



Agenda

Hardware Configuration

- **System Architecture**
- **Components and Options**
- **Configuration Guidelines**
 - Cisco 7200 PCI Bus Loading and Balancing**
 - Cisco 7500 CyBus Loading**
 - Cisco 7500 VIP2 and Port Adapters**

Agenda (Cont.)

Software Configuration

- **Basic Configuration Tasks**
- **Boot Sequence**
- **Switching Modes**
- **Performance Parameters**
- **Packet Buffers and Queues**
- **Interfaces and IDBs**

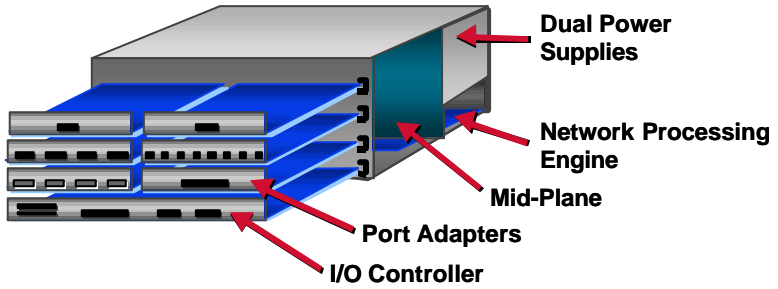
Hardware Configuration

Cisco 7200, 7100, and 7500

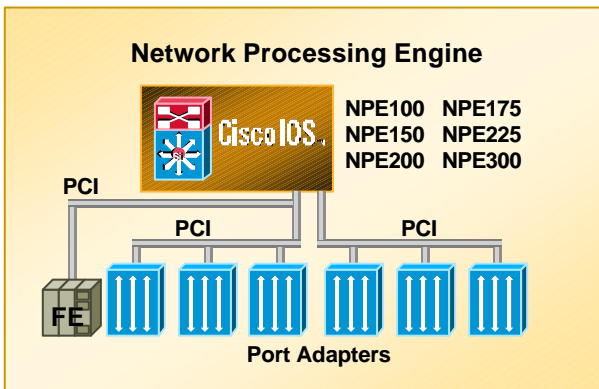
Cisco 7200



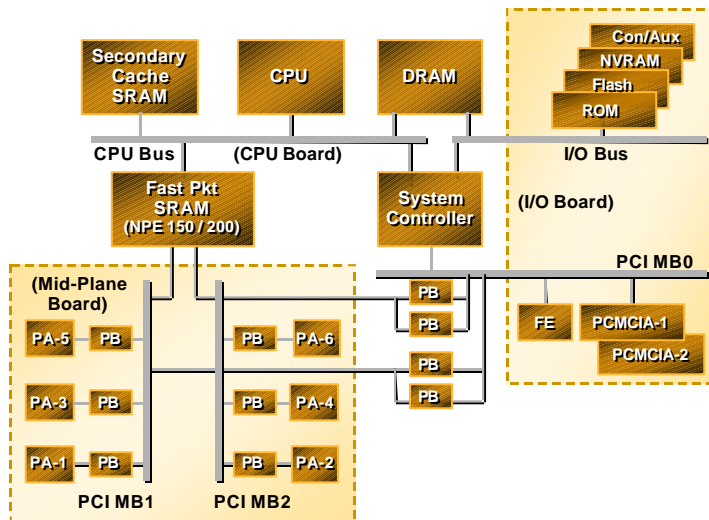
Cisco 7200 Hardware Architecture



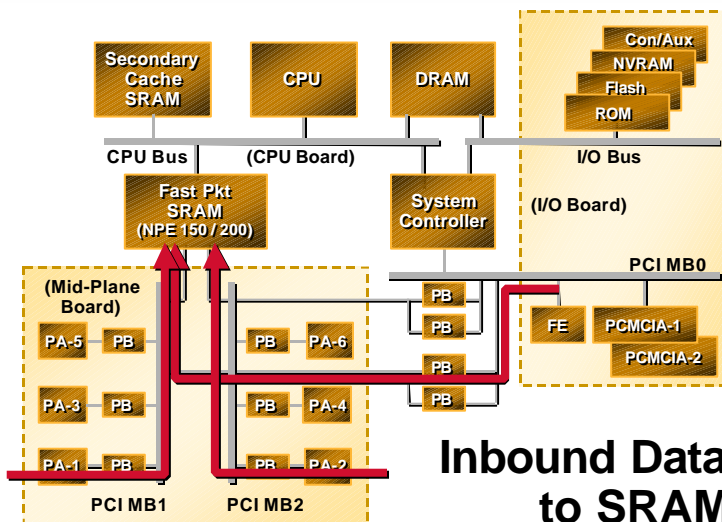
Cisco 7200 Bus Architecture



Cisco 7200 (NPE200/150/100) Internal Architecture

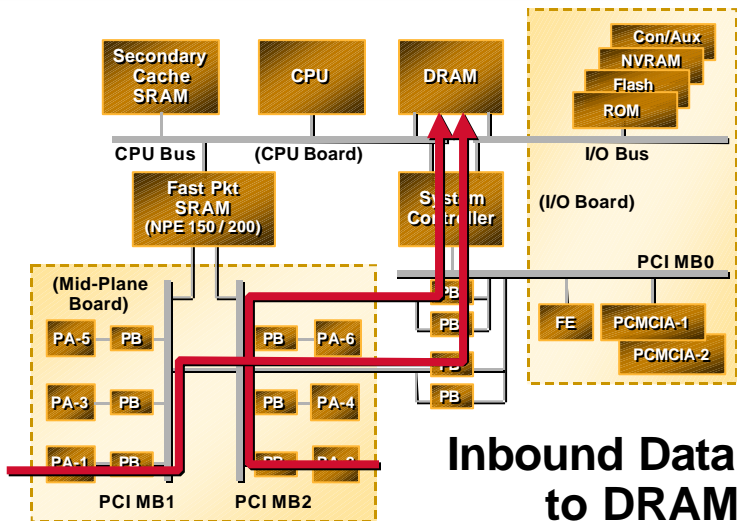


Cisco 7200 (NPE200/150) Data Path

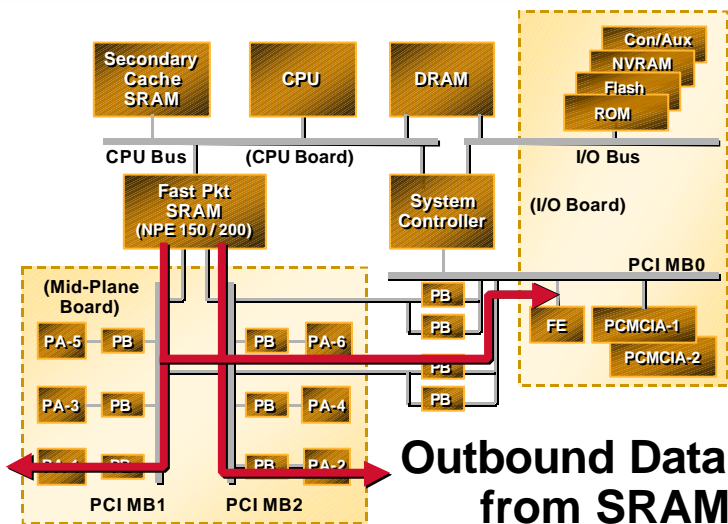


**Inbound Data
to SRAM**

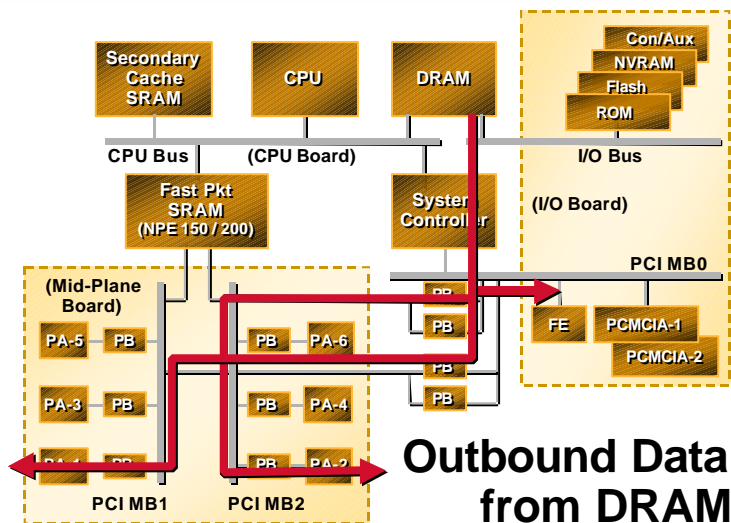
Cisco 7200 (NPE200/150/100) Data Path



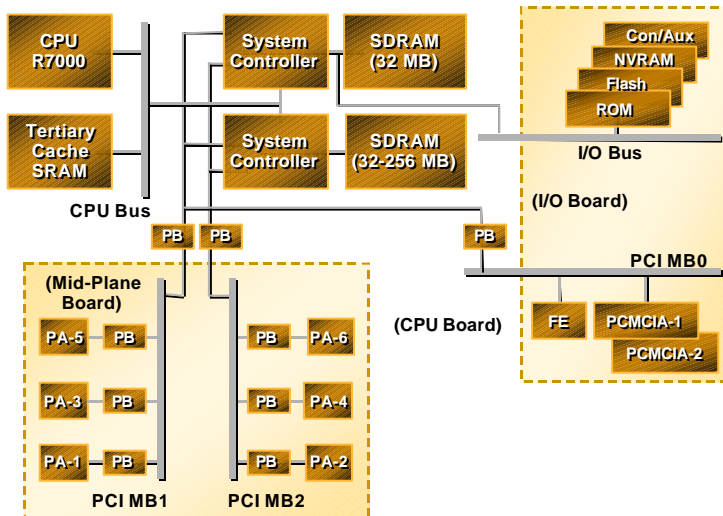
Cisco 7200 (NPE200/150) Data Path



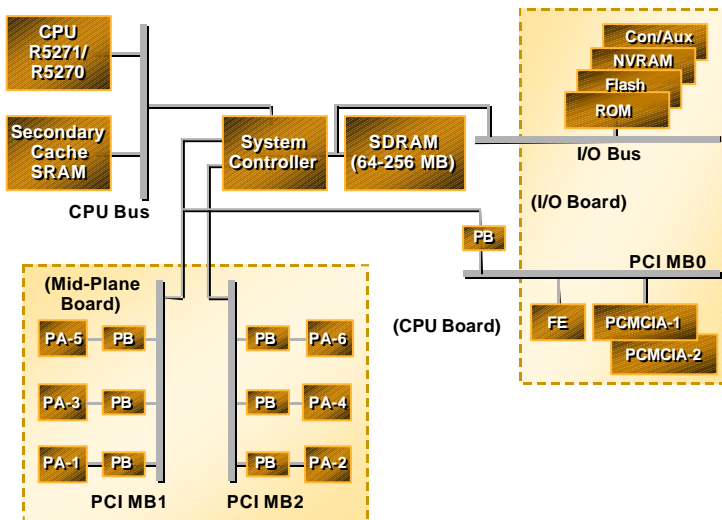
Cisco 7200 (NPE200/150/100) Data Path



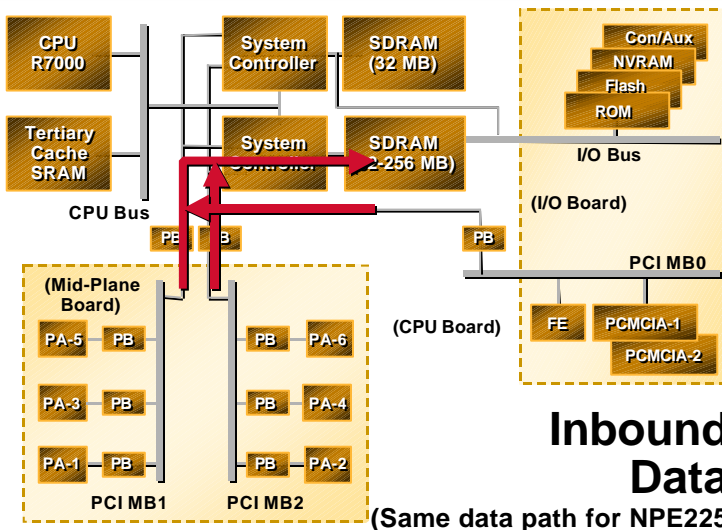
Cisco 7200VXR (NPE300) Internal Architecture



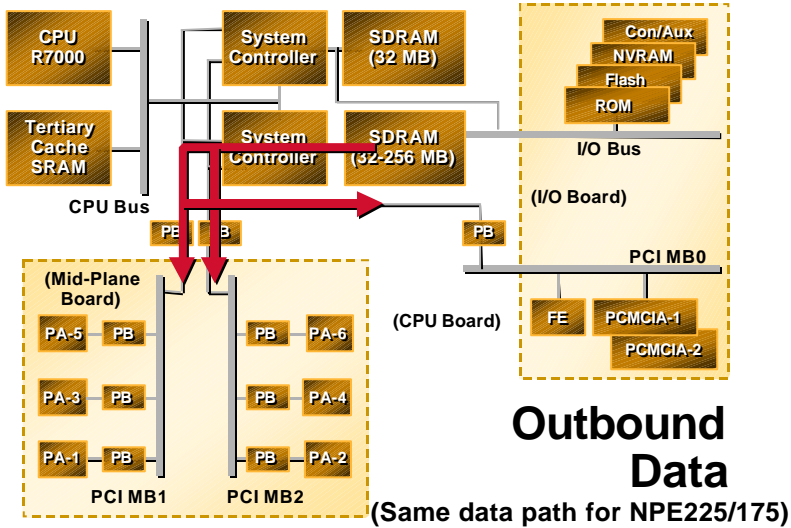
Cisco 7200VXR (NPE225/175) Internal Architecture



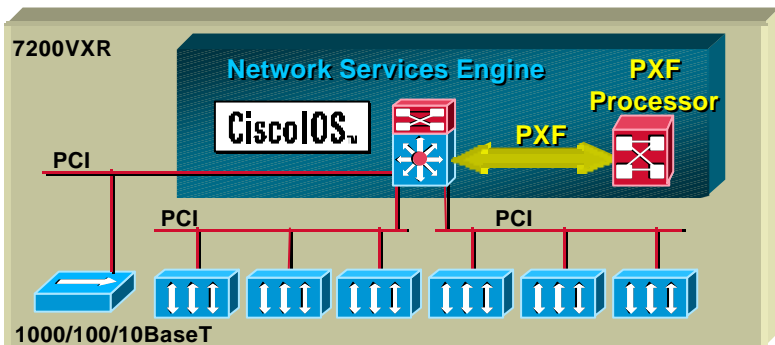
Cisco 7200VXR (NPE300) Data Path



Cisco 7200VXR (NPE300) Data Path

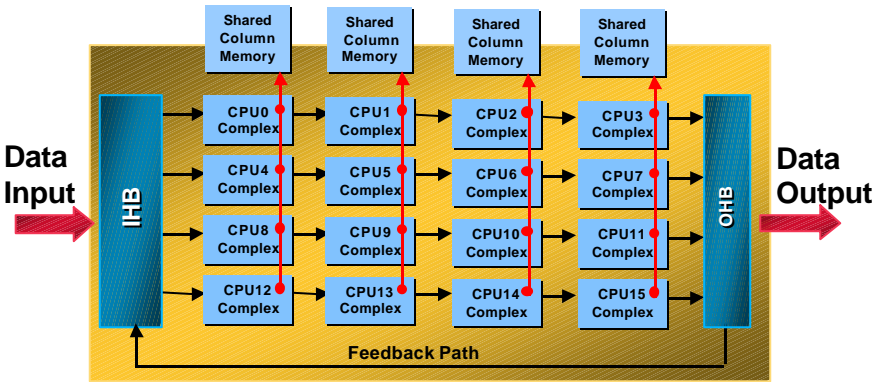


Network Services Engine NSE-1



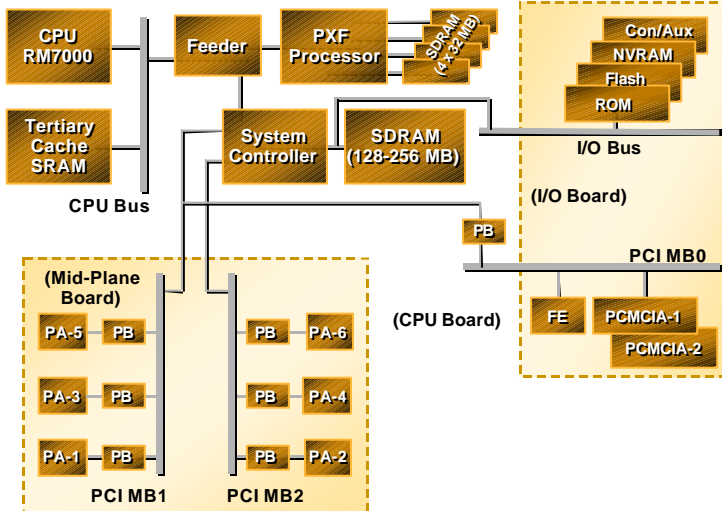
- **Embedded PXF Processor for service acceleration:**
CEF, NetFlow, ACL, WFQ, WRED, NAT at FCS;
more to follow
- **Same port adapter configuration guideline as NPE300**

PXF Processor Block Diagram

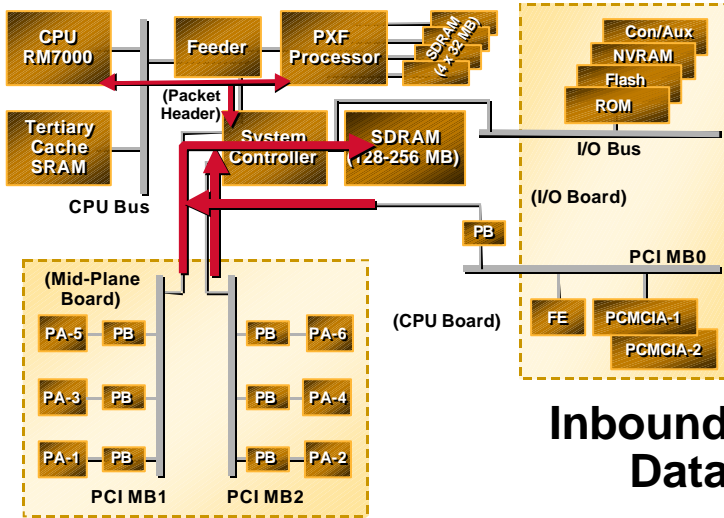


- Multiple on-chip processors using pipelining and parallelism to maximize utilization of external data memories

Cisco 7200VXR (NSE-1) Internal Architecture

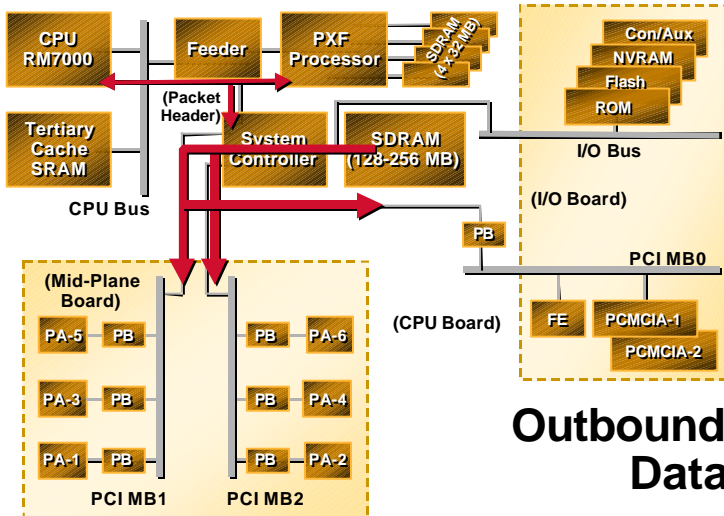


Cisco 7200VXR (NSE-1) Data Path



**Inbound
Data**

Cisco 7200VXR (NSE-1) Data Path

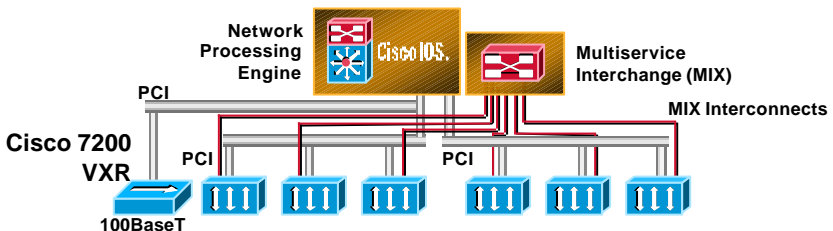


**Outbound
Data**

7200VXR Multiservice Interchange

- **Built-in TDM buses and switching capabilities integrated into the midplane**
- **Each PA slot has two full-duplex 8.192-Mbps TDM streams, and each stream has 128 DS0 channels (128 x 64 Kbps = 8.192 Mbps)**
- **Switching among all 12 streams at DS0 level done by Multiservice Interchange (MIX) on the midplane, no NPE processing involved**
- **TDM capabilities available with all NPE/NSE models**

Multiservice Interchange



- **Multiservice Interchange (MIX) integrated into 7200 VXR**
 - Switches DS0 time slots between up to 12 MIX interconnects
 - Based on time division multiplexing (TDM) technology
- **Two bi-directional 8.192 Mbps MIX interconnects to each port adapter slot (128 DS0 channels per stream)**

Cisco 7200 Components

- Chassis
- Power supply
- NPE/NSE
- Memory
- Software
- I/O controller
- Port adapters

Cisco 7200 Chassis

- **Cisco 7206 and 7206 VXR—six slots**
- **Cisco 7204 and 7204 VXR—four slots**
- **Each slot takes a port adapter**
- **Same port adapters are used on all Cisco 7xxx routers (a few PAs are not supported on all models)**

Cisco 7200 Power Supply

- Single AC
- Single DC
- Dual AC (load-shared redundant)
- Dual DC (load-shared redundant)
- Not AC and DC on same chassis

Cisco 7200 NPE/NSE

Model	Processor	CPU Clock Rate	Fast Packet Memory
NPE100	RISC 4700	150 MHz	None
NPE150	RISC 4700	150 MHz	1 MB SRAM
NPE200	RISC 5000	200 MHz	4 MB SRAM
NPE175	RISC 5270	200 MHz	32+ MB SDRAM
NPE225	RISC 5271	262.5 MHz	32+ MB SDRAM
NPE300	RISC 7000	262.5 MHz	32+ MB SDRAM
NSE-1	RISC 7000 PXF (4x4)	262.5 MHz 100 MHz (x16)	128+ MB SDRAM

7200 Chassis and NPE/NSE

Cisco 7206VXR	NPE 300/225/175/200/150/100, NSE-1
Cisco 7204VXR	NPE 300/225/175/200/150/100, NSE-1
Cisco 7206	NPE 225/175/200/150/100
Cisco 7204	NPE 225/175/200/150/100

Cisco 7200 Memory

- **NPE DRAM options: 32, 64, 128 MB (256 MB SDRAM option for NPE300)**
- **NSE-1 SDRAM options: 128, 256 MB**
- **Flash SIMM: 4 MB**
- **Flash memory card: 8, 16, 20 MB**
- **Flash disk: 40, 110 MB**
- **Two PCMCIA slots**

Cisco 7200 Software Feature Sets

- **Enterprise**
- **Enterprise with APPN**
- **Desktop and IBM**
- **IP routing (11.2+)**
- **Encryption options to above (IPSec DES, 3DES)**
- **Firewall option to above**

Cisco 7200 Software Feature Licenses

- **WAN Packet Protocols/NetFlow**
ATM, FR, SMDS, X.25, NetFlow
- **Interdomain Routing/Tag Switching**
BGP, EGP, Tag Switching

Cisco 7200 I/O Controller

- **Standard**

Console port

Aux port

Two PCMCIA slots

- **Optional**

Embedded Fast Ethernet interface with both RJ45 and MII connector, full duplex

Cisco 7200 Port Adapters

LAN

1p Fast Ethernet (TX/FX)
2p Fast Ethernet (TX/FX)
4p and 8p Ethernet (10BaseT)
5p Ethernet (10BaseFL)
4p Token Ring (HDX/FDX)
1p FDDI (HDX and FDX)
1p 100VG
1p Gigabit Ethernet
EtherSwitch (12E/2FE)

WAN

4p and 8p Serial
4p E1 G.703
1p and 2p HSSI
1p and 2p T3/E3
4p and 8p BRI
1p ATM-CES
1p ATM T3/E3/OC-3
1p SRP OC-12

1p Multichannel T3/E3
1p Channelized T3
4p and 8p Multichannel T1/E1
2p PRI/Channelized T1/E1
1p Packet-Over-SONET
1p Channel (ESCON, Parallel)
8p T1/E1 ATM with IMA

L3 Services

Encryption
Compression
Encr + Comp

Voice

2 T1/E1 Voice
(2 versions)



Cisco 7200 Port Adapters

LAN

- One-port Fast Ethernet 100Base (TX, FX, VG)
- Two-port Fast Ethernet 100Base (TX, FX)
- Four- and eight-port Ethernet 10BaseT
- Five-port Ethernet 10BaseFL
- Fourteen-port (12E/2FE) EtherSwitch (Cisco 7200 only)
- One-port Gigabit Ethernet (SX, LX, LH) (Cisco 7200 only)
- Four-port Token Ring (HDX, FDX)
- One-port FDDI (HDX, FDX; SM, MM)
- One-port ATM (OC3; SM, MM)

Cisco 7200 Port Adapters

WAN

- Four- and eight-port serial
- Two-port serial (JT2) (Cisco 7500 only)
- One- and two-port HS serial (T3, E3)
- One- and two-port HSSI
- One-port Packet-Over-SONET
- One-port DPT (OC12) (Cisco 7200 only)
- Eight-port BRI (S/T) (Cisco 7200 only)
- Four-port BRI (U) (Cisco 7200 only)

Cisco 7200 Port Adapters

WAN (Cont.)

- Two-port channelized/PRI (T1, E1)
- One-port channelized (T3 + 4 DSX1 breakouts)
- Four- and eight-port multichannel (T1, E1, DSX1)
- One-port multichannel (T3, E3)

Cisco 7200 Port Adapters

WAN (Cont.)

- One-port ATM CES (OC-3, DS3) (Cisco 7200 only)
- One-port enhanced ATM (OC-3, DS3, E3; SM, MM)
- Eight-port ATM with IMA (T1, E1)
- One-port Channel (ESCON, parallel) (Cisco 7200 only)
- Two-port T1/E1 Digital Voice

Channelized vs. Multichannel

Model	DS1 Channels	DS0 Channels	PRI Support	Full DS0	Int'f Type
C T1/E1	No	Yes	Yes	Yes	DSX1
MC-T1/E1	Yes	Yes	Yes	No	T1/E1
CT3	Yes	No	No	No	T3
MC-T3/E3	Yes	Yes	Yes	No	T3/E3

Cisco 7200 Service Adapters

- **Compression (CSA)**
- **Encryption (ESA)**
- **Integrated (ISA)**

Cisco 7200 VXR and Port Adapters

- Following port adapters are **not** supported in Cisco 7200VXR (regardless of NPE/NSE model):
PA-F-xx, PA-F/FD-xx, PA-4R, PA-4R-FDX, PA-CT3/4T1, PA-2CT1/PRI, PA-2CE1/PRI, SA-COMP, PA-A1 (NSE-1 only)
- Following port adapters require specific minimum hardware revision levels when used in 7200VXR:
PA-4E, PA-8E, PA-5EFL, PA-H, PA-2H, PA-A3-xx, PA-8T-232, PA-8T-V35, PA-8T-X21 (Upgrade program available)
- For more details, see
www.cisco.com/warp/public/770/fn3028_02221999.html

Cisco 7200 PA Slot Numbering

Slot 5	Slot 6
Slot 3	Slot 4
Slot 1	Slot 2
Slot 0 (I/O FE)	

Cisco 7200 PA Classification

- **Low-BW PAs:**
All T1's, all E1's, PRI, BRI, CSA,
1-port parallel channel
- **Medium-BW PAs:**
All 10Base Ethernets,
Token Ring (HDX), ESA
- **High-BW PAs:**
Those not listed above

Cisco 7200 PA Configuration Guidelines

- **For NPE150, NPE200, NPE175,
and NPE225**
Three or fewer high BW PAs
Five or fewer high and medium BW PAs
- **For NPE100:**
Two or fewer high BW PAs
Four or fewer high and medium BW PAs

Cisco 7200 PA Configuration Guidelines

- I/O FE counted as one high BW PA
- All PAs counted regardless of configuration status
- Only one ATM CES PA supported per chassis (this is a double-wide PA and it uses PCI Bus 2)
- EtherSwitch PA is double-wide and automatically picks the less loaded (BW) PCI Bus at boot time

NPE300 and NSE-1 Port Adapter Configurations

- Use BW points (~aggregate interface BW) for each PA:

400:	PA-GE	90:	All single-DS3/E3 PA's (serial, MC, ATM)
300:	PA-xx-OC-3, PA-12E/2FE, PA-2FEISL, PA-SRP-OC-12	80:	PA-8E
200:	PA-FE, PA-2H	60:	PA-4R, CSA, ESA
180:	PA-2T3, PA-2E3	50:	PA-5E
120:	PA-4R-FDX/DTR	40:	PA-4E
100:	PA-1H, PA-1C-E4	0:	All low-BW PA's
- Each PCI bus can support **600** BW points
- Don't forget I/O FE on bus 1

Cisco 7200 Bus Balancing

- PA load should be balanced between two PCI buses to optimize performance
- Configure PAs as follows
 - Sort PAs in descending order of bandwidth
 - Fill in slot 2, slot 1, slot 4, slot 3, slot 6, slot 5
 - Adjust for better balancing as appropriate
- I/O FE uses Bus 1

Cisco 7200 NPE200/150 Configuration Examples

Serial	Serial
Ethernet	Ethernet
HSSI	ATM (OC-3)
Slot 0 (I/O FE)	

Cisco 7200 NPE200/150 Configuration Examples (Cont.)

Ethernet	Serial
FDDI	Serial
ATM CES	
Slot 0 (No I/O FE)	

Cisco 7200 NPE 300 Configuration Examples

8E	MC-8T
MC-T3	FE
2T3	A3-OC-3
I/O FE	

$$\text{Bus1} = 200 + 180 + 90 + 80 = 550$$

$$\text{Bus2} = 300 + 200 + 0 = 500$$

Cisco 7200 NPE300 Configuration Examples (Cont.)

FE	2H
POS	A3-OC-3
A2-T3	
No I/O FE	

$$\text{Bus1} = 300 + 200 = 500$$

$$\text{Bus2} = 90 + 300 + 200 = 590$$

Cisco 7200 NPE300 Configuration Examples (Cont.)

FE	T3
POS	FE
EtherSwitch	
No I/O FE	

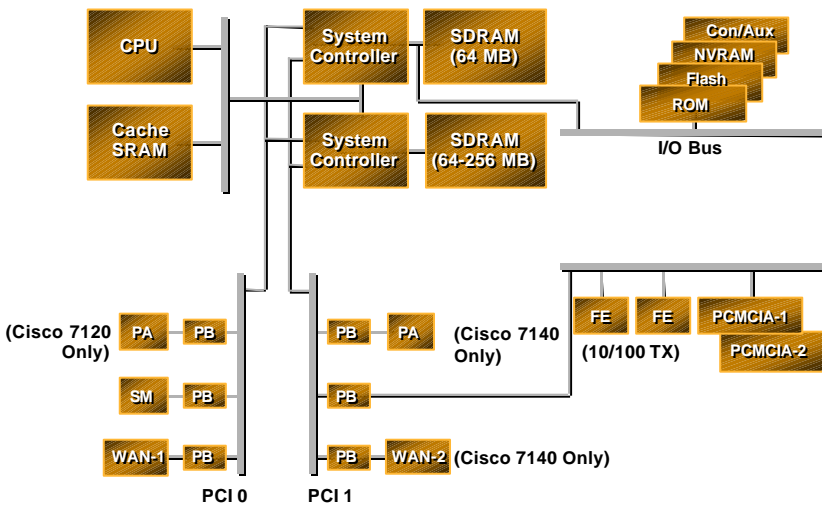
$$\text{Bus1} = 300 + 200 = 500$$

$$\text{Bus2} = 300 + 200 + 90 = 590$$

Cisco 7100



Cisco 7100 Internal Architecture



Cisco 7100 Factory Options

Model	Power Supply	Fixed WAN Interface Options	Fixed LAN	PA Slot	SM Slot
Cisco 7120	Single AC	1-Port ATM-OC-3 (SMI) 1-Port ATM T3 or E3 1-Port T3 or E3 4-Port Serial (T1/E1)	Dual 10/100 FE	1	1
Cisco 7140	Dual AC	2-Port ATM-OC-3 (MM) 2-Port ATM T3 or E3 2-Port T3 or E3 8-Port Serial (T1/E1) No WAN (2 FE only)	Dual 10/100 FE	1	1

PA slot supports one port adapter

SM slot supports one service module (ISM)

Cisco 7100 Memory

- SDRAM options: 64, 128, 192, 256 MB
- Flash SIMM: 8 MB
- Flash memory card: 8, 16, 20 MB
- Flash disk: 40, 110 MB
- Two PCMCIA slots
- Default SDRAM is 64 MB

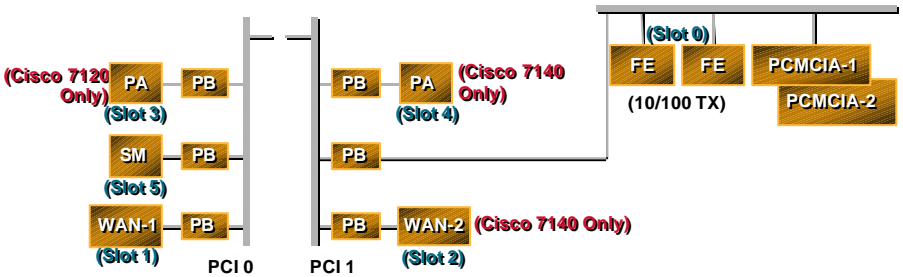
Cisco 7100 PA Support

- All Cisco 7200 VXR PA's **except:**
 - Channelized/Multichannel PA's
 - Packet-Over SONET and DPT PA's
 - IBM Channel PA
 - Dual-wide PA's (PA-A2 and PA-12E/2FE)
 - CSA, ESA, PA-100VG
- PA-GE and voice PA's will be supported

Cisco 7100 Software Feature Sets

- Enterprise
- IP
- Encryption options to above
(IPSec DES, 3DES)
- Firewall option to above

Cisco 7100 Bus Balancing



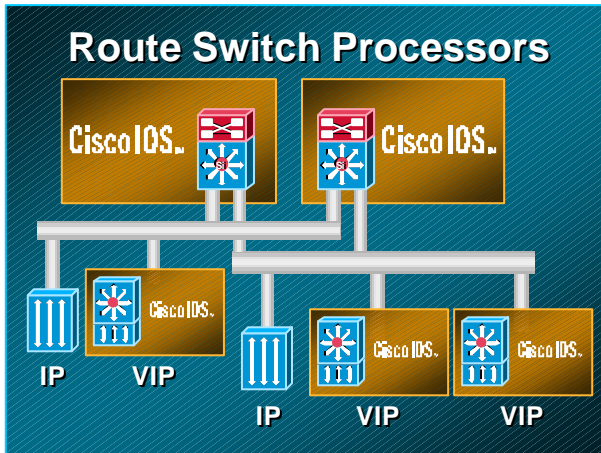
- In Cisco 7140, use WAN-1 as primary

Cisco 7500

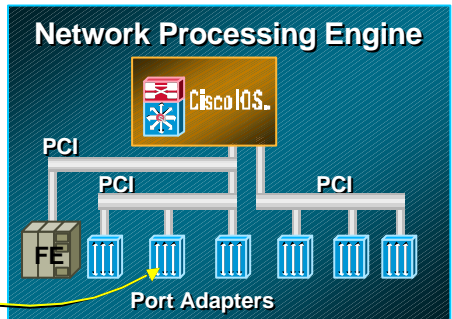
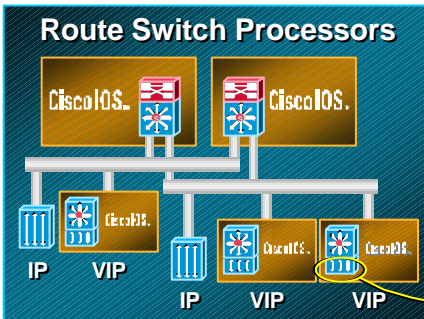
- Architecture
- Components and options
- Distributed switching
- System bus bandwidth
- VIP2 and port adapters



Cisco 7500 System Architecture



Common Port Adapters



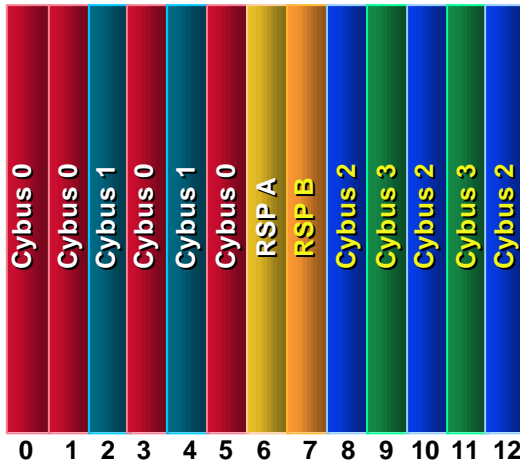
Cisco 7500 Components

- Chassis and power supply
- CPU
- Memory
- Software
- VIP2
- Port adapters
- Interface processors

Cisco 7500 Chassis

Model	RSP	CyBus	Power Supply	No. of xIP Slots
Cisco 7505	Single	Single	Single	4
Cisco 7507	Single/ Dual	Dual	Single/ Dual	5
Cisco 7513	Single/ Dual	Dual	Single/ Dual	11
Cisco 7576	Single(x2)	Dual (x2)	Single/ Dual	11

Cisco 7576 Chassis Slots



Cisco 7500 CPU

- **RSP1**—for Cisco 7505 only
- **RSP2**—for Cisco 7507 and 7513
- **RSP4**—for Cisco 7505, 7507, 7513, and 7576
- **RSP8**—for Cisco 7505, 7507, 7513, and 7576

Cisco 7500 Memory (Per RSP)

- **DRAM options: 32, 64, 128 MB, 256 MB (RSP4 and RSP8 only)**
- **Flash SIMM: 8 MB (16 MB for RSP8)**
- **Flash memory card: 8, 16, 20 MB**
- **Flash disk: 40, 110 MB**
- **Two PCMCIA slots**
- **Default DRAM is 32 MB (64 MB for RSP8)**

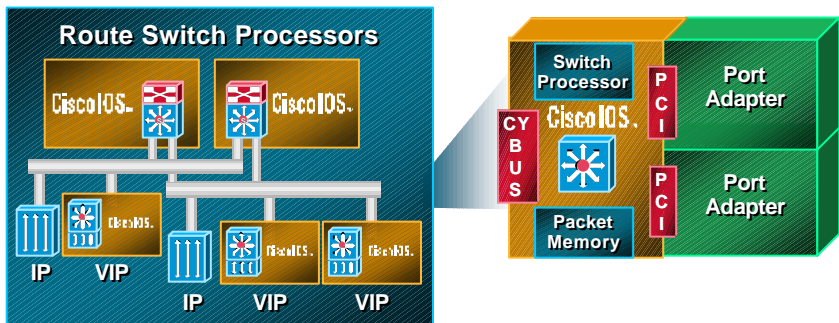
Cisco 7500 Software Feature Sets

- **Enterprise**
- **Enterprise with APPN**
- **Desktop and IBM**
- **IP routing**
- **Encryption options to above (IPSec DES, 3DES)**

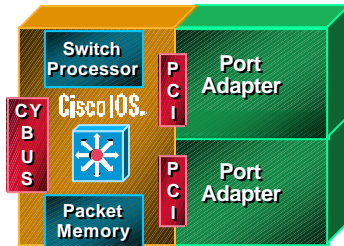
Cisco 7500 Software Feature Licenses

- **WAN Packet Protocols/NetFlow**
ATM, FR, SMDS, X.25, NetFlow
- **Interdomain Routing/Tag Switching**
BGP, EGP, Tag Switching

Cisco 7500 Versatile Interface Processor



VIP2 Options



Product	SRAM	DRAM	Dist Sw	Dist Svcs
VIP2-15	1 MB	8 MB	No	No
VIP2-40	2 MB	32 MB	Yes	Yes
VIP2-50	4/8 MB	32–128 MB	Yes	Yes
VIP4-50	64 MB	64–256 MB	Yes	Yes
VIP4-80	64 MB	64–256 MB	Yes	Yes

Distributed Services

Basic Switching

- Cisco Express Forwarding
- IP Fragmentation
- Fast EtherChannel

VPN

- Access Lists—Extended and Turbo
- Cisco Encryption
- GRE Tunnels
- IP Security
- L2TP Tunnels

QoS

- NBAR
- Traffic Shaping
- Policing (CAR)
- Congestion Avoidance
- Guaranteed Minimum Bandwidth
- Policy Propagation
- Policy Routing

Multiservice

- Low Latency Queuing
- FRF.11 and FRF.12
- RTP Header Compression

Accounting

- Output Accounting
- Flow Export
- Precedence and MAC Accounting

Load Balancing

- CEF Load Balancing
- Multilink PPP

Caching

- WCCP v1

Compression

- L2 SW and HW Compression

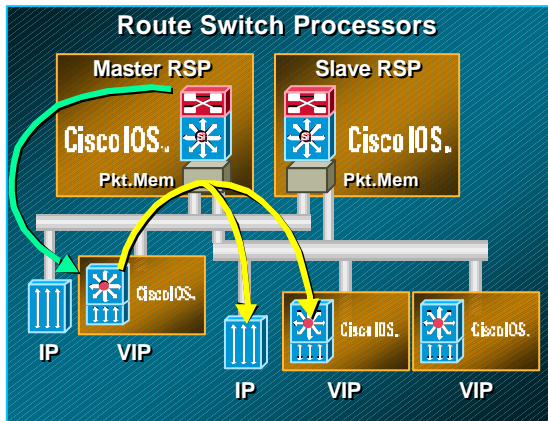
Cisco 7500 Port Adapters

- **Fast Ethernet, Ethernet**
- **FDDI, Token Ring**
- **POS, ATM**
- **Serial**
- **Channelized, multichannel**
- **PRI**
- **CSA, ESA, ISA**

Cisco 7500 Interface Processors

- **Early IPs:**
**EIP, TRIP, FIP, HIP, FSIP, AIP,
MIP, CIP2, FEIP**
- **New IPs (VIP2-based,
fixed-configuration):**
POSIP, CT3IP, FEIP2, GE

VIP2 Distributed Switching



Cisco 7500 System Bus Bandwidth

- **Cisco 7507, Cisco 7513, and “half-7576”**
 - Dual CyBus
 - 1066 Mbps each, total 2 Gbps
- **Cisco 7505**
 - Single CyBus at 1066 Mbps
- **RSP7000 (and Cisco 7000/7010)**
 - Single CxBus at 533 Mbps

Cisco 7500 IP/VIP Classification

- **Cy mode**

All VIPs and VIP-based IPs, CIP, FEIP

Use CyBus at 1066 Mbps

- **Cx mode**

All other IPs

Use CyBus at 533 Mbps

Cy Mode and Cx Mode on CyBus

Cx Mode



One bit per clock cycle, bus bandwidth is 533 Mbps

Cy Mode



Two bits per clock cycle, same basic clock rate as Cx, total bus bandwidth becomes 1066 Mbps (Two "Cy clock cycles" = One "Cx clock cycle")

Cy Mode and Cx Mode Bandwidth Consumption

- **CyBus bandwidth is 1066 Mbps in Cy mode**
- **Cx mode uses two “Cy clock cycles” per bit**
- **Cx card takes up twice as much CyBus capacity as Cy card**

Cisco 7500 Bus Bandwidth

- **Each VIP/IP requires bandwidth from the bus**
- **Aggregate bandwidth requirement should not exceed bus capacity**
 - Over-subscription**
 - Bus overhead**
 - Interface utilization**
- **Two CyBuses are independent**
- **Balance between the two buses**

Cisco 7500 Bus Bandwidth Calculation

$$\sum (IP_BW \times \%IP_Util) \leq Bus_BW \times \%Bus_Util$$

gives

$$\sum \frac{(IP_BW \times \%IP_Util)}{\%Bus_Util} \leq Bus_BW$$

- Define the fraction term as:
Interface Bus Bandwidth Factor (IBBF)
- Pre-calculate IBBF for each interface

Cisco 7500 IBBF Assumptions

- 75% utilization for all channelized interfaces (CT3, MC-T3/E3, CT1/E1, MC-T1/E1, MIP, CIP)
- 75% utilization for all ATM interfaces
- 100% utilization for all other interfaces
- 80% utilization on system buses
- These are very conservative assumptions

Cisco 7500 IBBF Examples

- **EIP6**

Total IP BW = 60 Mbps, %IP_Util = 100%

$$\text{IBBF-Cx} = (60 \times 100)/(80) = 75$$

Since EIP is Cx, IBBF-Cy = 150

- **CT3IP**

Total IP BW = 45 x 2 = 90 Mbps,

%IP_Util = 75%

$$\text{IBBF-Cx} = (90 \times 75)/(80) = 84$$

Since CT3IP is Cy, IBBF-Cy = 84

IBBF Table—Part 1

IP	Cx or Cy	IBBF-Cx	IBBF-Cy
EIP-2	Cx	25	50
EIP-4	Cx	50	100
EIP-6	Cx	75	150
TRIP-2	Cx	40	80
TRIP-4	Cx	80	160
FIP	Cx	125	250

IBBF Table—Part 2

IP	Cx or Cy	IBBF-Cx	IBBF-Cy
HIP	Cx	113	226
FSIP-4	Cx	20	40
FSIP-8	Cx	40	80
AIP-DS3	Cx	84	168
AIP-TAXI	Cx	188	376
AIP-OC3	Cx	291	582
MIP-1	Cx	4	8
MIP-2	Cx	8	16

IBBF Table—Part 3

IP	Cx or Cy	IBBF-Cx	IBBF-Cy
FEIP-1	Cy	250	250
FEIP-2	Cy	291	291
CIP-1	Cy	113	113
CIP-2	Cy	150	150

IBBF Table—Part 4

IP	Cx or Cy	IBBF-Cx	IBBF-Cy
POSIP	Cy	388	388
CT3IP	Cy	84	84
FEIP2	Cy	500	500
FEIP	Cy	500	500

IBBF Table—Part 5

PA	Cx or Cy	IBBF-Cx	IBBF-Cy
PA-FE (FDX)	Cy	250	250
PA-FE (HDX)	Cy	125	125
PA-100VG	Cy	125	125
PA-FDDI	Cy	125	125
PA-FDDI/FD	Cy	250	250
PA-ATM (OC3)	Cy	291	291
PA-ATM (DS3)	Cy	84	84
VIP2-Limit	Cy	500	500
VIP4-Limit	Cy	1000	1000

Note: VIP2 (VIP4) card bandwidth cap at 400 (800), which gives IBBF cap at 500 (1000)

IBBF Table—Part 6

PA	Cx or Cy	IBBF-Cx	IBBF-Cy
PA-8E	Cy	100	100
PA-4E	Cy	50	50
PA-5EFL	Cy	63	63
PA-4R	Cy	80	80
PA-4R/FD	Cy	160	160
VIP2-Limit	Cy	500	500
VIP4-Limit	Cy	1000	1000

Note: VIP2 (VIP4) card bandwidth cap at 400 (800), which gives IBBF cap at 500 (1000)

IBBF Table—Part 7

PA	Cx or Cy	IBBF-Cx	IBBF-Cy
PA-2H, 2T3	Cy	225	225
PA-H, T3	Cy	113	113
PA-2E3	Cy	170	170
PA-E3	Cy	85	85
PA-MC-T3	Cy	84	84
PA-MC-E3	Cy	64	64
PA-2JT2	Cy	32	32
VIP2-Limit	Cy	500	500
VIP4-Limit	Cy	1000	1000

Note: VIP2 (VIP4) card bandwidth cap at 400 (800), which gives IBBF cap at 500 (1000)

IBBF Table—Part 8

PA	Cx or Cy	IBBF-Cx	IBBF-Cy
PA-8T	Cy	40	40
PA-4T	Cy	20	20
PA-MC-8T1	Cy	23	23
PA-MC-4T1	Cy	12	12
PA-MC-8DSX1	Cy	23	23
PA-MC-8E1	Cy	30	30
PA-2CT1	Cy	6	6
PA-2CE1	Cy	8	8
CSA	Cy	IBBF x 2	IBBF x 2
VIP2-Limit	Cy	500	500
VIP4-Limit	Cy	1000	1000

Note: VIP2 (VIP4) card bandwidth cap at 400 (800), which gives IBBF cap at 500 (1000)

How to Use IBBF

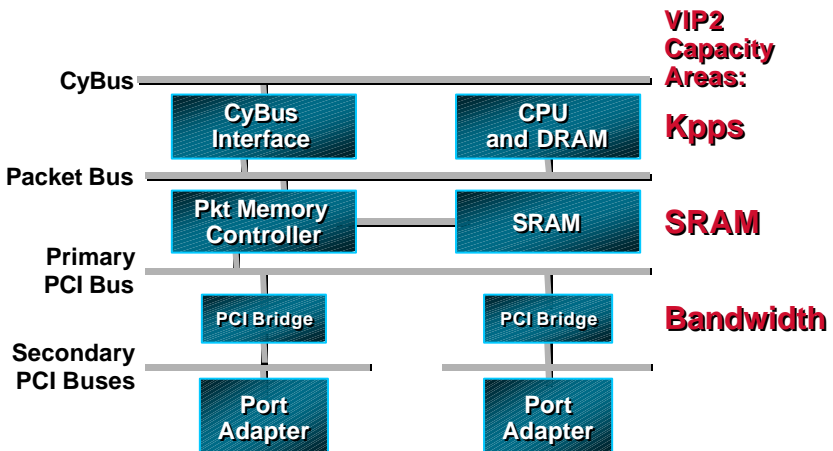
- Use IBBF-Cy values for CyBus systems (75xx), and IBBF-Cx values for CxBus systems (RSP 7000 and 70x0)
- To verify a given configuration, sum up corresponding IBBFs for each bus, and check that it is within limit (1066 for CyBus and 533 for CxBus) plus over-subscription allowance
- Balance between two buses where appropriate

Cisco 7500 IBBF and Bus Over-Subscription

- Conservative assumptions (i.e., worst-case scenarios) are used as a start
- Real-world networks are not 100% utilized (queuing delay)
- Bi-directional links are usually asymmetrically loaded
- Some links may be used as backup only
- Full-duplex/half-duplex
- Over-subscription is possible

But no fixed rules

Cisco 7500 VIP2 Block Diagram



VIP2 Configuration

SRAM Capacity Consideration

- **Particles and descriptors allocated out of SRAM for each PA**
- **Number of particles varies with PA**
- **Particle size depends on PA-pair and VIP2 model (amount of SRAM)**
- **Does not affect VIP2-40 and above**

VIP2 Configuration

PCI Bandwidth Consideration

- **Electrical bandwidth is 800 Mbps, but data throughput is about 400 Mbps**
- **Overhead due to bus arbitration and non-data traffic, varies by PA**
- **Effective data throughput on PCI bus determines PA-pairing support**

VIP2 Configuration

Switching Capacity Consideration

- **VIP2-40 (VIP2-50) distributed switching at 65 Kpps (100 Kpps)**
- **VIP2 forwarding to RSP at 135 Kpps**
- **Forwarding puts load on RSP**
- **Estimate Kpps load from each PA**

VIP2 Configuration

Current Guidelines

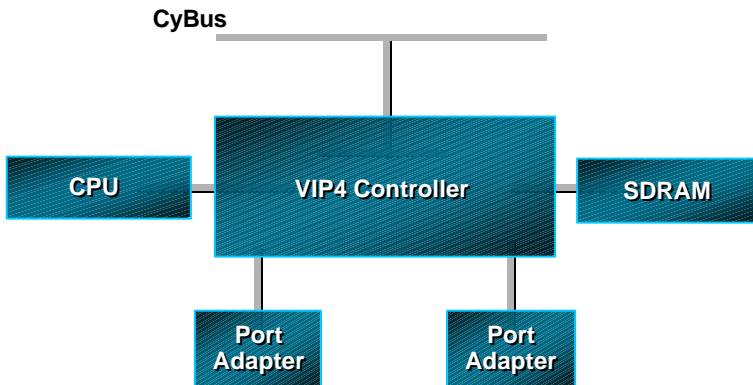
- **ATM OC-3 PA requires a dedicated VIP2 (except PA-A3-OC-3 on VIP2-50)**
- **PA-A3, PA-MC-T3/E3/T1/E1, PA-2JT2, CSA, and ESA require VIP2-40 or above**
- **4R paired with 8T require VIP2-40 or VIP2-50**

VIP2 Configuration

Current Guidelines (Cont.)

- **VIP2-50 supports all existing PAs except 100VG and TR**
- **Balance PA's across VIP's to optimize VIP resource utilization on router**

Cisco 7500 VIP4 Block Diagram



VIP4 Configuration

- **Distributed switching capacity:**
 - 150 to 210 Kpps for VIP4-80
 - 100 to 135 Kpps for VIP4-50
- **Aggregate bandwidth capacity 750+ Mbps**
- **VIP4 does not support PA-A1, PA-2JT2, PA-4E1G, PA-4R, CSA, and ESA**
- **Supports VIP4 and VIP2 on same chassis**



Software Configuration

Software Configurations

- **Basic configuration tasks**
- **Boot sequence**
- **Switching modes**
- **Performance parameters**
- **Packet buffers and queues**
- **Interfaces and IDBs**

Basic Configuration Tasks

- **Enable routed protocols**
- **Configure interface addresses and parameters**
- **Select switching mode(s)**
- **Activate routing protocol(s)**
- **Add packet services**
- **Set up network management, etc.**

Boot Sequence

- **ROM monitor**
 - Wakes up the CPU
 - Finds and loads “boot loader”
- **Boot loader**
 - Brings up all hardware components
 - Finds and loads or net boots system image
 - No routing
- **System image**

Basic Boot Configurations

```
boot bootldr bootflash:rsp-boot-mz.121-2  
boot system flash slot0:rsp-pv-mz.121-2
```

- **Boot loader image should be current with respect to hardware components**
- **Good practice: use the same release of boot loader image as system image**

Cisco 7200 Switching Modes

- **Process switching**

 - Packets copied to system memory

 - Handled at process level

- **All other switching**

 - Packets switched in fast packet memory

 - Handled at interrupt level

Cisco 7200 Switching Modes

- **Process switching—Process level**

- **Fast switching—Uses fast switching cache**

- **Optimum switching—Improved search algorithm and data caching**

- **NetFlow switching—NetFlow cache identifies data flows and maintains flow statistics**

Cisco 7200 Switching Modes

- **Cisco Express Forwarding (CEF)**—Forwarding information based on routing table instead of route cache built from demand
- **Tag Switching**—Based on tags and Tag Distribution Protocol
- **Not all switching modes are available in all releases**

Cisco 7500 Switching Modes

- **RSP-based switching**—Process, fast, optimum, NetFlow, CEF, Tag
- **VIP distributed switching**—Optimum, NetFlow, CEF, Tag
- **Not all switching modes are available in all releases**

Switching Configuration Commands—Fast/Opt/Flow

- **ip route-cache**
- **ip route-cache *[optimum | flow]***
- **ip route-cache distributed**
- **These are interface config commands**

Switching Configuration Commands—CEF

- **CEF switching is configured with global configuration commands**
 - ip cef switching**
 - ip cef distributed switching
(Cisco 7500 only)**
- **CEF global command will enable CEF on all supported interfaces**

Switching Configuration Commands—Tag

- **Tag Switching requires CEF**
- **Tag Switching global configuration command**
`tag-switching advertise-tags`
- **Tag Switching interface configuration command**
`tag-switching ip`

Which Switching Mode Is in Effect?

- **Inbound packets entering the **same** interface can be switched by **different** modes**
- **Switching mode of a packet is determined by switching config at both its input and its output interface**

Switching Configuration Matrix

Input Interface	Output Interface	Sw Mode
ip route-cache cef	- any -	cef
- any except CEF -	no ip route-cache	process
no ip route-cache	ip route-cache	fast
no ip route-cache	ip route-cache opt/flow/cef	fast
ip route-cache	ip route-cache	fast
ip route-cache	ip route-cache opt/flow/cef	fast
ip route-cache opt/flow	ip route-cache	opt/flow
ip route-cache opt/flow	ip route-cache opt/flow/cef	opt/flow

Understanding Kpps

- Measure of switching rate or capacity
- Smallest packets are used in testing, typically 64 bytes, to avoid saturating bandwidth before hitting switching capacity limit
- Lab traffic is deterministic
- Real world traffic is random and not all 64 bytes

How Important Is “Line Rate”?

Traffic Mix			Line Rate for a Given Bandwidth
64-Byte Packets	256-Byte Packets	1518-Byte Packets	
100%	0%	0%	X Kpps
90%	10%	0%	77% of X Kpps
60%	30%	10%	24% of X Kpps

Delay and Latency

- **End-to-end network delay components**

Propagation Delay: approx. 1000 usec per 100 miles

Example coast-to-coast: ~30,000 usec or 30 msec

Insertion Delay (a.k.a. Serialization Delay)

Example with 250-byte packet: 1000 usec on 2-Mbps link
200 usec on 10-Mbps link
20 usec on 100-Mbps link

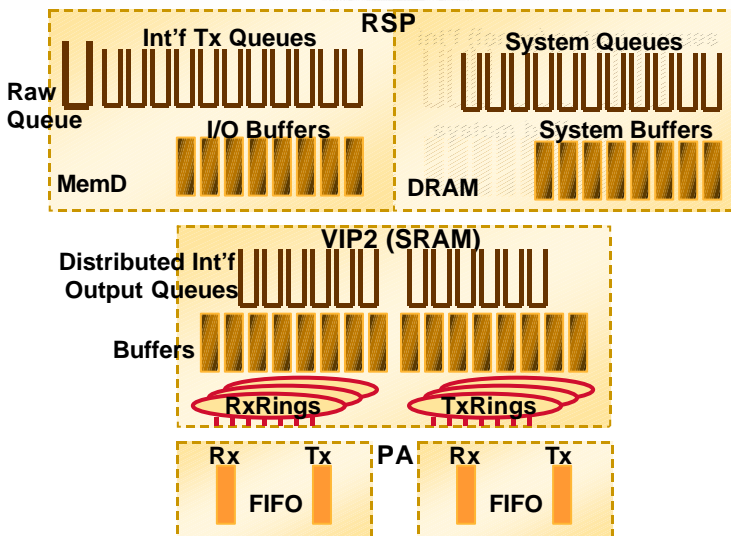
Queuing Delay = queue depth x insertion delay

Router Latency: less than 100 usec for Cisco 7500
(64-byte packets over FDDIs, varies with packet sizes)

Packet Buffers and Queues

- A packet buffer is a group of memory cells where a packet is stored
- A queue is a data structure to keep track of the ordering of packets stored in memory
- A queue is typically implemented as a linked list of pointers pointing to the packet buffers
- Queue manipulations are just linked list operations, the packet stays in the same buffer
- Copying of packets is needed only when moving between different memory areas (e.g. from VIP2 SRAM to RSP MemD)

Packet Buffers in Cisco 7500



Interfaces and IDB

- **Interface descriptor block (IDB)**
 - Software data structure
 - Stores configuration and status of all interfaces
- **Software IDB**
- **Hardware IDB**

IDB Allocation

- **Non-channelized cards**
 - One hardware IDB and one software IDB per physical port
- **Channelized cards**
 - One hardware IDB and one software IDB per channel
- **Subinterfaces**
 - One software IDB per subinterface
- **Example: FR interface with 10 subinterfaces ⇒ 11 IDBs**

Interface Scalability in Cisco 7xxx

- **Aggregation scalability has been significantly enhanced in 12.0:**
 - 750+ interfaces
 - 1200+ subinterfaces (FR)
- **300 software IDBs per chassis supported in 11.1 and 11.2**
- **All physical interfaces take up IDBs, regardless of configuration and status**

Subinterfaces and IDB


- **Subinterfaces take up IDBs**
- **Subinterfaces add routing overhead**
- **For ATM and FR:**
 - An interface or subinterface can terminate multiple PVCs**
 - Usually there is **no** need to configure a subinterface for **each** PVC**
 - A PVC does not necessarily use up an IDB**

Summary— Hardware Configuration

- **Cisco 7100**
“Fixed” configuration and PA support
- **Cisco 7200**
Number of high-BW and medium-BW PAs
PCI bus loading and balancing
- **Cisco 7500**
System bus loading
CyBus balancing in dual-bus systems
PA configuration (pairing) on VIP2 cards

Summary— Software Configuration

- **Commands and features specific to Cisco 7xxx platform operations**
- **Understanding performance**
- **Networkers sessions available on topics such as EIGRP, OSPF, BGP, security, VPN, QoS, and others**
- **Network design clinics**



Cisco 7000 Family Hardware Configuration and Performance Optimization

Session 2805



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