



# CSC OPEN CLASS

ISRG2 Architecture Introduce & Common Issue **Troubleshooting**

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# Agenda

Integrated Services Router Generation 2 Overview

Xformers Architecture

IOS Software Evolution

Power Supply and Inline Power Management

Common issue troubleshooting





# Integrated Services Routers Generation 2 Overview

# Introducing: Cisco Integrated Services Router Generation 2

Performance, Scalability, Availability

860, 880, 890



Virtual Office



1941, 1941W



Secure Mobility



Customizable Applications



2901, 2911, 2921,  
2951



Secure Collaboration



3925, 3945



Scalable Rich-Media Services

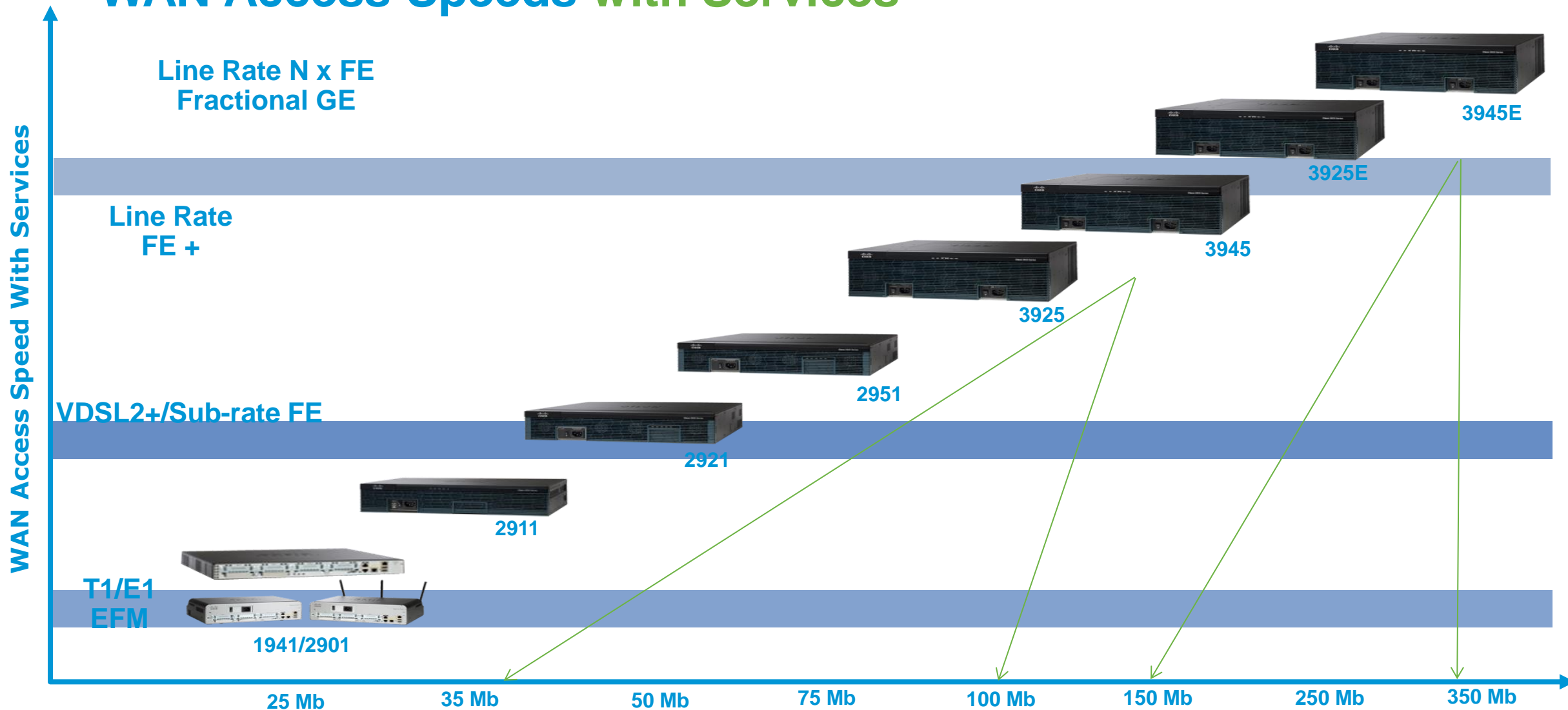


← Enhancing the Customer Experience →



# ISR G2 Performance Recommendations

## WAN Access Speeds with Services



# ISR G2 Technical Innovations

## Under the Covers

### Services Performance Engine (3900)

- SPE-100/SPE-150 for FE line rate
- Introducing SPE-200/SPE-2500 for more performance

### Multi-core Network Processor

- 3-8x performance increase
- Integrated encryption HW

### Multi Gigabit Fabric

- Module to module communications
- Packet prioritization and shaping

### NG DSP Modules

- Video ready DSP modules
- 4x increase in audio conferencing and transcoding
- Configurable power savings modes

### EHWIC

- 2x performance increase
- HWIC/WIC/VWIC/VIC support natively
- EPoE capable

### GE Ports

- Plus GE ports (4 on 3900E, 3 on 2911+)
- SFP slots on 2921 and above

### Service Modules

- 3x-7x increase in service module performance
- Existing NM support through adapter
- EPoE capable

### Internal Services Module

- 3x increase in service module performance
- Configurable power savings mode
- 802.11n Option on 19xx

### USB

- Console over USB
- Convenience storage
- Security credentials



# Cisco 800 Series

## Integrated Services Routers



	890	880G	880	860
10/100/1000 WAN	✓			
10/100 WAN	✓	✓	✓	✓
ADSL2/2+ WAN		✓	✓	✓
VDSL WAN		✓	✓	
G.SHDSL WAN		✓	✓	
LAN Interfaces	8x 10/100	4x 10/100	4x 10/100	4x 10/100
802.11n (a/b/g/n)	✓			
802.11n (b/g/n)		✓	✓	✓
SRST (4 users)			✓*	
3G Wireless		✓		
Backup	V.92 modem or ISDN BRI	3G or ext. modem	ISDN BRI or ext. modem	ext. modem

## Secure Mobility Platform

Very small offices, Cisco Virtual Office (teleworkers)

- Up to 15 Mbps WAN Access with Security
- Integrated 3G + VDSL on 880 platforms
- Fixed configurations:

Pick your:

1. WAN interface(s)
2. 802.11 Wireless (Y/N)
3. SRST\* (Y/N)
4. Backup Interface

\* SRST available with 10/100 or G.SHDSL WAN

# Cisco 1900 Series



	1941W	1941
SM Slots	0	0
ISM Slots	Fixed 802.11n Radio	1
EHWIC Slots	2	2
Onboard WAN Ports	2 GE	2 GE
Onboard DSP Slots	0	0
Default Flash	256 MB	256 MB
Default DRAM	512 MB	512 MB
Form Factor	2RU	2RU

## Secure Mobility Platform

- 25Mbps WAN Access with Services
- Factory selectable Integrated wireless 802.11n option
- Desktop form factor with Double Wide HWIC Support



# Cisco 2900 Series



	2951	2921	2911	2901
SM Slots	2	1	1	0
ISM Slots	1	1	1	1
EHWIC Slots	4	4	4	4
Onboard DSP Slots	3	3	2	2
Onboard WAN Ports	3 GE (1 SFP)	3 GE (1 SFP)	3 GE	2 GE
Default Flash	256 MB	256 MB	256 MB	256 MB
Default DRAM	512 MB	512 MB	512 MB	512 MB
Form Factor	2RU	2RU	2RU	1RU

## Secure Collaboration Platform

- Up to 75Mbps WAN Access with Services
- Video-ready DSP support
- Increased service density with Second Services module Slot
- 12 Inch Depth on 2911

# New Cisco 3900E Series

Applications

Services Performance Engine 250  
Services Performance Engine 200



	3945E	3925E	3945	3925
Onboard WAN	4GE (2 SFP)	4GE (2 SFP)	3GE (2 SFP)	3GE (2 SFP)
Performance (IMIX 75% cpu)	350 Mbps	250 Mbps	150 Mbps	100 Mbps
SM Slots	4	2	4	2
ISM Slots	0	0	1	1
EHWIC Slots	3	3	4	4
Onboard DSP Slots	3	3	4	4
Field Upgradeable Motherboards	SPE-250	SPE-200	SPE-150	SPE-100
Integrated Redundant PS	Yes	Yes	Yes	Yes
Form Factor	3RU	3RU	3RU	3RU

## Scalable Rich-media Services for the Branch

- Up to 350Mbps WAN Access With Services (3945E)
- 2-3x performance improvement over 3945 & 3925
- 4 Onboard GE Ports
- Upgradeable Motherboard Provides Investment Protection
- Configurable Dual Integrated Redundant Power supplies
- Hot swappable Fans and Power supplies

# 3945E and 3925E Overview

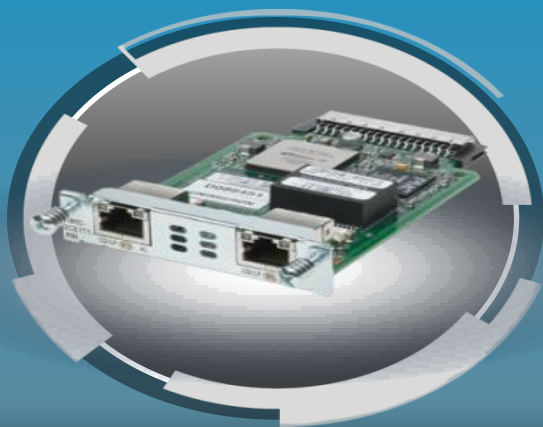
## What are they?

- New Processor Board (Service Processor Engine) PIDs:
  - C3900-SPE250/K9=
  - C3900-SPE200/K9=
- New 3900E base chassis product ID's:
  - **CISCO3945E/K9**
  - **CISCO3925E/K9**
  - New SEC, V, CME/SRST, VSEC and VSEC-SRE Bundles
- Requires 15.1(1)T (FCS: March 29,2010)
- ~x3 The Performance of ISR G2
- FCS : Mid-April 2010



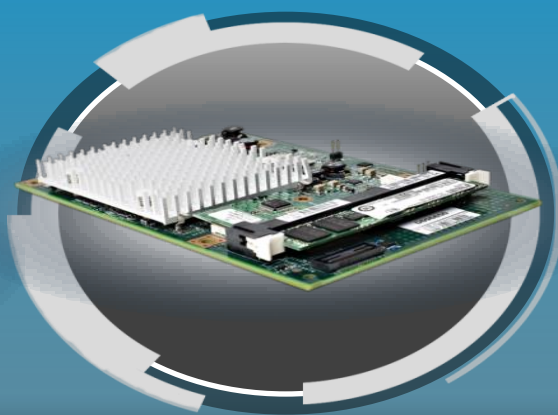
# Service Modules and Interface Cards

Interface Cards  
(WAN or LAN)



**EHWIC**  
Enhanced High Speed WAN  
Interface Card

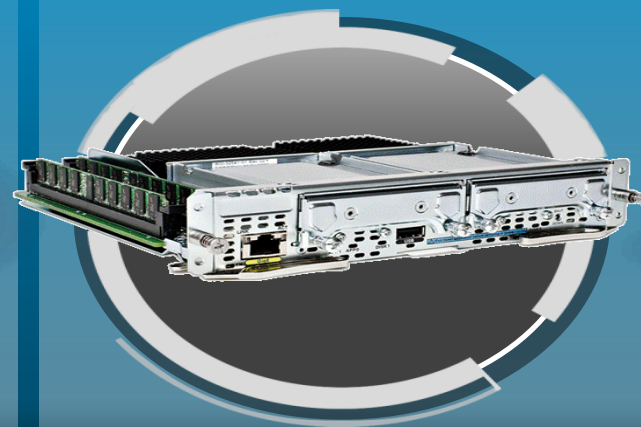
Internal Module for  
Running Services That  
Don't Require Interface  
Ports, Dedicated CPU and  
Memory



**ISM**  
Internal Service  
Module

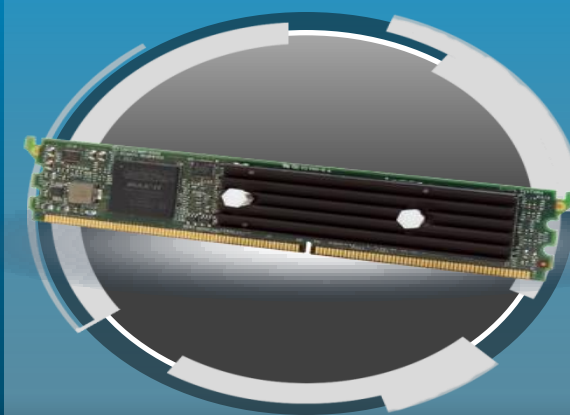
Independent CPU  
and Memory for Hosting  
Services or High Density  
Interface Ports.

Examples: Wireless LAN Controller,  
WAN Optimization, Etherswitch  
Module



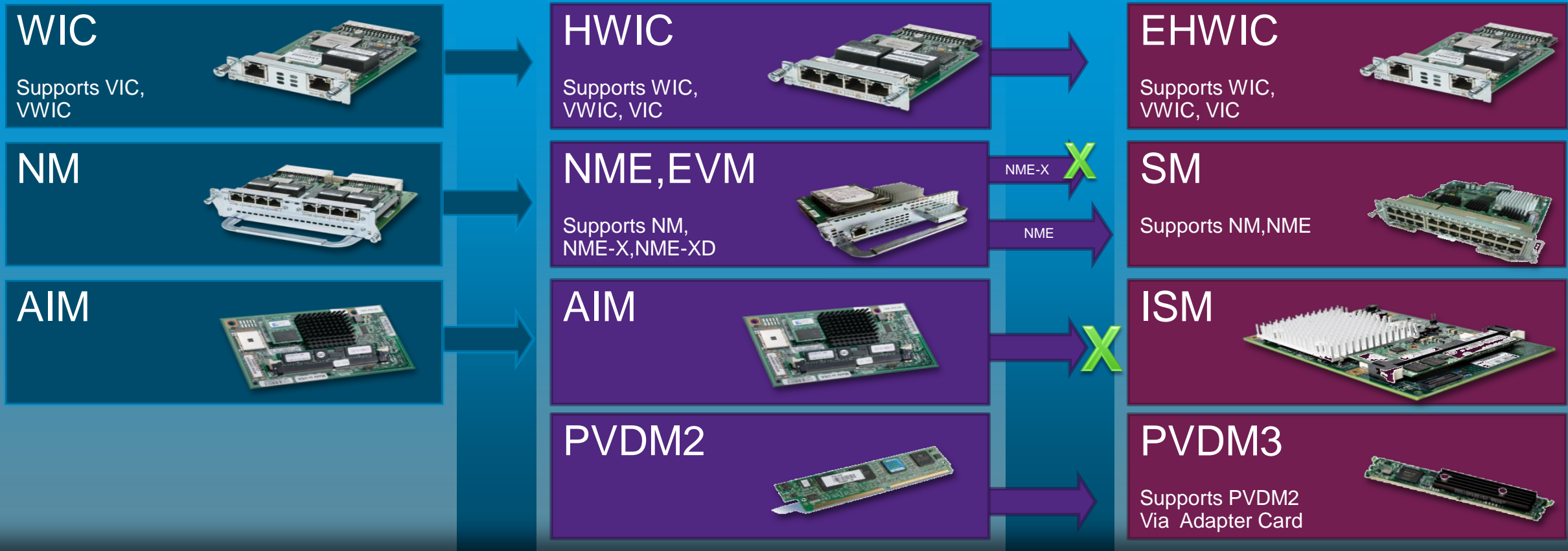
**SM**  
Service  
Module

High Density  
Rich-Media Voice  
and Video DSP Modules



**PVDM3**  
Packet Voice/  
Data Module

# Platform Module Slot Evolution



**Pre-ISR**

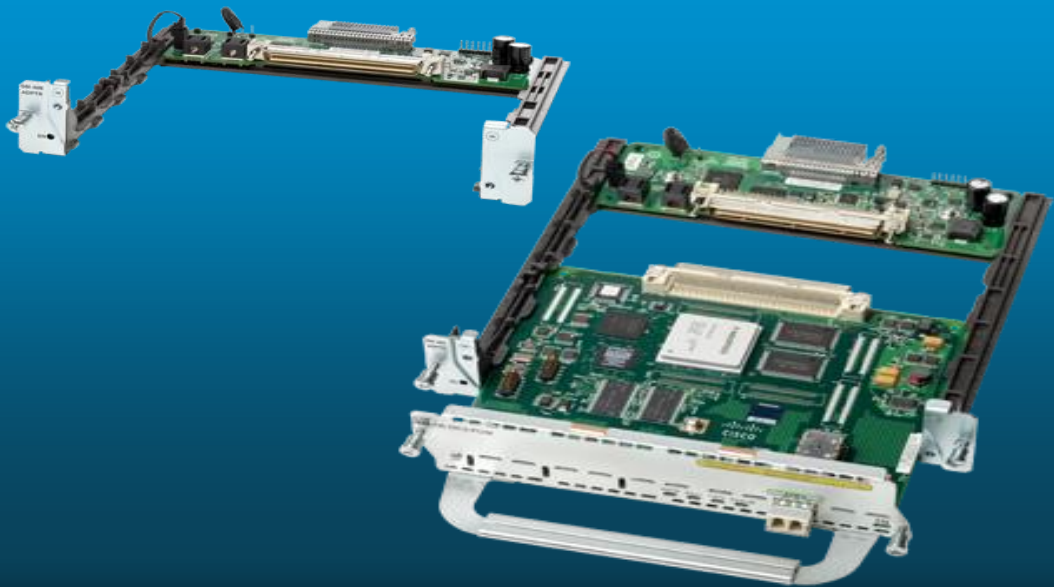
**ISR**

**ISR G2**



# Adapters

- Maximize investment protection, while allowing for platform evolution
- Provide maximum interface coverage at platform FCS



**NM to  
SM Adapter**

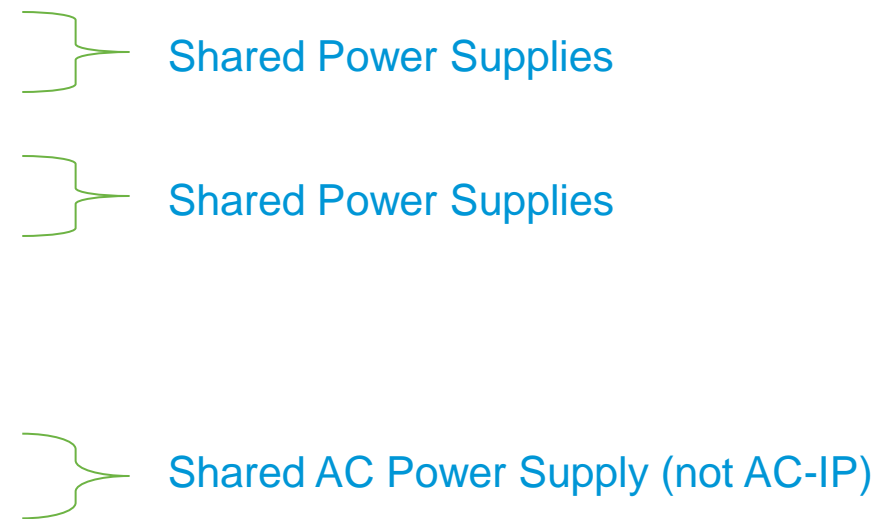


**PVDM2 to PVDM3  
Adapter**



# Xformers Architecture

# Xformers HW - Introduction

- Xformers is a next generation of ISRs.
  - Total of 7 platforms – listed from high end to low end
    - Cisco 3945
    - Cisco 3925
    - Cisco 2951
    - Cisco 2921
    - Cisco 2911
    - Cisco 2901
    - Cisco 1941/1941W (Wireless)
  - 5 unique motherboards + 3 unique midplanes
- 
- Shared Power Supplies
- Shared Power Supplies
- Shared AC Power Supply (not AC-IP)

# Xformers HW - Introduction

- Xformers platforms share a **common** hardware architecture.
- CPU processing power and the number of different slots/ports are the differences among the platforms.

# Xformers h/w – Memory (default config)

- Cisco 3945/Cisco 3925 – TWO Very Low Profile (VLP) registered DIMM slots – Both slots populated with 512MB DIMMs
- Cisco 3925 and 3945 – When populating two DIMMs they must be matched
- Cisco 2951 – TWO VLP registered DIMM slots – Only ONE DIMM slot is populated with 512MB VLP registered DIMM.
- **Cisco 3945, 3925 and 2951 support only VLP registered DIMMs and don't support un-buffered DIMMs (UDIMMs).**
- Cisco 2921, 2911, 2901 and 1941 – 512MB on-board memory and one Un-buffered DIMM (UDIMM) slot. UDIMM slot is not populated on these platforms.
- **Cisco 2921, 2911, 2901 and 1941 support only UDIMMs and don't support VLP registered DIMMs.**

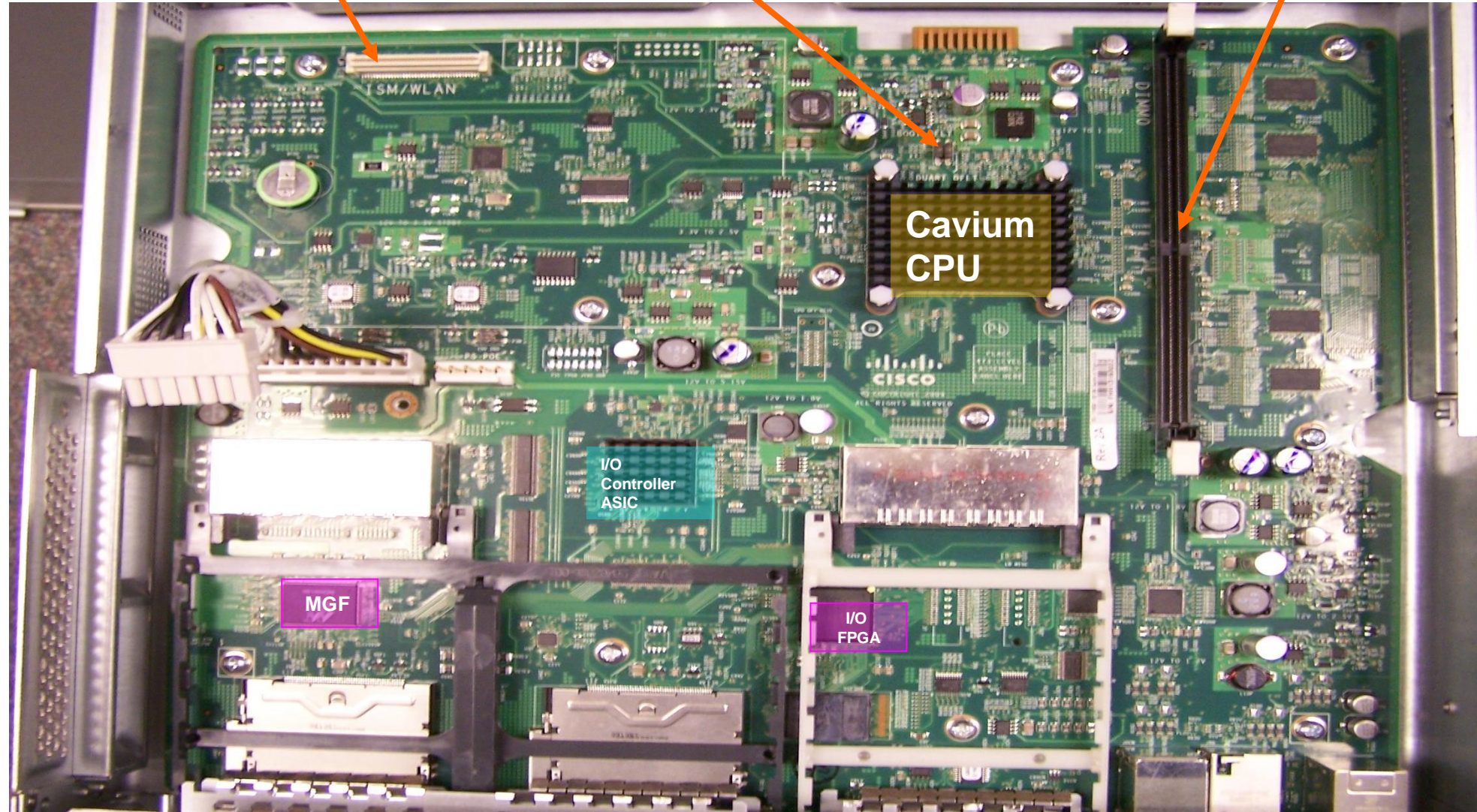


# Cisco1941, 1941W

ISM/WLAN Connector

BOOT DFLT and DUART DFLT Header Location \*

DIMM Slot

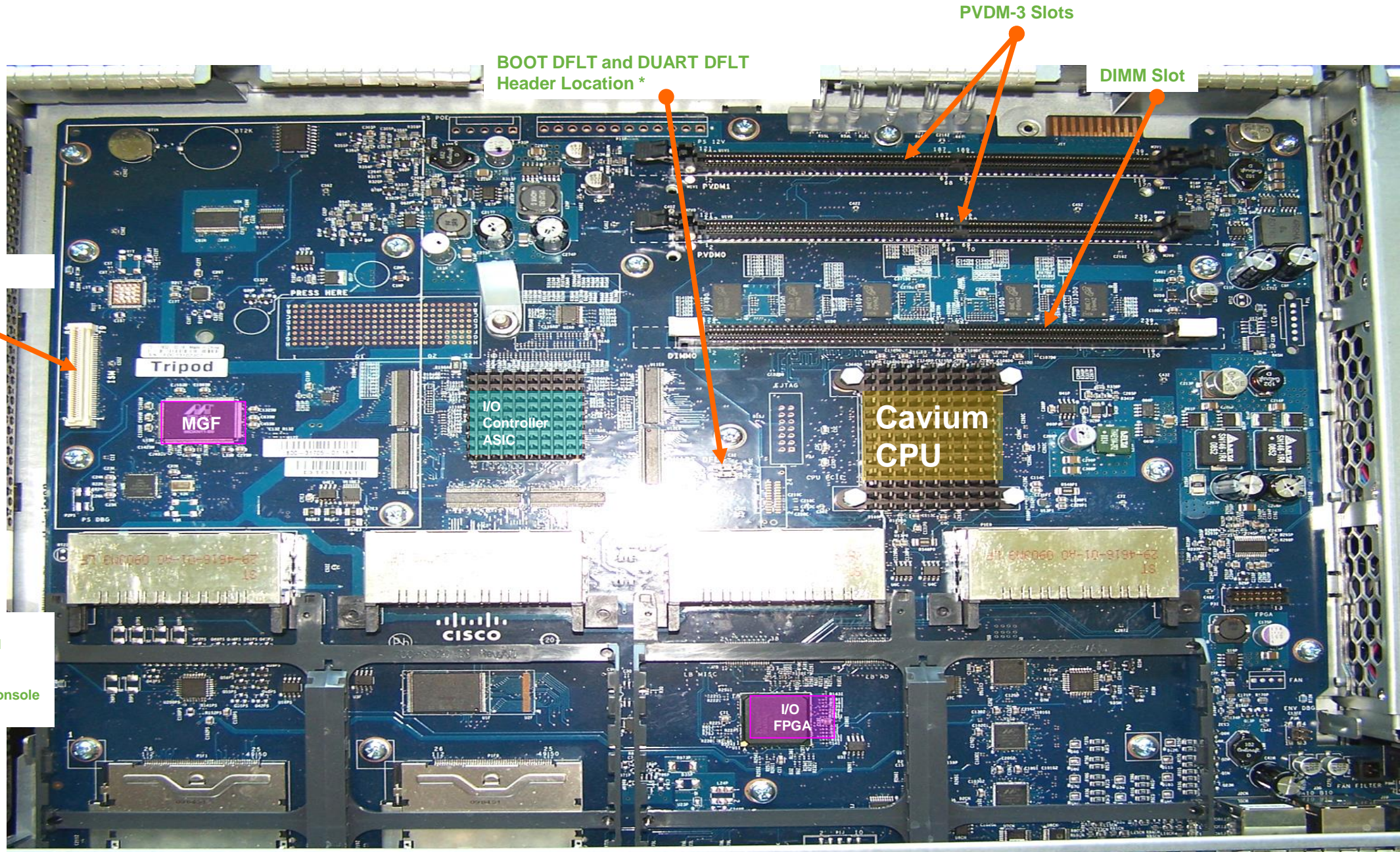


\* Note  
BOOT DFLT – Install jumper to boot RM1  
ROMMON

DUART DFLT – Install jumper to force Console  
to 9600 Baud, default settings



# Cisco2901, 2911



ISM Connector

BOOT DFLT and DUART DFLT Header Location \*

PVDM-3 Slots

DIMM Slot

Tripod

MGF

I/O Controller ASIC

Cavium CPU

I/O FPGA

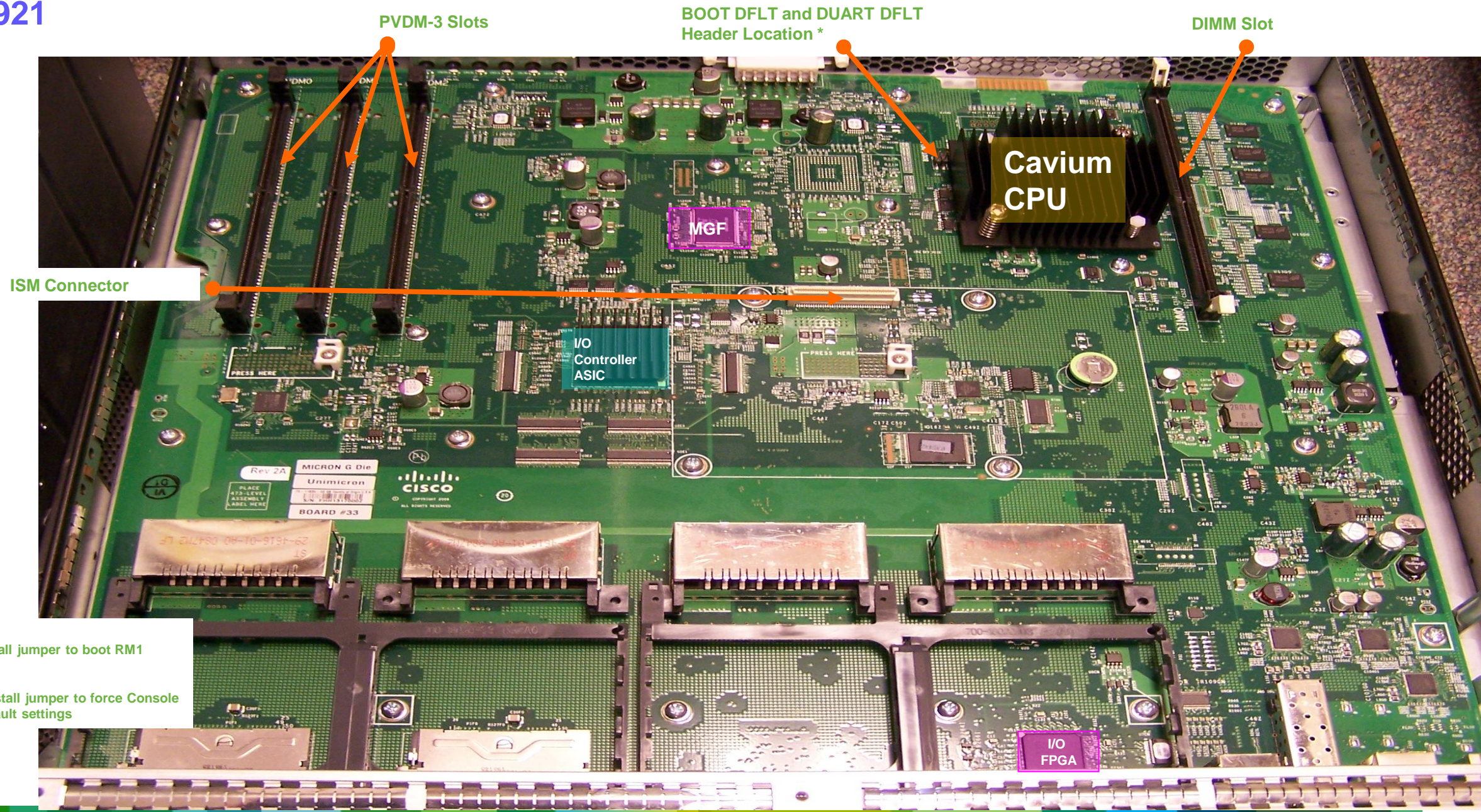
CISCO

\* Note  
BOOT DFLT – Install jumper to boot RM1 ROMMON

DUART DFLT – Install jumper to force Console to 9600 Baud, default settings

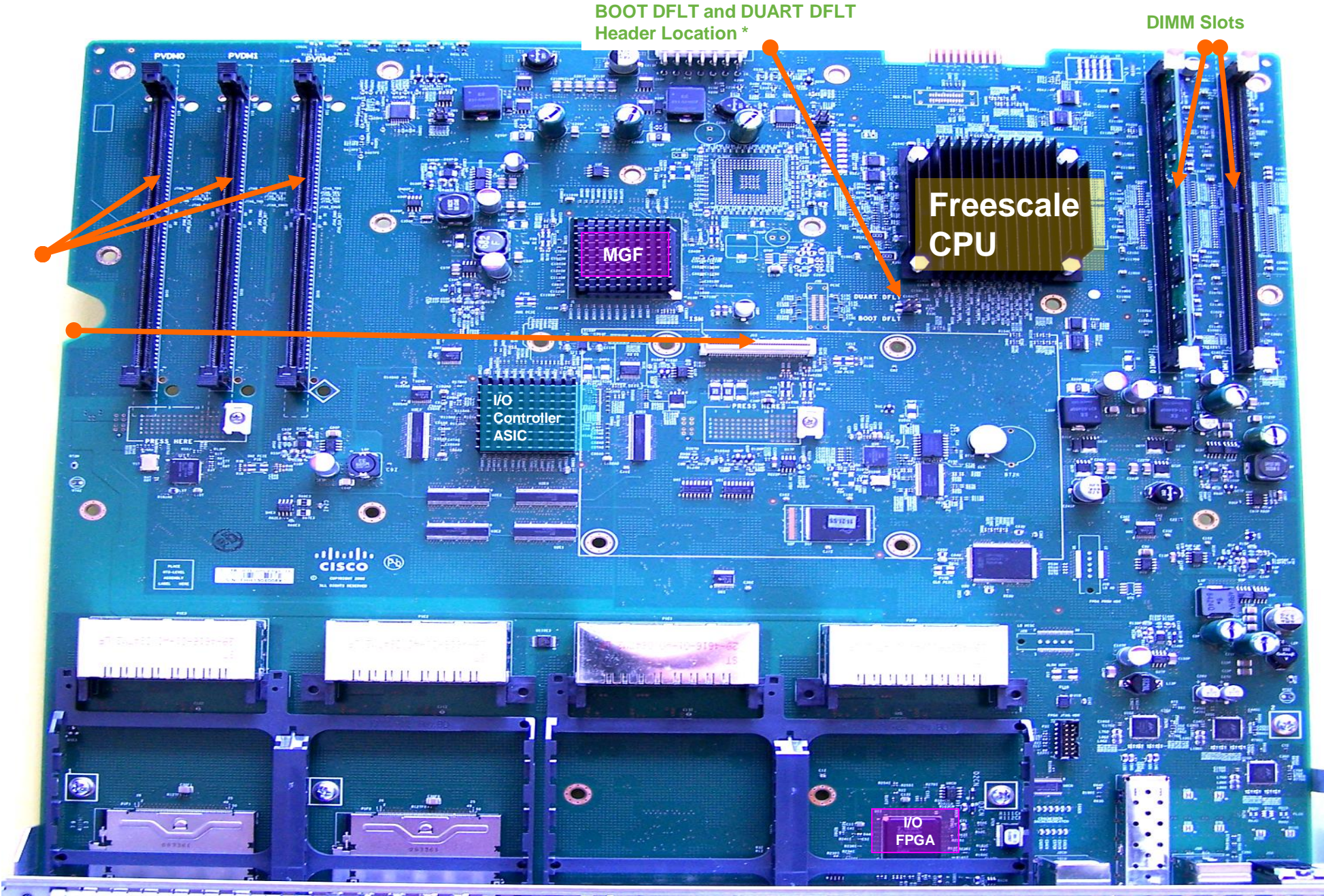


# Cisco2921





# Cisco2951



PVDM-3 Slots

ISM Connector

BOOT DFLT and DUART DFLT Header Location \*

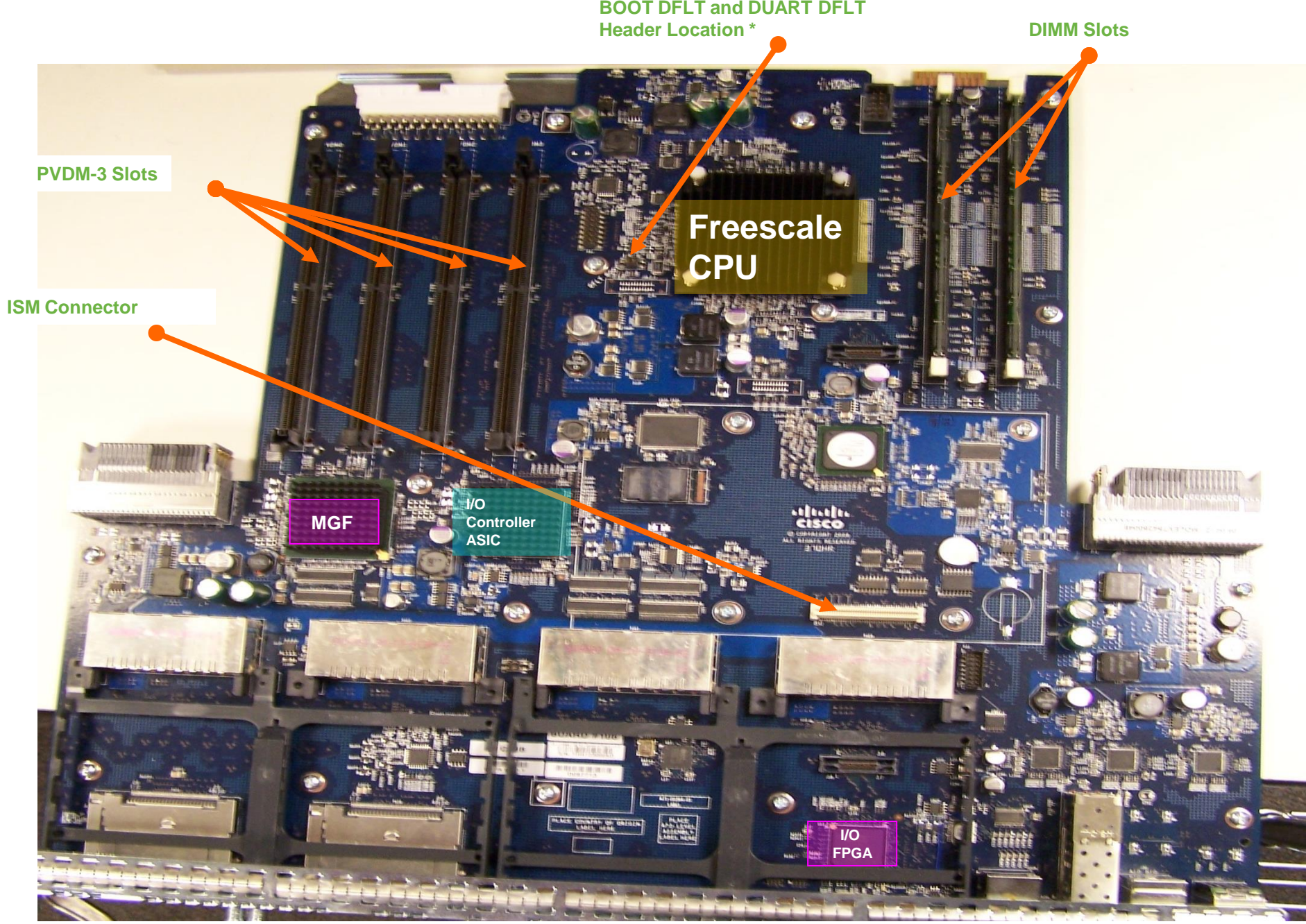
Freescale CPU

DIMM Slots

\* Note  
BOOT DFLT – Install jumper to boot RM1 ROMMON  
DUART DFLT – Install jumper to force Console to 9600 Baud, default settings



# Cisco 3925, 3945 \*\*



## Notes

\*

BOOT DFLT – Install jumper to boot RM1 ROMMON  
DUART DFLT – Install jumper to force Console to 9600, default settings

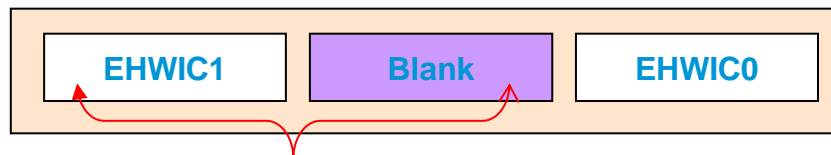
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Cisco Services Performance Engine 100 (SPE100) for Cisco 3925 ISR  
Cisco Services Performance Engine 150 (SPE150) for Cisco 3945 ISR



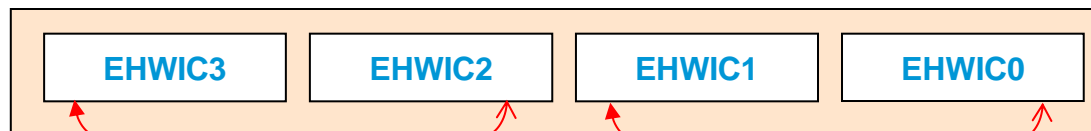
# Xformers h/w – EHWIC Slot enumeration

## Cisco 1941



DW, EHWIC1

## Cisco 2901 - Cisco 3945

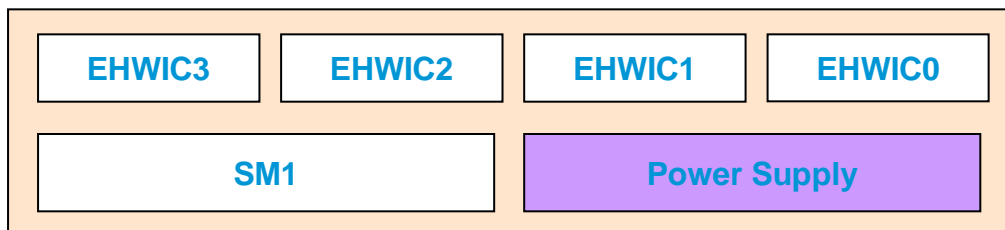


DW, EHWIC3

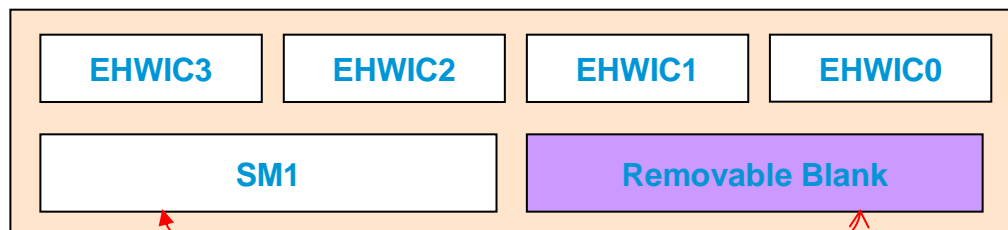
DW, EHWIC1

# Xformers h/w – SM Slot enumeration

Cisco 2911

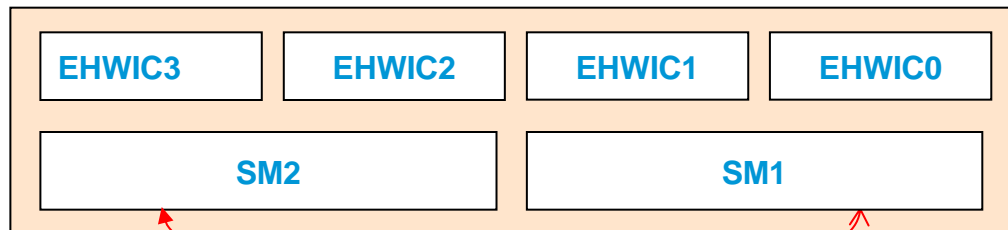


Cisco 2921



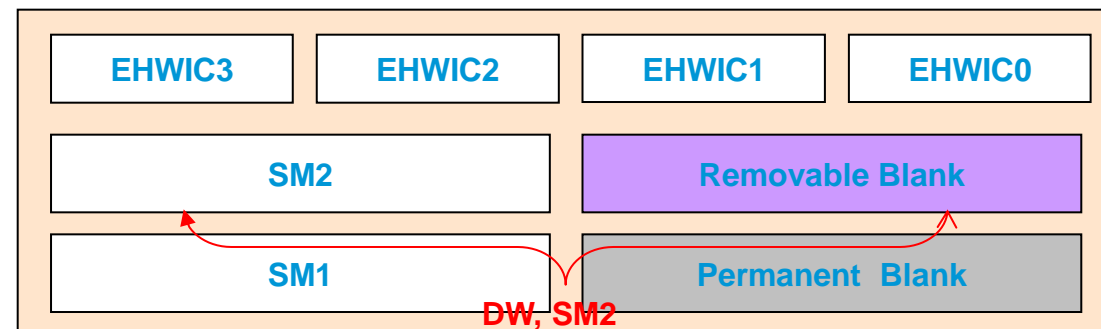
DW, SM1

Cisco 2951



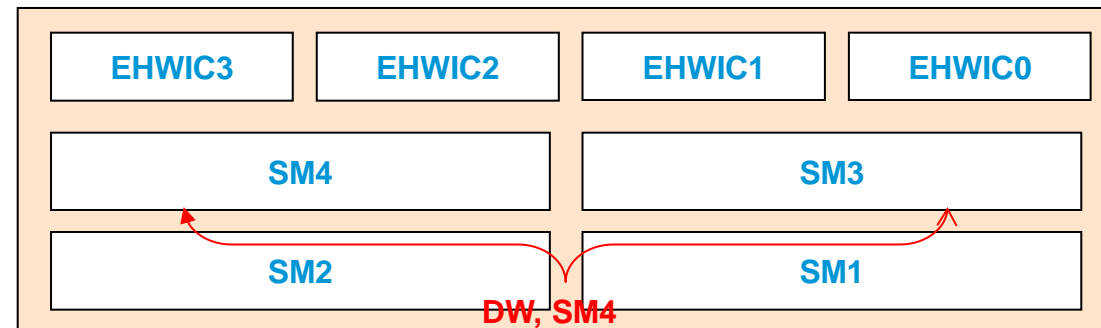
DW, SM2

Cisco 3925



DW, SM2

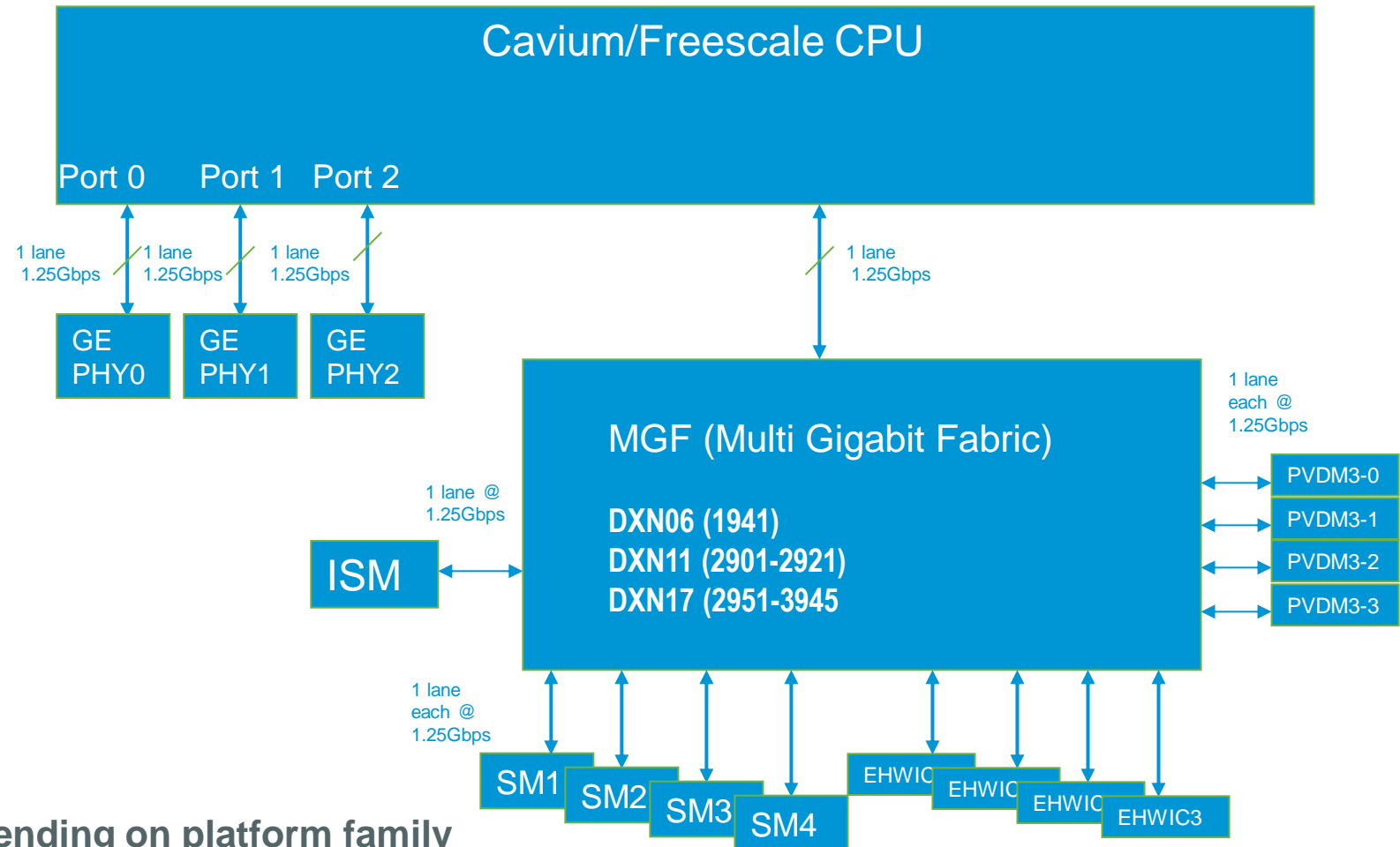
Cisco 3945



DW, SM4

Note the different SM number positions, depending on the platform

# MGF Architecture



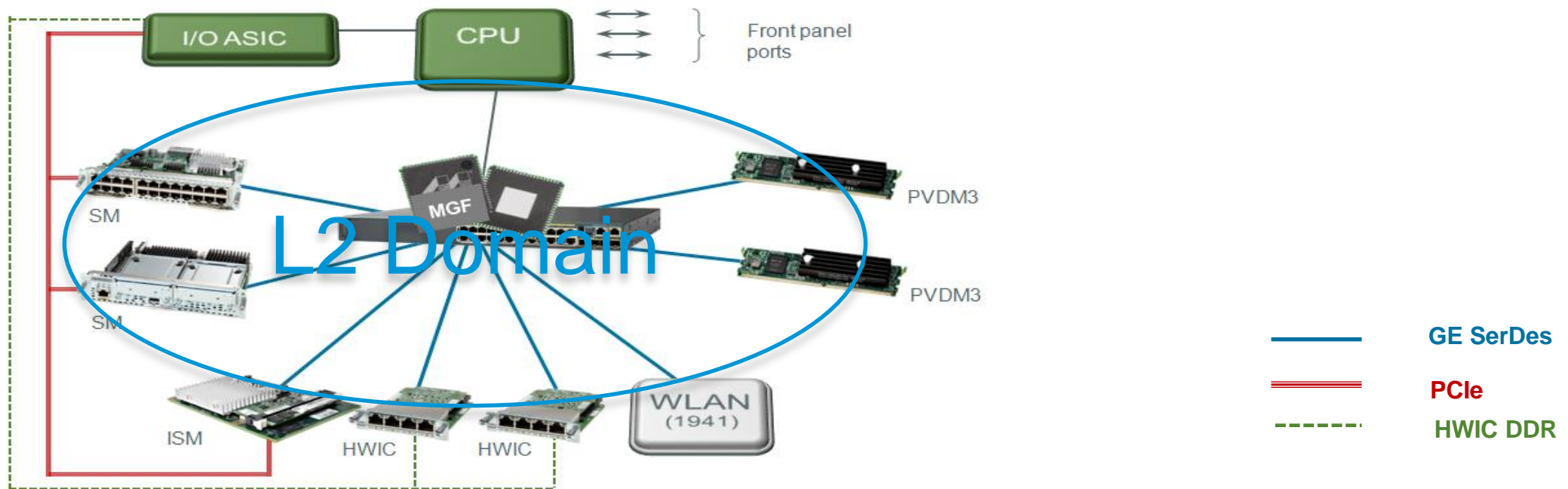
Lower end platforms will have fewer number of SMs, PVDMs and GE PHYs.

Different size of MGF switch depending on platform family

Raw ( payload ) Data Rate on each SerDes Lane is 1Gbps in each direction

Interface between MGF and CPU is hidden

# MGF Layer 2 domains



Modules in the same domain can communicate with each other without CPU intervention  
SM Etherswitch and EHWIC switch can communicate without external cabling

Not recommended to mix ISR G1 HWIC-4/9ESW & NM-16ESW modules with SM Etherswitch  
**HWIC-4/9ESW or NM-16ESW will disable MGF when present in chassis together with an SM Etherswitch module.**  
Communicating over PCIx bus will still work fine

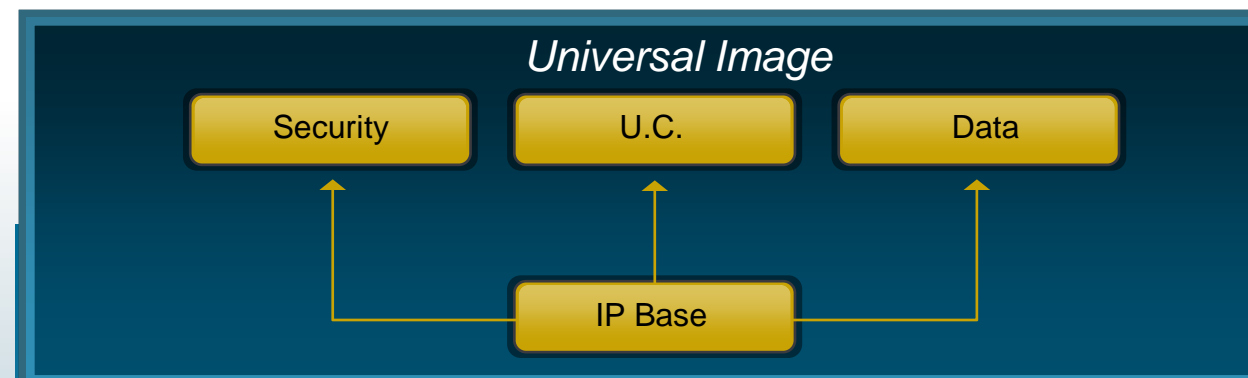
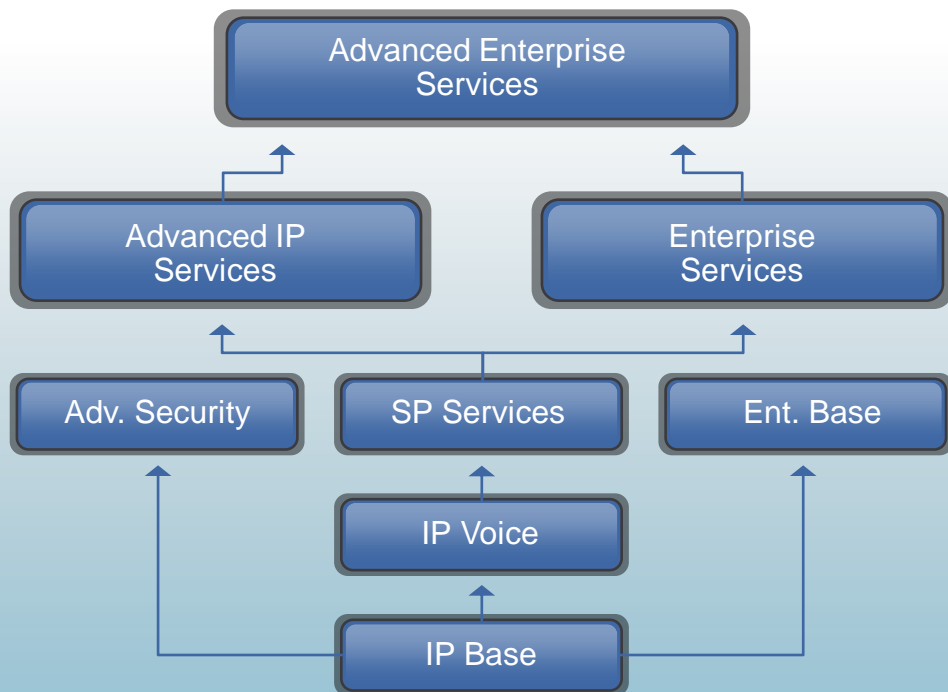
PVDMs can not communicate with other modules even if they are on the same VLAN



# IOS software Evolution



# IOS Software Packaging Evolution Summary



## ○ Simplified Software Management

A single IOS Universal Image will ship with all ISR G2 platforms

Four IOS enforceable licenses enable full suite of functionality that were previously offered in eight images

## ○ Less Costly Software Upgrades

IOS feature upgrades can be done by enabling a new license key, reducing the need for truck-roll to remote offices

## ○ Enable Development of New Software Based Business Models

Services on Demand—purchase upgrades as you need them via Cisco licensing

## Right to Use Feature Licences

- SSLVPN
- Intrusion Prevention (S)
- Content Filtering (S)

- MLPP
- LMR [Land Mobile Radio]
- CME: Voice and Video (C)
- SRST : Voice and Video (C)
- VXML/IVR Gateway (C)
- CUBE[IPIP Gateway] (C)
- CUBE[IP Trunk] (C)

- SNA switch

- MPLS BFD RSVP
- L2VPN
- L2TPv3
- Layer 2 Local Switching
- Mobile IP
- Multicast Authentication
- FHRP—GLBP
- ISIS IPv6 OSPFv6
- ISIS IPv6 OSPFv6
- IP SLAs PIR NTPv4
- DECnet ALPS
- AppleTalk RSRB BIP
- DLSw+ FRAS
- Token Ring
- ISL IPX STUN
- SNTP SDLC QLLC
- LAT

- IKE v1 / IPsec / PKI
- IPsec/GRE
- Easy VPN w/ DVTI
- DMVPN
- Static VTI
- Firewall
- Network Foundation Protection
- GETVPN

- CUBE [Gatekeeper] (C)

- TDM/PSTN Gateway
- Video Gateway[H320/324]
- Voice Conferencing
- Code Transcoding
- Secure Voice/ SRTP
- RSVP Agent (voice)
- FAX T.37/38
- CAC/QOS
- Hoot-n-Holler

**SEC**

**UC**

**Data**

### IP Base

AAA BGP, OSPF, EIGRP, ISIS, RIP PBR IGMP, Multicast DHCP HSRP,  
GLBP NHRP HTTP HQF QoS ACL, NBAR GRE CDP, ARP NTP PPP  
PPPoA PPPoE RADIUS TACACS SCTP SMDS SNMP STP VLAN DTP IGMP Snooping  
SPAN WCCP ISDN ADSL over ISDN NAT - Basic X.25, RSVP, Flexible Netflow

# New Model

- Each device is loaded with a universal IOS image
- A Software Activation License enables specific functionality
- Each SAL is unique to a particular device
- New devices are shipped with the Software Activation License pre-installed
- New functionality can be “switched on” with a new SAL

Simply order a PAK for the desired Feature Set

A Feature Set is purchased via a “Product Activation Key” (PAK)

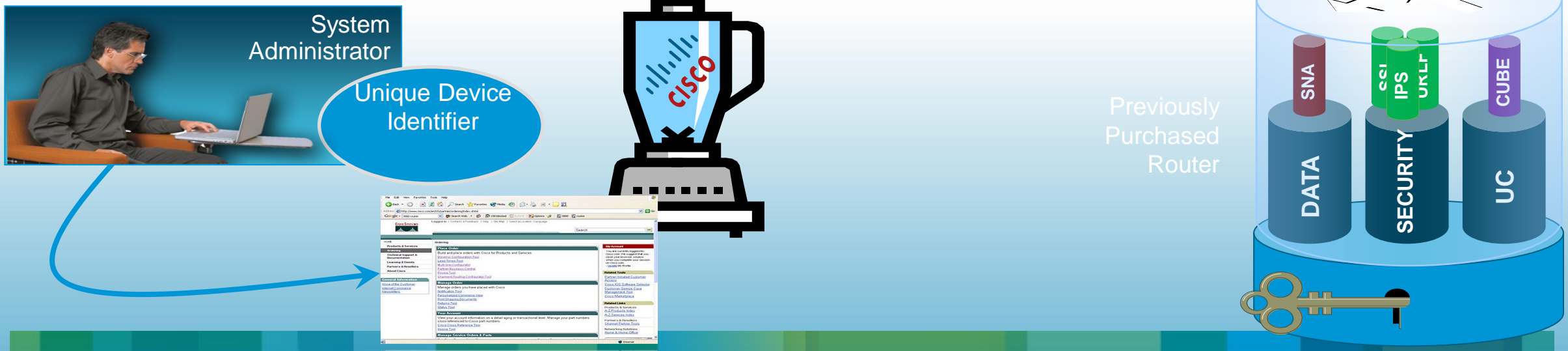
Product ID + Serial Number +  
PAK = Software Activation License



# IOS Software Activation

## Software Activation After Product Order

1. Customer purchases product activation keys (PAKs) for desired feature set and obtains Unique Device Identifier (Product ID + Serial Number), for the device he wants to upgrade
2. Using the Cisco website, the customer can purchase and generate a license for a feature set on that specific device
3. License is installed and activated using Cisco License Manager, Router Call-Home, or manual copy and install
4. These steps are the same for additional feature sets



# Introducing Cisco IOS Release 15 M and T

- New release strategy with feature delivery in a shorter amount of time
- Proactive support policies, consistent release numbering, clearer software deployment and migration guidance
- Predicable new feature release and rebuild schedules





# Release 15 M and T

- Follow-on to Release 12.4 Mainline and 12.4T
- Features and platform support inheritance from Release 12.4T
- Proactive release support policies and software migration guidelines
  - Extended Maintenance M releases for long-term support
  - Standard Maintenance T releases between EMs for faster Cisco feature delivery
- Predictable release and maintenance rebuild schedules with measurable milestones
- New release three times/year; Extended Maintenance (EM) release every 18–20 months
- Initial rollout, **Release 15.0(1)M**, with 1941, 2900, and 3900

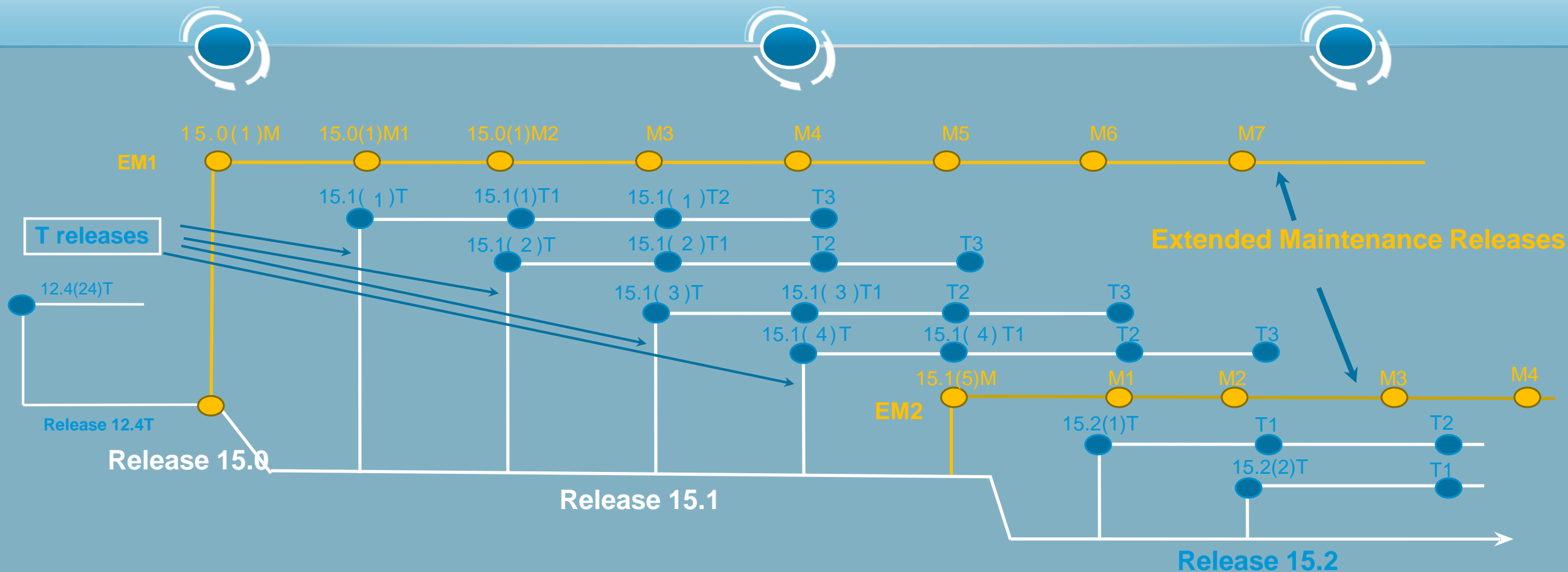


# Release 15.0 Numbering and Delivery

Single Train Release Model

Improved Quality and Management

Predictable Schedules





# Power Supply and Inline Power Management



# Module Introduction

- ISR NG enhances the legacy PoE feature on ISR. Now user has the flexibility to configure the extended PoE power capability with the help of redundant power supply.
- RPS 2300 provides power redundancy for mid end ISR NG routers. RPS 2300 is an intelligent power device with management and configuration capabilities which allow user to define and implement failover policy.

# Comparison with ISR

Features	ISR NG	ISR
Intelligent RPS 2300 Support with multiple-router connectivity to the same RPS.	Ability to Control and Monitor	Can not Monitor and Control RPS
Internal PSU with Cookie and Temp Sensor connected to I2C interface	Yes	No PSU cookie and Temp sensor in the PSUs
PSU OIR Support	Yes	No
Boost mode support to extend the maximum PoE supply limit	Yes	No

Note: RPS 2300 is supported on C2911/C2921/C2951 platforms only.

# ISR NG Power Supply Redundancy Model

Platforms	Power Supply redundancy model
<b>C3945 and C3925</b>	<b>Dual internal PSU based system with two identical power supply slots</b>
<b>C2951, C2921 and C2911</b>	<b>Single internal PSU slot and one RPS Adaptor slot for RPS 2300 connectivity</b>
<b>C2901 and C1941</b>	<b>Single Power supply unit slot. Power redundancy is not supported.</b>



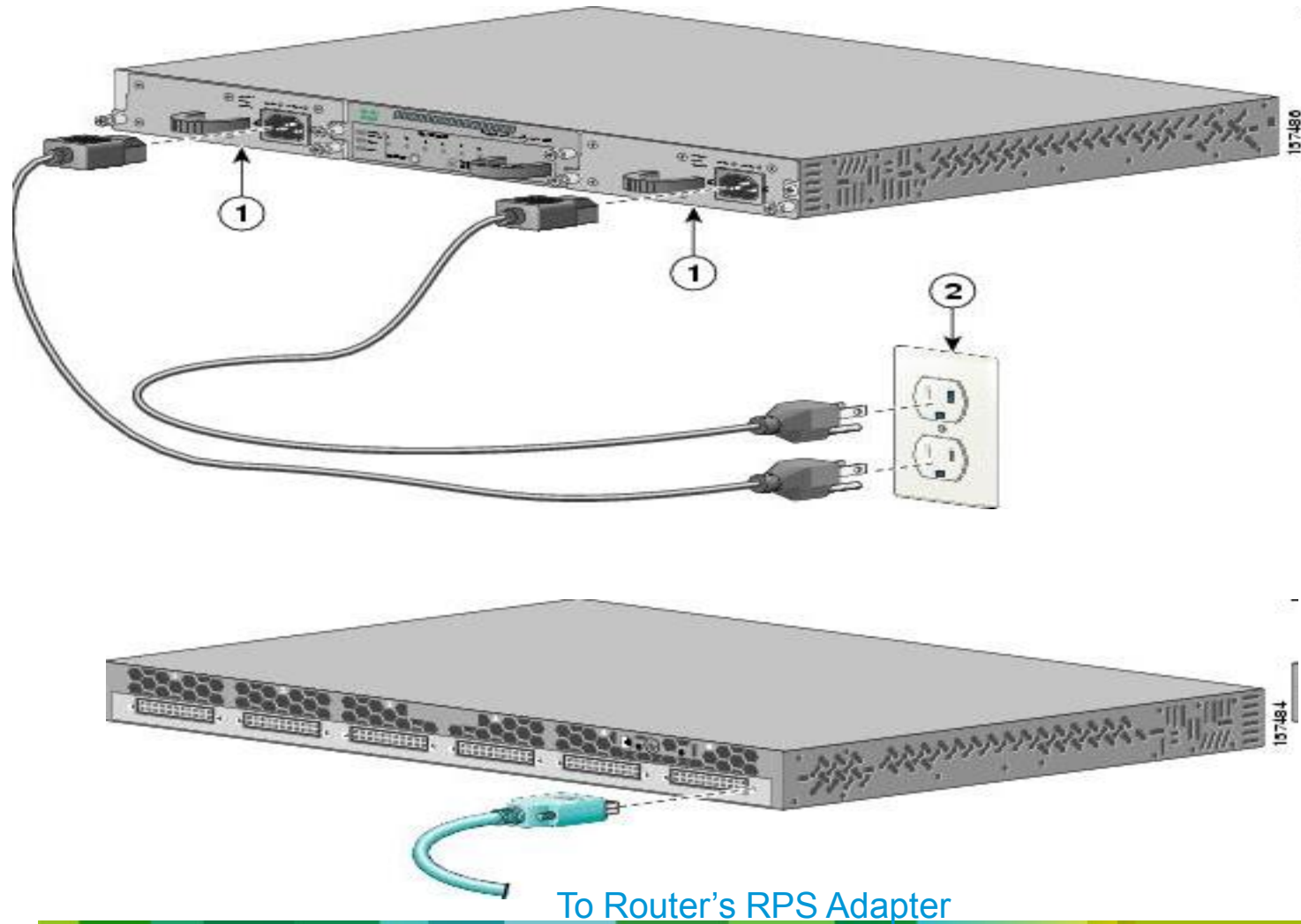
# Power Supply Capability Table

Platform	PSU1 Slot		PSU2 Slot		Comment
	Type	OIR Capable	Type	OIR Capable	
1941 2901	AC AC-PoE	No	Not Available	Not Available	Power redundancy is not supported
C2911 C2921 C2951	AC AC-PoE DC	Yes	External RPS with Adaptor	No	C2921 and C2951 uses the same PSU and RPS adaptor
C3925 C3945	AC AC-PoE DC	Yes	AC AC-PoE DC	Yes	Mix and Match of AC, AC-PoE and DC is supported

# Dual/Single Power Supply based Models

- Higher end ISR NG routers C3945 and C3925 have two identical PSU slots. Both the PSUs work in load sharing mode and share the entire chassis and PoE power consumption. Each PSU is capable of taking entire power load seamlessly in case of single PSU failure.
- In the PoE redundancy mode, total power consumption does not increase above the single PSU capacity. In the Boost mode, total PoE consumption can go upto combined capacity of two PSUs.
- PSU slot supports PSU OIR and it can be replaced with different PSU type as well.
- Low end routers C1941 and C2901 supports only one PSU slot. Power redundancy is not supported.

# RPS 2300 Introduction





# RPS 2300 Introduction ( cont...)

- RPS 2300 is an intelligent power redundancy CISCO product capable of monitoring its PS FRUs and connected switches/routers. Monitoring and configuration features of RPS 2300 is already supported by C3750E. Legacy ISR can also be connected to RPS 2300 for redundancy.
- ISR NG supports full monitoring and configuration features of RPS 2300 similar to C3750E. ISR NG achieves PoE Boost mode capability through RPS. Table in the next slide explains various backup scenarios possible through RPS with multi routers configuration.
- RPS provides complete power (12V and PoE ) to the router. Internal PSU's PoE power is switched off internally in the boost mode.
- C2921 and C2951 are treated as XLU (eXtended Load Unit) and C2911 is treated as PLU ( Phone Load Unit) by the RPS. One XLU needs two RPS FRUs for its backup. Xformers supports C3K-PWR-1150WAC and C3K-PWR-750WAC FRUs in the RPS.
- Please refer to following link for more details about RPS2300 .  
<http://www.cisco.com/en/US/products/ps7130/index.html>

# RPS multiple routers configurations

Following table gives the number of routers (Boost/Redundancy mode) can be backed up simultaneously in different RPS configurations.

Router	Single 750W FRU	Dual 750W FRUs	Single 1150W FRU	Dual 1150W FRUs	Comment
C2911 in Redundancy mode	1	2	1	2	
C2921/C2951 in Redundancy mode	0	1	0	1	XLU requires 2 RPS FRUs
C2911 in Boost mode	1	2	1	2	
C2921/C2951 in Boost mode	0	1	0	1	XLU requires 2 RPS FRUs

# Inline power Management

- ILP process polls PS/RPS PoE supply status every second. It shutdown or restarts the inline power supply based on the PS/RPS status.
- Modes :- PoE Mode can be configured using CLI under global config. This CLI is visible ONLY IF second/redundant Power supply is present and powered on.

- **Redundant mode**

```
router(config)#power inline redundant
```

Inline power is backed up with redundant power supply.

- **Boost mode**

```
router(config)#no power inline redundant
```

Inline power is extended to support more Powered Devices.



# PoE Power Ratings

Platforms	Internal PoE Power in Watts	RPS based External POE Boost Power in Watts	Internal Dual POE Power in Watts
C1941	80	N/A	N/A
C2901	130	N/A	N/A
C2911	200	750	N/A
C2921	280	750	N/A
C2951	370	750	N/A
C3925/C2945	520	N/A	1040

# Dual Power Supply based PoE Support

- Redundancy mode:-

- Power (12V and PoE power) is load shared between both the PSUs. If one PSU fails then second PSU is available to provide the power without any failure. Total power supply is limited to the single PSU capacity 520W.

- Boost mode:-

- Total inline power allocation can go up to 1040W. In this case there is no inline power redundancy.

- Boost mode CLI “no power inline redundant” is visible only if both PSUs are AC+IP and powered on.

- Power failure on any PSU can bring down the PoE power supply to the all the connected PoE devices. PoE supply can be recovered after reload with maximum of single PSU capacity.

# PSU and PoE related LEDs

LED	STATE		Comment
PSU	GREEN	If PSU is connected to the input source and powered ON	PSU LED would be OFF is the PSU type is not determined.
	AMBER	If any one power output 12 V or PoE is bad	
	OFF	If PSU is not connected to the input source or PSU is switched OFF	
PoE	GREEN	If the PoE power is Good either from PSU or RPS	
	AMBER	PoE power is present but not available due to Power failure.	
	OFF	PoE power in the not present.	
RPS	GREEN	RPS is backing up the router	Only on C2911/C2921/C2951
	OFF	RPS is not present or Router is UP on its internal Power.	
Boost	GREEN	Boost Mode is active	Only on C3925/C3945
	OFF	Redundancy Mode is active	



# show environment

```
Router#show environment
```

```
SYSTEM POWER SUPPLY STATUS
```

```
=====
```

```
Internal Power Supply Type: AC-POE
```

```
Internal Power Supply 12V Output Status: Normal
```

```
Internal Power Supply POE -48V Voltage Status: Normal
```

```
External Redundant Power Supply is present and available to backup the system.
```

```
System Power Supply POE Mode: Internal POE only
```

```
.....
```

```
.....
```

```
.....
```

```
■
```

# show environment rps

```
Router3#show env rps
```

```
RPS Name: RPS 2300
```

```
State: Active
```

```
PID: PWR-RPS2300
```

```
Serial#: CAT1142VG2W
```

```
Fan: Good
```

```
Temperature: Green
```

```
RPS Power Supply A: Present
```

```
  PID           : C3K-PWR-1150WAC
```

```
  Serial#       : DTH1119R01D
```

```
  System Power  : Good
```

```
  PoE Power     : Good
```

```
  Watts        : 300/850 (System/PoE)
```

```
RPS Power Supply B: Failed
```

```
  PID           : C3K-PWR-1150WAC
```

```
  Serial#       : DTH1209R823
```

```
  System Power  : Bad
```

```
  PoE Power     : Bad
```

```
  Watts        : 300/850 (System/PoE)
```

# show environment rps (cont...)

DCOut	State	Connected	Priority	BackingUp	WillBackup	PortName
1	Active	Yes	6	No	No	router1
2	Active	Yes	6	No	No	router2
3	Active	No	5	No	No	<>
4	Active	Yes	3	Yes	Yes	router3
5	Active	No	6	No	No	<>
6	Active	No	6	No	No	<>

router3#





## Troubleshooting common issue

# Hardware Troubleshooting

# Troubleshooting tips

- Board doesn't power on
  - Check LEDs for SYS power and possible PS failure

## If router powers up ok but no console

1. Check the state of SYS and ACT LEDs.
2. Check UART console connections and speed settings (router default is 9600 baud, No parity, 1 stop bit)

## If router fails to boot to rommon

1. Check rommon error messages

# Crash Troubleshooting



# Things to Gather for a Crash

- crashinfo
- show tech (includes show version, show context, show region)

- History up to the point of crash

Has this happened before—How often—Has anything changed on the network—Are you sure?

# Crashinfo

```
Router#dir flash:
```

```
Directory of flash:/
```

```
 1  -rw-      5043356   Jan 01 2000 00:02:53  gsr-boot-mz.120-8.S
 2  -rw-       126609   Jan 06 2000 08:50:00  crashinfo_20000106-085009
```

```
7602176 bytes total (2347160 bytes free)
```

```
Router#more flash:crashinfo_20000106-085009
```

# Crash type

SIG Value	Error Reason
2	unexpected hardware interrupt
3	abort due to break key
4	illegal opcode exception
5	abort due to Break Point or an arithmetic exception
8	floating point unit (FPU) exception
9	reserved exception
10	bus error exception
11	SegV exception
20	cache parity exception
21	write bus error interrupt
22	fatal hardware error
23	software-forced crash

# Processor Memory Parity Errors

- Soft parity errors—Transient
- Hard parity errors—Hardware

Processor Memory Parity Errors (PMPEs)

[http://www.cisco.com/warp/public/122/crashes\\_pmpe.html](http://www.cisco.com/warp/public/122/crashes_pmpe.html)

**If the error occurs once, it's probably a transient error**

**If it occurs frequently, then it's probably a hardware problem**



# Bus Error

What's it ?

The system encounters a bus error when the processor tries to access a memory location that either does not exist (a software error) or does not respond properly (a hardware problem)

```
Router uptime is 2 days, 21 hours, 30 minutes
```

```
System restarted by bus error at PC 0x30EE546, address 0xBB4C4
```

```
System image file is "flash:igs-j-1.111-24.bin", booted via flash
```



## Troubleshooting Bus Error Crashes

<http://www.cisco.com/c/en/us/support/docs/ios-nx-os-software/ios-software-releases-121-mainline/7949-crashes-buserror-troubleshooting.html>

# Software forced crash

## What's is it?

software-forced crash occurs when the router detects a severe, unrecoverable error and reloads itself to prevent the sending of corrupted data. A vast majority of software-forced crashes are caused by Software bugs, although some platforms may report a hardware problem

## Understanding Software-forced Crashes

<http://www.cisco.com/c/en/us/support/docs/routers/7500-series-routers/26145-crashes-swforced-troubleshoot.html>

# Watchdog

## What's is it ?

Cisco processors have timers that guard against certain types of system hangs. The CPU periodically resets a watchdog timer. The watchdog timer basically controls the time of each process. If the timer is not reset, a trap occurs. If a process is longer than it must be, the watchdog timer is used to escape from this process, thus leading to a reboot of the router.

## Troubleshooting Watchdog Timeouts

<http://www.cisco.com/c/en/us/support/docs/ios-nx-os-software/ios-software-releases-122-mainline/7956-crashes-watchdog-timeout.html>

# Memory Troubleshooting



# Memory Leaks

## What is it memory leak

A memory leak occurs when a process requests or allocates memory and then forgets to free (de-allocate) the memory when it is finished with that task. As a result, the memory block is reserved until the router is reloaded. Over time, more and more memory blocks are allocated by that process until there is no free memory available. Depending on the severity of the low memory situation at this point, the only option you may have is to reload the router to get it operational again

The first step is to determine which memory pool the leak is in

The information needed to troubleshoot a leak in a processor memory pool is completely different than the information needed to troubleshoot a problem in an input/output memory pool

## Troubleshooting Memory Problems

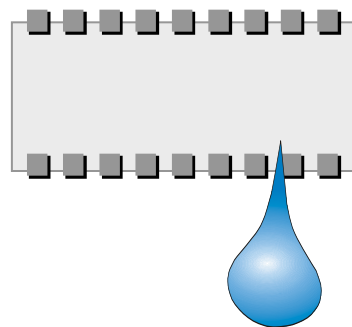
<http://www.cisco.com/c/en/us/support/docs/ios-nx-os-software/ios-software-releases-121-mainline/6507-mallocfail.html#tshoot4>

# Determining if Memory Is Leaking

```
2651#show process memory
```

```
Total: 35629228, Used: 5869824, Free: 29759404
```

PID	TTY	Allocated	Freed	Holding	Getbufs	Retbufs	Process
0	0	74032	1808	3398376	0	0	*Init*
0	0	1112	1088412	1112	0	0	*Sched*
0	0	188452152	180090408	1261304	164928	0	*Dead*
....							
103	0	708	0	16840	0	0	IP-EIGRP Router



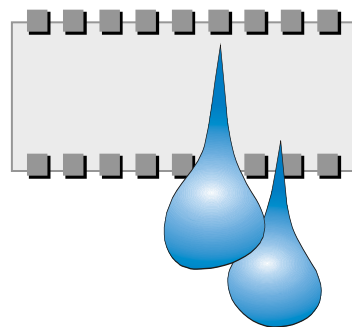
**Watch for the Process to Hold Increasing Amounts of Memory when There Is No Corresponding Activity to Explain the Memory Usage Increase...**

# Determining if Memory is Leaking

```
2651#show process memory
```

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Total: 35629228, Used: 5869824, Free: 29759404
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0	0	1112	1088412	1112	0	0	*Sched*
0	0	188452152	180090408	1261304	164928	0	*Dead*
....							
103	0	708	0	121480	0	0	IP-EIGRP Router



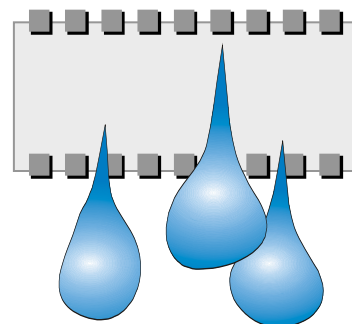
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# Determining if Memory Is Leaking

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0	0	1112	1088412	1112	0	0	*Sched*
0	0	188452152	180090408	1261304	164928	0	*Dead*
....							
103	0	708	0	4595678	0	0	IP-EIGRP Router



**Watch for the Process to Hold Increasing Amounts of Memory when There Is No Corresponding Activity to Explain the Memory Usage Increase...**



# MallocLite Memory Leaks Troubleshooting


“%SYS-2-MALLOCFAIL: Memory allocation of 11493748 bytes failed from 0x601351E8, alignment 0 Pool: Processor Free: 18830784 Cause: Memory fragmentation”  
Alternate Pool: None Free: 0 Cause: No Alternate pool

Cisco 3845 (revision 1.0) with 217088K/45056K bytes of memory.

**NOTE: the device have 256M memory**

```
FJFZRT01011# show processes memory sorted holding
Processor Pool Total: 92050336 Used: 72062980 Free: 19987356
I/O Pool Total: 46136832 Used: 19896768 Free: 26240064

PID TTY Allocated Freed Holding Getbufs Retbufs Process
  0  0 150801588 95134648 49802768 0 0 *Init*
  0  0 0 0 16962772 0 0 *MallocLite*
  1  0 16357708 6979584 9477196 0 0 Chunk Manager
```



**Customer need collect command:**

show memory statistics

show memory allocating-process totals

show memory debug leak chunks

show mem debug leaks summary

show process memory sorted holding

# Fragmentation

- Memory allocation failures can also be caused by fragmentation, rather than the router running out of memory.
- Examine the Largest and Free columns in the output of show memory to determine the difference.

```
router#show memory
```

	Total (b)	Free (b)	Largest (b)
Processor	35629228	29918872	1298
I/O	5242880	3097864	3097820

↑  
**Fragmentation**

# Process memory fragment

## General Troubleshooting Steps:

### 1/Verify That Memory is Fragmented

```
VANBR7206401GEO1#sho mem sum
```

	Head	Total (b)	Used(b)	Free (b)	Lowest (b)	Largest (b)
Processor	609C1230	17034704	12765012	4269692	2237852	140832
I/O	7800000	8388608	8312920	75688	75416	596
PCI	4B000000	1048584	679640	368944	368944	368892

### 2/Capture Data to Troubleshoot the Problem

```
show memory free
show memory summary
show processor memory
show running-config
show version
```

### 3/Analyze the Data That Was Captured

look for "(fragment) (Free Blocks)" and "(coalesced) (Free Blocks)".

look the most frequent entries that have the same allocating PC and decode the allocating PC

# High CPU Troubleshooting

# High Processor Utilization

```
7206#show processes cpu
```

```
CPU utilization for five seconds 83%/21%; one minute: 79%; five minutes: 84%
```

PID	Runtime(ms)	Invoked	uSecs	5Sec	1Min	5Min	TTY	Process
2	68	227	299	0.00%	0.00%	0.00%	0	Exec
....								
14	6608	119562	55	0.00%	0.00%	0.00%	0	ARP Input
35	4520	68993	65	48.00%	30.00%	52.00%	0	IP Input
82	90896	22759	3993	0.00%	0.00%	0.00%	0	Per-minute Jobs

- Is the router spending most of its time running processes, or in interrupt context?
- Here, we have 21% interrupt context, with 83% total utilization
- $83 - 21 == 62\%$  of the time running processes



# Situations and features triggering traffic to CPU

## Packets destined to the router

- ✓ Control plane( BFD,IP SLA,HSRP)
- ✓ Routing protocol(OSPF, EIGRP, BGP)
- ✓ SNMP, Telnet, SSH
- ✓ ARP

## Packets requires processing

- ✓ IP option, TTL failure
- ✓ ICMP related: unreachable, redirect
- ✓ Hardware full

## ACL-based

- ✓ ACL deny + IP unreachable
- ✓ ACL with log

Netflow-based: NAT, WCCP(Only first packet)

## ISRG2 Hardware performance

<http://www.cisco.com/web/partners/downloads/765/tools/quickreference/routerperformance.pdf>

# TS high cpu by interrupt basic command

show commands: many times when high cpu

- ✓ show interface stats
- ✓ show interface switching (Hidden command)
- ✓ show ip traffic
- ✓ Show interface

```
DL-CISCO2921#show inter g0/0 stats
GigabitEthernet0/0
  Switching path      Pkts In   Chars In   Pkts out   Chars Out
  Processor           24446    1467427    105508     10241124
  Route cache         69       9282       69         9282
  -----
  Total                24515    1476709    105577     10250406
```

```
DL-CISCO2921#show inter g0/0 switching
GigabitEthernet0/0
  Throttle count      0
  Drops               RP      0
  SPD Flushes         Fast   0
  SPD Aggress         Fast   0
  SPD Priority        Inputs 24344
  Drops               0

Protocol IP
Switching path      Pkts In   Chars In   Pkts Out   Chars Out
Process            94       6307       67         9076
Cache misses       0
Fast               69       9282       69         9282
Auton/SSE          0         0          0          0
```

```
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec..
```

# High cpu by transience

## EPC+EEM solution

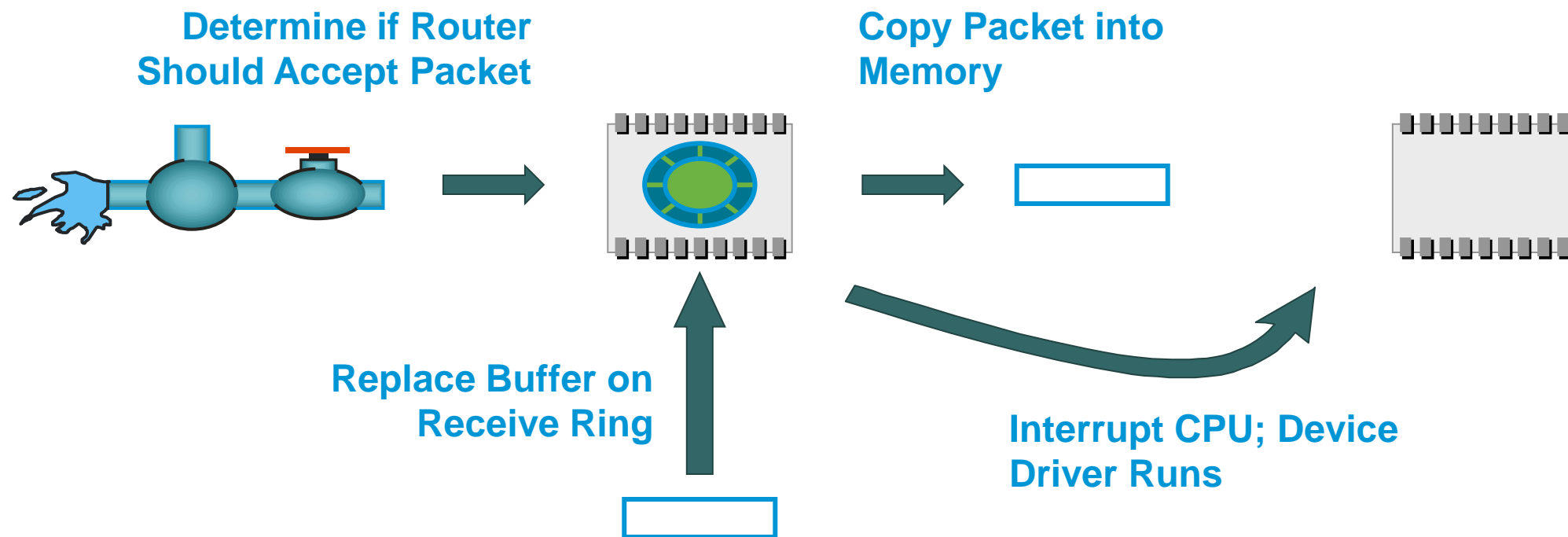
```
monitor capture buffer BUF
monitor capture point ip process-switched POINT both
monitor capture point associate POINT BUF
```

```
process cpu threshold type total rising 85 interval 5 <<<<当CPU利用率到达85%以上的时候, 就会报出log "%SYS-1-CPURISINGTHRESHOLD"
```

```
event manager session cli username "username"
event manager applet high-cpu
event syslog pattern "CPURISINGTHRESHOLD"
action 0.1 syslog msg "EEM: HIGH CPU detected. Writing info to flash:eem-log.txt"
action 0.2 cli command "enable"
action 0.8 cli command "monitor capture point start POINT "
action 0.9 cli command "show process cpu sorted | append flash:eem-log.txt"
action 1.0 cli command "show process cpu history | append flash:eem-log.txt"
action 1.1 cli command "show proc mem sorted | append flash:eem-log.txt"
action 1.2 cli command "show memory allocating-process totals | append flash:eem-log.txt"
action 1.3 cli command "show buffers | append flash:eem-log.txt"
action 1.4 cli command "show interfaces | append flash:eem-log.txt"
action 1.5 cli command "show interfaces stat | append flash:eem-log.txt"
action 1.6 cli command "show ip traffic | append flash:eem-log.txt"
action 1.7 cli command "show process cpu history | append flash:eem-log.txt"
action 1.8 wait 60
action 1.9 cli command "monitor capture point stop all" action 2.0 syslog msg "EEM: Self-removing applet from configuration..."
action 2.1 cli command "configure terminal"
action 2.2 cli command "no event manager applet high-cpu"
action 2.3 cli command "end"
```

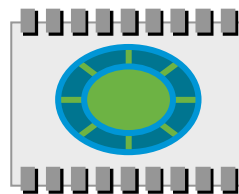
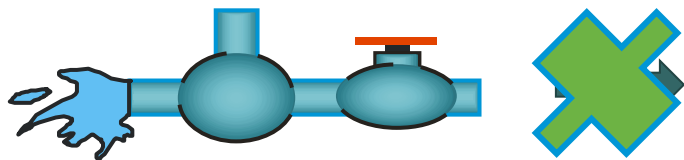
# Packet Drop

# Inbound Packet Loss





# Inbound Packet Loss



```
router#show interface  
FastEthernet0/0 is up, line protocol is up
```

....

```
0 input errors, 0 CRC, 0 frame 0 overrun, 0 ignored
```

....

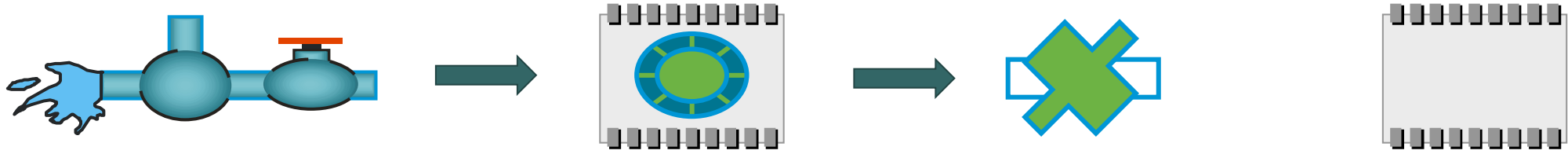
**Other Errors**

**CRC Check Failed**

**Packet Framed Incorrectly**

**Packet Not Accepted by Interface Processor**

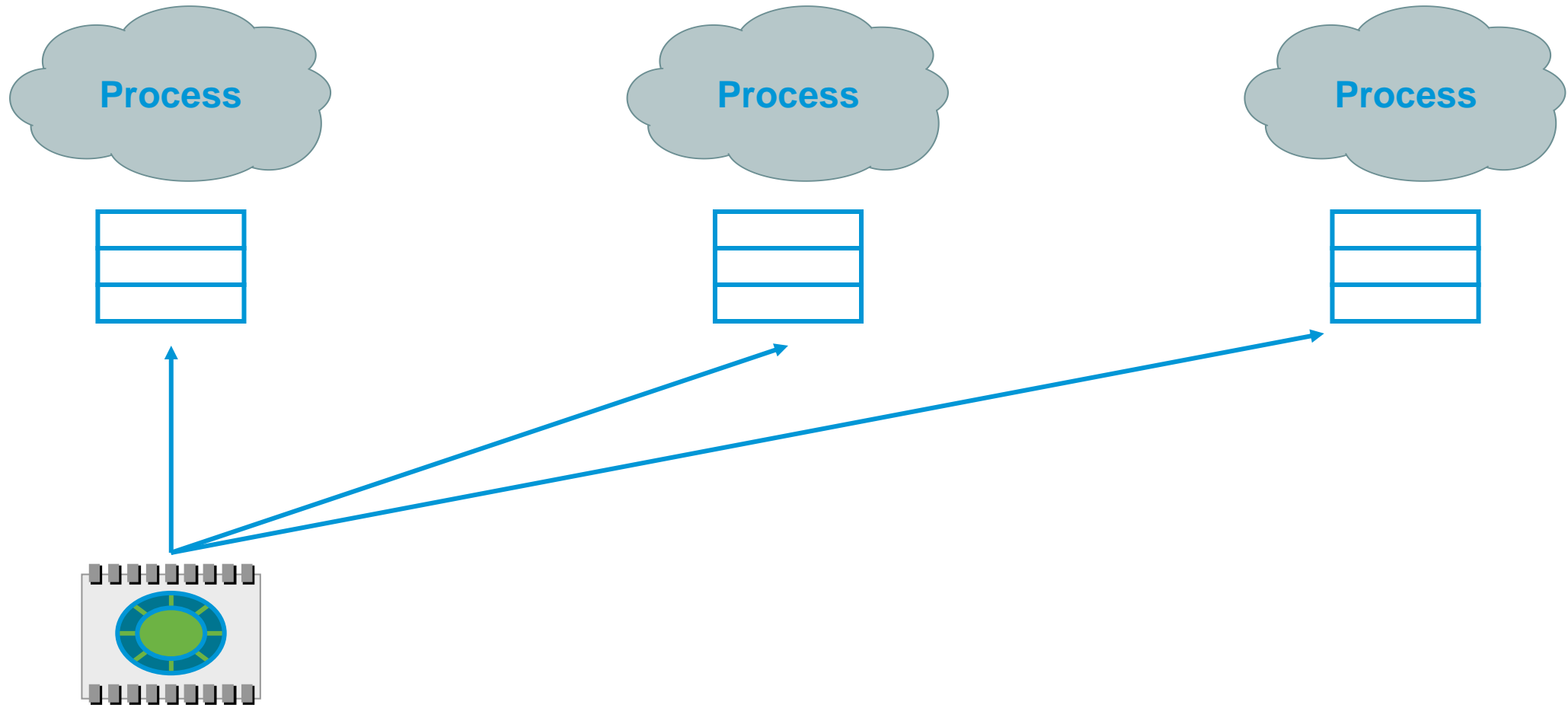
# Inbound Packet Loss



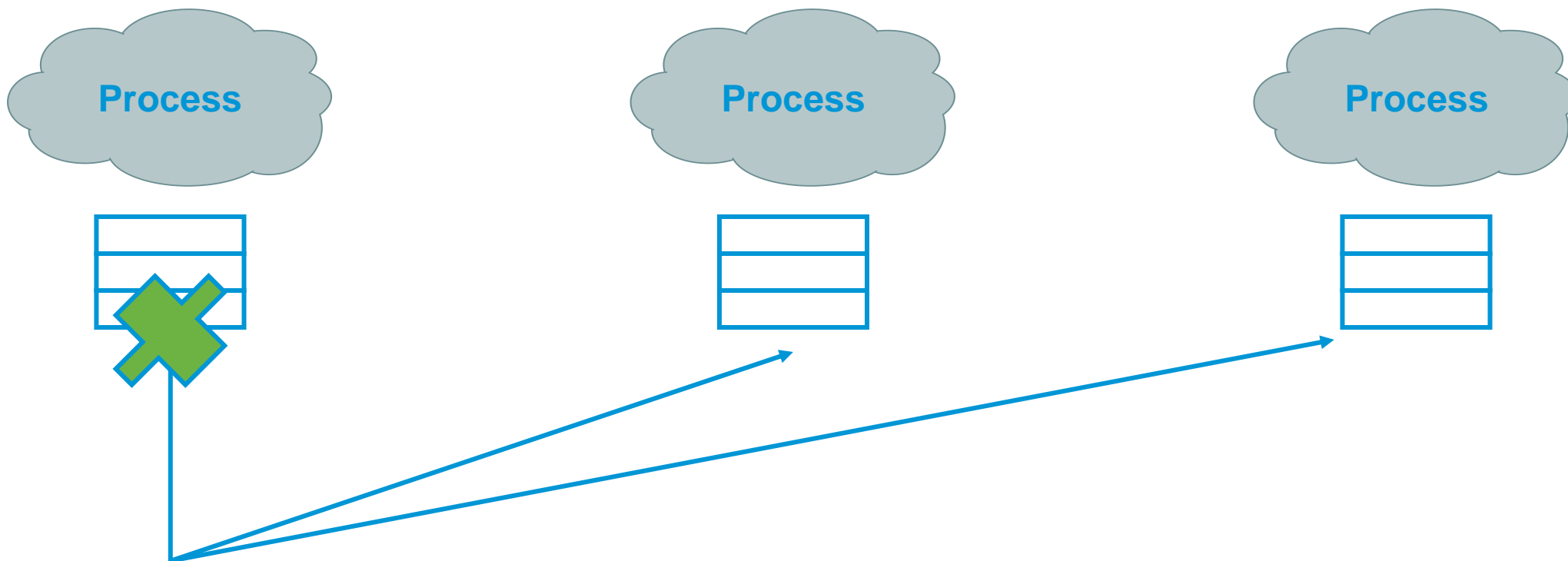
```
router#show interface  
FastEthernet0/0 is up, line protocol is up  
.....  
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
```

- The interface processor copies the packet faster than memory can accept it

# Receive and Process Packet Loss



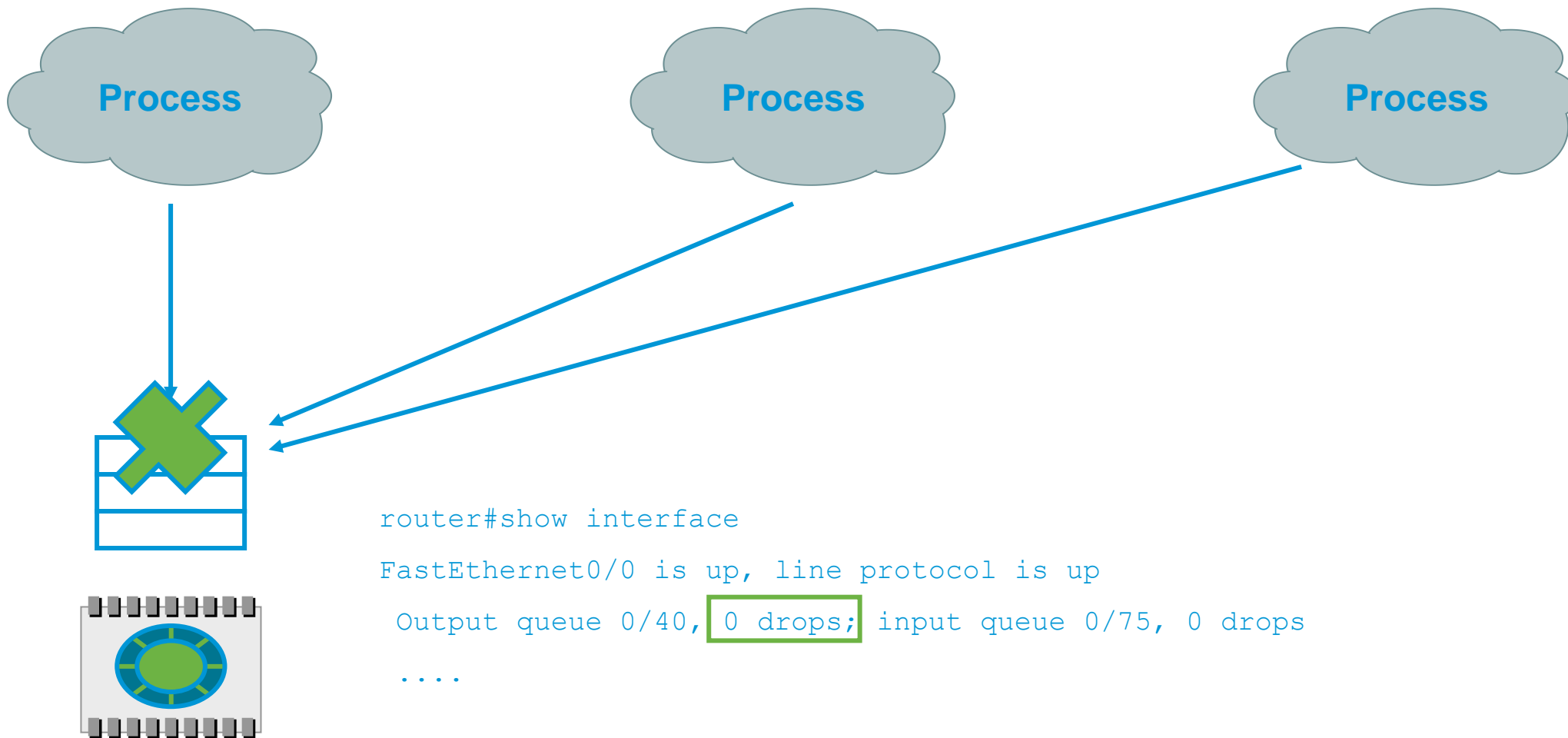
# Receive and Process Packet Loss



```
router#show interface  
FastEthernet0/0 is up, line protocol is up  
Output queue 0/40, 0 drops; input queue 0/75, 0 drops
```

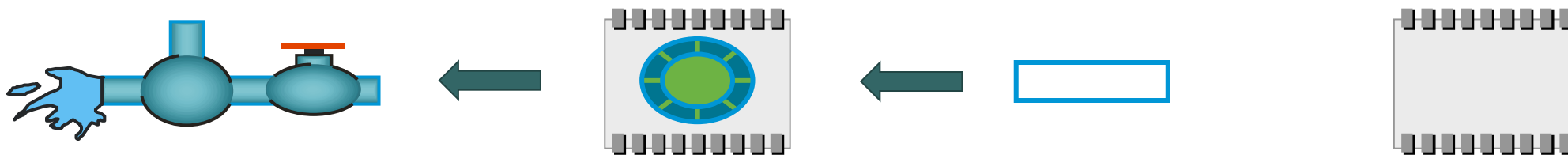
....

# Outbound Packet Loss





# Outbound Packet Loss



```
router#show interface
FastEthernet0/0 is up, line protocol is up
....
0 packets output, 0 bytes, 0 underruns (0/0/0)
0 output errors, 0 collisions, 0 interface resets
```

## Other Errors when Transmitting the Packet

# Loop test

1. **Hardware loop test**
2. **Software loop test**

# Hardware loop test

- 1. T1/E1 wan line**
- 2. Optical line**
- 3. Copper line**

# Software loop test (12.4train)

- 1. controller t1 0  
loopback local**
- 2. interface serial 0  
loopback remote**
- 3. interface serial 1  
loopback line**

# Useful link

## **Troubleshooting Ethernet**

<http://www.cisco.com/en/US/docs/internetworking/troubleshooting/guide/tr1904.html>

## **Troubleshooting Input Queue Drops and Output Queue Drops**

<http://www.cisco.com/c/en/us/support/docs/routers/10000-series-routers/6343-queue-drops.html>

## **Loopback Tests for T1/56K Lines**

<http://www.cisco.com/c/en/us/support/docs/wan/t1-e1-t3-e3/5708-hard-loopback.html>

## **Hard Plug Loopback Tests for E1 Lines**

<http://www.cisco.com/c/en/us/support/docs/wan/t1-e1-t3-e3/14165-e1-hard-loopback.html>



Thank You !