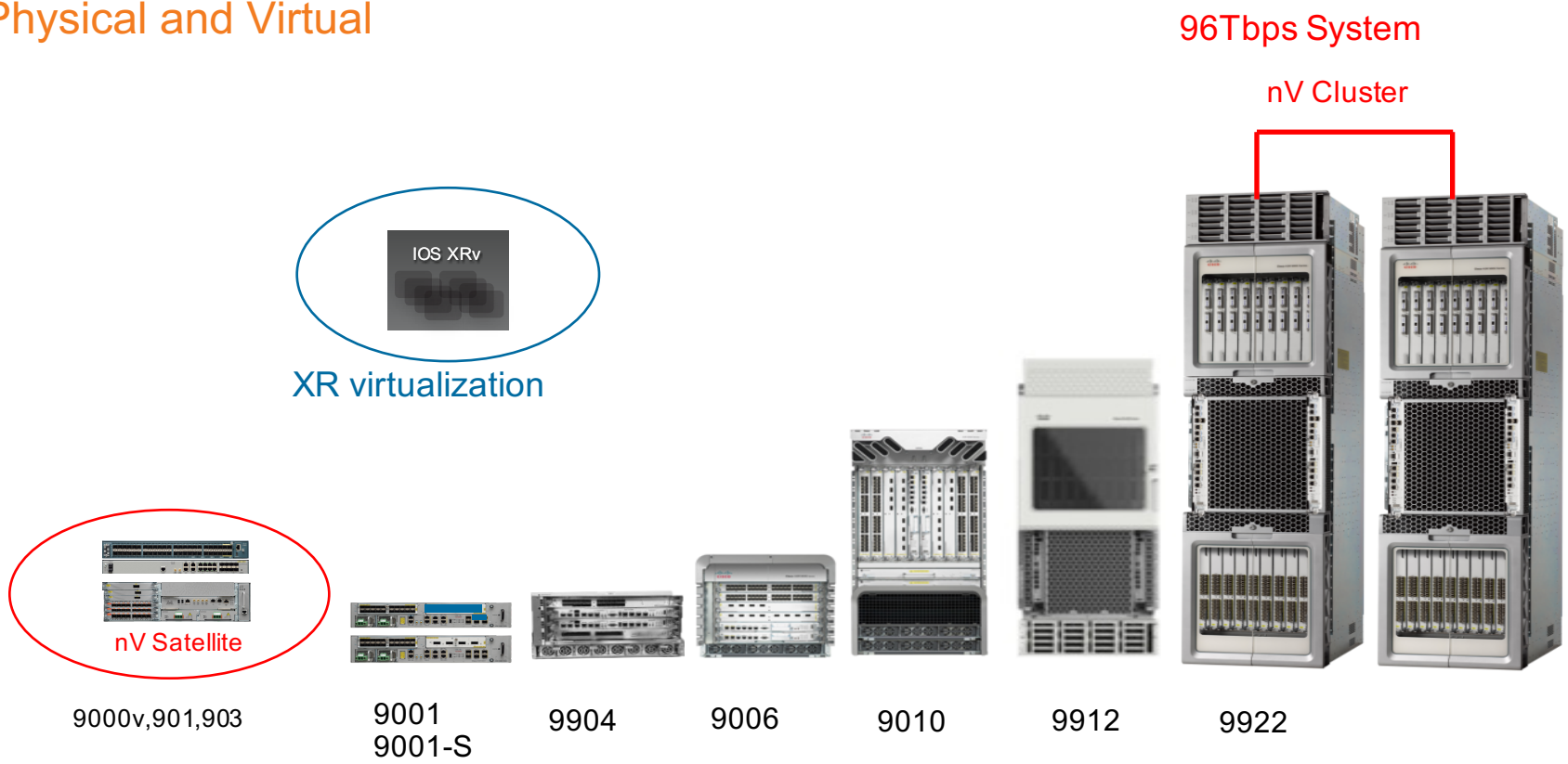
1. DC Interconnect
2. DC WAN Edge
3. WEB/OTT

3. Services Router

1. Business Services
2. Residential Broadband
3. Converged Edge/Core
4. Enterprise WAN

Scalable System Architecture and Portfolio

Physical and Virtual



Agenda

- Hardware Architecture
- Operating System & Configuration
- Frame Journey
- Control, Management, & Security
- Troubleshooting

Hardware Architecture

ASR 9010 and ASR 9006 Chassis

Shipping since day 1

Front-to-back air flow with air flow baffles, 13RU, vertical

Side-to-back airflow, 10 RU

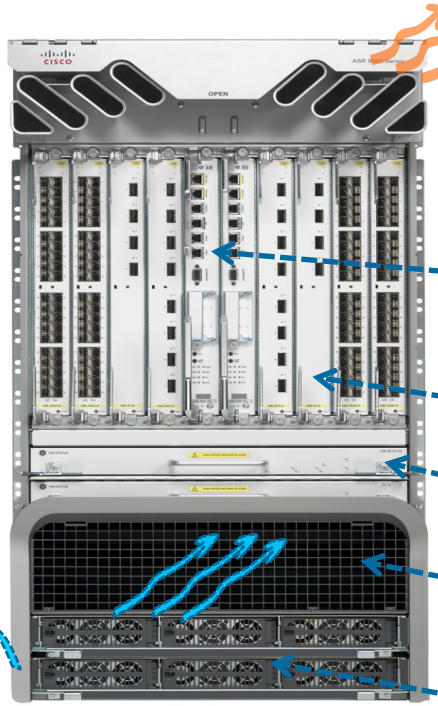
System fan trays (2x)

Line Card (0-3)

RSP (0-1) (integrated switch fabric)

Power shelf for modular AC|DC PS

Front-to-back airflow



RSP (0-1) (integrated switch fabric)

Line Card (0-3, 4-7)

System fan trays (2x)

Air draw

21RU

2 power shelves for modular AC|DC PS

ASR 9001 Compact Chassis

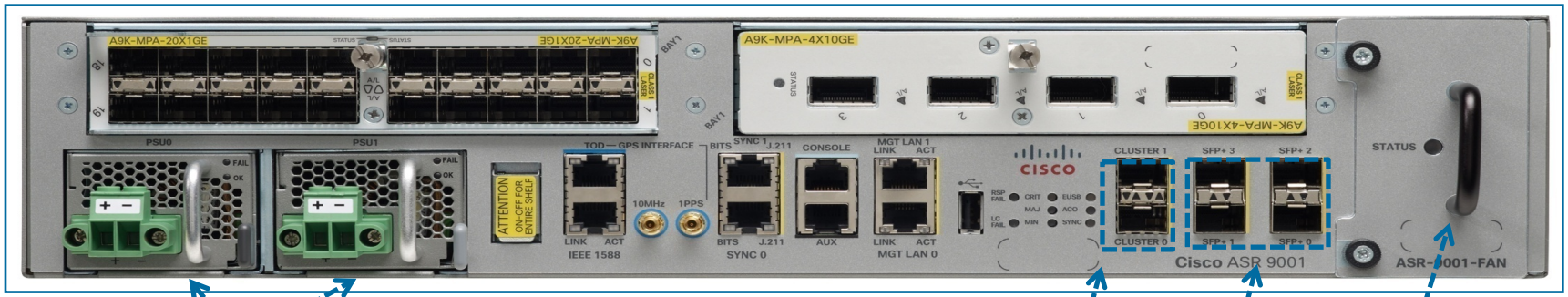
Shipping since IOS-XR 4.2.1 May 2012

Side-to-Side airflow
2RU

Front-to-back air flow with air flow baffles, 4RU, require V2 fan

Sub-slot 0 with MPA

Sub-slot 1 with MPA



Redundant
(AC or DC)
Power Supplies
Field Replaceable

Supported MPAs:

20x1GE
2x10GE
4x10GE
1x40GE

EOBC
(cluster)

Fixed 4x10G SFP+ ports

Fan Tray
Field Replaceable

ASR 9001-S Compact Chassis

Shipping since IOS-XR 4.3.1 May 2013

Side-to-Side airflow
2RU

Front-to-back air flow with air flow baffles, 4RU, require V2 fan

Supported MPAs:

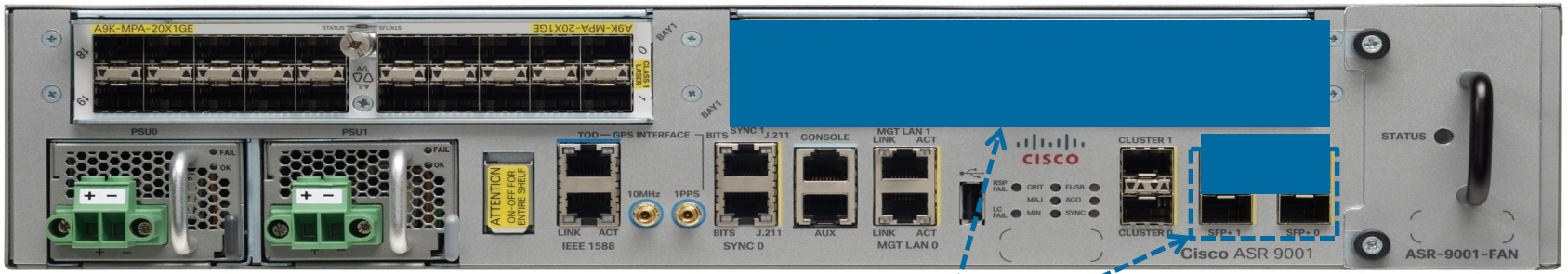
20x1GE
2x10GE
4x10GE
1x40GE

Pay As You Grow

- Low entry cost
- **SW License upgradable to full 9001**

Sub-slot 0 with MPA

Sub-slot 1 with MPA

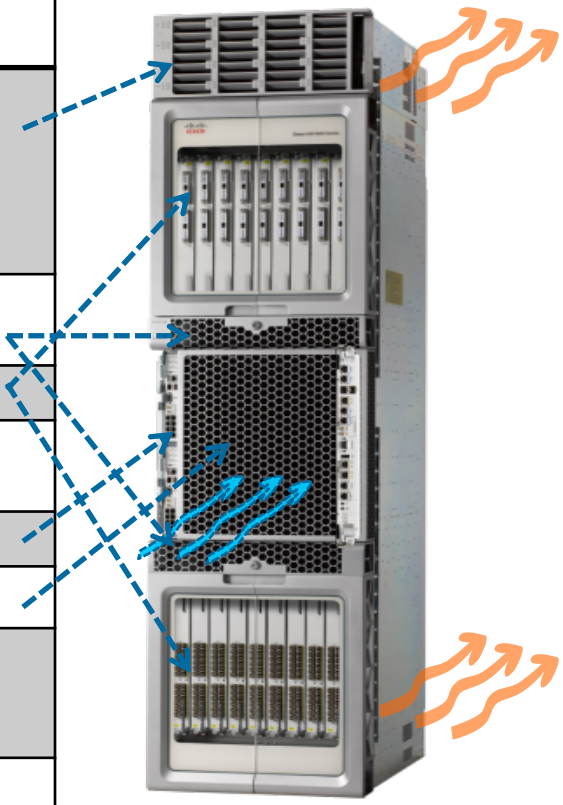


60G bandwidth are disabled by software. SW license to enable it

ASR 9922 Large Scale Chassis

Shipping since IOS-XR 4.2.2 August 2012

Features	Description
Power	4 Power Shelves, 12|16 Power Modules 4.4 | 2.1 kW DC ; 6.0 | 3.0 kW AC supplies N+N AC supply redundancy N+N | N+1 DC supply redundancy
Fan	4 Fan Trays Front to back airflow
I/O Slots	20 I/O slots
Rack Size	44 RU
RP	1+1 RP redundancy
Fabric	6+1 fabric redundancy.
Bandwidth	Phase 1: 550Gb per Slot Phase 2: 1.6Tb per Slot Future: 2+Tb per Slot
SW	XR 4.2.2 – August 2012

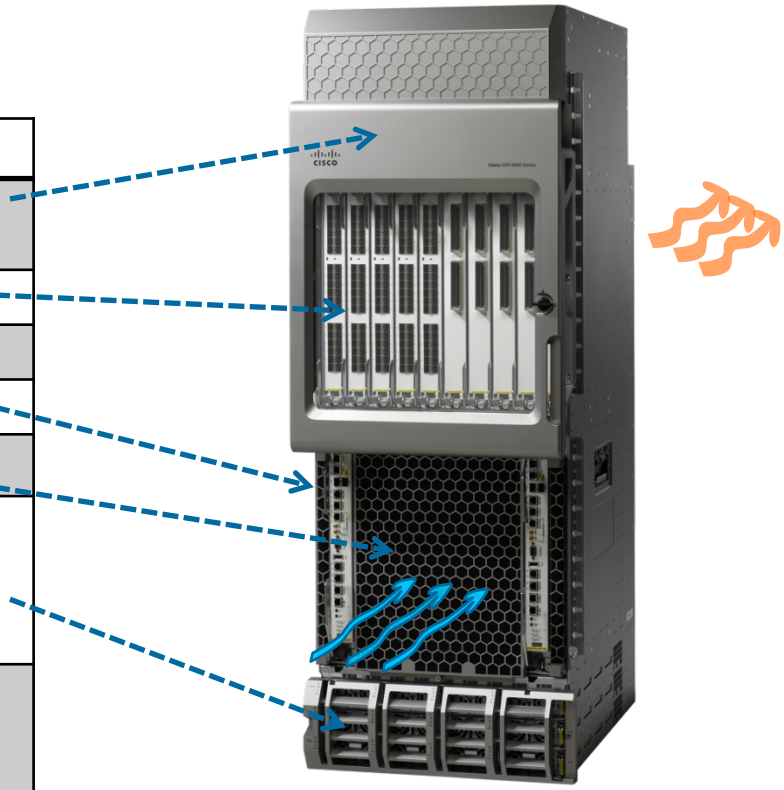


Fully loaded Engineering testbed

ASR 9912 Large Scale Chassis

Shipping since XR4.3.2 & 5.1.0, Sep 2013

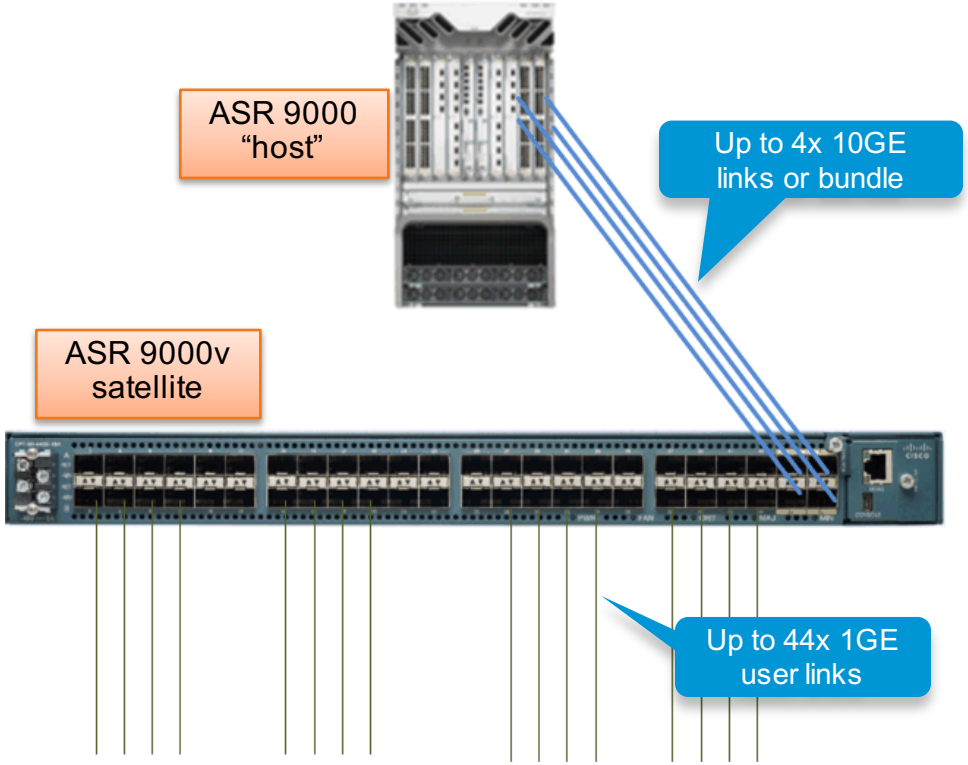
Features	Description
Fan	2 Fan Trays Front to back airflow
I/O Slots	10 I/O slots
Rack Size	30 RU
RP	1+1 RP redundancy
Fabric	6+1 fabric redundancy
Power	3 Power Shelves, 9|12 Power Modules 4.4 | 2.1 kW DC ; 6.0 | 3.0 kW AC supplies N+N AC power supply redundancy N+N | N+1 DC power supply redundancy
Bandwidth	Phase 1: 550Gb per Slot Phase 2: 1.6Tb per Slot Future: 2+Tb per Slot
SW	XR 4.3.2 & 5.1.0



ASR 9000v “Satellite”

Local or remote 10G to 1G fan out

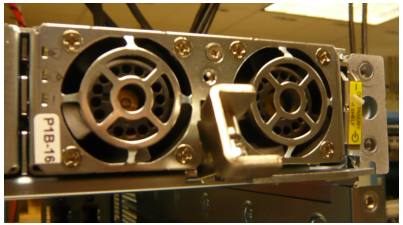
- Local or remote
- All configuration done on host
- L2/3/4 operation done on host
  - No local switching on satellite
  - Ingress & egress QoS done on host
- 1GE ports can be assigned to specific 10G ports or bundle



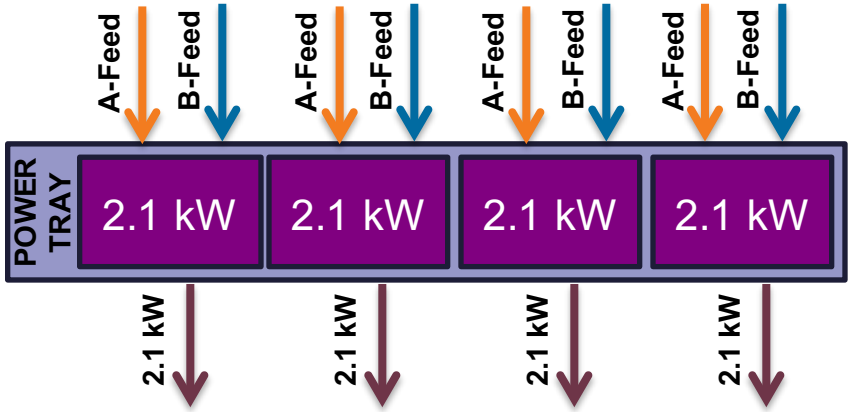
Power and Cooling

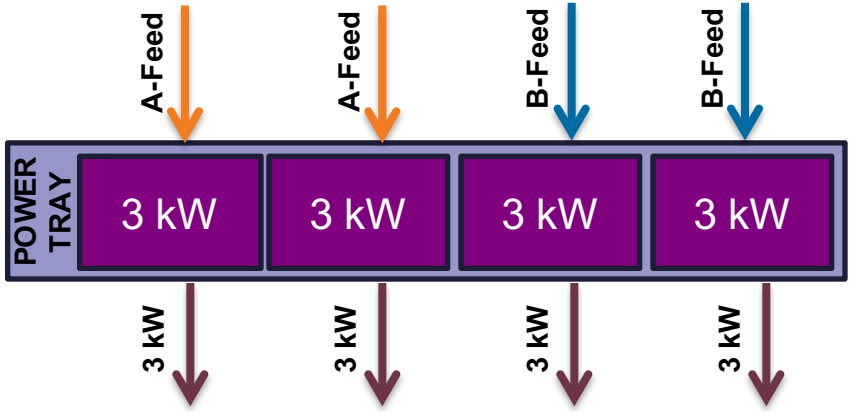
ASR-9010-FAN

ASR-9006-FAN



Power Supply

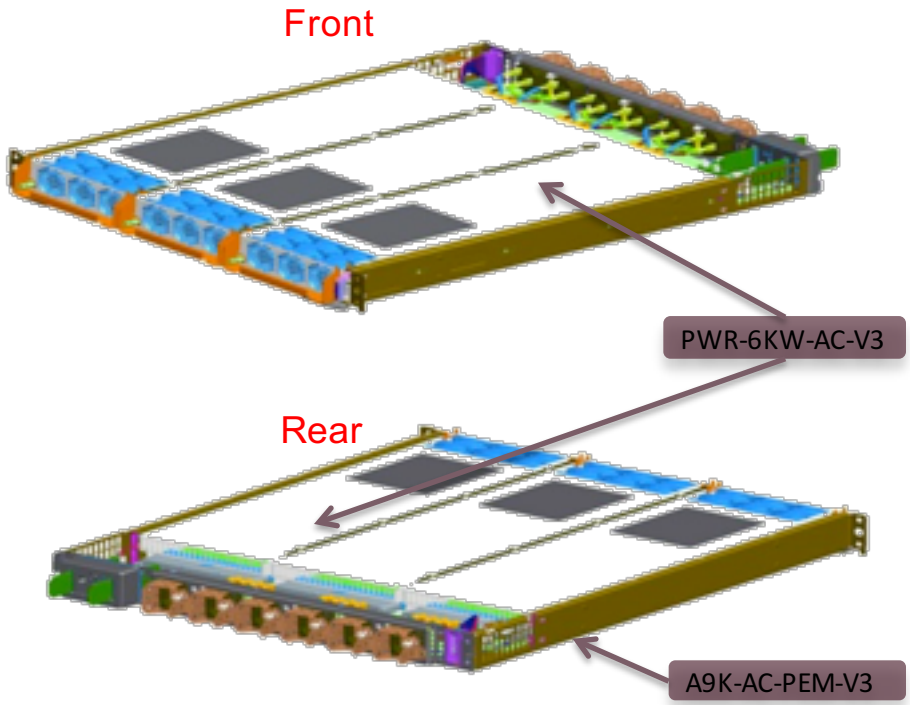




Version 3 AC Power Supply

New Power Tray and Power Supply

- Three 6kW AC PMs per tray
- Two logically AND'ed single phase 3kW AC power inputs per PM
  - If both inputs are active, output is max 6kW
  - If only one input is active, Power Supply is still working, output will be max 3kW
- Input 16/20A@230V AC & same power cords → easily upgradeable!

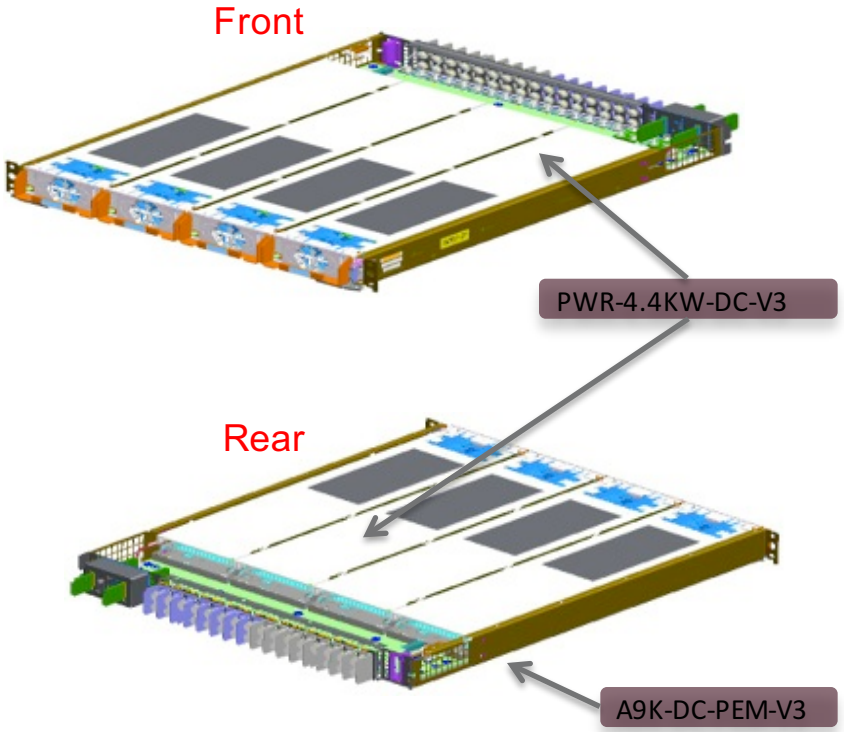


New AC Tray

Version 3 DC Power Supply

New Power Tray and Power Supply

- Four 4.4kW DC PMs per tray
- Two logically AND'ed DC power feeds per PM
  - If both inputs are active, output is max 4.4kW
  - If only one input is active, Power Supply is still working, output will be max 2.2kW
- DC power requirements & DC lug → "easily" upgradeable if you like copper ☺



New DC Tray

ASR9000 Power Supplies

	AC V2	AC V3	DC V2	DC V3
Max Power	3 kW	6 kW	2.1 kW	4.4 kW
# of Feeds	1	2	2	2
Feed redundancy in PEM	n/a	No	Yes	No
# of PSs per power tray	4	3	4	4
Redundancy scheme[1)]	N+N	N+N	N+1	N+N

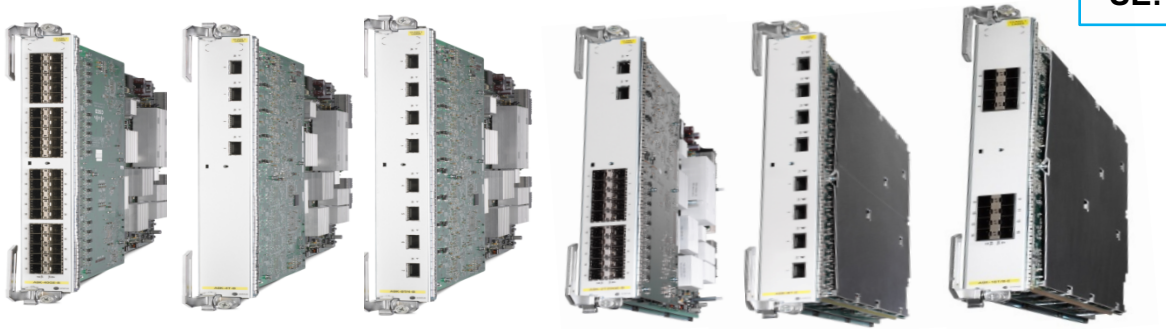
number of modules required to protect from feed failure (e.g. power grid outage)

ASR 9K Ethernet Line Card Overview

-TR: Transport Optimized
-SE: Service edge Optimized

First-generation LC (Trident NP)

-L, -B, -E

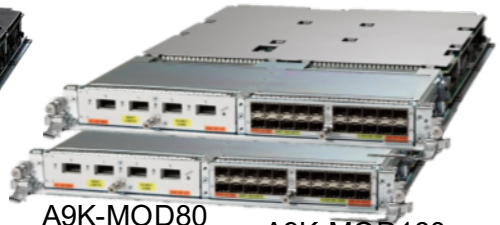


A9K-40G | A9K-4T | A9K-8T/4 | A9K-2T20G | A9K-8T | A9K-16T/8

Second-gen LC (Typhoon)

-TR, -SE

A9K-24x10GE A9K-2x100GE



A9K-MOD80 A9K-MOD160

A9K-36x10GE

MPAs
20x1GE
2x10GE
4x10GE
8x10GE
1x40GE
2x40GE

Third-gen LC (Tomahawk)

-TR, -SE

Tomahawk 8x100GE CPAK Line Card

Tomahawk 4x100GE CPAK Line Card

ASR 9000 Tomahawk Line Cards

Built with Cutting Edge, Customized, Flexible, Efficient Silicon

Cutting Edge

- Unprecedented Scale – 240Gbps in one ASIC!
- Hardware Offload of CPU Intensive Protocols

Customized

- High Availability Customized Silicon – Hitless FPD Upgrades
- Embedded MACSec for Increased Security

Flexible

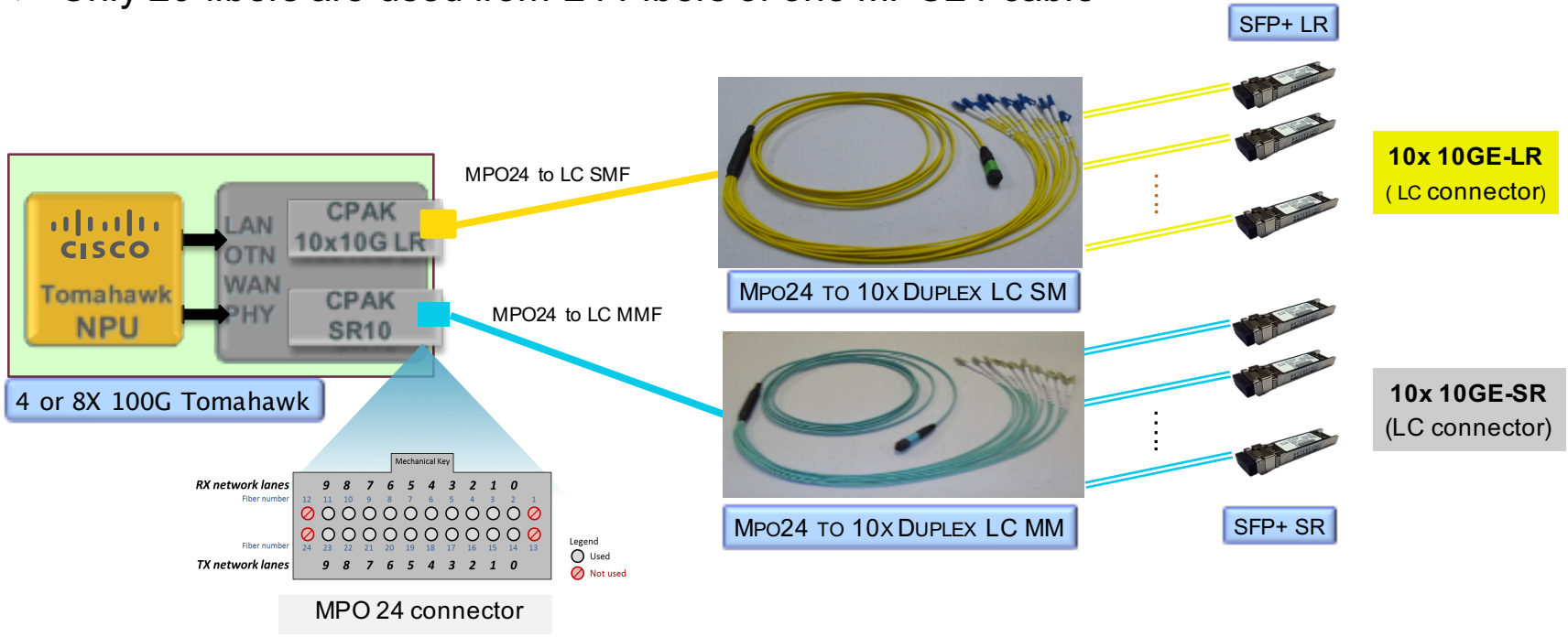
- CPAK Delivers 10G, 40G or 100G on any Interface on One LC
- Common Sparing and Onetime LC Qualification

Efficient

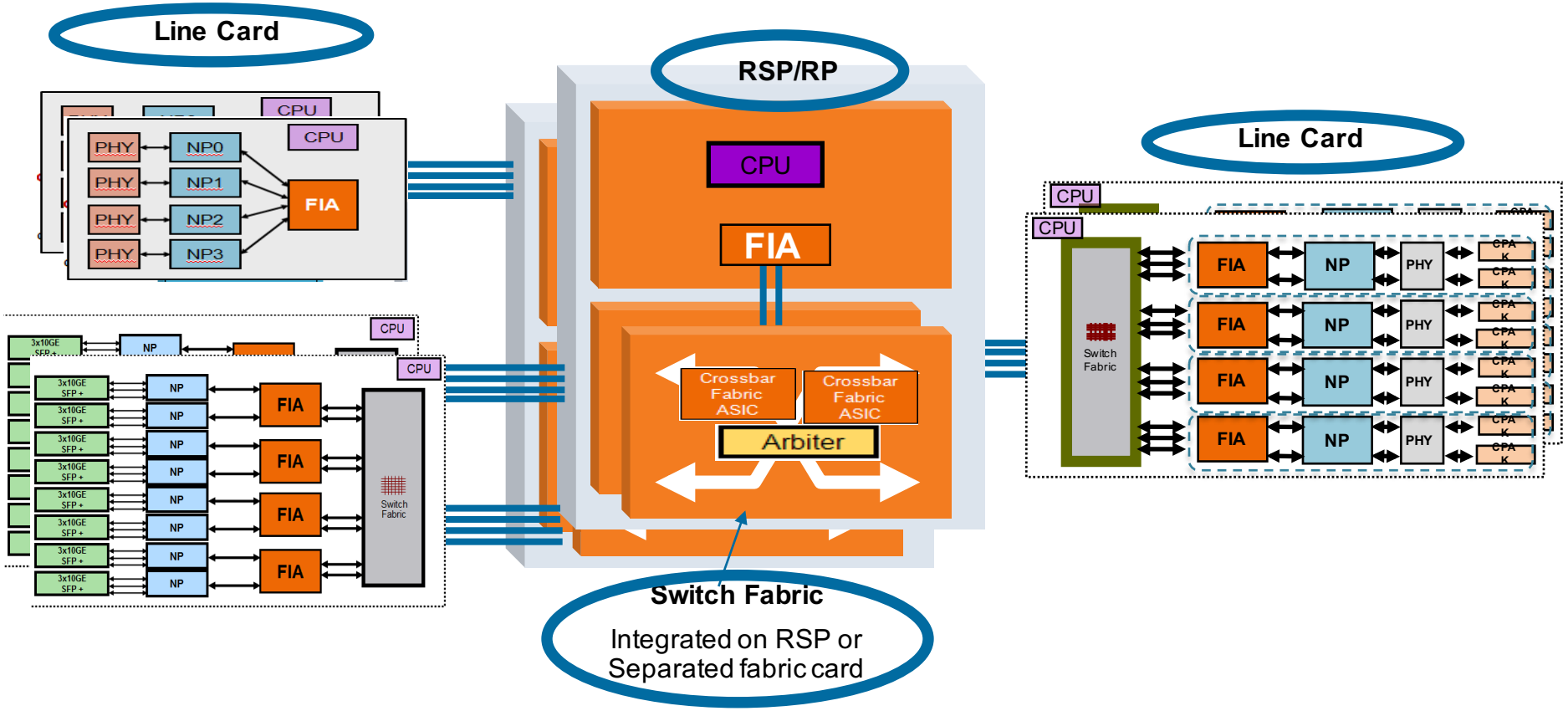
- Power Down Unused Linecard Slices to Increase Efficiency
- Lowest Watts per Gbps with CPAK and Optimized Silicon

Breakout Cable Solution – 100G → 10x 10G

- 10 : 1 Breakout Cable with a MPO24 MMF or SMF cable
- Only 20 fibers are used from 24 Fibers of one MPO24 cable



Cisco ASR 9000 Hardware System Components

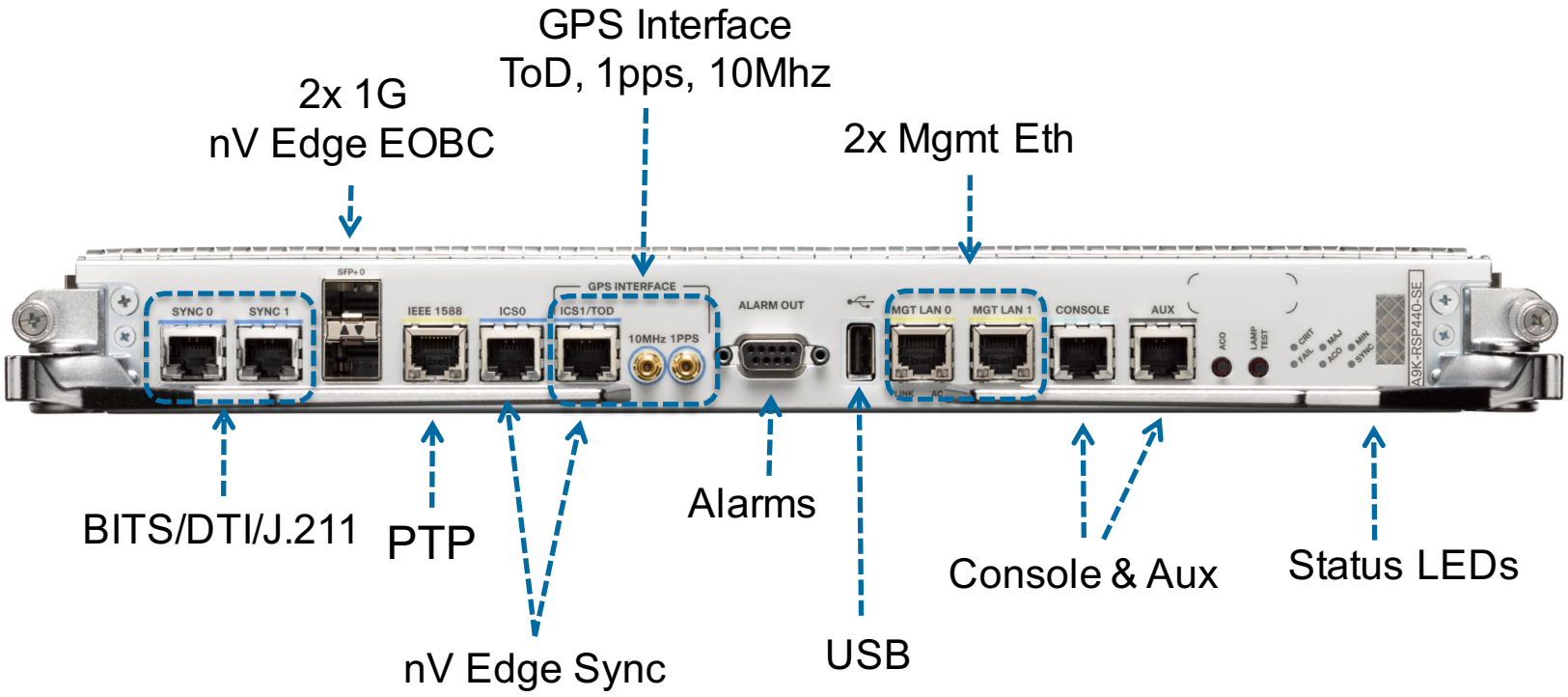


Route Switch Processors and Route Processors

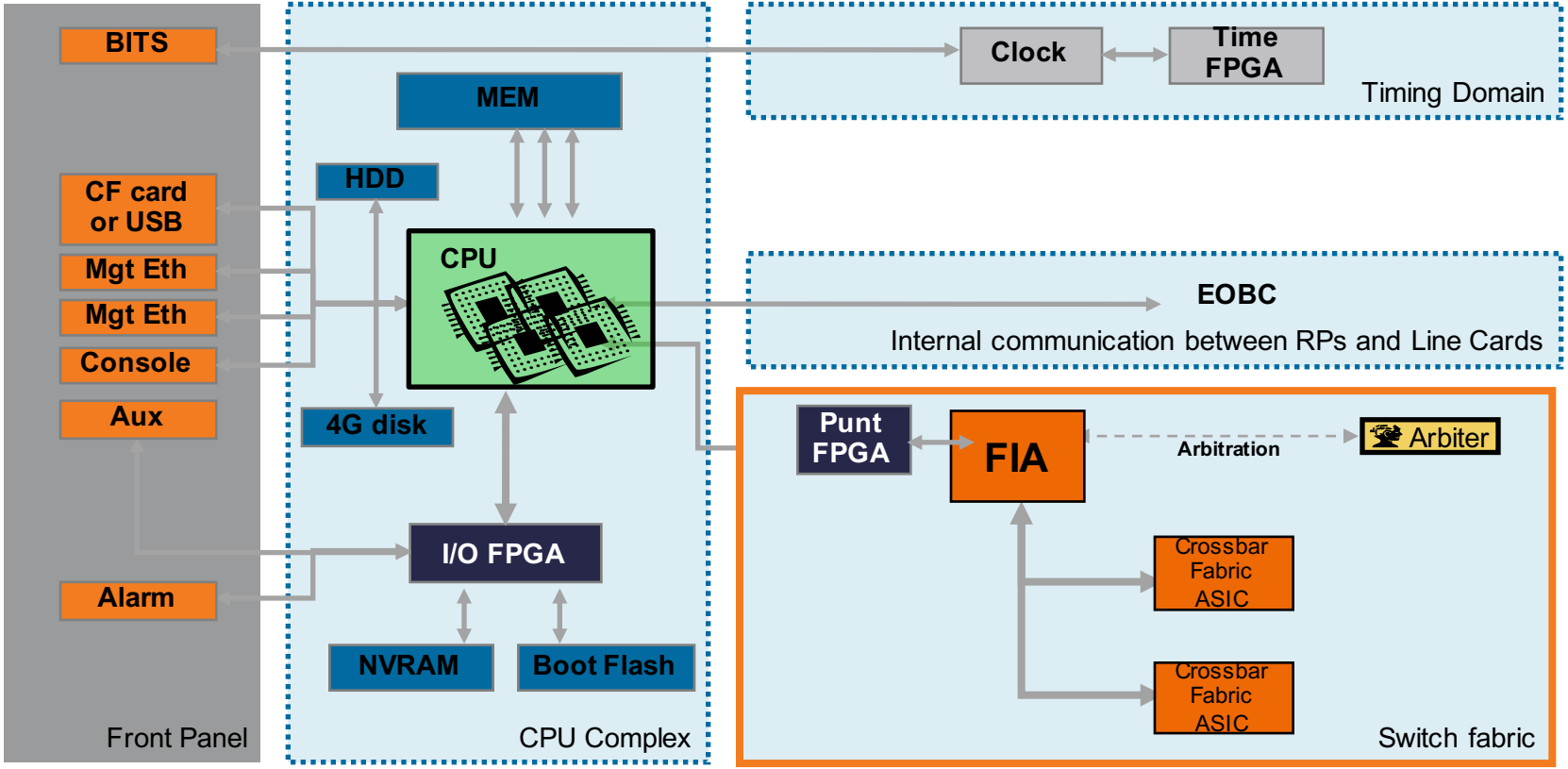
RSP used in ASR9904/9006/9010, RP in ASR9922/9912

	9006/9010 RSP	9904/9006/9010 RSP440	9922/9912 RP1	RSP880	9922/9912 RP2
	1nd Gen RP	2nd Gen RP and Fabric ASIC		3rd Gen RP and Fabric ASIC	
Processors	Freescale 8641D 2 x 1.5GHz	Intel x86 4 Core 2.27 GHz	Intel x86 4 Core 2.27 GHz	Intel x86 (Ivy Bridge EP) 6 Core 2GHz	Intel x86 (Ivy Bridge EP) 6 Core 2GHz
RAM	RSP-4G: 4GB RSP-8G: 8GB	RSP440-TR: 6GB RSP440-SE: 12GB	-TR: 6GB -SE: 12GB	-TR: 16GB -SE: 32GB	-TR: 16GB -SE: 32GB
SSD	N/A: 4G / 30G-HDD	2x 16GB Slim SATA	2x 16GB Slim SATA	2x 32GB Slim SATA	2x 32GB Slim SATA
nV EOBC ports	N/A	2 x 1G/10G SFP+	2 x 1G/10G SFP+	4 x 1/10G SFP+	4 x 1/10G SFP+
Punt BW		10GE	10GE	40GE	40GE
Switch fabric bandwidth	92G + 92G (9006/9010)	220G + 220G (9006/9010) 385G + 385G (9904) (fabric integrated on RSP)	660G+110G (separated fabric card)	460G + 460G (9006/9010) 805G + 805G (9904) (fabric integrated on RSP)	1.38Tb + 230G (separated fabric card)

RSP440 – Faceplate and Interfaces



RSP Engine Architecture



ASR 9000 Switch Fabric Overview

Integrated fabric/RP/LC

9001, 2RU, 120G

9001-S, 2RU, 60G

Fabric is integrated on RSP
1+1 redundancy

9904

RSP880: 805G+805G /slot

RSP440: 385G+385G /slot

9006

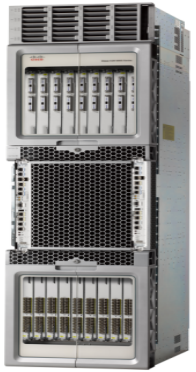
9010

RSP880: 460G+460G /slot

RSP440: 220G+220G /slot

Separated fabric card
6+1 redundancy

9912



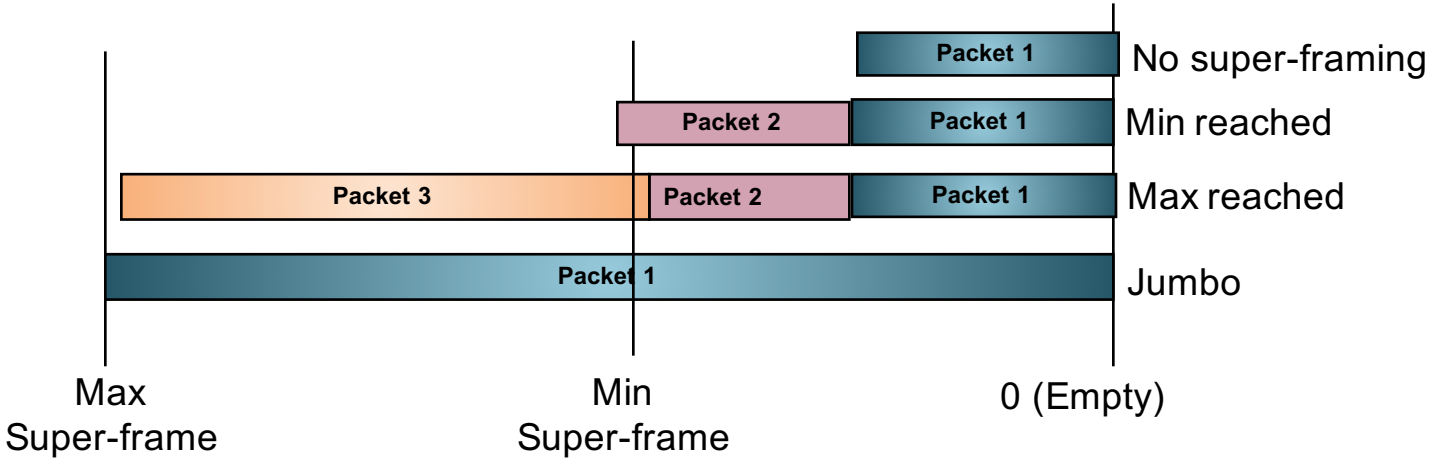
9922

SFC2: 1.38T+230G /slot

SFC1: 660G+110G /slot

Fabric Super-framing Mechanism

- **Multiple unicast frames** from/to same destinations aggregated into **one super frame**
- Super frame is created if there are frames waiting in the queue, up to 32 frames or when min threshold met, can be aggregated into one super frame
- Super frame only apply to unicast, **not multicast**
- Super-framing significantly **improves total fabric throughput**

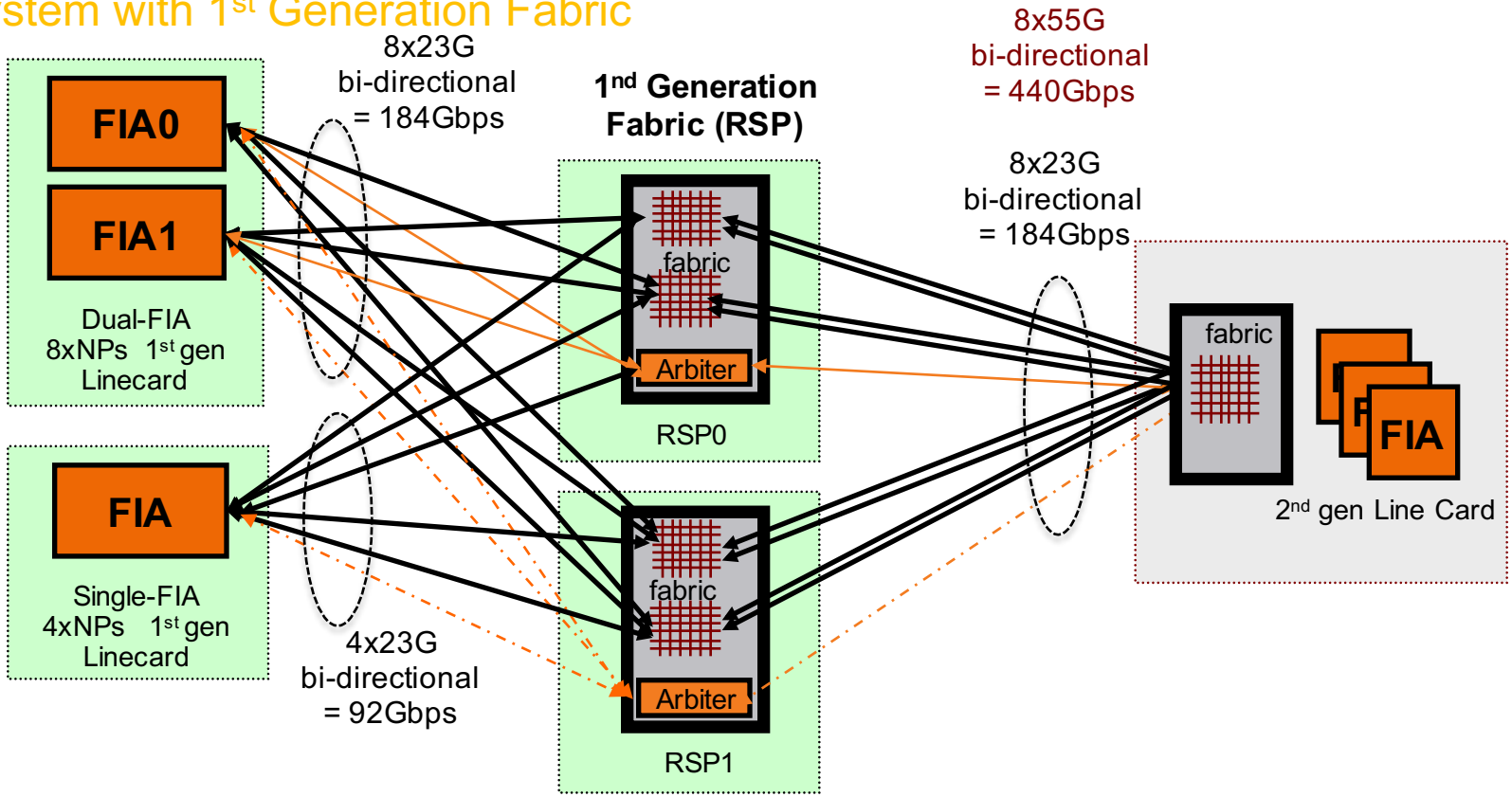


- Note that fabric counters are showing super frames not individual packets!!

show controller fabric fia stats loc 0/X/CPU0

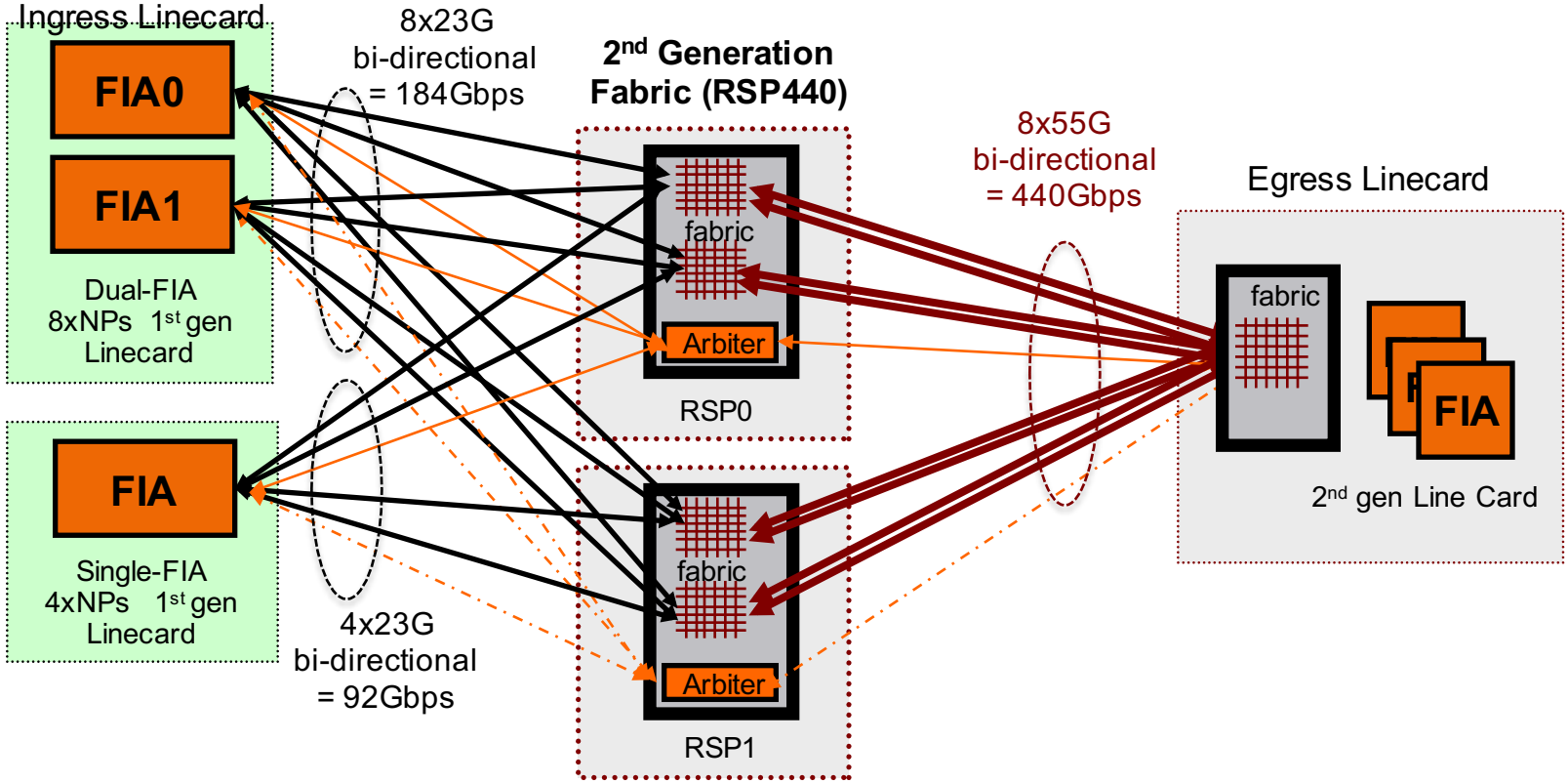
1st/2nd Generation switch fabric compatibility

System with 1st Generation Fabric



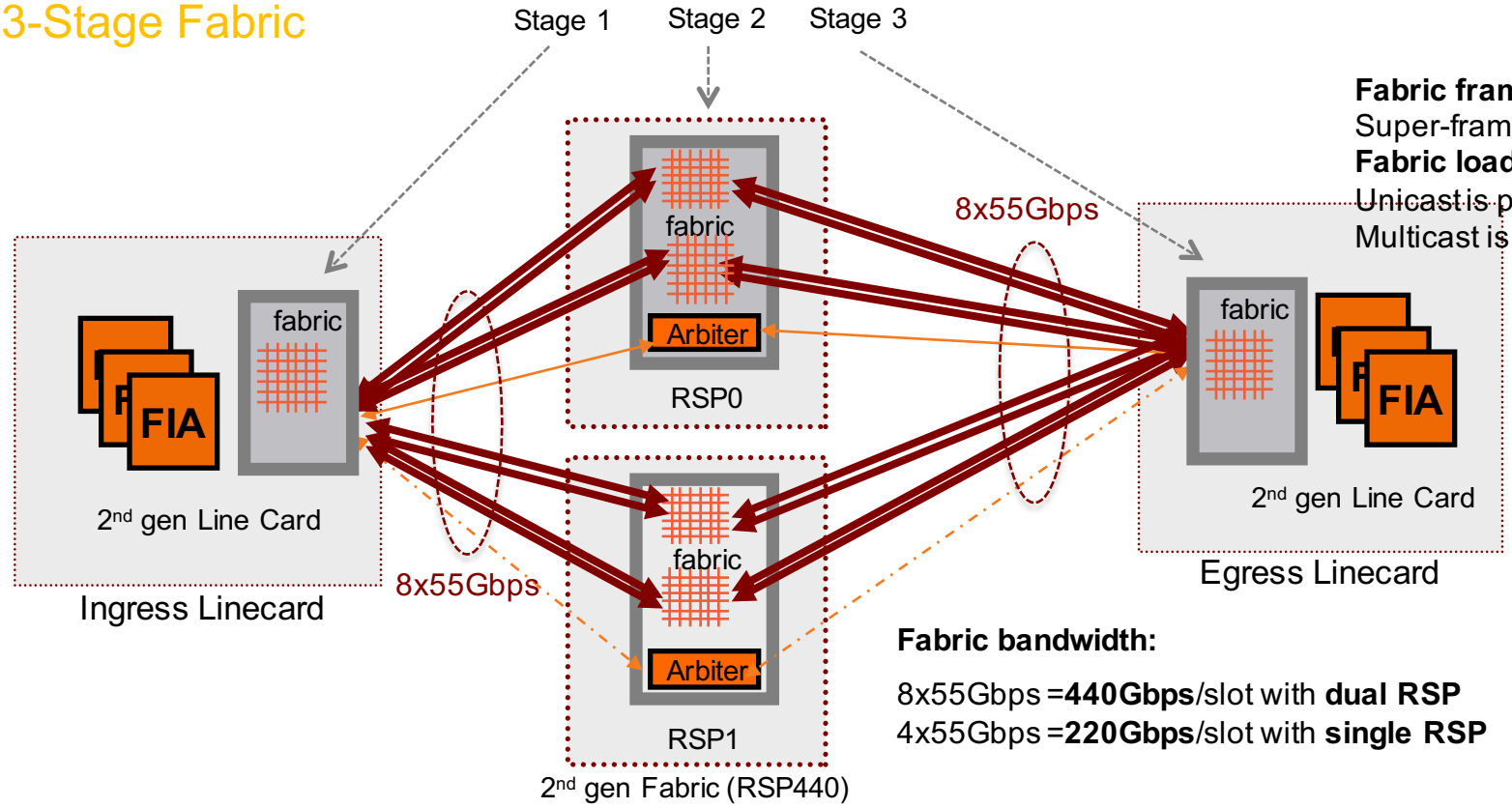
1st/2nd Generation switch fabric compatibility

System With 2nd Generation Fabric



ASR9006/9010 RSP440 Switch Fabric Architecture

3-Stage Fabric



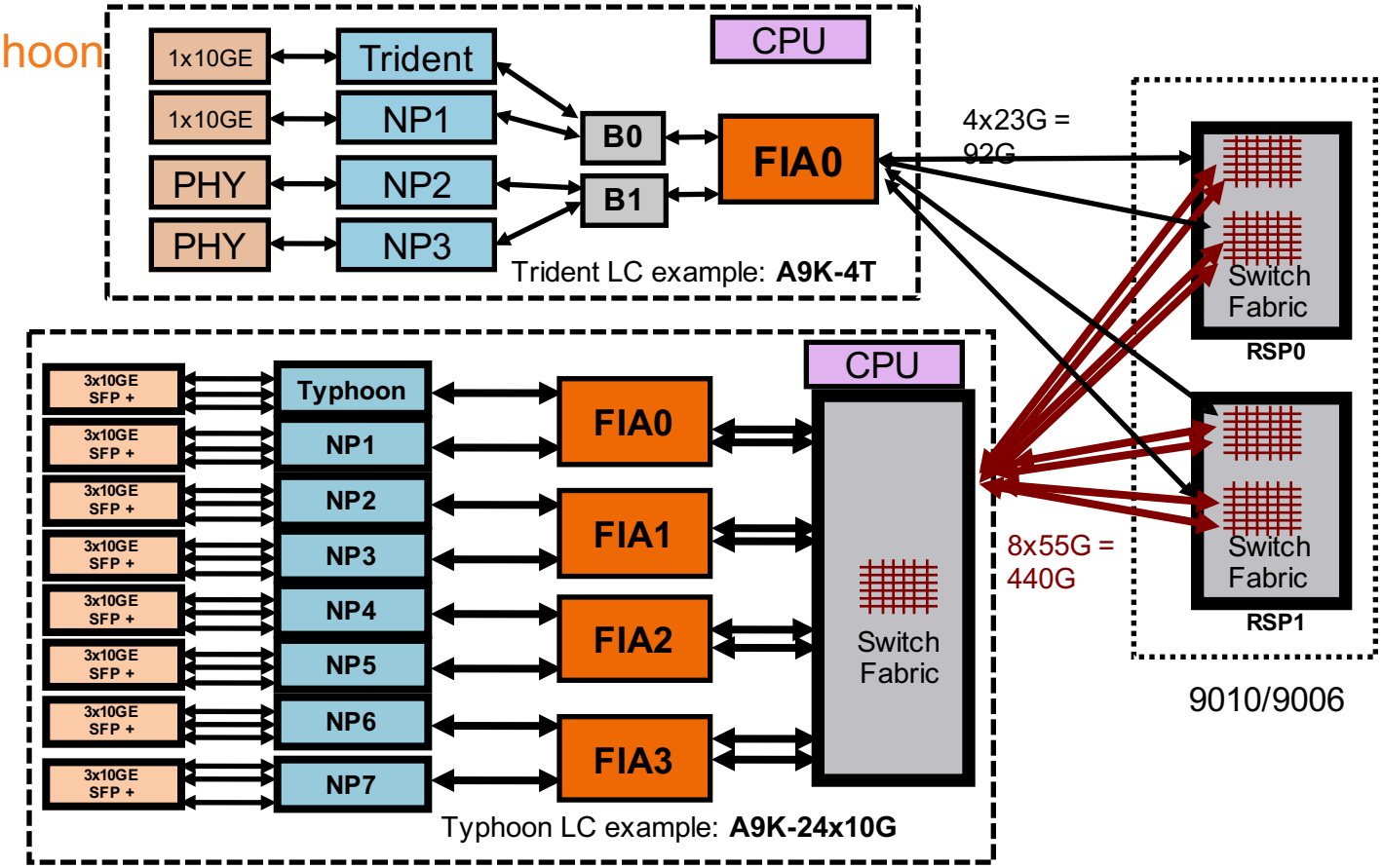
Fabric frame format:
Super-frame
Fabric load balancing:
Unicast is per-packet
Multicast is per-flow

Fabric bandwidth:

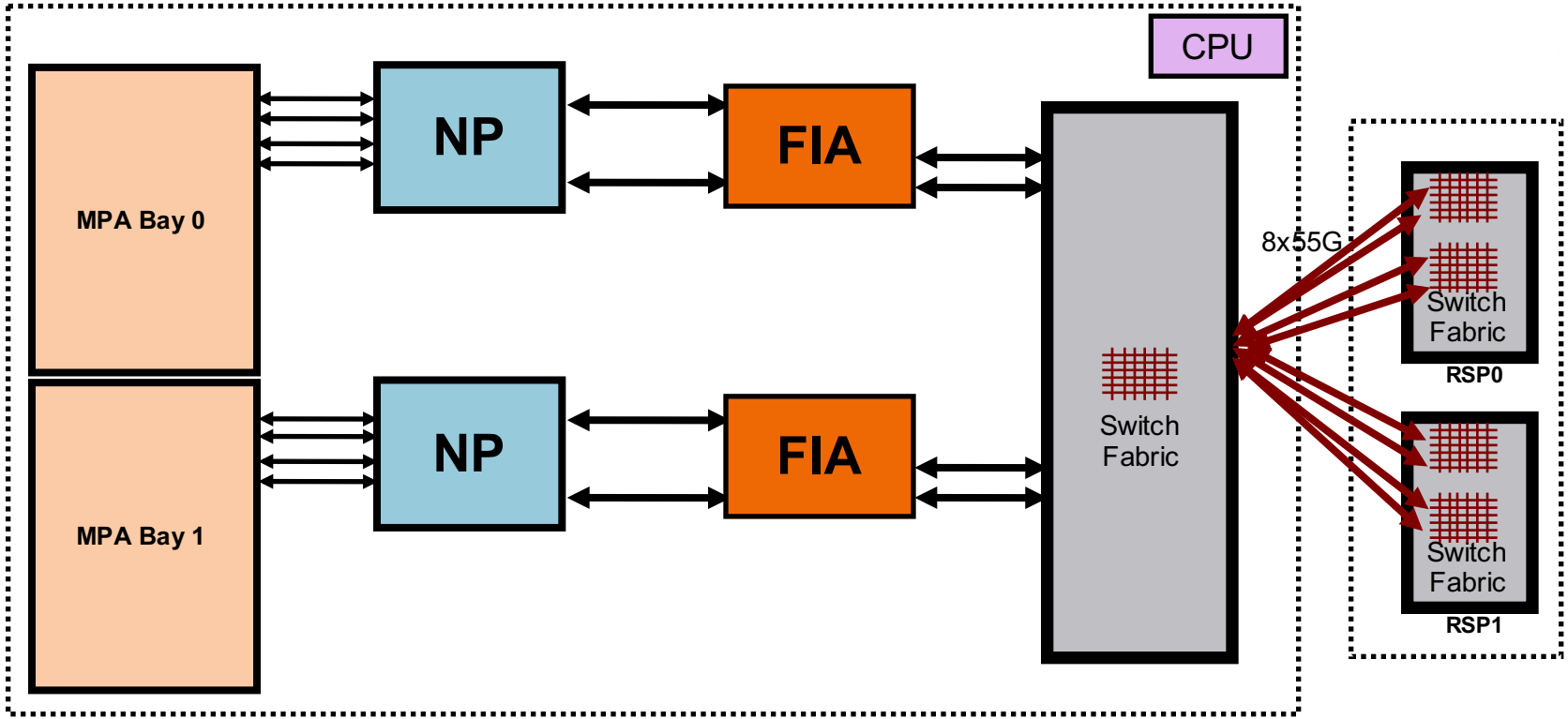
8x55Gbps = **440Gbps**/slot with **dual RSP**
4x55Gbps = **220Gbps**/slot with **single RSP**

ASR 9000 Line Card Architecture Overview

Trident and Typhoon

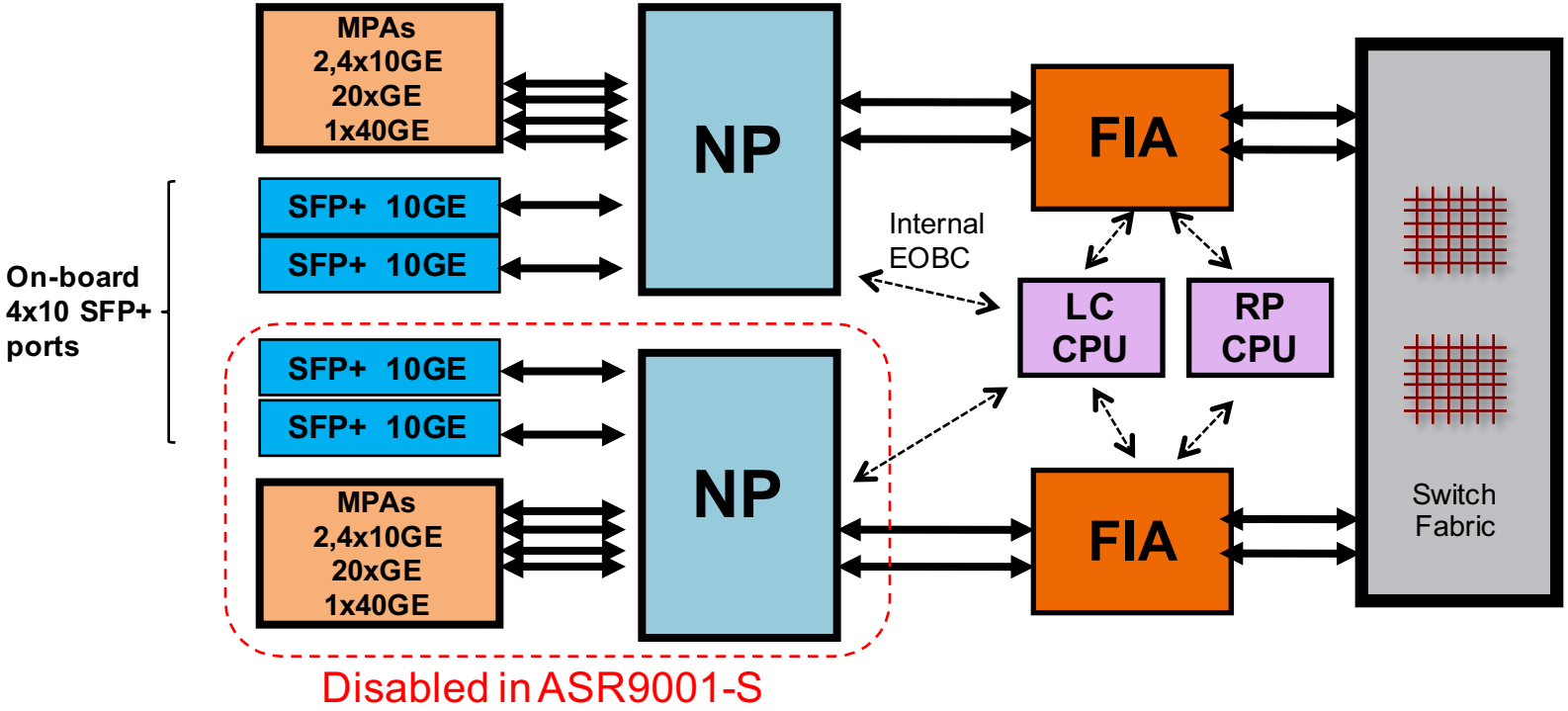


Module Cards – MOD80

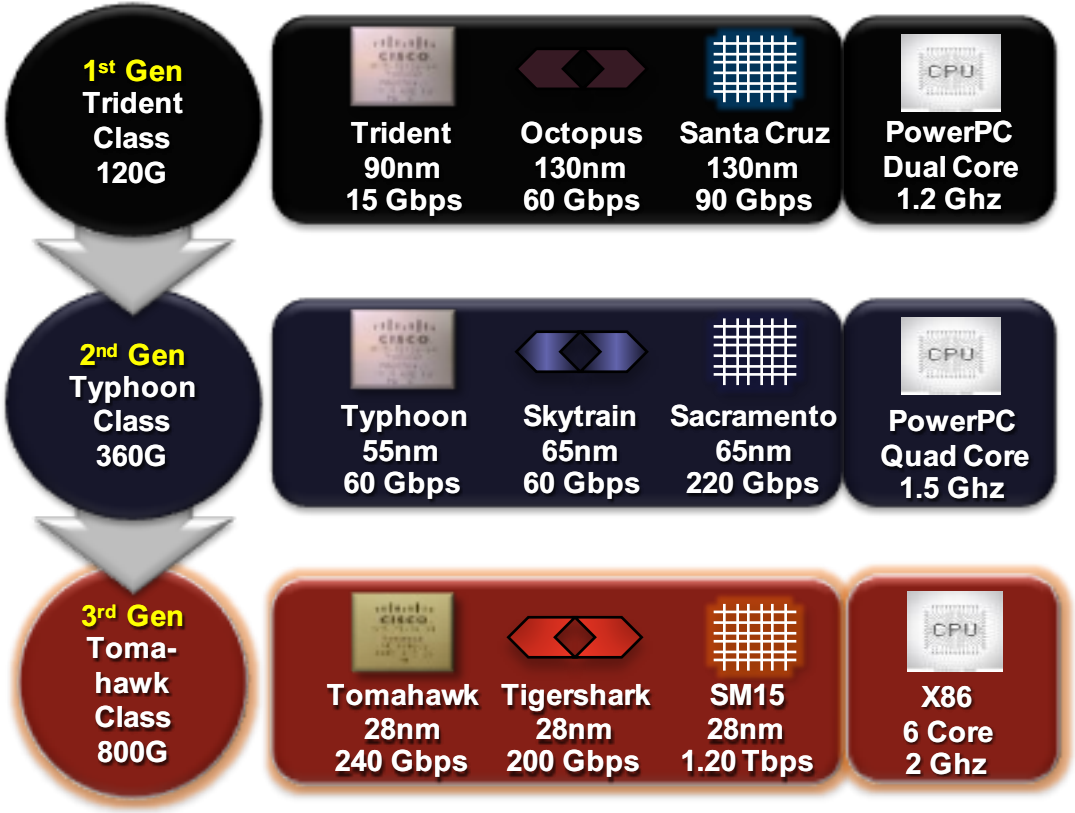


ASR 9001 Architecture

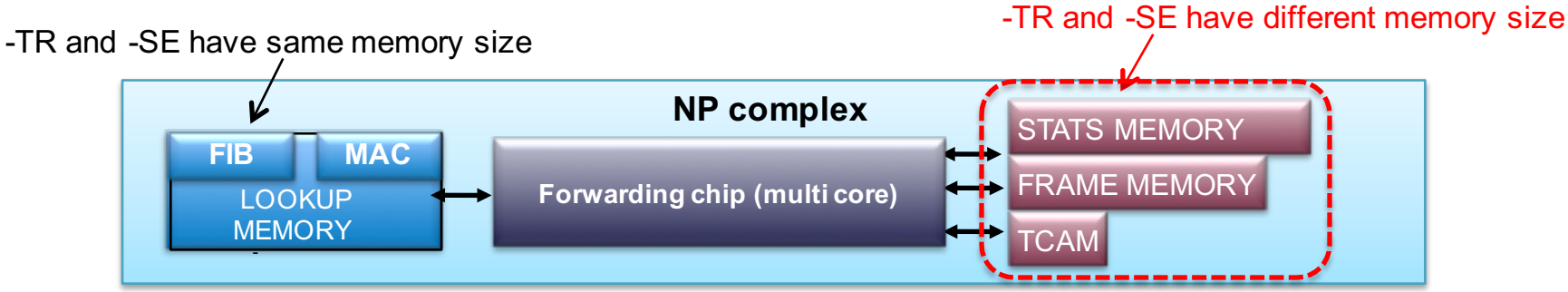
Identical HW Components as the Modular Systems



Edge Linecard Silicon Slice Evolution



Network Processor Architecture Details



- TCAM: VLAN tag, QoS and ACL classification
- Stats memory: interface statistics, forwarding statistics etc
- Frame memory: buffer, Queues
- Lookup Memory: forwarding tables, FIB, MAC, ADJ
- TR / SE
  - Different TCAM/frame/stats memory size for different per-LC QoS, ACL, logical interface scale
  - Same lookup memory for same system wide scale mixing different variation of LCs doesn't impact system wide scale

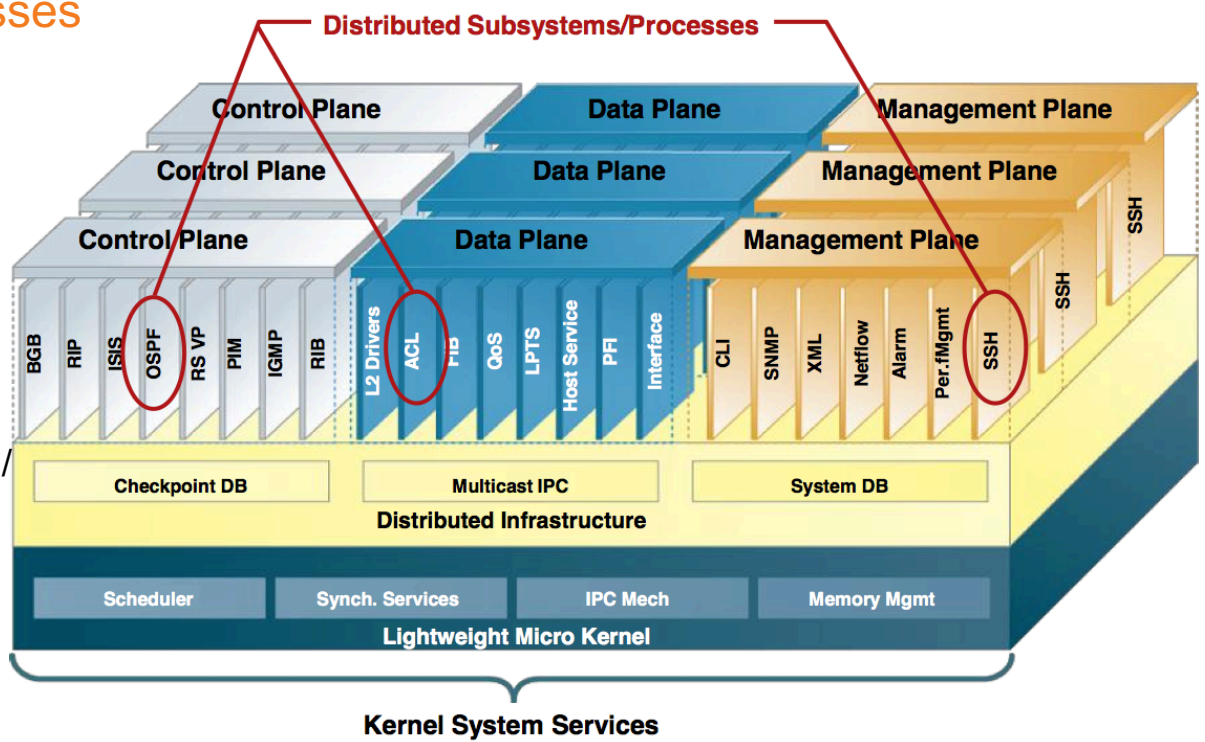
-TR: Transport optimized
-SE: Service Edge optimized

Operating System & Configuration
IOS-XR Architecture

IOS-XR Operating System

Kernel and distributed processes

- Micro-kernel
  - QNX kernel
- Restartable processes
  - A process may start/ terminate based on configuration
  - Scheduler keeps track of process starts/spawning/ priority/path
  - A process can crash/restart/patched
- Distributed processing
  - Processes run on RP and LC CPU's



IOS-XR Operating System

RSP and LC CPU's

- To monitor: a CPU on every card
- Instances of processes running on RSP and LC CPU's

```
RP/0/RSP0/CPU0:rasr9k-1y#show processes cpu location 0/RSP0/CPU0 | exclude ”
0%       0%       0%”
Wed Nov 28 01:36:52.203 UTC

CPU utilization for one minute: 26%; five minutes: 25%; fifteen minutes: 22%

PID    1Min    5Min    15Min Process
94243    3%      3%       3% spp
254074  23%     22%      19% netio

RP/0/RSP0/CPU0:rasr9k-1y#show processes cpu location 0/0/CPU0 | exclude ” 0%
0%       0%”
Wed Nov 28 01:28:52.281 UTC

CPU utilization for one minute: 46%; five minutes: 48%; fifteen minutes: 39%

PID    1Min    5Min    15Min Process
45085   22%     23%      22% spp
180316  23%     23%      23% netio

RP/0/RSP0/CPU0:ASR9010-1#show process distribution netio
Mon Jul 27 06:22:43.321 UTC
3 processes found
NODE             PID        JID  #THR  TYPE PROGRAM
0/RSP0/CPU0      532616         333    16  RP   netio
0/RSP1/CPU0      532613         333    16  RP   netio
0/6/CPU0      364639        274      8  LC   netio
```

Demonstrating Process Restart

Same Job ID, New Process ID

```
RP/0/RSP0/CPU0:rasr9000-2w-a#show processes bgp
Wed Jan 15 17:58:34.050 EST
                  Job Id: 1048
                     PID: 287056
         Executable path: /disk0/iosxr-routing-
4.2.3.CSCuh52959-1.0.0/0x100305/bin/bgp
             Instance #: 1
             Version ID: 00.00.0000
                Respawn: ON
          Respawn count: 1
  Max. spawns per minute: 12
           Last started: Thu Jan  2 09:11:18 2014
          Process state: Run
          Package state: Normal
       Started on config: default
           Feature name: ON
                    Tag : default
          Process group: v4-routing
                   core: MAINMEM
               Max. core: 0
              Placement: Placeable
           startup_path: /pkg/startup/bgp.startup
                  Ready: 0.700s
              Available: 85.082s
        Process cpu time: 21.760 user, 2.619 kernel,
24.379 total
JID    TID CPU Stack pri state         TimeInState
HR:MM:SS:MSEC    NAME
1048    1    2  384K  10 Receive         0:00:03:0395
```

```
RP/0/RSP0/CPU0:rasr9000-2w-a#process restart bgp
Wed Jan 15 18:03:24.836 EST
RP/0/RSP0/CPU0:Jan 15 18:03:24.874 :
sysmgr_control[65784]: %OS-SYSMGR-4-PROC_RESTART_NAME :
User cisco (con0_RSP0_CPU0) requested a restart of
process bgp at 0/RSP0/CPU0
RP/0/RSP0/CPU0:rasr9000-2w-a#show processes bgp
Wed Jan 15 18:03:28.726 EST
                  Job Id: 1048
                     PID: 3182840
         Executable path: /disk0/iosxr-routing-
4.2.3.CSCuh52959-1.0.0/0x100305/bin/bgp
             Instance #: 1
             Version ID: 00.00.0000
                Respawn: ON
          Respawn count: 2
  Max. spawns per minute: 12
           Last started: Wed Jan 15 18:03:24 2014
          Process state: Run (last exit due to SIGTERM)
          Package state: Normal
       Started on config: default
           Feature name: ON
                    Tag : default
          Process group: v4-routing
                   core: MAINMEM
               Max. core: 0
              Placement: Placeable
           startup_path: /pkg/startup/bgp.startup
                  Ready: 0.225s
```

Process Dumps

Where?

```
RP/0/RSP0/CPU0:rasr9000-2w-a#admin show exception
Sat Jan  4 00:15:27.885 EST
 Exception path for choice 1 is not configured or removed
 Exception path for choice 2 is not configured or removed
 Exception path for choice 3 is not configured or removed
 Choice fallback one path = dumper_harddisk:/dumper compress = on filename = <process_name>
 Choice fallback two path = dumper_disk1a:/dumper compress = on filename = <process_name>
 Choice fallback three path = dumper_disk0a:/dumper compress = on filename = <process_name>
 Kernel dump not configured
 Tftp route for kernel core dump not configured
 No config for pakmem tuple
 No config for sparse tuple
 No config for sprsize tuple
 No config for coresize tuple
 No config for memory-threshold tuple
 No config for core-verification tuple

RP/0/RSP0/CPU0:rasr9000-2w-a#dir harddisk:/dumper
Sat Jan  4 00:16:10.138 EST
Directory of harddisk:/dumper
24922       -rw-  216304651   Sat Jan  4 00:16:08 2014  ce_switch.log
24665       -rw-  42408       Tue Nov  5 19:06:35 2013  crashinfo.by.kernel.19070930-173606
24694       -rw-  1586390     Tue Nov  5 19:06:36 2013  kernel_core.by.kernel.19070930-173606.Z
24695       -rw-  1044480     Tue Nov  5 19:06:36 2013  pcds_dump.19070930-173606
24697       -rw-  4813080     Fri Nov  8 17:03:11 2013  first.mpls_lsd_338.node0_RSP0_CPU0.x86.Z
.
```

Operating System & Configuration
IOS-XR Install & Upgrade & Config

Reading Installed Packages

Example

```
RP/0/RSP0/CPU0:rasr9000-2w-b#show  install  active
detail
Sun Jan  4 23:43:14.325 EST
Secure Domain Router: Owner
  Node  0/RSP0/CPU0  [RP]  [SDR:  Owner]
    Boot Device:  disk0:
    Boot Image:  /disk0/asr9k-os-mbi-
5.1.3/0x100305/mbiasr9k-rsp3.vm
    Active  Packages:
      disk0:asr9k-mpls-px-5.1.3
          disk0:iosxr-mpls-5.1.3
      disk0:asr9k-mgbl-px-5.1.3
          disk0:asr9k-mgbl-supp-5.1.3
          disk0:iosxr-mgbl-5.1.3
      disk0:asr9k-optic-px-5.1.3
          disk0:asr9k-optics-supp-5.1.3
      disk0:asr9k-k9sec-px-5.1.3
          disk0:iosxr-security-5.1.3
          disk0:asr9k-k9sec-supp-5.1.3
      disk0:asr9k-doc-px-5.1.3
          disk0:asr9k-doc-supp-5.1.3
      disk0:asr9k-fpd-px-5.1.3
          disk0:asr9k-fpd-5.1.3
      disk0:asr9k-mini-px-5.1.3
          disk0:asr9k-scfclient-5.1.3
          disk0:asr9k-os-mbi-5.1.3
           disk0:asr9k-cpp-5.1.3
          disk0:asr9k-ce-5.1.3
          disk0:iosxr-ce-5.1.3
          disk0:asr9k-diags-supp-5.1.3
          disk0:iosxr-diags-5.1.3
          disk0:asr9k-fwding-5.1.3
          disk0:iosxr-fwding-5.1.3
          disk0:iosxr-routing-5.1.3
          disk0:iosxr-infra-5.1.3
          disk0:asr9k-base-5.1.3
      disk0:asr9k-mcast-px-5.1.3
          disk0:asr9k-mcast-supp-5.1.3
          disk0:iosxr-mcast-5.1.3


.
  Node  0/1/CPU0  [LC]  [SDR:  Owner]
    Boot Device:  mem:
    Boot Image:  /disk0/asr9k-os-mbi-5.1.3/lc/mbiasr9k-
lc.vm
    Active  Packages:
      disk0:asr9k-mpls-px-5.1.3
          disk0:iosxr-mpls-5.1.3
      disk0:asr9k-optic-px-5.1.3
          disk0:asr9k-optics-supp-5.1.3
      disk0:asr9k-mini-px-5.1.3
          disk0:asr9k-scfclient-5.1.3
          disk0:asr9k-os-mbi-5.1.3
          disk0:asr9k-cpp-5.1.3
          disk0:asr9k-ce-5.1.3
          disk0:iosxr-ce-5.1.3
          disk0:asr9k-diags-supp-5.1.3
          disk0:iosxr-diags-5.1.3
          .
```

Software Maintenance Updates (SMUs)

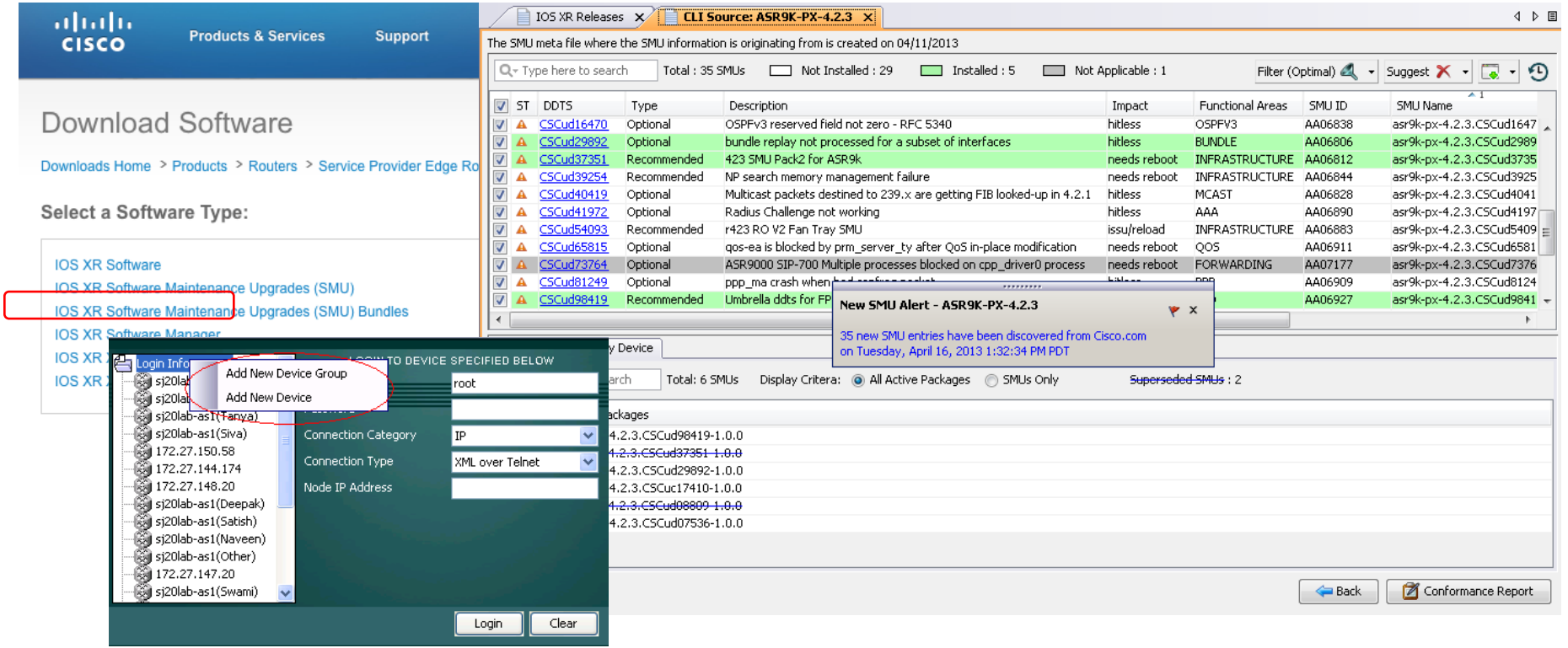
- Allows for software package installation/removal leveraging on Modularity and Process restart
- Redundant processors are not mandatory (unlike ISSU) and in many cases is non service impacting and may not require reload.
- Mechanism for
  - delivery of critical bug fixes without the need to wait for next maintenance release
- SMU is named by release, package, and bugid
  - Examples
    - asr9k-px-4.2.3.CSCud37351-1.0.0
    - asr9k-px-4.2.0.CSCtx28089-1.0.0

IOS-XR Version

Defect ID

Cisco Software Manager

Available on CCO in the Downloads Section for ASR9000



Turboboot

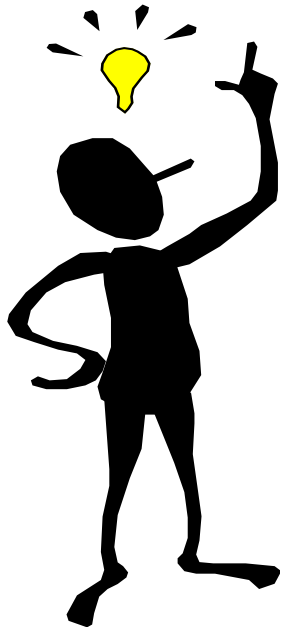
A “fresh” start!

- Previous disk data is wiped
- A clean “re-image” as a new router
- Potential recovery mechanism
- Not an “upgrade” method

```
Rommon1>unset BOOT
Rommon2>confreg 0x102
Rommon3>sync
Rommon4>reset


Rommon1>IP_ADDRESS=<a.b.c.d>
Rommon2>IP_SUBNET_MASK=<mask>
Rommon3>TFTP_SERVER=<a.b.c.d>
Rommon4>DEFAULT_GATEWAY=<a.b.c.d>
Rommon5>TFTP_RETRY_COUNT=4
Rommon6>TFTP_TIMEOUT=60
Rommon7>TFTP_CHECKSUM=1
Rommon8>priv
Rommon9>diswd
Rommon10>unset BOOT
Rommon11>TURBOBOOT=on,disk0,format
Rommon12>sync
Rommon13>boot tftp://a.b.c.d/path/asr9k-
mini-px.vm-4.2.3
```

PIE Installation Concepts

- PIE install used once system is operational w/ XR
  - .vm files can be used if booting from rommon is required
- Packages can be added or upgraded
- Install from Exec or Admin Mode
- 3 phase install
  - Add – Copy package and unpack
  - Activate – Restart processes/nodes with new code
  - Commit – Lock activated packages through reset



Cards' FPD

Verify/upgrade FPD version

```
RP/0/RSP0/CPU0:rasr9000-2w-b#admin  show hw-module  fpd location  all
==============================  ========================================
                                Existing  Field Programmable  Devices
                                ========================================
                                  HW                            Current  SW  Upg/
Location       Card  Type       Version  Type  Subtype  Inst    Version     Dng?
============   ================  =======  ====  =======  ====  ===========  ====
0/RSP0/CPU0    A9K-RSP440-SE       1.0    lc    cbc      0       16.115     No
                                          lc    fpga1    0        0.09      No
                                          lc    fpga2    0        1.06      No
                                          lc    fpga3    0        4.09      No
                                          lc    rommon   0        0.62      No
-------------------------------------------------------------------------------
0/RSP0/CPU0    ASR-9006-FAN        1.0    lc    cbc      2        5.02      No
-------------------------------------------------------------------------------
0/0/CPU0       A9K-24x10GE-SE      1.0    lc    cbc      0       19.110     No
                                          lc    fpga2    0        1.02      No
                                          lc    fpga3    0        1.01      No
                                          lc    fpga4    0        1.05      No
                                          lc    rommon   0        1.28      No
-------------------------------------------------------------------------------
0/1/CPU0       A9K-MOD80-SE        1.0    lc    cbc      0       20.116     No
                                          lc    fpga2    0        1.01      No
                                          lc    fpga4    0        1.05      No
                                          lc    rommon   0        1.28      No
RP/0/RSP0/CPU0:rasr9000-2w-a#admin  upgrade  hw-module  fpd all  location  0/1/CPU0
```

No == good. No change needed

If LC1 needs upgrade

Cards' FPD

Verify/upgrade FPD version

```
RP/0/RSP0/CPU0:rasr9000-2w-a#admin show running-config
.
fpd auto-upgrade
.
RP/0/RSP0/CPU0:rasr9000-2w-a#admin upgrade hw-module fpd all location all
Wed Jan 15 18:57:04.683 EST

***** UPGRADE WARNING MESSAGE: *****
  *  This upgrade operation has a maximum timout of 160 minutes.   *
  *  If you are executing the cmd for one specific location and  *
  *  card in that location reloads or goes down for some reason  *
  *  you can press CTRL-C to get back the RP's prompt.           *
  *  If you are executing the cmd for _all_ locations and a node *
  *  reloads or is down please allow other nodes to finish the   *
  *  upgrade process before pressing CTRL-C.                     *

% RELOAD REMINDER:
  - The upgrade operation of the target module will not interrupt its normal
    operation. However, for the changes to take effect, the target module
    will need to be manually reloaded after the upgrade operation. This can
    be accomplished with the use of "hw-module <target> reload" command.
  - If automatic reload operation is desired after the upgrade, please use
    the "reload" option at the end of the upgrade command.
  - The output of "show hw-module fpd location" command will not display
    correct version information after the upgrade if the target module is
    not reloaded.
NOTE: Chassis CLI will not be accessible while upgrade is in progress.
Continue? [confirm]
```

Auto FPD upgrade configuration

Manual FPD upgrade

Command Modes

Exec, exec config, admin, admin config

Exec – Normal operations – monitoring interfaces, routing, CEF, and VPNs

```
RP/0/RSP1/CPU0:viking-1#
show ipv4 interfaces brief    show running-config
show install active           show cef summary location 0/5/CPU0
show l2vpn xconnect
```

Config – Normal configuration for router

```
RP/0/RSP1/CPU0:viking-1(config)#
router bgp 100          l2vpn              policy-map foo
mpls ldp                ipv4 access-list block-junk
```

Admin – Chassis operations (i.e. fans & power)

```
RP/0/RSP1/CPU0:viking-1(admin)#
Config-register <0x1922>      show platform
```

Admin Config – admin plane config

```
RP/0/RSP1/CPU0:viking-1(admin-config)#
username admin-root
```

Rack/Slot/Module/Port

```
RP/0/RSP0/CPU0:asr9001(admin)#show platform
Node                   Type                              State              Config State
------------------------------------------------------------------------------------------
0/RSP0/CPU0     ASR9001-RP(Active)   IOS XR RUN     PWR,NSHUT,MON
0/FT0/SP             FAN TRAY                      READY
0/0/CPU0             ASR9001-LC                    IOS XR RUN     PWR,NSHUT,MON
0/0/0                    A9K-MPA-4X10GE       OK                          PWR,NSHUT,MON
0/0/1                    A9K-MPA-4X10GE       OK                          PWR,NSHUT,MON
0/PM0/SP            A9K-750W-AC             READY                 PWR,NSHUT,MON

RP/0/RSP0/CPU0:asr9001-nV-Edge(admin)#show platform
Node                   Type                              State               Config State
------------------------------------------------------------------------------------------
0/RSP0/CPU0    ASR9001-RP(Active)   IOS XR RUN       PWR,NSHUT,MON
0/FT0/SP             FAN TRAY                     READY
0/0/CPU0            ASR9001-LC                    IOS XR RUN       PWR,NSHUT,MON
0/0/0                   A9K-MPA-20X1GE        OK                             PWR,NSHUT,MON
0/0/1                   A9K-MPA-4X10GE        OK                             PWR,NSHUT,MON
0/PM0/SP          A9K-750W-DC              READY                  PWR,NSHUT,MON
1/RSP0/CPU0  ASR9001-RP(Active)     IOS XR RUN      PWR,NSHUT,MON
1/FT0/SP           FAN TRAY                      READY
1/0/CPU0          ASR9001-LC                     IOS XR RUN
1/0/0                 A9K-MPA-20X1GE         OK                             PWR,NSHUT,MON
1/0/1                 A9K-MPA-2X10GE         OK                             PWR,NSHUT,MON
1/PM0/SP         A9K-750W-DC               READY                  PWR,NSHUT,MON
```

A cluster node

XR Configuration Key Concepts

Two Stage Commit, Verification

Syntax Check
after each line
PASSES

```
Interface GigabitEthernet0/3/0/0
  ipv4 address 9.9.9.9/24
taskgroup bgp
  task read bgp
  task write bgp
```

Target Configuration

Semantic Check
during commit
FAILS
BGP cannot be taskgroup name

Active Configuration
***Before* Commit**

```
hostname odin
line default
 exec-timeout 1440 0
!
taskgroup ops
 task read boot
 task write boot
 task execute bgp
!
router static
 address-family ipv4 unicast
  0.0.0.0/0 7.1.9.1
  7.7.7.77/32 7.1.9.1
```

Active Configuration
***After* Commit**

No Change

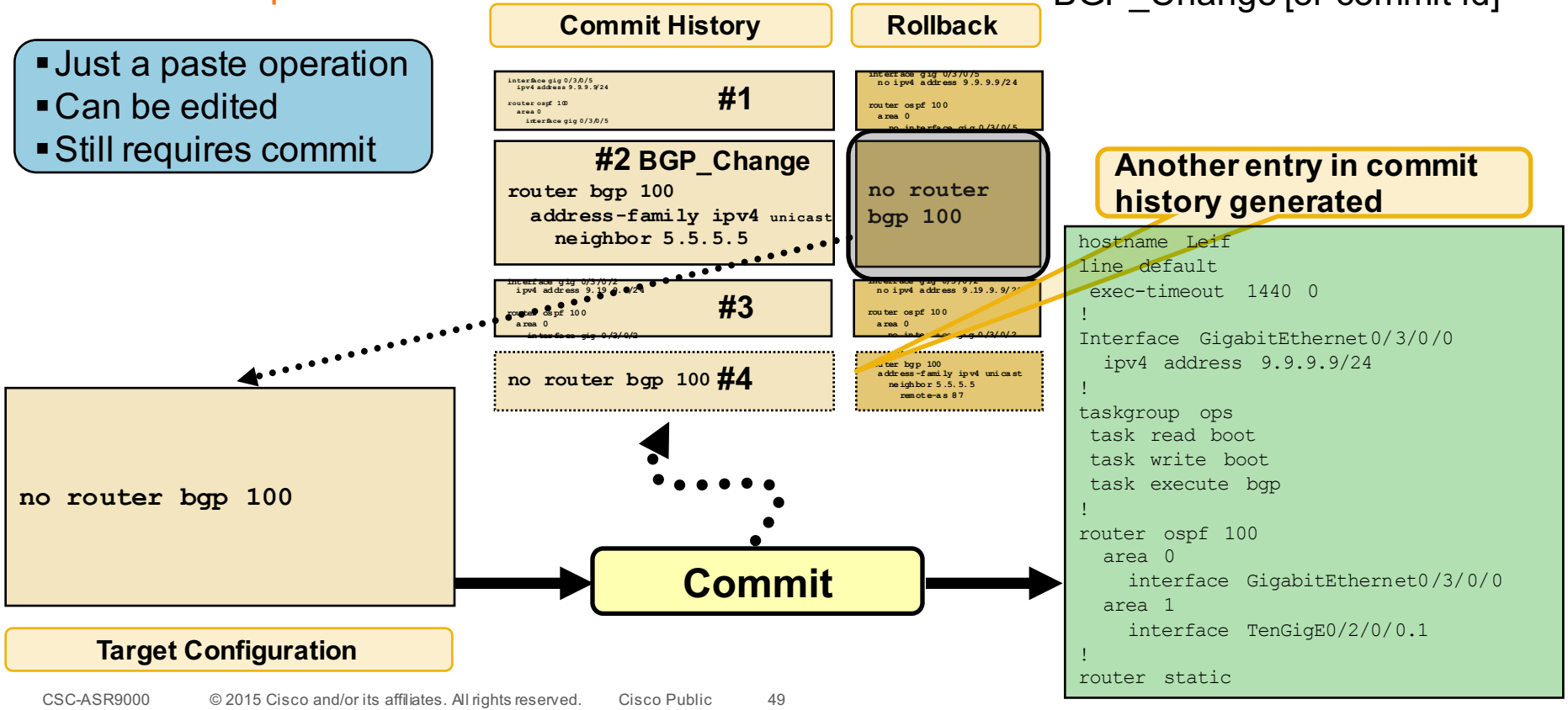
```
hostname odin
line default
 exec-timeout 1440 0
!
taskgroup ops
 task read boot
 task write boot
 task execute bgp
!
router static
 address-family ipv4 unicast
  0.0.0.0/0 7.1.9.1
  7.7.7.77/32 7.1.9.1
```

XR Configuration Key Concepts

Rollback a Specific Commit

(config)#load rollback changes BGP_Change [or commit id]

- Just a paste operation
- Can be edited
- Still requires commit



XR Configuration Key Concepts

Concurrent config sessions and exclusive

Enter Proposed Changes

```
interface gig 0/3/0/0
  ipv4 address 9.9.9.9/24
router ospf 100
  area 0
    interface gig 0/3/0/0
  area 1
    interface gig 0/4/0/0
```

First to Commit

Normal Commit
only first user's changes

Enter Proposed Changes

```
interface gig 0/3/0/0
  ipv4 address 9.9.9.7/24
router ospf 100
  area 2
    interface gig 0/3/0/0
  area 4
    interface gig 0/4/0/0
```

Second to Commit

Use `config exclusive` mode to block other users from committing

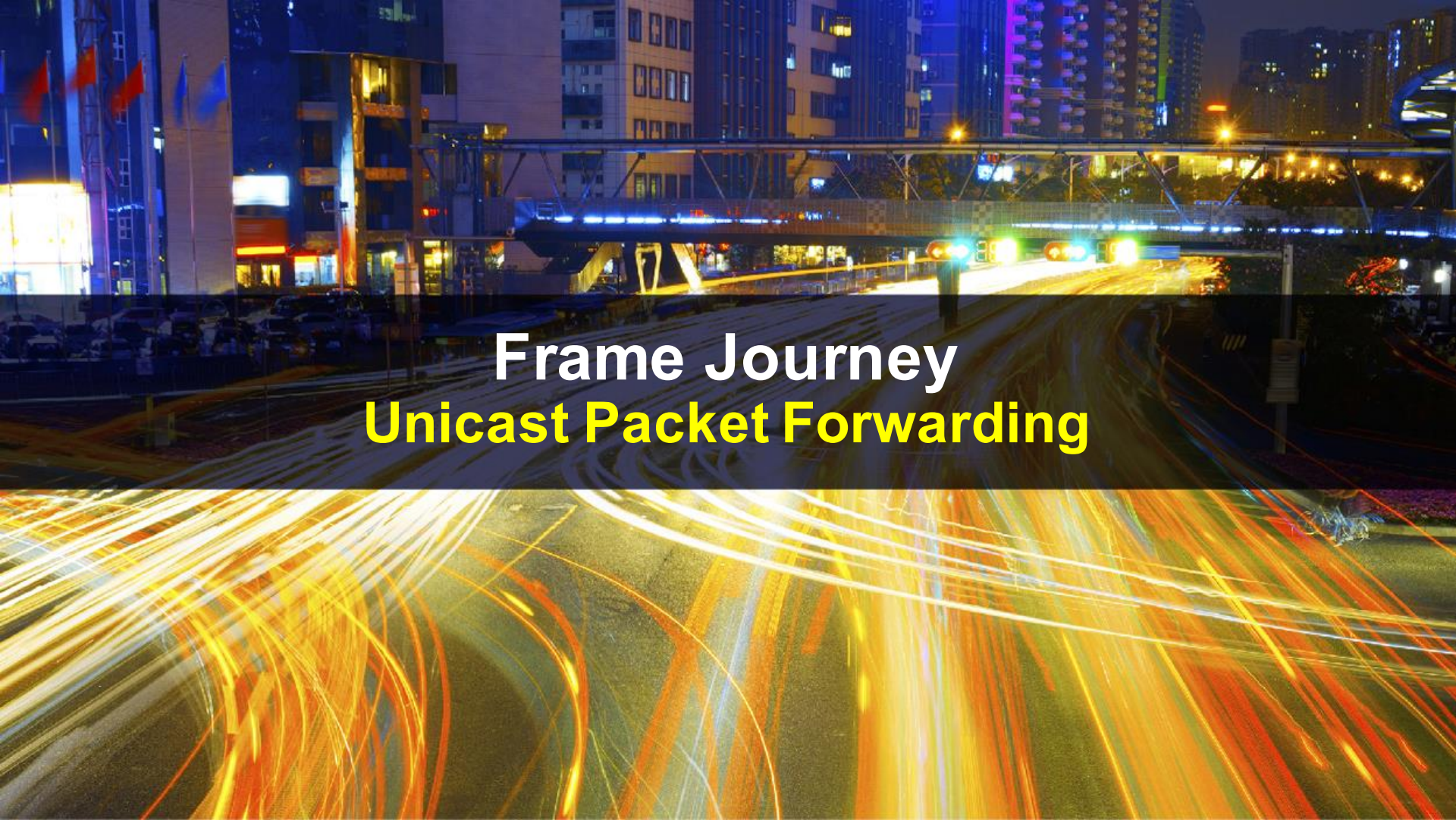
```
One or more commits have occurred from
other configuration sessions since this
session started or since the last commit
was made from this session.
You can use the 'show configuration commit
changes' command to browse the changes.
Do you wish to proceed with this commit
anyway? [no]:
```

XR Configuration Key Concepts

Monitoring Configuration , commits, changes, sessions

```
RP/0/RSP0/CPU0:rasr9000-2w-b#show  running-config
Mon Jan  5 00:35:19.951 EST
Building configuration...
!! IOS XR Configuration 5.1.3
!! Last configuration change at Tue Dec  2 22:19:25 2014 by cisco
!
service unsupported-transceiver
hostname rasr9000-2w-b
clock timezone EST -5
.
RP/0/RSP0/CPU0:rasr9000-2w-b#show  configuration  commit  list
Mon Jan  5 00:35:34.747 EST
SNo.  Label/ID     User       Line                 Client       Time Stamp
~~~~  ~~~~~~~~     ~~~~       ~~~~                 ~~~~~~       ~~~~~~~~~~
1     1000000033   cisco      con0_RSP0_CPU0       CLI          Tue Dec  2 22:19:25 2014
2     1000000032   cisco      con0_RSP0_CPU0       CLI          Tue Dec  2 22:15:54 2014
3     1000000031   cisco      con0_RSP0_CPU0       CLI          Tue Dec  2 22:14:18 2014
.
RP/0/RSP0/CPU0:rasr9000-2w-b#show  configuration  commit changes last 5
Mon Jan  5 00:36:17.813 EST
Building configuration...
!! IOS XR Configuration 5.1.3
interface GigabitEthernet0/1/0/4
 ipv4 address 10.6.7.6 255.255.255.0
!
.
RP/0/RSP1/CPU0:viking-1#  show config sessions
Current Configuration Session   Line       User       Date                      Lock
00000051-004c4104-00000000      con0_RSP1_ ww         Tue Jul 21 16:58:22 2009
```

```
RP/0/0/CPU0:P103#show running-config
router bgp
Mon Jan  5 15:06:29.774 EST
router bgp 65001
 bgp router-id 10.100.103.1
 bgp cluster-id 10.100.101.1
 bgp graceful-restart
 address-family ipv4 unicast
 !
 address-family vpnv4 unicast
 !
 address-family ipv6 unicast
 !
 address-family l2vpn vpls-vpws
 !
 neighbor-group iBGP
  remote-as 65001
  keychain CISCO
  update-source Loopback0
  address-family ipv4 unicast
   route-reflector-client
  !
  address-family vpnv4 unicast
   route-reflector-client
  !
  address-family ipv6 unicast
   route-reflector-client
```

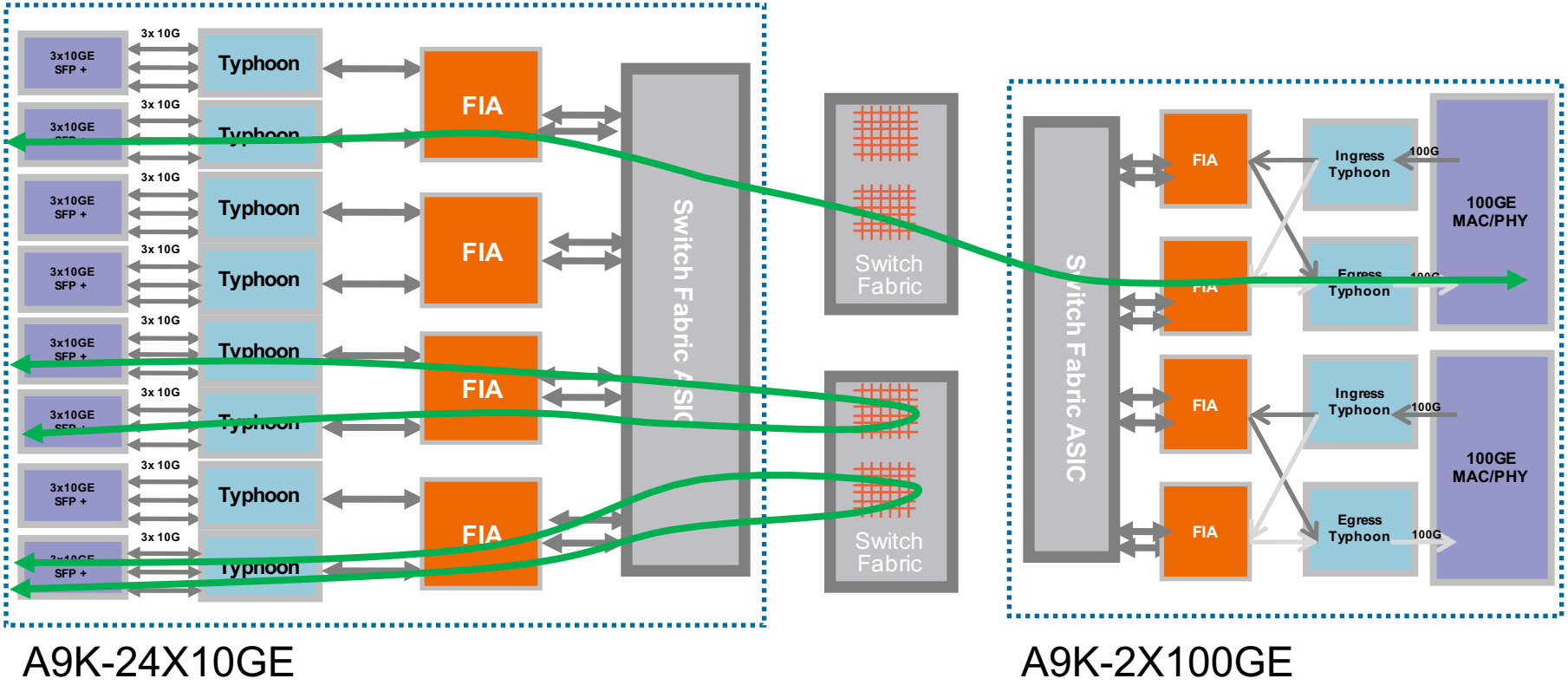


Frame Journey

Unicast Packet Forwarding

Unicast Transit Frame Path

Physical > NP > FIA > Fabric > FIA > NP > Physical



A9K-24X10GE

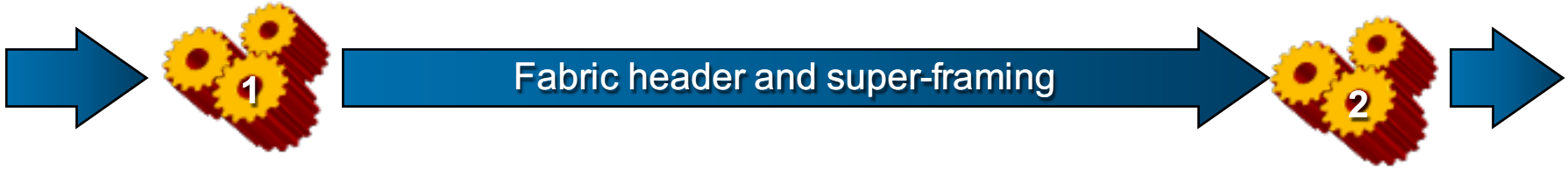
A9K-2X100GE

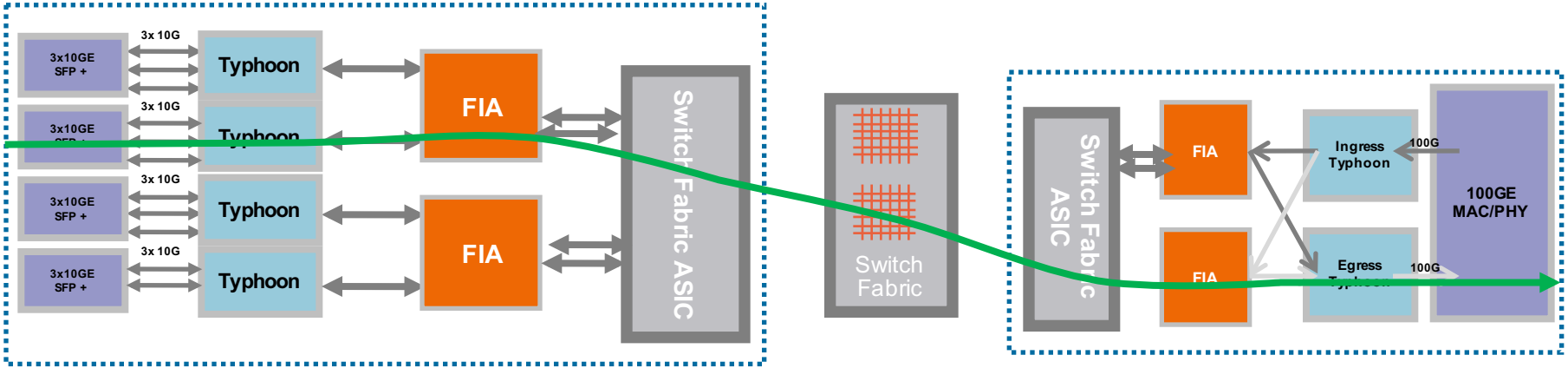
Unicast Two Stage Forwarding

By ingress NP and egress NP

First stage: lookup on **ingress NPU** → Egress NPU (or **SFP**: switch fabric port)

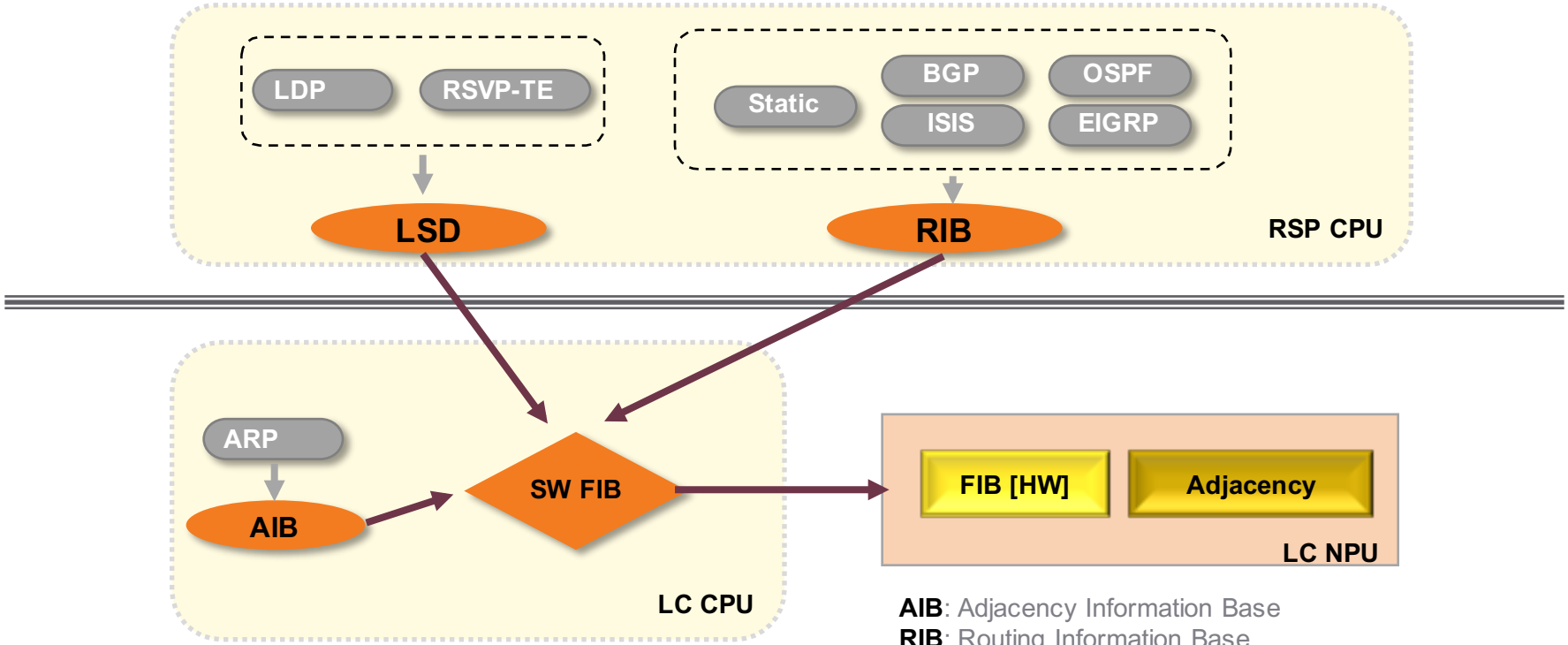
Second stage: lookup on **egress NPU** → Egress port and rewrite information





The NP FIB

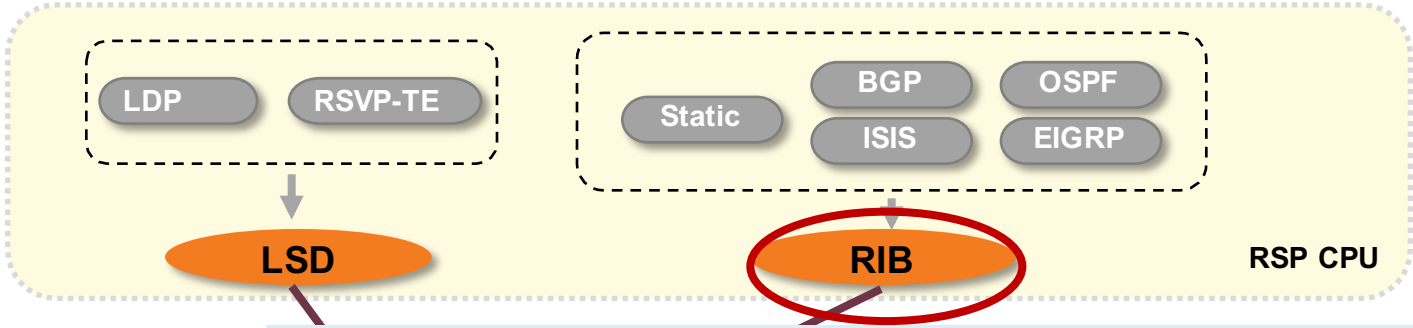
From RP control plane to data plane NP



AIB: Adjacency Information Base
RIB: Routing Information Base
FIB: Forwarding Information Base
LSD: Label Switch Database

The NP FIB

RIB info: example

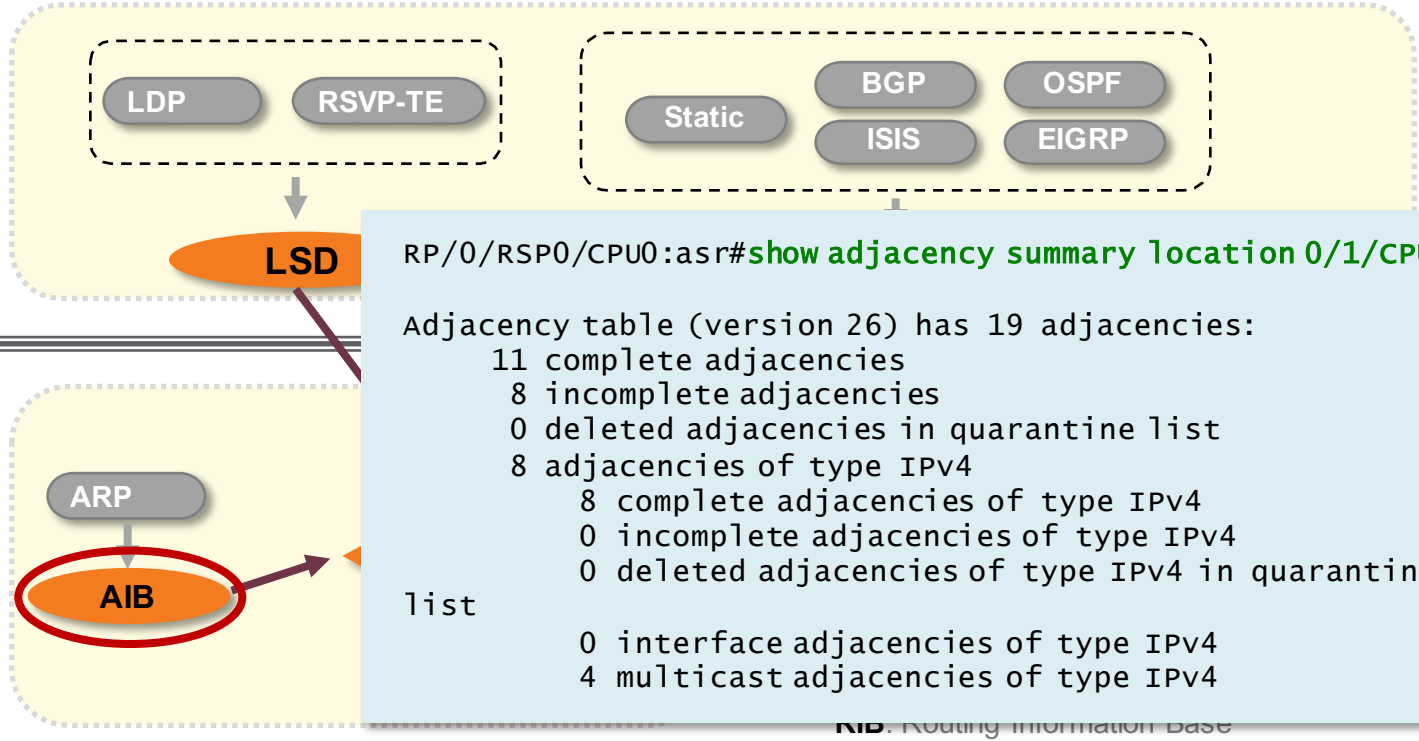



```
RP/0/RSP0/CPU0:asr#sh route 222.0.0.6/31

Routing entry for 222.0.0.6/31
  Known via "isis isis1", distance 115, metric 20, type level-1
  Installed Mar  2 17:58:12.251 for 00:00:47
  Routing Descriptor Blocks
    222.0.0.2, from 222.2.2.1, via TenGigE0/1/0/3
      Route metric is 20
  No advertising protos.
```

RIB: Routing Information Base
FIB: Forwarding Information Base
LSD: Label Switch Database

The NP FIB

Line card adjacency



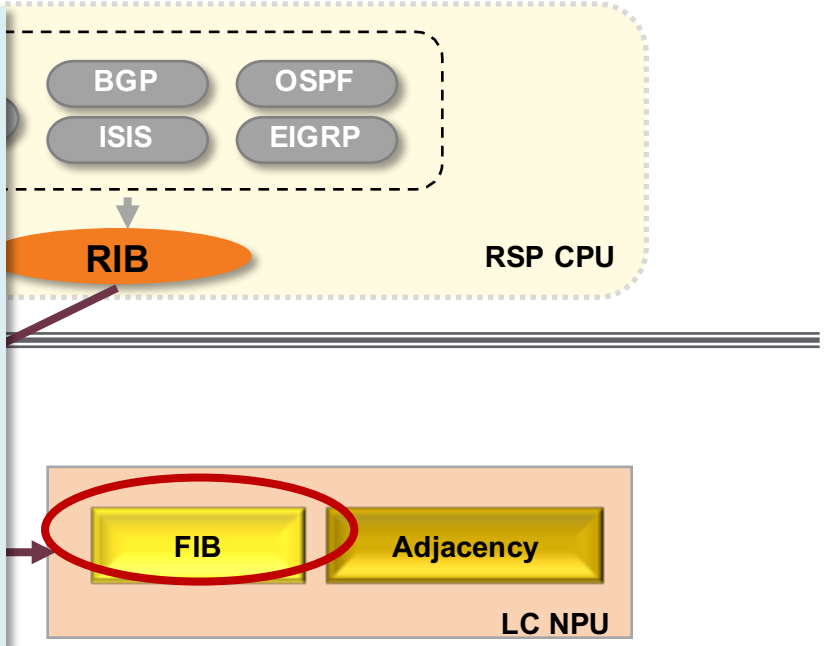

```
RP/0/RSP0/CPU0:asr#show adjacency summary location 0/1/CPU0

Adjacency table (version 26) has 19 adjacencies:
     11 complete adjacencies
      8 incomplete adjacencies
      0 deleted adjacencies in quarantine list
      8 adjacencies of type IPv4
          8 complete adjacencies of type IPv4
          0 incomplete adjacencies of type IPv4
          0 deleted adjacencies of type IPv4 in quarantine
list
          0 interface adjacencies of type IPv4
          4 multicast adjacencies of type IPv4
```

RIB: Routing Information Base
FIB: Forwarding Information Base
LSD: Label Switch Database

The NP FIB

FIB entry in NP: example

```
RP/0/RSP0/CPU0:asr#sh cef 222.0.0.6 hardware ingress lo 0/1/CPU0
222.0.0.6/31, version 1, internal 0x40000001 (0xb1d66c6c) [1], 0x0
(0xb1b4f758), 0x0 (0x0)
 Updated Mar  2 17:58:11.987
 local adjacency 222.0.0.2
 Prefix Len 31, traffic index 0, precedence routine (0)
   via 222.0.0.2, TenGigE0/1/0/3,  5 dependencies,  weight 0, class 0
    next hop 222.0.0.2
    local adjacency
        EZ:0 Leaf
        ============
  Search ctrl-byte0:     0x3   ctrl-byte1:     0x8   ctrl-byte2:0x5
  Leaf Action :     FORWARD
prefix length :     31
Search Control Flags :
    match          :   1        valid:    1
    done           :   0        ifib_lookup:     0
    ext_lsp_array  :   0        match_all_bit:     0
    recursive      :   0        nonrecursive    :   1
    default_action:    1

  Non Recursive Leaf:
  -------------------
    ldi ptr    : 10936 (0x2ab8)        igp statsptr:0
  rpf ptr :     0x0000
```



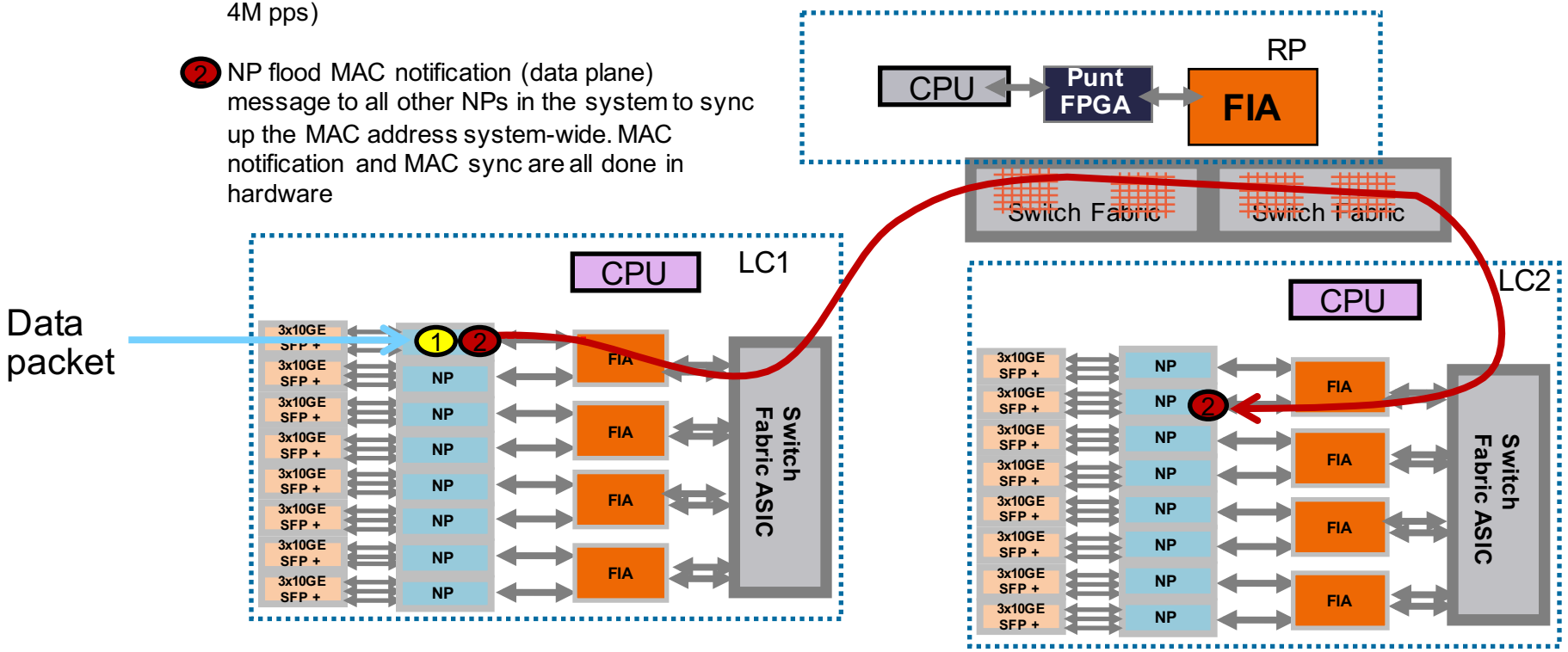
AIB: Adjacency Information Base
RIB: Routing Information Base
FIB: Forwarding Information Base
LSD: Label Switch Database

MAC learning and synchronization

Hardware based MAC learning: ~4Mpps/NP

1. NP learn MAC address in hardware (around 4M pps)

2. NP flood MAC notification (data plane) message to all other NPs in the system to sync up the MAC address system-wide. MAC notification and MAC sync are all done in hardware



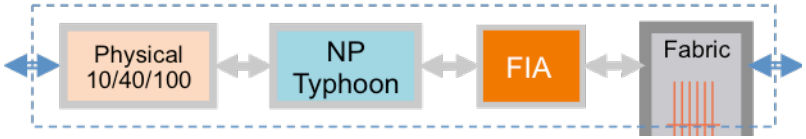
MAC learning and synchronization

show controllers np struct 18 detail all-entries npx location 0/x/cpu0 | i 00000c07acd0 <<< replace your client MAC

```
RP/0/RSP0/CPU0:rasr9k-1y#show l2vpn forwarding bridge-domain BRIDGES:DOMAIN-A mac-address
hardware ingress location 0/4/CPU0
Fri Feb 22 18:50:08.433 UTC
 To Resynchronize MAC table from the Network Processors, use the command...
    l2vpn resynchronize forwarding mac-address-table location <r/s/i>

Mac Address    Type    Learned from/Filtered on    LC learned Resync Age          Mapped to
--------------------------------------------------------------------------------
0000.c001.0167 dynamic Gi0/0/1/0.200               0/0/CPU0   0d 0h 0m 18s        N/A
0000.c001.016b dynamic Gi0/0/1/0.200               0/0/CPU0   0d 0h 0m 11s        N/A
0000.c001.016c dynamic Gi0/0/1/0.200               0/0/CPU0   0d 0h 0m 9s         N/A
0000.c001.016d dynamic Gi0/0/1/0.200               0/0/CPU0   0d 0h 0m 18s        N/A
0000.c001.016e dynamic Gi0/0/1/0.200               0/0/CPU0   0d 0h 0m 20s        N/A
0000.c001.016f dynamic Gi0/0/1/0.200               0/0/CPU0   0d 0h 0m 8s         N/A
0000.c001.0171 dynamic Gi0/0/1/0.200               0/0/CPU0   0d 0h 0m 17s        N/A
0000.c001.0102 dynamic Te0/4/0/20.101              0/4/CPU0   0d 0h 0m 16s        N/A
0000.c001.0104 dynamic Te0/4/0/20.101              0/4/CPU0   0d 0h 0m 20s        N/A
0000.c001.0105 dynamic Te0/4/0/20.101              0/4/CPU0   0d 0h 0m 8s         N/A
0000.c001.0106 dynamic Te0/4/0/20.101              0/4/CPU0   0d 0h 0m 9s         N/A
0000.c001.0107 dynamic Te0/4/0/20.101              0/4/CPU0   0d 0h 0m 18s        N/A
0000.c001.0108 dynamic Te0/4/0/20.101              0/4/CPU0   0d 0h 0m 15s        N/A
0000.c001.0109 dynamic Te0/4/0/20.101              0/4/CPU0   0d 0h 0m 3s         N/A
0000.c001.010a dynamic Te0/4/0/20.101              0/4/CPU0   0d 0h 0m 4s         N/A
.
```

L3 Unicast Packet Journey

Mapping the port to NP and FIA

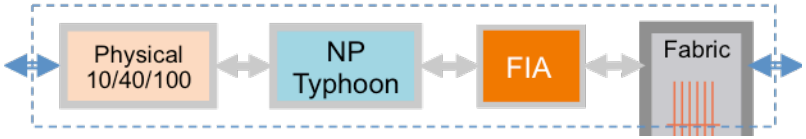



```
! Example:  Path from GigabitEthernet0/0/1/0  192.3.1.2 TO TenGigE0/4/0/20.6  192.6.1.2

RP/0/RSP0/CPU0:rasr9k-1y#show controllers NP ports all location 0/0/CPU0
Fri Feb 22 15:57:32.307 UTC
                   Node: 0/0/CPU0:
----------------------------------------------------------------
NP Bridge Fia                          Ports
-- ------ --- --------------------------------------------------
0  --     0   TenGigE0/0/0/0, TenGigE0/0/0/1, TenGigE0/0/0/2, TenGigE0/0/0/3
1  --     1   GigabitEthernet0/0/1/0 - GigabitEthernet0/0/1/19

RP/0/RSP0/CPU0:rasr9k-1y#show controllers NP ports all location 0/4/CPU0
Fri Feb 22 15:55:22.370 UTC
                   Node: 0/4/CPU0:
----------------------------------------------------------------
NP Bridge Fia                          Ports
-- ------ --- --------------------------------------------------
0  --     0   TenGigE0/4/0/0, TenGigE0/4/0/1, TenGigE0/4/0/2
1  --     0   TenGigE0/4/0/3, TenGigE0/4/0/4, TenGigE0/4/0/5
2  --     1   TenGigE0/4/0/6, TenGigE0/4/0/7, TenGigE0/4/0/8
3  --     1   TenGigE0/4/0/9, TenGigE0/4/0/10, TenGigE0/4/0/11
4  --     2   TenGigE0/4/0/12, TenGigE0/4/0/13, TenGigE0/4/0/14
5  --     2   TenGigE0/4/0/15, TenGigE0/4/0/16, TenGigE0/4/0/17
6  --     3   TenGigE0/4/0/18, TenGigE0/4/0/19, TenGigE0/4/0/20
7  --     3   TenGigE0/4/0/21, TenGigE0/4/0/22, TenGigE0/4/0/23
```

Map the port to NP and FIA

L3 Unicast Packet Journey

The egress interface identifier




```
RP/0/RSP0/CPU0:rasr9k-1y#show controllers pm interface tenGigE 0/4/0/20.6
Fri Feb 22 16:45:22.404 UTC
Ifname(1): TenGigE0_4_0_20.6, ifh: 0xc001340 :
iftype              0x19
egress_uidb_index   0x1d
ingress_uidb_index  0x1d
port_num            0x14
subslot_num         0x0
phy_port_num        0x14
channel_id          0x6
channel_map         0x0
lag_id              0x0
virtual_port_id     0x0
switch_fabric_port  0x136
in_tm_qid_fid0      0x0
in_tm_qid_fid1      0x0
in_qos_drop_base    0x0
out_tm_qid_fid0     0x0          0x0          0x0          0x0          0x0          0x0          0x0
0x0
out_tm_qid_fid1     0x0          0x0          0x0          0x0          0x0          0x0          0x0
0x0
out_qos_drop_base   0x0
bandwidth           10000000 kbps
.
```

Get internal identifiers

Interface handle: unique to logical sub-interface

Fabric port, shared between all port sub-interfaces. The fabric destination.

L3 Unicast Packet Journey

Ingress NP FIB

```
RP/0/RSP0/CPU0:rasr9k-1y#show cef ipv4 192.6.1.2
hardware ingress location 0/0/CPU0
Fri Feb 22 17:40:35.887 UTC
192.6.1.0/24, version 364, attached, connected,
internal 0xc0000c1 (ptr 0x8856b534) [1], 0x0
(0x873dde50), 0x0 (0x0)
 Updated Feb 22 16:09:42.862
 remote adjacency to TenGigE0/4/0/20.6
 Prefix Len 24, traffic index 0, precedence
routine (0), priority 0
   via TenGigE0/4/0/20.6, 2 dependencies, weight
0, class 0 [flags 0x8]
    path-idx 0 [0x8a60a7bc 0x0]
    remote adjacency
LEAF - HAL pd context :
 sub-type : IPV4, ecd_marked:0,
has_collapsed_ldi:0, collapse_bwalk_required:0,
ecdv2_marked:0
Leaf H/W Result:

    Physical Result: 0x11dd0600 (LE)

    Raw Data0: 0x91ad1000 00000001 360c0013
40000000
    Raw Data1: 0x00000000 00000136 00180000
00000000
    .
```

```
RX H/W Result on NP:1 [Adj ptr:0x3a (BE)]:

    Raw Data0:  0x91000000  00000136  0c001340  00000000
    adj_resolve_control_byte0
                          match: 1
valid: 1
                     iptunl_adj: 0
                    remote_rack: 0

    adj_resolve_control_byte1
                       adj_down: 0
mgscp_en: 0
      rx_lag_hash_en: 0
          rx_lag_adj: 0

    adj_resolve_control_byte2
                     rx_lag_adj: 0
rx_adj_null0: 0
                    rp_destined: 0
rx_punt: 0
                         rx_drop: 0
    sfp/vqi           : 0x136
    if_handle         : 0xc001340
.
```

L3 Unicast Packet Journey

Egress NP FIB

```
RP/0/RSP0/CPU0:rasr9k-1y#show cef ipv4 192.6.1.2
hardware egress location 0/4/CPU0
Fri Feb 22 17:55:28.494 UTC
192.6.1.2/32, version 0, internal 0x4080001 (ptr
0x8efc2704) [1], 0x0 (0x8e0f2210), 0x0 (0x0)
 Updated Feb 22 16:13:35.351
 local adjacency 192.6.1.2
 Prefix Len 32, traffic index 0, Adjacency-
prefix, precedence routine (0), priority 0
   via 192.6.1.2, TenGigE0/4/0/20.6, 3
dependencies, weight 0, class 0 [flags 0x0]
    path-idx 0 [0x91a2cef8 0x0]
    next hop 192.6.1.2
    local adjacency
LEAF - HAL pd context :
 sub-type : IPV4, ecd_marked:0,
has_collapsed_ldi:0, collapse_bwalk_required:0,
ecdv2_marked:0
Leaf H/W Result:

    Physical Result: 0x11e80300 (LE)

    Raw Data0: 0x91ad1000 8a030001 360c0013
40400000
   .
```

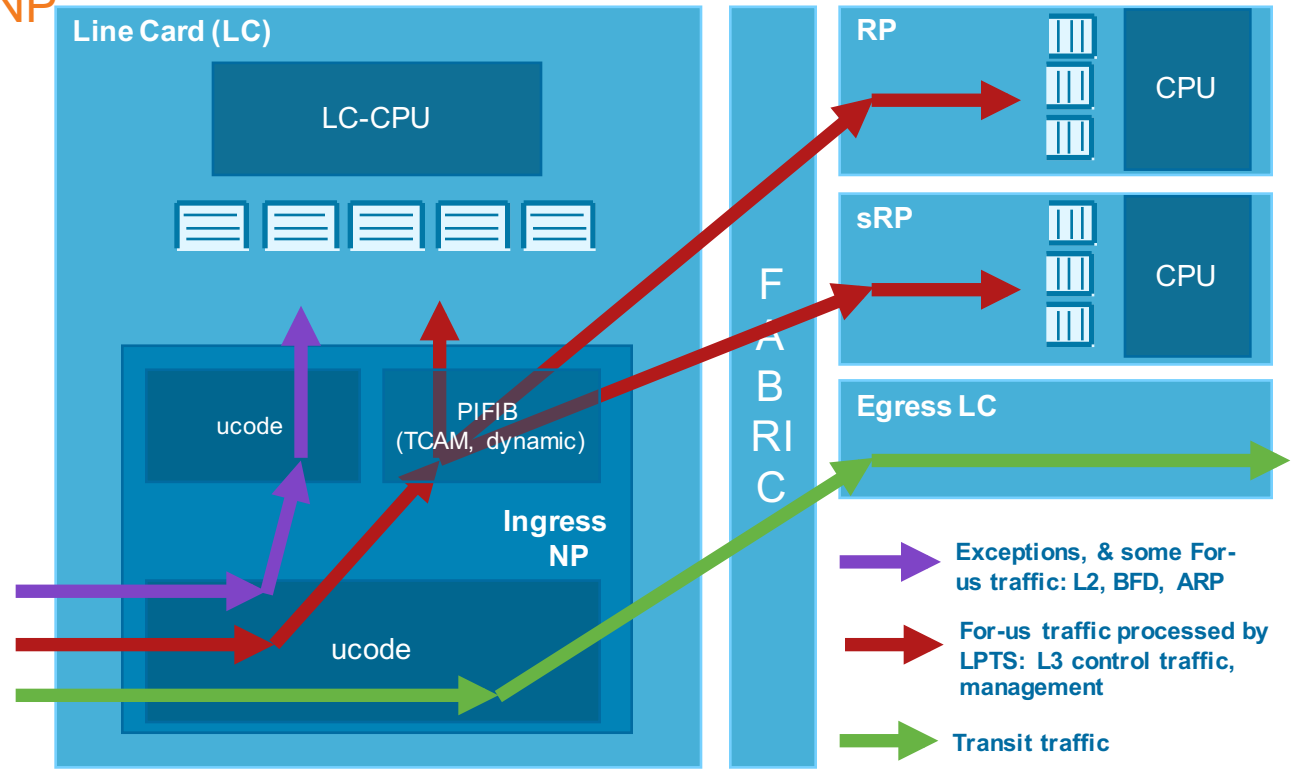
```
TX H/W Result for NP:6 (index: 0x38a (BE)):
    Raw Data0:  0x91080000  1d000000  dc050000  400b5f00
    Raw Data1:  0x0000c006  01020000  00000000  00000000
    adj_resolve_control_byte0
                      reserved: 0
egr_uidb_internal: 1
                         match: 1
valid: 1
                    iptunl_adj: 0
    adj_resolve_control_byte1
                  tx_adj_null0: 0
tx_punt: 0                    tx_drop: 0
               default_action: 1
spare: 0
    adj_resolve_control_byte2
                         spare: 0
spare_cb: 0
    flags
        gre_adj          : 0
    uidb_index       : 0x1d00 (LE)
    reserve_pad_word: 0
    l3_mtu           : 1500
    reserve_pad_1    : 0
    adj_stats_index : 0x400b5f00
    dest_mac         : 0x0000.c006.0102
    ether reserved   : 0000000000000000
.
```


Control, Management, & Security
For Us, Exceptions, & Resource Protection

Traffic: Transit, For us, and Exceptions

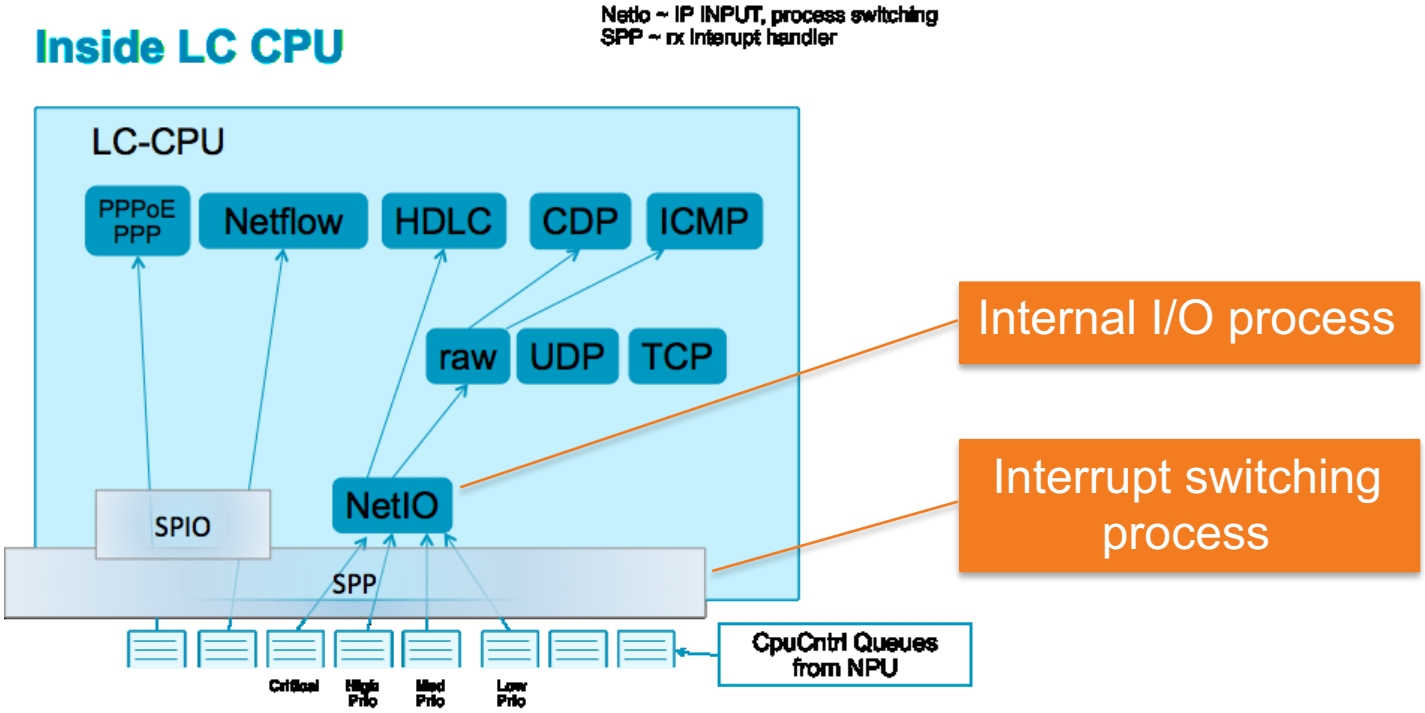
Differentiate on ingress NP

- Transit
  - Look up, re-write, forward
- For us
  - Destined to RP, or link local scope
  - Punt to RP or ingress LC CPU
- Exception
  - MTU failure, TTL failure, etc. Should have been transit
  - Punt to LC CPU



For Us Frame Path

From ingress NP to RP CPU or LC CPU



Control Plane Protection

LPTS flow type policers

#clear controller np counters all location …

```
RP/0/RSP0/CPU0:rasr9k-1y#show lpts pifib hardware police location 0/0/CPU0
Sun Dec  2 06:07:36.931 UTC
---------------------------------------------------------------------
              Node 0/0/C
---------------------------------------------------------------------
 Burst = 100ms for all flo
---------------------------------------------------------------------
FlowType              Polic      pe     Cur. Rate  Def. Rate  Accepted             Dropped
--------------------- -----      ---- ---------- ---------- -------------------- --------------------
unconfigured-default  10         Static  2500      2500       0                    0
Fragment                         Local   0         2500       0                    0
OSPF-mc-known         102        Static  2000      2000       0                    0
OSPF-mc-default       103        Local   0         1500       53                   26
OSPF-uc-known         104        Static  2000      2000       0                    0
OSPF-uc-defaul        105        Loc                                               0
ISIS-known            143        Sta                           0890                0
ISIS-defa    t        144                                                          0
.
BGP-known             106        Static  2500      2500       4070                 0
BGP-cfg-peer          107        Static  2000      2000       17                   0
BGP-default           108        Local   400000    1500       138918630            3848639925
PIM-mcast-default                         0                                        0
PIM-mcast-known       176        Static  2                                         0
PIM-ucast             110        Static  1                                         0
IGMP                  111        Static  3000      3000       0                    0
```

Established session packets

Configured peer packets

BGP packets from unknown

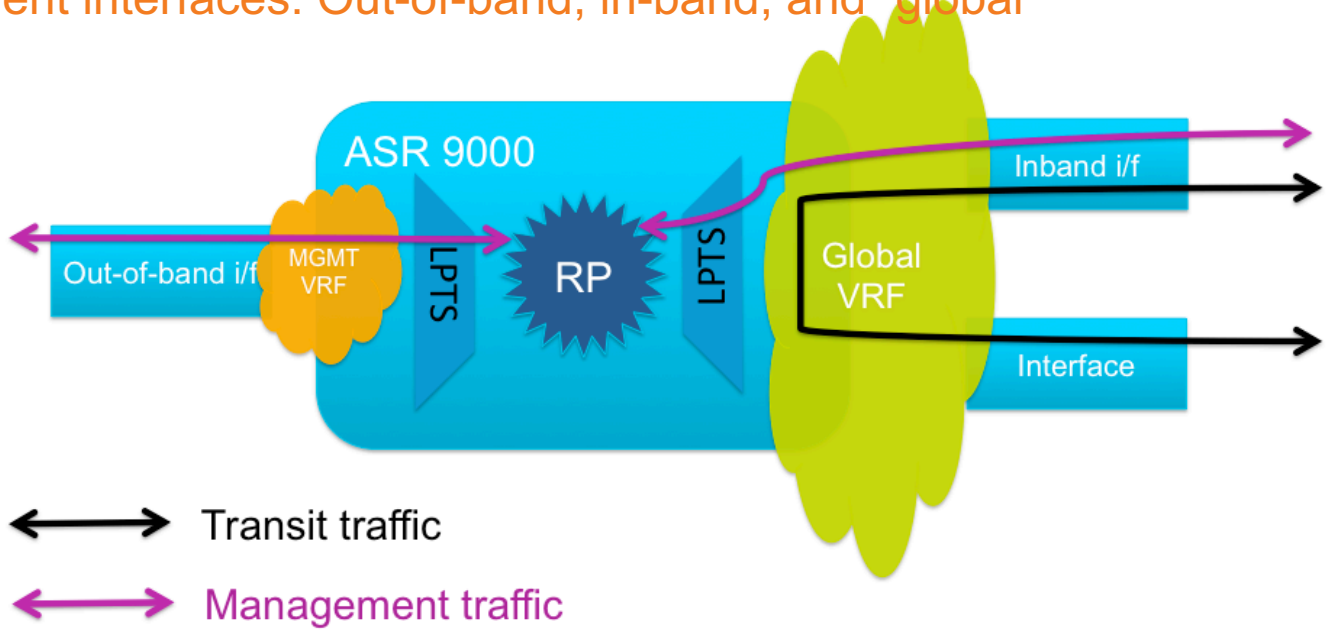
Management

Management Plane Protocols

- Simple Network Management Protocol (SNMP)
- Telnet / SSH
- SFTP / FTP / TFTP
- Secure Copy Protocol (SCP)
- TACACS+ / RADIUS
- NetFlow (also used by the Data Plane as that is where the traffic comes from)
- Network Time Protocol (NTP)
- Syslog

Management Traffic

Management interfaces: Out-of-band, in-band, and “global”



- No communication permitted between inband and out-of-band
- Management VRF is not necessary, but looks cleaner

Management Traffic

Out-of-Band: Virtual address, interfaces, and protocols

```
RP/0/RSP0/CPU0:rasr9k-1y#show running-config
control-plane management-plane out-of-band
Wed Dec  5 00:45:07.132 UTC
control-plane
 management-plane
  out-of-band
   vrf MGMT
   interface MgmtEth0/RSP0/CPU0/0
    allow SSH peer
     address ipv4 172.16.1.0/24
    !
    allow SNMP peer
     address ipv4 172.16.1.98
    !
   !
   interface MgmtEth0/RSP1/CPU0/0
    allow SSH peer
     address ipv4 172.16.1.0/24
    !
    allow SNMP peer
     address ipv4 172.16.1.98
    !
   !
  !
```

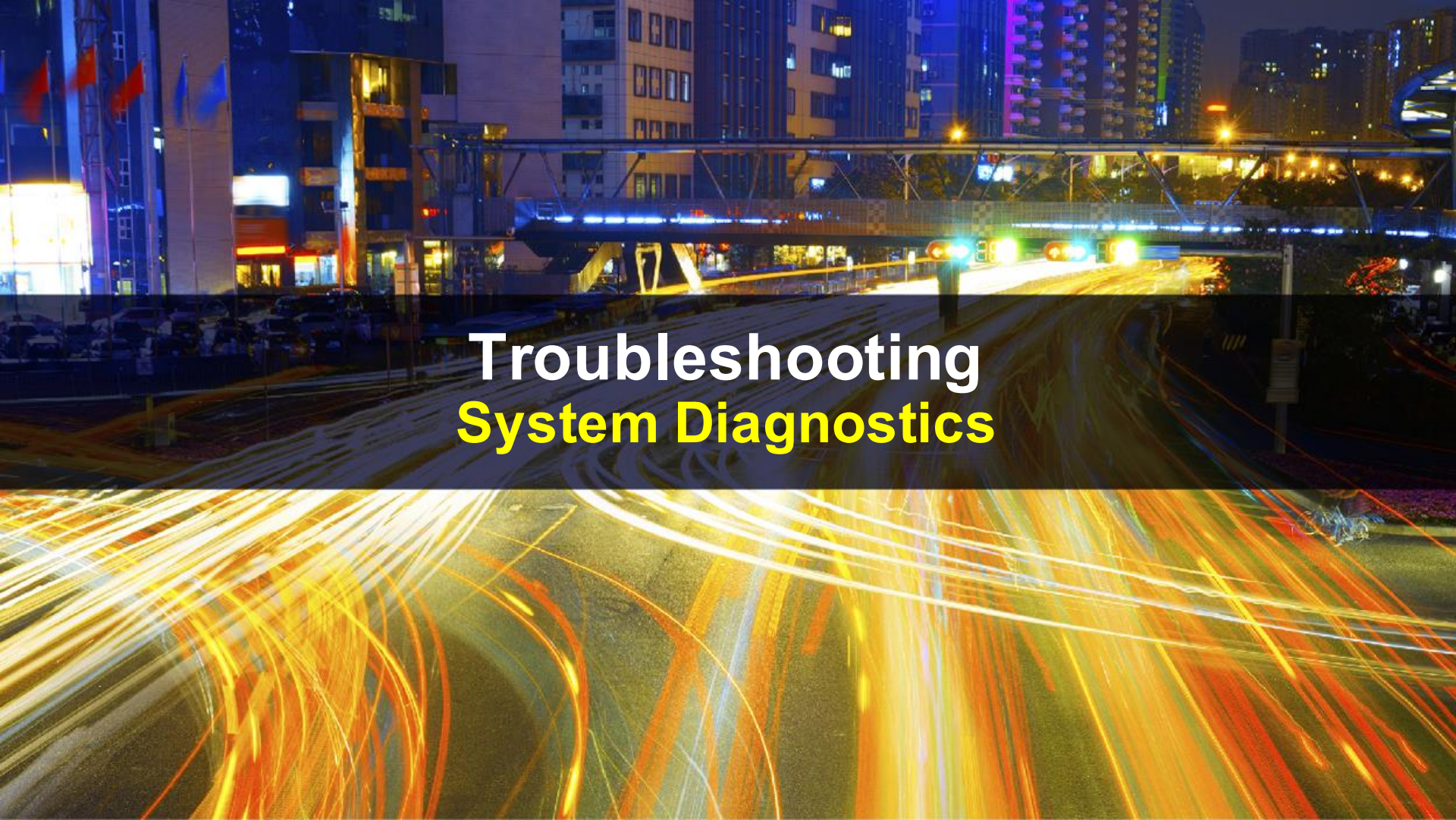
```
RP/0/RSP0/CPU0:rasr9k-1y#show mgmt-plane
Wed Dec  5 00:46:26.162 UTC

Management Plane Protection

inband interfaces
----------------------
interface - TenGigE0_0_0_2/
        ssh configured -
                peer v4 allowed - 192.168.1.0/24

outband interfaces
----------------------
interface - MgmtEth0_RSP0_CPU0_0/
        ssh configured -
                peer v4 allowed - 172.16.1.0/24
        snmp configured -
                peer v4 allowed - 172.16.1.98
interface - MgmtEth0_RSP1_CPU0_0/
        ssh configured -
                peer v4 allowed - 172.16.1.0/24
        snmp configured -
                peer v4 allowed - 172.16.1.98
```

Management Traffic

In-band: If OOB is not available

```
RP/0/RSP0/CPU0:rasr9k-1y#show running-config
control-plane management-plane inband
Tue Dec 11 23:05:11.597 UTC
control-plane
 management-plane
  inband
   interface TenGigE0/0/0/2
    allow SSH peer
     address ipv4 192.168.1.0/24
    !
   !
  !
 !
!
```

```
RP/0/RSP0/CPU0:rasr9k-1y#show mgmt-plane
Wed Dec  5 00:46:26.162 UTC

Management Plane Protection

inband interfaces
----------------------
interface - TenGigE0_0_0_2/
        ssh configured -
                peer v4 allowed - 192.168.1.0/24

outband interfaces
----------------------
interface - MgmtEth0_RSP0_CPU0_0/
        ssh configured -
                peer v4 allowed - 172.16.1.0/24
        snmp configured -
                peer v4 allowed - 172.16.1.98
interface - MgmtEth0_RSP1_CPU0_0/
        ssh configured -
                peer v4 allowed - 172.16.1.0/24
        snmp configured -
                peer v4 allowed - 172.16.1.98
```



Troubleshooting
System Diagnostics

Background Diagnostics

RSP default diagnostics

```
RP/0/RSP0/CPU0:rasr9000-2w-a#admin show diagnostic content location 0/RSP0/CPU0
Wed Dec 11 19:44:32.957 EST

RP 0/RSP0/CPU0:

  Diagnostics test suite attributes:
    M/C/* - Minimal bootup level test / Complete bootup level test / NA
    B/O/* - Basic ondemand test / not Ondemand test / NA
    P/V/* - Per port test / Per device test / NA
    D/N/* - Disruptive test / Non-disruptive test / NA
      S/* - Only applicable to standby unit / NA
      X/* - Not a health monitoring test / NA
      F/* - Fixed monitoring interval test / NA
      E/* - Always enabled monitoring test / NA
      A/I - Monitoring is active / Monitoring is inactive

                                                          Test Interval    Thre-
  ID   Test Name                                Attributes  (day hh:mm:ss.ms shold)
  ==== ================================== ============ ================ =====
    1) CPUCtrlScratchRegister ----------> ***N****A      000 00:01:00.000 1
    2) ClkCtrlScratchRegister ----------> ***N****A      000 00:01:00.000 1
    3) ZenJfScratchRegister ------------> ***N****A      000 00:01:00.000 1
    4) FabSwitchIdRegister -------------> *B*N****A      000 00:01:00.000 1
    5) SrspStandbyEobcHeartbeat --------> *B*NS***A      000 00:00:05.000 3
    6) SrspActiveEobcHeartbeat ---------> *B*NS***A      000 00:00:05.000 3
    7) FabricLoopback ------------------> MB*N****A      000 00:01:00.000 3
    8) PuntFabricDataPath --------------> *B*N****A      000 00:01:00.000 3
```

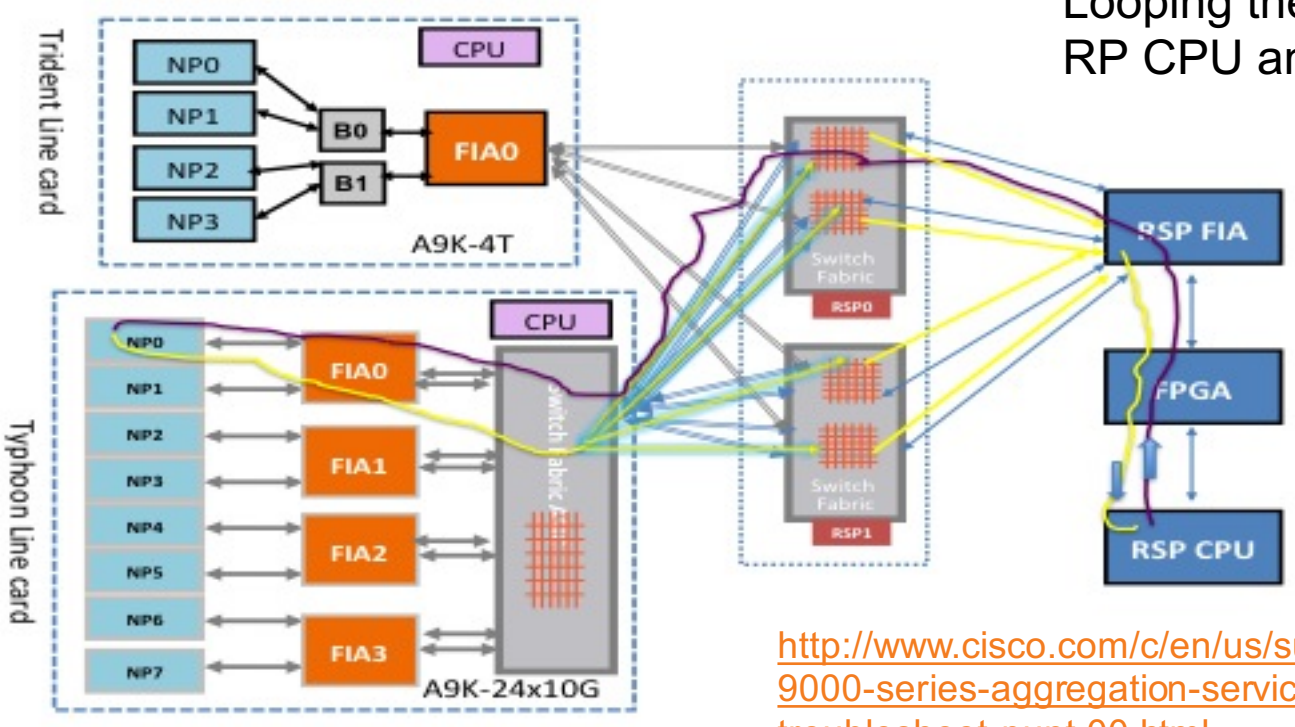
Every minute or every 5 seconds

Error threshold (consecutive)

Background Diagnostics

Test example: PuntFabricDataPath

Looping the path between RP CPU and each NP



http://www.cisco.com/c/en/us/support/docs/routers/asr-9000-series-aggregation-services-routers/116727-troubleshoot-punt-00.html

Background Diagnostics

LC default diagnostics

```
RP/0/RSP0/CPU0:rasr9000-2w-a#admin show diagnostic content location 0/0/CPU0
Wed Dec 11 20:32:08.842 EST

A9K-24x10GE-SE 0/0/CPU0:

  Diagnostics test suite attributes:
    M/C/* - Minimal bootup level test / Complete bootup level test / NA
    B/O/* - Basic ondemand test / not Ondemand test / NA
    P/V/* - Per port test / Per device test / NA
    D/N/* - Disruptive test / Non-disruptive test / NA
      S/* - Only applicable to standby unit / NA
      X/* - Not a health monitoring test / NA
      F/* - Fixed monitoring interval test / NA
      E/* - Always enabled monitoring test / NA
      A/I - Monitoring is active / Monitoring is inactive

                                                          Test Interval    Thre-
  ID   Test Name                                Attributes  (day hh:mm:ss.ms shold)
  ==== ================================== ============ ================ =====
    1) CPUCtrlScratchRegister ----------> *B*N****A      000 00:01:00.000 1
    2) PHYCtrlScratchRegister ----------> *B*N****A      000 00:01:00.000 1
    3) PortCtrlScratchRegister ---------> *B*N****A      000 00:01:00.000 1
    4) FIAScratchRegister --------------> *B*N****A      000 00:01:00.000 1
    5) LcEobcHeartbeat -----------------> *B*N****A      000 00:00:05.000 3
    6) NPULoopback ---------------------> *B*N****A      000 00:01:00.000 3
```

Background Diagnostics

Errors and clears

- Set: threshold exceeded
  - Path to LC 2 NP 0 failed in this example
- Clear: test previously failing, now passed
  - Indication of “transient” fault. Keep watching
- “show pfm location all” shows platform errors reported

```
RP/0/RSP0/CPU0:Feb 5 05:05:44.051 :
pfm_node_rp[354]:%PLATFORM-DIAGS-3-PUNT_FABRIC_DATA_PATH_FAILED :
Set|online_diag_rsp[237686]|System Punt/Fabric/data Path
Test(0x2000004)|failure threshold is 3, (slot, NP)failed:
(0/2/CPU0, 0)
```

```
RP/0/RSP0/CPU0:Feb 5 05:05:46.051 :
pfm_node_rp[354]:%PLATFORM-DIAGS-3-PUNT_FABRIC_DATA_PATH_FAILED :
Clear|online_diag_rsp[237686]|System Punt/Fabric/data Path
Test(0x2000004)|failure threshold is 3, (slot, NP)failed:
(0/2/CPU0, 0)
```

LC & NP Resources

L3 forwarding resources

```
RP/0/RSP0/CPU0:rasr9000-2w-a#show cef resource hardware ingress detail location 0/0/CPU0
Wed Dec 11 22:27:57.319 EST
CEF resource availability summary state: GREEN
CEF will work normally
  ipv4 shared memory resource:
        CurrMode GREEN, CurrAvail 1609412608 bytes, MaxAvail 1683308544 bytes
  ipv6 shared memory resource:
        CurrMode GREEN, CurrAvail 1609412608 bytes, MaxAvail 1683308544 bytes
  mpls shared memory resource:
        CurrMode GREEN, CurrAvail 1609412608 bytes, MaxAvail 1683308544 bytes
  common shared memory resource:
        CurrMode GREEN, CurrAvail 1609412608 bytes, MaxAvail 1683308544 bytes
  DATA_TYPE_TABLE_SET hardware resource: GREEN
  DATA_TYPE_TABLE hardware resource: GREEN
  DATA_TYPE_IDB hardware resource: GREEN
  DATA_TYPE_IDB_EXT hardware resource: GREEN
  DATA_TYPE_LEAF hardware resource: GREEN
  DATA_TYPE_LOADINFO hardware resource: GREEN
  DATA_TYPE_PATH_LIST hardware resource: GREEN
  DATA_TYPE_NHINFO hardware resource: GREEN
  DATA_TYPE_LABEL_INFO hardware resource: GREEN
  DATA_TYPE_FRR_NHINFO hardware resource: GREEN
  DATA_TYPE_ECD hardware resource: GREEN
.
```

LC & NP Resources

L2 service resources

```
RP/0/RSP0/CPU0:rasr9000-2w-a#show l2vpn forwarding resource hardware ingress detail location
0/0/CPU0
Wed Dec 11 22:26:07.070 EST
L2VPN forwarding resource availability summary state: GREEN
  shared memory resource:
        CurrMode GREEN, CurrAvail 1609412608 bytes, MaxAvail 1650212864 bytes
  AC hardware resource: GREEN
  MPLS hardware resource: GREEN
  PBB PORT hardware resource: GREEN
  NHOP hardware resource: GREEN
  L2TP hardware resource: GREEN
  L2TP_SESSION hardware resource: GREEN
  VFI hardware resource: GREEN
  BRIDGE hardware resource: GREEN
  BRIDGE SHG hardware resource: GREEN
  BRIDGE PORT hardware resource: GREEN
  BRIDGE MAC hardware resource: GREEN
  MSTI MAIN PORT hardware resource: GREEN
  BRIDGE MAIN PORT hardware resource: GREEN
  MCAST TABLE hardware resource: GREEN
  MCAST LEAF hardware resource: GREEN
  MCAST XID hardware resource: GREEN
  PBB BMAC SA hardware resource: GREEN
.
```

TCP Resources

TCP connections states

```
RP/0/RSP0/CPU0:rasr9000-2w-a#show tcp brief
Fri Dec 13 22:29:33.189 EST
   PCB      VRF-ID     Recv-Q Send-Q Local Address          Foreign Address        State
0x10174ad8 0x60000000      0      0  :::179                :::0                    LISTEN
0x101745f8 0x60000001      0      0  :::179                :::0                    LISTEN
0x10174798 0x60000002      0      0  :::179                :::0                    LISTEN
0x10174938 0x60000003      0      0  :::179                :::0                    LISTEN
0x101cce2c 0x6000000b      0      0  :::179                :::0                    LISTEN
0x1016fefc 0x00000000      0      0  :::179                :::0                    LISTEN
0x101ac7ac 0x60000000      0      0  10.101.111.1:179      10.100.101.1:20100      ESTAB
0x1017bbf4 0x60000000      0      0  10.101.111.1:646      10.101.188.1:30687      ESTAB
0x10182b38 0x60000000      0      0  10.101.111.1:179      10.100.103.1:59214      ESTAB
0x1002e004 0x6000000d      0      0  10.100.111.1:17514    10.100.111.100:13680    ESTAB
0x10161e18 0x60000000      0      0  0.0.0.0:23            0.0.0.0:0               LISTEN
0x101cc968 0x00000000      0      0  0.0.0.0:23            0.0.0.0:0               LISTEN
0x101594b4 0x60000000      0      0  0.0.0.0:646           0.0.0.0:0               LISTEN
0x1016f7f0 0x60000000      0      0  0.0.0.0:179           0.0.0.0:0               LISTEN
0x10165d74 0x60000001      0      0  0.0.0.0:179           0.0.0.0:0               LISTEN
0x1016f4b0 0x60000002      0      0  0.0.0.0:179           0.0.0.0:0               LISTEN
0x1016f650 0x60000003      0      0  0.0.0.0:179           0.0.0.0:0               LISTEN
0x101ade54 0x6000000b      0      0  0.0.0.0:179           0.0.0.0:0               LISTEN
0x1016276c 0x00000000      0      0  0.0.0.0:179           0.0.0.0:0               LISTEN
0x1015e304 0x00000000      0      0  0.0.0.0:0             0.0.0.0:0               CLOSED
```

TCP Resources

TCP connections parameters

```
RP/0/RSP0/CPU0:rasr9000-2w-a#show tcp detail pcb 0x10182b38
Wed Dec 11 22:47:18.708 EST

================================================================
Connection state is ESTAB, I/O status: 0, socket status: 0
Established at Thu Dec  5 04:13:28 2013

PCB 0x10182b38, SO 0x10182968, TCPCB 0x101cc2b4, vrfid
0x60000000,
Pak Prio: Medium, TOS: 192, TTL: 255, Hash index: 717
Local host: 10.101.111.1, Local port: 179 (Local App PID:
287053)
Foreign host: 10.100.103.1, Foreign port: 59214

Current send queue size in bytes: 0 (max 24576)
Current receive queue size in bytes: 0 (max 32768)  mis-
ordered: 0 bytes
Current receive queue size in packets: 0 (max 0)

Timer          Starts    Wakeups         Next(msec)
Retrans          9789          0                 0
SendWnd             0          0                 0
TimeWait            0          0                 0
AckHold          9817       9605                 0
KeepAlive           1          0                 0
PmtuAger            0          0                 0
GiveUp              0          0                 0
Throttle            0          0                 0

   iss: 2038437204  snduna: 2038628753  sndnxt: 2038628753
sndmax: 2038628753  sndwnd: 31856       sndcwnd: 3648
   irs: 2495655735  rcvnxt: 2495854116  rcvwnd: 31894
rcvadv: 2495886010
```

```
SRTT: 217 ms,  RTTO: 300 ms,  RTV: 11 ms,  KRTT: 0 ms
minRTT: 1 ms,  maxRTT: 289 ms

ACK hold time: 200 ms, Keepalive time: 0 sec, SYN waittime: 30
sec
Giveup time: 0 ms, Retransmission retries: 0, Retransmit
forever: FALSE
Connect retries remaining: 0, connect retry interval: 0 secs

State flags: none
Feature flags: MD5, Win Scale, Nagle
Request flags: Win Scale

Datagrams (in bytes): MSS 1216, peer MSS 1216, min MSS 1240,
max MSS 1240

Window scales: rcv 0, snd 0, request rcv 0, request snd 0
Timestamp option: recent 0, recent age 0, last ACK sent 0
Sack blocks {start, end}: none
Sack holes {start, end, dups, rxmit}: none

Socket options: SO_REUSEADDR, SO_REUSEPORT, SO_NBIO
Socket states: SS_ISCONNECTED, SS_PRIV
Socket receive buffer states: SB_DEL_WAKEUP
Socket send buffer states: SB_DEL_WAKEUP
Socket receive buffer: Low/High watermark 1/32768
Socket send buffer   : Low/High watermark 2048/24576, Notify
threshold 0

PDU information:
 #PDU's in buffer: 0
FIB Lookup Cache:  IFH: 0x134e0  PD ctx: size: 8  data: 0x0
0xb1494a74
  Num Labels: 0  Label Stack:
```

Troubleshooting
Forwarding Path

Monitor Interface

See interface stats in almost real time

```
RP/0/RSP0/CPU0:rasr9000-2w-b#monitor  interface  tenGigE  0/1/1/1

rasr9000-2w-b          Monitor  Time:  00:00:22            SysUptime:  501:59:18

TenGigE0/1/1/1  is up, line protocol  is up
Encapsulation  ARPA

Traffic  Stats:(2  second  rates)                                    Delta
  Input   Packets:                2495245669613                     14890408
  Input   pps:                            7441113
  Input   Bytes:                164703177204108                    982758522
  Input   Kbps (rate):                    3928857                     ( 39%)
  Output  Packets:                3017277633655                     13261227
  Output  pps:                            6626897
  Output  Bytes:                205177835436607                    901762428
  Output  Kbps (rate):                    3605031                     ( 36%)

Errors  Stats:
  Input   Total:                                1                          0
  Input   CRC:                                  0                          0
  Input   Frame:                                0                          0
  Input   Overrun:                              0                          0
  Output  Total:                                0                          0
  Output  Underrun:                             0                          0

Quit='q',  Freeze='f',  Thaw='t',  Clear='c',  Interface='i',
Next='n',  Prev='p'

Brief='b',  Detail='d',  Protocol(IPv4/IPv6)='r'
```

The Physical

Checking on port physical: SFP/XFP, levels

```
RP/0/RSP0/CPU0:rasr9000-2w-b#show  controllers  TenGigE  0/0/0/0  phy
Mon Dec  9 13:53:37.848  EST

SFP  EEPROM   port:  0
         Xcvr  Type:  SFP
         Xcvr  Code:  SFP-10G-SR
         Encoding:  64B66B
         Bit  Rate:  10300  Mbps
         Link  Reach  50u  fiber:  80  meter
         Link  Reach  62.5u  fiber:  20  meter
         Vendor  Name:  CISCO-FINISAR
         Vendor  OUI:  00.90.65
         Vendor  Part  Number:  FTLX8571D3BCL-C2  (rev.:  A    )
         Laser  wavelength:  850 nm (fraction:  0.00 nm)
         Optional  SFP  Signal:  Rate  Sel,  LOS
         Vendor  Serial  Number:  FNS164018G7
         Date  Code  (yy/mm/dd):  12/10/06   lot  code:

         Thresholds:                      Alarm  High          Warning  High          Warning  Low           Alarm  Low
               Temperature:              +75.000  C             +70.000  C             +0.000  C             -5.000  C
                   Voltage:             3.630  Volt            3.465  Volt            3.135  Volt           2.970  Volt
                      Bias:            11.800  mAmps           10.800  mAmps           5.000  mAmps          4.000  mAmps
          Transmit  Power:   1.479  mW  (1.70  dBm)    0.741  mW  (-1.30  dBm)    0.186  mW  (-7.30  dBm)    0.074  mW  (-11.30  dBm)
           Receive  Power:   1.585  mW  (2.00  dBm)    0.794  mW  (-1.00  dBm)    0.102  mW  (-9.90  dBm)    0.041  mW  (-13.90  dBm)
         Temperature:  26.684
         Voltage:  3.301  Volt
         Tx  Bias:  7.612  mAmps
         Tx  Power:   0.613  mW  (-2.13  dBm)
         Rx  Power:   0.567  mW  (-2.46  dBm)
         Oper.  Status/Control:
```

The Physical

Reading the controller counters: In, out, invalid, unicast, mcast, frame sizes

```
RP/0/RSP0/CPU0:rasr9k-1y#show controllers TenGigE0/4/0/20 stats
Sun Feb 24 14:44:18.899 UTC
Statistics for interface TenGigE0/4/0/20 (cached values):
Ingress:
    Input total bytes          = 3081227904920
    Input good bytes           = 3081227904920

    Input total packets        = 23220024479
    Input 802.1Q frames        = 0
    Input pause frames         = 0
    Input pkts 64 bytes        = 7143534733
    Input pkts 65-127 bytes    = 2888766549
    Input pkts 128-255 bytes   = 13124923916
    Input pkts 256-511 bytes   = 62799261
    Input pkts 512-1023 bytes  = 0
    Input pkts 1024-1518 bytes = 0
    Input pkts 1519-Max bytes  = 0

    Input good pkts            = 23220024479
    Input unicast pkts         = 23220023458
    Input multicast pkts       = 62
    Input broadcast pkts       = 959

    Input drop overrun         = 0
.
```

```
Egress:
    Output total bytes         = 1345771624
    Output good bytes          = 1345771624

    Output total packets       = 21895707
    Output 802.1Q frames       = 0
    Output pause frames        = 0
    Output pkts 64 bytes       = 21665536
    Output pkts 65-127 bytes   = 21179
    Output pkts 128-255 bytes  = 168767
    Output pkts 256-511 bytes  = 40225
    Output pkts 512-1023 bytes = 0
    Output pkts 1024-1518 bytes = 0
    Output pkts 1519-Max bytes = 0

    Output good pkts           = 21895707
    Output unicast pkts        = 21870499
    Output multicast pkts      = 25195
    Output broadcast pkts      = 13
  Output drop underrun         = 0
    Output drop abort          = 0
    Output drop other          = 0

    Output error other         = 0
```

The Internal Path

Troubleshooting NP Forwarding

1. Identify interface in questions with problme
2. Identify the mapping from interface to NPU
3. Examine NP counters
4. Look for rate counter that match lost traffic rate
   - If none of the coutner match the expect traffic, check drops at interface controller
5. Lookup the counter description
6. If required capture the packets hitting the counter (typhoon only)
7. If packets are forwarded to the fabric, run fabric troubleshooting steps
8. Identify egress NP and repeat 3 to 6.

Inside Typhoon NP

Reading pipeline counters

```
show controllers np descriptions location
0/0/cpu0 | i PARSE_DROP_IN_UIDB_TCAM_MISS
```

```
RP/0/RSP0/CPU0:rasr9000-2w-a#show controllers NP counters np0 location 0/1/CPU0
Wed Nov 27 21:09:07.635 EST

                Node: 0/1/CPU0:
----------------------------------------------------------------

Show global stats counters for NP0, revision v2

Read 64 non-zero NP counters:
Offset   Counter                                  FrameValue     Rate (pps)
----------------------------------------------------------------------------
  16   MDF_TX_LC_CPU                                6722114             10
  17   MDF_TX_WIRE                                  1826039              3
  21   MDF_TX_FABRIC                                1635541              2
  29   PARSE_FAB_RECEIVE_CNT                        1837406              3
  33   PARSE_INTR_RECEIVE_CNT                       5083364              7
  37   PARSE_INJ_RECEIVE_CNT                        1228130              2
 499   RSV_ING_L2_SMAC_MISS                              60              0
 502   RSV_ING_L2_LEARN                                  60              0
 541   RSV_REFRESH_FROM_NOTIFY_CNT                       62              0
 584   RSV_L2BC_BVI                                       2              0
 604   RESOLVE_REMOTE_RACK_PREP_CNT                 5539915              8
 708   LRN_PERIODIC_AGING_DELETE_ENTRY                   60              0
 774   ARP                                              119              0
 848   PUNT_ADJ                                           2              0
 852   PUNT_ACL_DENY                                    161              0
 900   PUNT_STATISTICS                              5083356              7
 902   PUNT_DIAGS_RSP_ACT                             11419              0
 904   PUNT_DIAGS_RSP_STBY                            11427              0
```

List of NP counters:
https://supportforums.cisco.com/docs/DOC-26566

Typhoon Counters and Rates

NP drops, rate and direction

```
RP/0/RSP0/CPU0:rasr9000-2w-b#show  controllers  NP counters  np0 location  0/0/CPU0
Tue Dec 10 14:18:39.195 EST
                Node: 0/0/CPU0:
----------------------------------------------------------------

Show global stats counters for NP0, revision v2

Read 59 non-zero NP counters:
Offset   Counter                                        FrameValue     Rate (pps)
--------------------------------------------------------------------------------
  16   MDF_TX_LC_CPU                                      11004363             9
  17   MDF_TX_WIRE                                     8712222364719      29761820
  21   MDF_TX_FABRIC                                  11063035007386      27714366
  29   PARSE_FAB_RECEIVE_CNT                           8712222113330      29761820
  33   PARSE_INTR_RECEIVE_CNT                             9401470             9
  37   PARSE_INJ_RECEIVE_CNT                               832185             1
  41   PARSE_ENET_RECEIVE_CNT                         11070653296959      27714366
  45   PARSE_TM_LOOP_RECEIVE_CNT                          8437075             5
 359   PARSE_MAC_NOTIFY_RCVD                                  183             0
 367   PARSE_FAST_DISCARD_LOW_PRIORITY_DROP_0         106211394050      883832
 368   PARSE_FAST_DISCARD_LOW_PRIORITY_DROP_1         106210662138      883856
 369   PARSE_FAST_DISCARD_LOW_PRIORITY_DROP_2         106211061617      883943
 370   PARSE_FAST_DISCARD_LOW_PRIORITY_DROP_3         106211474043      883922
 373   DBG_RSV_EP_L_RSV_ING_L3_IFIB                    3707021673             0
 830   PUNT_NO_MATCH                                         4746             0
 831   PUNT_NO_MATCH_EXCD                                464963896             0
 849   PUNT_ADJ_EXCD                                     273406             0
 852   PUNT_ACL_DENY                                    1479378             0
 853   PUNT_ACL_DENY_EXCD                               1163570900             0
```

To egress

To fabric

From fabric

From interface

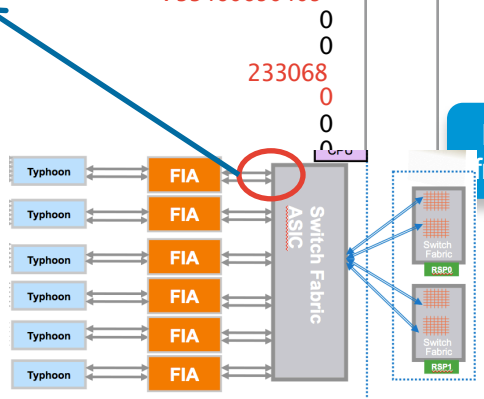
NP catching up

FIA Counters

FIA counts, drops and direction

https://supportforums.cisco.com/document/12135016/asr9000xr-understanding-and-**troubleshooting-fabric-issues**-a9k

```
RP/0/RSP0/CPU0:rasr9000-2w-b#show controllers fabric
fia instance 0 stats location 0/0/CPU0
Tue Dec 10 14:49:58.704 EST

 **********  FIA-0 **********
Category:  count-0
          From Unicast Xbar[0]              733461306331
          From Unicast Xbar[1]              733460650405
          From Unicast Xbar[2]                         0
          From Unicast Xbar[3]                         0
       From MultiCast Xbar[0]                    233068
       From MultiCast Xbar[1]                         0
       From MultiCast Xbar[2]                         0
       From MultiCast Xbar[3]                         0
            To Unicast Xbar[0]
            To Unicast Xbar[1]
            To Unicast Xbar[2]
            To Unicast Xbar[3]
         To MultiCast Xbar[0]
         To MultiCast Xbar[1]
         To MultiCast Xbar[2]
         To MultiCast Xbar[3]
          To Line Interface[0]              457138023968
          To Line Interface[1]            11117127781061
       From Line Interface[0]               489302108080
       From Line Interface[1]                97191712670
                Ingress drop:                          0
                 Egress drop:                97191712670
                 Total drop:
```



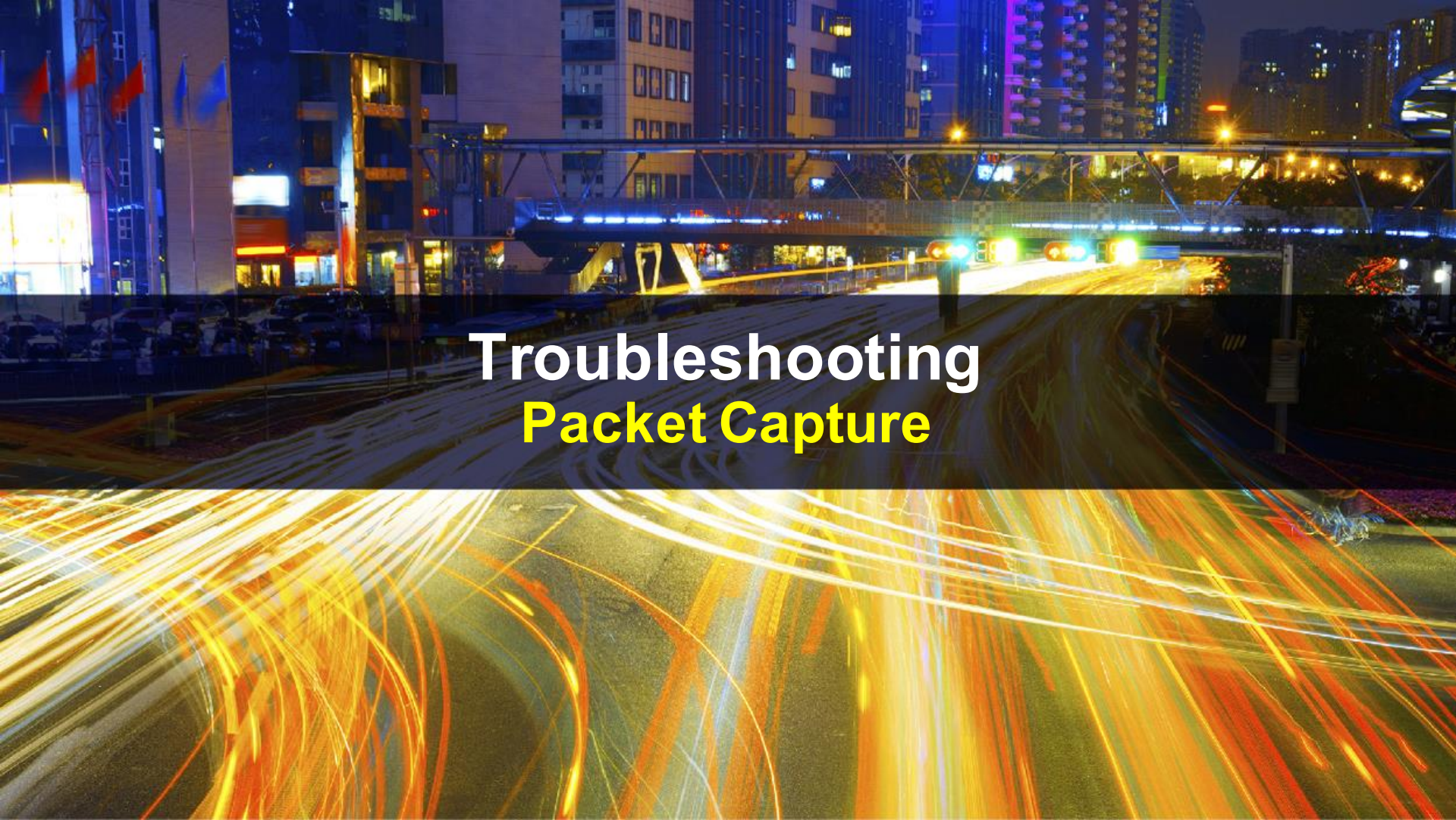
Back pressure from egress NP

```
RP/0/RSP0/CPU0:rasr9000-2w-b#show controllers fabric fia
instance 0 drops ingress location 0/0/CPU0
Tue Dec 10 15:33:37.655 EST

 **********  FIA-0 **********
Category:  in_drop-0
                From Spaui Drop-0                              0
                     accpt tbl-0                               0
                       ctl len-0                               0
                     short pkt-0                               0
                   max pkt len-0                               0
                   min pkt len-0                               0
                From Spaui Drop-1                              0
                     accpt tbl-1                               0
                       ctl len-1                               0
                     short pkt-1                               0
                   max pkt len-1                               0
                   min pkt len-1                               0
                        Tail drp                  125787328841
                         Vqi drp                               0
           Header parsing drp                                  0
                  pw to ni drp                                 0
               ni from pw drp                                  0
                  sp0 crc err                                  0
                sp0 bad align                                  0
                 sp0 bad code                                  0
               sp0 align fail                                  3
                 sp0 prot err                                  0
                  sp1 crc err                                  0
                sp1 bad align                                  0
.
```

Enhancement TS commands

- The “show drops location” was available before 5.3.0 but it only listed the NP and fabric drops so HW drops. With the “**all**” keyword being introduced, we now have the ability to check both HW and SW drops.
- the command is extensible live on the router by editing a grammer file saved under “disk0a:/usr/packet_drops.list”, default path "/pkg/etc/packet_drops.list”

```
RP/0/RSP0/CPU0:ASR9010-1#show drops all location 0/6/cpu0
Sun Jul 26 23:14:14.374 UTC

====================================
Checking for drops on 0/6/CPU0
====================================

show arp traffic:
[arp:ARP] IP Packet drop count for node 0/6/CPU0: 4

show cef drops:
[cef:0/6/CPU0] No route drops       packets : 69
[cef:0/6/CPU0] Discard drops        packets : 5

show controllers fabric fia drops egress:
[fabric:FIA-0] Uc eq pkt-len-crc/lookup-drp: 7
[fabric:FIA-1] Uc eq pkt-len-crc/lookup-drp: 3

show controllers fabric fia drops ingress:
[fabric:FIA-0] sp0 align fail: 5
[fabric:FIA-0] sp1 crc err: 21
```



Troubleshooting
Packet Capture

Packet Capture: Problem Packets

Example: incrementing drops

```
RP/0/RSP0/CPU0:rasr9000-2w-b#show controllers NP counters np0 location 0/0/CPU0 | include DROP
Sat Jan 18 18:46:52.618 EST
.
 370  RSV_DROP_XID_NO_MATCH                          209680463          0
 404  RSV_ING_VPWS_ERR_DROP                     3719838164404   11160601
 411  RSV_L2_SHG_DROP                               27390624          0
1171  MDF_PUNT_POLICE_DROP                      7924962278163   23809032
1178  MODIFY_PUNT_REASON_MISS_DROP                         1          0
1246  VIRTUAL_IF_GENERIC_INPUT_DROP                        1          0



RP/0/RSP0/CPU0:rasr9000-2w-b#show controllers NP counters np0 location 0/0/CPU0 | include DROP
Sat Jan 18 18:46:56.297 EST
.
 370  RSV_DROP_XID_NO_MATCH                          209680463          0
 404  RSV_ING_VPWS_ERR_DROP                     3719879236984   11161027
 411  RSV_L2_SHG_DROP                               27390624          0
1171  MDF_PUNT_POLICE_DROP                      7925049898728   23809936
1178  MODIFY_PUNT_REASON_MISS_DROP                         1          0
1246  VIRTUAL_IF_GENERIC_INPUT_DROP                        1          0
```

incrementing

Rate [PPS] or increments from last command run

Packet Capture: Problem Packets

Example: incrementing drops

```
RP/0/RSP0/CPU0:rasr9000-2w-b#monitor np counter RSV_ING_VPWS_ERR_DROP np0 count 3 location
0/0/CPU0
Sat Jan 18 19:02:36.386 EST
Warning: Every packet captured will be dropped! If you use the 'count'
         option to capture multiple protocol packets, this could disrupt
         protocol sessions (eg, OSPF session flap). So if capturing protocol
         packets, capture only 1 at a time.

Warning: A mandatory NP reset will be done after monitor to clean up.
         This will cause ~50ms traffic outage. Links will st
 Proceed y/n [y] >
 Monitor RSV_ING_VPWS_ERR_DROP on NP0 ... (Ctrl-C to qui
Sat Jan 18 19:02:44 2014 -- NP0 packet

 From TenGigE0/0/0/0: 157 byte packet, bytes[0-3] invalid!
0000: 00 00 02 01 61 90 00 00 c0 02 01 02 81 00 00 0a    ....a...@.......
0010: 08 00 45 00 00 8b 00 00 00 00 40 3d f8 30 c0 01    ..E.......@=x0@.
0020: 01 01 c0 01 01 02 00 00 00 00 00 00 00 00 00 00    ..@.............
0030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
0040: 10 f3 11 05 00 00 00 00 00 00 00 00 00 00 00 00    ....
0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ....
0060: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ....
0070: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
0080: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
0090: 00 00 00 00 00 00 00 00 00 00 00 00 00 00          ..............
```

Ignore [internal]

UP to 300 B
No CRC

Packet Capture: Problem Packets

Decoding

```
00 00 02 01 61 90 00 00 c0 02 01 02 81 00 00 0a
08 00 45 00 00 8b 00 00 00 00 40 3d f8 30 c0 01
01 01 c0 01 01 02 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
10 f3 11 05 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

https://scripts.cisco.com/ui/use/xr_monitor_np_counter

Use a decoder

```
Ethernet II, Src: WesternD_02:01:02 (00:00:c0:02:01:02), Dst: Xerox_01:61:90 (00:00:02:01:61:90)
    Destination: Xerox_01:61:90 (00:00:02:01:61:90)
    Source: WesternD_02:01:02 (00:00:c0:02:01:02)
    Type: 802.1Q Virtual LAN (0x8100)
802.1Q Virtual LAN, PRI: 0, CFI: 0, ID: 10
    000. .... .... .... = Priority: 0
    ...0 .... .... .... = CFI: 0
    .... 0000 0000 1010 = ID: 10
    Type: IP (0x0800)
Internet Protocol, Src: 192.1.1.1 (192.1.1.1), Dst: 192.1.1.2 (192.1.1.2)
    Version: 4
    Header length: 20 bytes
    Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)
    Total Length: 139
```

Packet Capture: Transit Packets

Example: IPv4 L3VPN ingress

```
RP/0/RSP0/CPU0:rasr9000-2w-b#show running-config ipv4 access-list CAPTURE
Sat Jan 18 20:13:35.941 EST
ipv4 access-list CAPTURE
 10 permit ipv4 192.4.1.0/24 10.10.6.0/24 capture
 20 permit ipv4 any any
!
RP/0/RSP0/CPU0:rasr9000-2w-b#show running-config interface TenGigE 0/0/0/2
Sat Jan 18 20:13:50.654 EST
interface TenGigE0/0/0/2
 vrf TRAFFIC
 ipv4 address 192.4.1.1 255.255.255.0
 ipv4 access-group CAPTURE ingress
!
RP/0/RSP0/CPU0:rasr9000-2w-b#show controllers NP counters np0 location 0/0/CPU0 | include
ACL_CAPTURE_NO_SPAN
Sat Jan 18 20:14:26.109 EST
 477   ACL_CAPTURE_NO_SPAN                                6802507       38003
RP/0/RSP0/CPU0:rasr9000-2w-b#show controllers NP counters np0 location 0/0/CPU0 | include
ACL_CAPTURE_NO_SPAN
Sat Jan 18 20:14:28.819 EST
 477   ACL_CAPTURE_NO_SPAN                                6905417       380
RP/0/RSP0/CPU0:rasr9000-2w-b#show controllers NP counters np0 location 0/0/
ACL_CAPTURE_NO_SPAN
Sat Jan 18 20:14:34.597 EST
 477   ACL_CAPTURE_NO_SPAN                                7124969       37991
```

Count in NP

Let all else go!

Apply to transit

NP ACL “capture” counter incrementing

Packet Capture: Transit Packets

Example: IPv4 L3VPN ingress

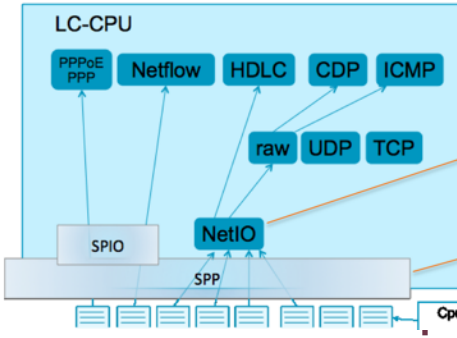
```
RP/0/RSP0/CPU0:rasr9000-2w-b#monitor np counter ACL_CAPTURE_NO_SPAN np0 count 3 location 0/0/CPU0
Sat Jan 18 20:31:53.311 EST
Warning: Every packet captured will be dropped! If you use the 'count'
         option to capture multiple protocol packets, this could disrupt
         protocol sessions (eg, OSPF session flap). So if capturing protocol
         packets, capture only 1 at a time.

Warning: A mandatory NP reset will be done after monitor to clean up.
         This will cause ~50ms traffic outage. Links will stay Up.
 Proceed y/n [y] >
 Monitor ACL_CAPTURE_NO_SPAN on NP0 ... (Ctrl-C to quit)
Sat Jan 18 20:32:34 2014 -- NP0 packet
 From TenGigE0/0/0/2: 250 byte packet, bytes[0-3] invalid
0000: 00 11 0b 00 61 92 00 00 c0 04 01 02 08 00 45 60   ....a...@.....E`
0010: 00 ec 00 00 00 00 40 3d a8 08 c0 04 01 02 0a 0a   .l....@=(.@.....
0020: 06 5d 00 00 00 00 00 00 00 00 00 00 00 00 00 00   .]..............
0030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
0040: 10 f3 11 05 00 00 00 00 00 00 00 00 00 00 00 00   .s..............
0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
0060: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
0070: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
0080: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
0090: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
.
```

Those 3 packets are dropped!

SPP packet captures

```
RP/0/RSP0/CPU0#run attach 0/0/CPU0

attach: Starting session 1 to node 0/0/CPU0

# spp_ui
spp-ui>

spp-ui> trace filter node client/punt
Node "client/punt" set for trace filtering. Index: 11


spp-ui> trace filter set 52 4 0xD4000001
Modified filter for offset 52 successfully
spp-ui> trace filter set 56 4 0xD4000002
Modified filter for offset 56 successfully
```

```
RP/0/RSP0/CPU0:A9K-BNG#packet-trace spp platform
protocol arp start-capture count 5 location 0/0/cpu0
Wed Mar 12 16:28:30.176 EDT
Sending command: trace filter
Trace filter set for protocol: ARP
Sending command: trace start 5
Started capture for 5 packets

Wrote ASCII trace to /tmp/spp_p
Sending command: trace print
Packet serial 3
client/inject:
  length 110 phys_int_index -1 next_ctx 0xdeadbeef time
16:28:30.512
  00: 00 65 7a 00 00 00 00 70 72 00 00 02 00 5e 00 00
  10: 80 00 00 00 00 00 0f 8c 40 c1 0c c8 50 00 00 00
  20: 00 00 0d 34 3f ff f2 90 20 04 fe 03 01 04 00 05
  30: 00 00 00 00 5e 00 00 00 00 00 00 00 00 04 00 02
  40: 40 00 10 34 ff ff ff ff ff ff 66 66 44 44 22 22
```



Decoder https://scripts.cisco.com/ui/use/xr_spp_ui_to_pcap


Thank you.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