




IP + Optical Big Bang Seminar
2001



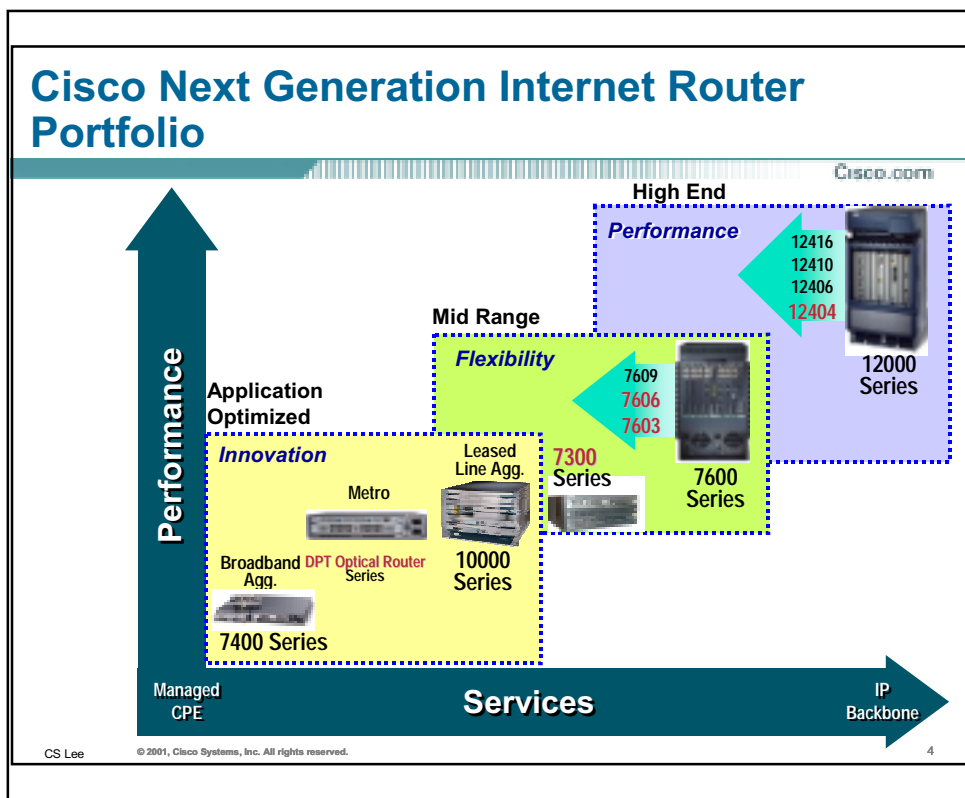


Next Generation Internet Routing Product *Update*

Chang Soo LEE(cslee@cisco.com)
Systems Engineer,
NSP

November 2001

Course Number
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The slide features a blue header with a blurred image of a Cisco 12000 Series router. The title "Cisco 12000 Series 10G Product Overview" is centered in a large, bold, black font. The Cisco logo and "Cisco.com" are in the top right. Footer text includes "Course Number Presentation_ID", "© 2001, Cisco Systems, Inc. All rights reserved.", and the page number "5".

Cisco 12000 Series 10G Product Overview

Course Number
Presentation_ID

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The slide has a blue header with the word "Agenda" in a large, bold, blue font. Below the header is a horizontal bar with a blue-to-white gradient. The Cisco logo and "Cisco.com" are in the top right. The agenda items are listed in a dark blue box with white text. The footer includes "CS Lee", "© 2001, Cisco Systems, Inc. All rights reserved.", and the page number "6".

Agenda

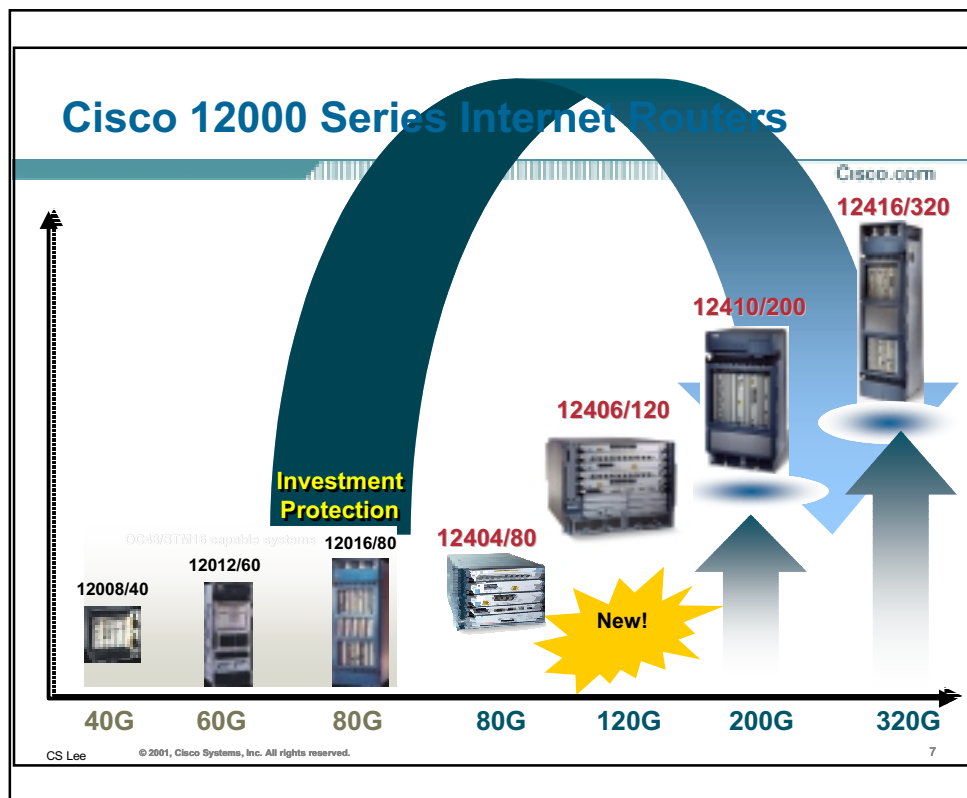
Cisco.com

- **10 Gbps Chassis Overview**
 - Cisco 12416/12410/12406/12404 Internet Routers
- **10 Gbps Backbone Line Cards**
 - 1-port OC-192c/STM-64c POS
 - 4-port OC-48c/STM-16c POS
 - 10-port GE / 1port GE

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Cisco 12400 Family Internet Routers

The Premier Router for 10G Networking

Cisco.com

- Highest Scalability**
 - Two times the capacity, three times as many 10G platforms
 - Only distributed system architecture
- Highest Performance**
 - Line rate performance for IP forwarding and MPLS switching in a fully loaded system
 - 375Mpps forwarding capacity delivers 25% greater performance per slot than competitive solutions
- Guaranteed Priority Packet Delivery**
 - Only system with WRED, LLQ and absolute packet-sequence integrity – all needed for packet-telephony
- Best Investment Protection**
 - All line cards are forward-compatible
 - Cisco 12000 field upgrades
 - 10G and beyond ...

Cisco 12400 Family

10 Gbps Line Cards:

- 1 port OC-192c/STM-64c
- 4 port OC-48c/STM-16c
- 10 port GigE

12404 12406 12410 12416

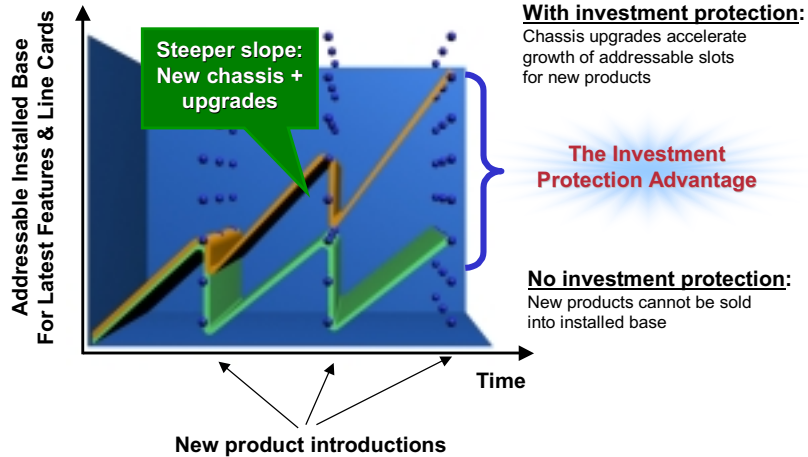
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Cisco's Investment Protection Advantage

Cisco.com

Over 17,000 Cisco 12000 units shipped to date!



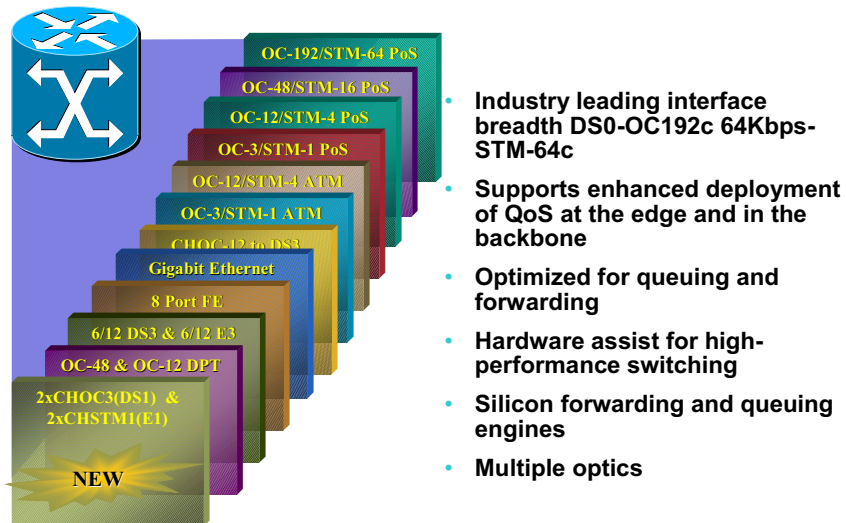
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Cisco 12000 Series Interface Overview

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12416 Internet Router

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- **Largest Capacity 12000 Router**
 - Full-rack system (19" wide)
 - 320 Gbps switch fabric capacity
 - 16-slot chassis, 20 Gbps per slot
 - 1 slot required for Route Processor
- **Line Card Support**
 - 1-port OC-192c/STM-64c POS(E4)
 - 4-port OC-48c/STM-16c POS(E4)
 - 10-port GE (E4)
 - **All existing 12000 Series line cards(E0/E1/E2)**
- **Distributed Architecture**
- **Power Options: 3AC, 4DC**



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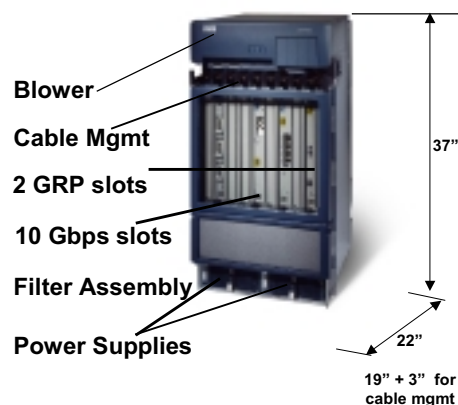
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12410 Internet Router

Cisco.com

- **10 Gbps Capable 12000 Router**
 - Half-rack system (19" wide)
 - 200 Gbps switch fabric capacity
 - 10-slot chassis, 20 Gbps per slot
 - 2 narrow slots for Route Processors
- **Line Card Support**
 - 1-port OC-192c/STM-64c POS
 - 4-port OC-48c/STM-16c POS
 - 10-port GE (E4)
 - **All existing 12000 Series line cards**
- **Distributed Architecture**
- **Power Options: AC, DC**



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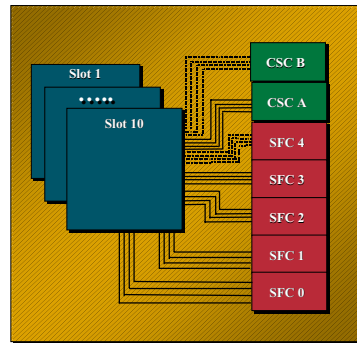
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12410 Switch Fabric

Cisco.com

12410 Switch Fabric

- Fabric Cards Include
 - 2 **Dedicated** Clock/Schedulers
 - 5 **Dedicated** Switch Fabric Cards
- Increased Reliability
 - 1+1 for Clock/Scheduler Cards
 - 4+1 for Switch Fabric Cards



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Cisco 12406 Internet Router

The Only 1/4-rack 10G Router in the Industry

Cisco.com

Small footprint and low cost

- Extends carrier class design and the power of 10G to applications such as the Internet data center and small PoPs

Unique form factor

- Gives Cisco the highest 10G rack-density in the industry
- Delivers 6 times the performance of competing solutions in the same space

Provides the throughput necessary for the next generation of IP services anywhere in an IP network



Cisco 12406

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Expanding 10G Routing Solutions with the Cisco 12404 Internet Router

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The Cisco 12404 is the smallest footprint 10G router in the industry

- The most efficient 10G router in the industry – including rack and power consumption
- Compatible with all Cisco 12000 Series line cards
- Highest switch fabric capacity of 80 Gbps in a 5 RU system
- Up to 8 systems per rack



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Agenda

Cisco.com

- **10 Gbps Chassis Overview**
 - Cisco 12416/12410/12406/12404 Internet Routers
- **10 Gbps Backbone Line Cards**
 - 1-port OC-192c/STM-64c POS
 - 4-port OC-48c/STM-16c POS
 - 10-port GE /1port 10GE

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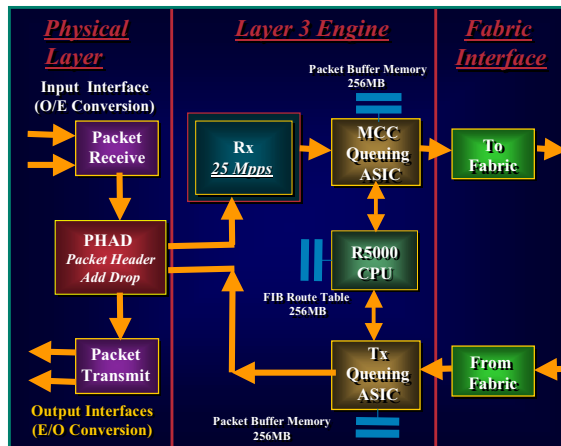
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Engine 4 Architecture

Cisco.com

- **Physical Layer**
 - O/E Conversion
 - Clock Data Recovery
 - SONET/SDH Framing
- **Layer 3 Engine**
 - Forwarding in hardware
 - Queuing in hardware
 - CPU for exceptions
- **Fabric Interface**
- **Memory Options**
 - 256MB CPU (default)
 - 512MB Packet (default)



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1-Port OC-192c/STM-64c POS Line Card

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- **1-Port OC-192c/STM-64c**
 - 10 Gbps concatenated interface
 - Packet-over-SONET/SDH
 - Single chassis slot per line card
- **Layer 3 Forwarding**
 - Dedicated **25 Mpps ASIC**
 - Line rate IP+MPLS forwarding at 40 byte packets
- **Optics Available**
 - 1310 nm Short Reach (<2km)
 - 1550 nm Intermediate Reach (<40km)



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Very Short Reach Optics

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- Created by Cisco to reduce OC-192c/STM-64c costs
- Standardized by Optical Internetworking Forum (OIF)
- Technology
 - Designed for 300m intra-POP transmission
 - 12-parallel VCSEL lasers in ribbon fiber
 - Examples: Router-to-Router, Router-to-DWDM
- Status
 - Technology proven: DWDM interoperability demonstrated
 - On Roadmap for 12000 Series Routers (OC-192c/STM-64c POS only)

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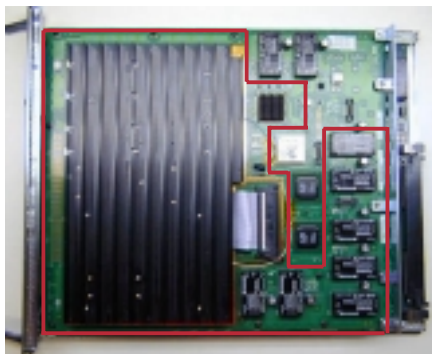
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VSR Optics Footprint

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OC-192c/STM-64c POS SR/IR



OC-192c/STM-64c POS VSR



 OC-192c/STM-64c POS Optics Circuitry

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4-Port OC-48c/STM-16c POS Line Card

Cisco.com

- **4-Port OC-48c/STM-16c**
 - 2.5 Gbps concatenated interfaces
 - Packet-over-SONET/SDH
 - Single chassis slot per line card
- **Layer 3 Forwarding**
 - Dedicated 25 Mpps ASIC
 - Line rate IP+MPLS forwarding at 40 byte packets
- **Optics Available**
 - 1310 nm Short Reach (<2km)
 - 1550 nm Long Reach (<80km)



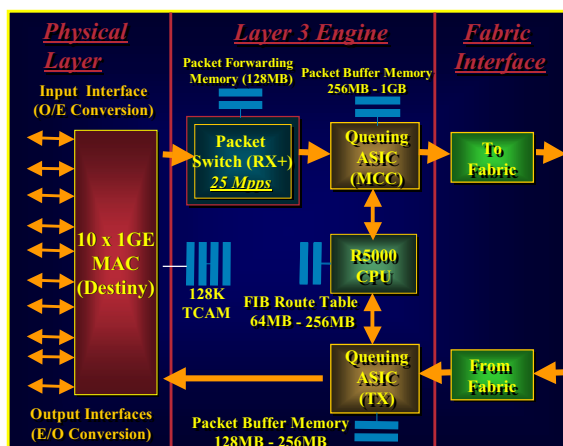
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Architecture of 10G Capable Linecards 10 x 1GigE

Cisco.com



Physical Layer

- Optics, 1 GE MAC
- & Packet Extraction

Layer 3 Switching Engine

- E4 - 25Mpps ASIC Based
- Forwarding
- CPU - Processor Based
- Forwarding
- (ICMP, IP Options
- & Non IPv4
- Packets)

Fabric Interface

- Tx/Rx From
- Other LCs

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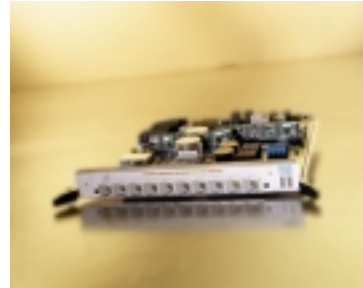
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10x1GE Line Card

Cisco.com

- 10X1 GE card
 - Utilizes a single slot in any of the 12400 Series Router
- Layer 3 Forwarding
 - Line rate IP+MPLS forwarding at 64 byte packets
- Optics Available
 - 850 nm SX (<550m)
 - 1310 nm LH (<10km)



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10x1GE Line Card Features (E4 Based)

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- 10-port GE line card with modular SFPs
- Optics: SX (850nm/550m), LH (1310nm/10km)
- Hardware consists of RX+, TX, Destiny ASICs
- Features Supported Include:
 - Line rate IP forwarding for 64 byte Ethernet frames
 - MPLS switching/TE: 'P' functionality
 - Src/Dst MAC accounting
 - ARP/RARP
 - HSRP/VRRP
 - IP load balancing: 8 paths
 - Auto Negotiation
 - Input (x)ACLs (Destiny) on per VLAN basis (800-1,500 rules per port)
 - QoS: MDRR/WRED/output DTS/MPLS<->IP TOS mapping
 - 802.1q VLAN trunking (1,500 VLANs per system)
 - Per VLAN packet accounting
 - Jumbo Frames: 9,000 bytes

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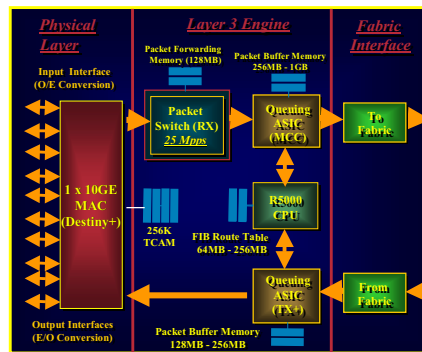
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1 x 10GE Features

Cisco.com

- **FCS Features based on TX+**
- **CAR w/ ICMP Rate Limiting (prevents DOS attacks)**
- **BGP Policy Accounting**
- **IP ToS to MPLS CoS**
- **802.1p to IP ToS Mapping**



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1x10GE Line Card Features (E4, TX+ Based)

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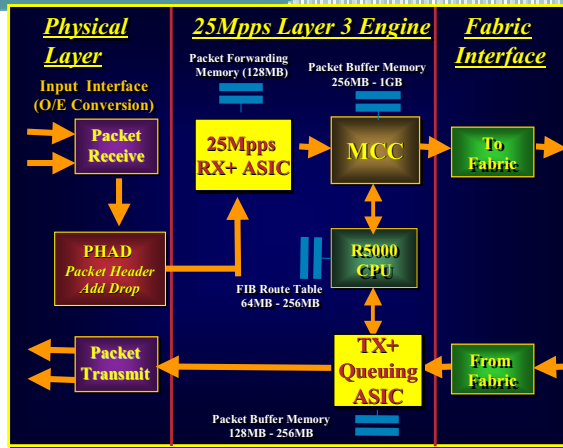
- **Optics: LR (1310nm, 10km)**
- **Hardware consists of RX, TX+, Destiny ASICs**
TX+ ASIC included to support output (x)ACLs
- **Features Supported Include:**
 - Line rate IP forwarding for 64 byte Ethernet frames
 - MPLS switching/TE: 'P' functionality
 - Src/Dst MAC accounting
 - ARP/RARP
 - HSRP/VRRP
 - IP load balancing: 8 paths
 - High Availability: RPR+, NSF
 - Input (x)ACLs (Destiny) on per VLAN basis (8,000-15,000 rules)
 - Output (x)ACL (TX+) on per port basis (1,024 rules)
 - QoS: MDRR/WRED/output DTS/MPLS<->IP TOS mapping
 - 802.1q VLAN trunking (1,500 VLANs per system)
 - Per VLAN packet accounting
 - Jumbo Frames: 9,000 bytes

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10G Line card Release II Architecture (Based on RX+ & TX+)



**Enhancements
to RX & TX**

- Additions to Rx Packet Switching ASIC: RX+
- Additions to Tx Queuing ASIC: TX+
- Release II of QOC48c/STM-16, OC192c/STM-64 and GE/FE Combo Linecards

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GE/FE Combination Card (E4+ Based)

- **Modular GE/FE Solution Consisting of:**
 - Fixed 1GE port, plus...
 - Up to 3 modules of 3-port 1GE or 24-port FE
- **Optics: GE (SX/550m, LH/10km) and FE (TX/100m)**
- **Hardware consists of RX+, TX+, Destiny+ ASICs**
- **Additional Features (Beyond E4) Include:**
 - IP load balancing: 16 paths
 - MPLS load balancing
 - MPLS VPN PE
 - VLAN to MPLS VPN mapping
 - Ethernet over MPLS (both imposition & disposition)
 - QoS: Map 802.1q 'P' bits to IP TOS
 - Policy-Based Routing
 - BGP Policy Accounting
 - CAR w/ ACLs (per VLAN support)
 - GE Channel
 - Sampled Netflow
 - Packet or byte accounting
 - High Availability: RPR+, NSF

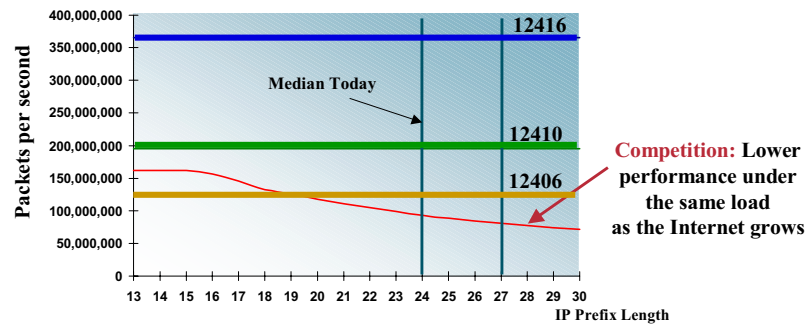
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Highest Performance Consistent 10Gbps Throughput

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Performance Scalability

- Linear performance increase as cards are added
 - competitors cannot sustain performance due to centralized forwarding architecture
- Consistent performance across longer prefix lengths
 - competitive systems prefix lookup is optimized for memory space, not performance

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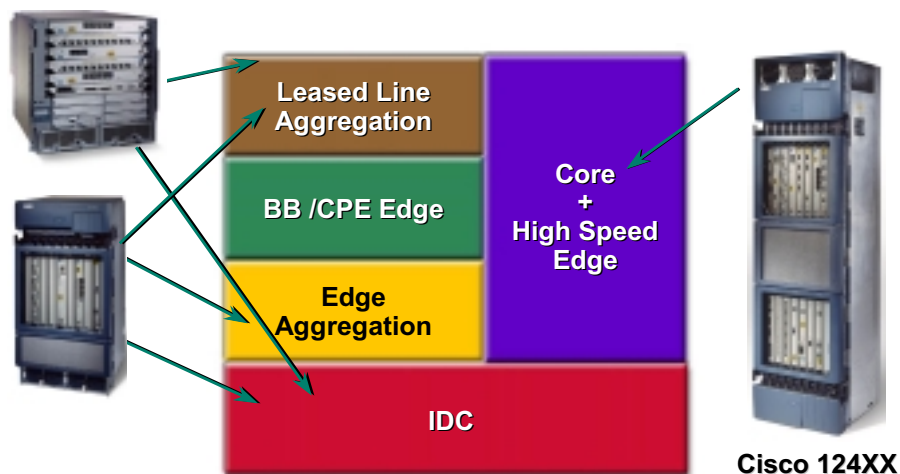
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Cisco 12000 Series Scaling to New Dimensions

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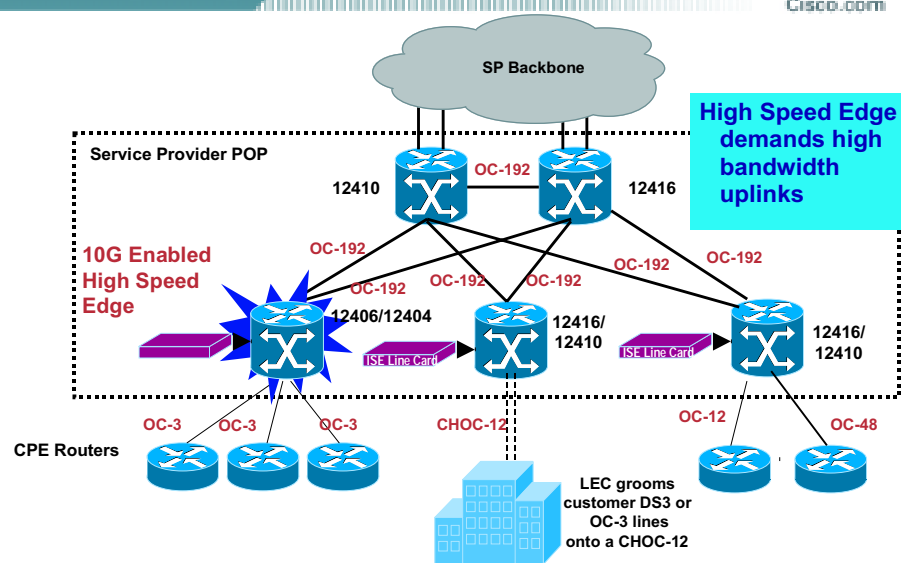
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Introducing the New 12000 Series ISE Technology

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IP Services Engine (ISE) 10G Enabling the High Speed Provider Edge



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IP Services Engine (ISE) Operational Efficiency at the High Speed Provider Edge

Before

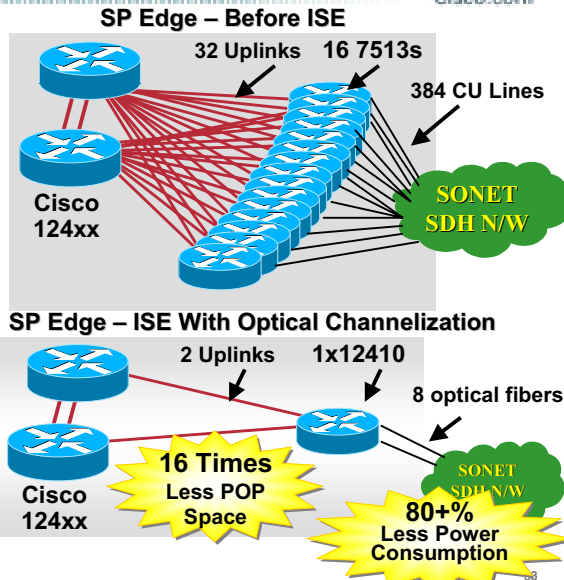
- 16 Cisco 7513s (8 Racks)
- 384 Cu DS3 terminations
- 25,000 Watts
- 80 Square Feet of Rack Foot Print

After

- 1x12410 (Half Rack)
- 8 x 1portCHOC48(DS3) – 8 Fibers to DACS/ADM
- ~ 2700 Watts
- 5 Square Feet of Rack Foot Print

Benefits ...

- Saves over 75 sq ft of rack space
- Saves over 22,000 Watts
- Redundancy with APS
- Flexible channelization
- Dynamic provisioning



ISE Roadmap

• Release 1 - FCS Sept 17

- 12.0(19)S
- OC12/STM4 & OC3/STM1
- CAR, ACL, Sampled Netflow
- Focus on customer testing
 - Limited quantities
 - EOS @ release 2

• Release 2 - FCS Nov5

- 12.0(20)S, 12.0(20)ST
- Add OC48/STM12
- S/W: MPLS, MPLS VPN
- H/W: DS3 subrate (Kentrox), agg. netflow, dynamic provisioning
- Volume deployment
- Free upgrade from rel 1

• Release 3 - FCS January 2002

- 12.0(21)S, 12.0(21)ST
- Multicast (fast path), unicast RPF, BGP policy accounting, CSC, FRR guaranteed & auto bandwidth TE, PBR for IP, Interprovider VPN, etc
- Software upgrade to release 2

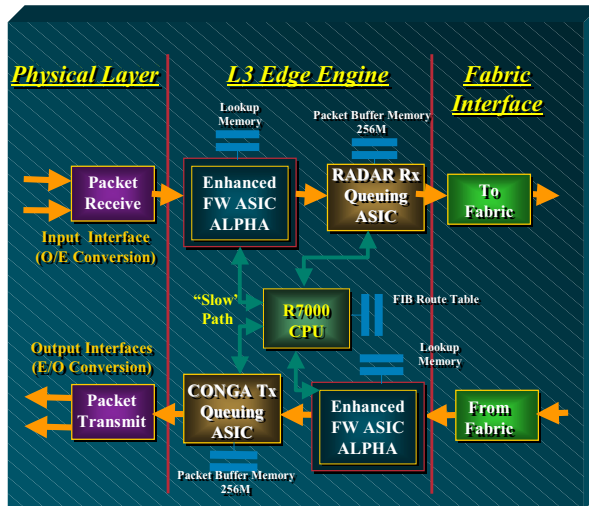
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ISE Line Card Architecture

Cisco.com



Physical Layer

- Optics, Framing & Packet Extraction
- **Layer 2 Encapsulations**
 - HDLC, PPP, POS, FR, etc
- **Layer 3 Switching Engine**
 - **Ingress** - Forwarding, Policing, Classifier, Accounting, etc.
 - **Egress** - Forwarding, Policing, Classifier, Accounting, etc.
 - CPU - R7K
- **Fabric Interface**
 - Tx/Rx To/ From Other LCs/GRP

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Major ISE Features Summary

Cisco.com

- "2 x 7513 on a GSR blade"
- Major "edge" features @ line rate
- Micro-programmable – service implementation network processor
- **Ipv4 @ 4MPPS**
- High speed – "fast path" ipv6 (post-FCS)
- **Line-rate tens of thousands of extended access lists (xACL)**
- **Line-rate committed access rate (CAR) up to 3 continues**

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Major ISE Features Summary (continued)

Cisco.com

- **QoS support**
 - TOS/Diffserv/exp QoS processing
 - Priority queues (ingress & egress) for high priority traffic
 - Weighted random early detection (WRED)
 - Modified deficit round robin (MDRR)
- **Traffic shaping – egress & ingress**
- **Billing / stats**
 - Policy based accounting
 - V5 sampled Netflow
 - V8 aggregated Netflow support

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Other Features

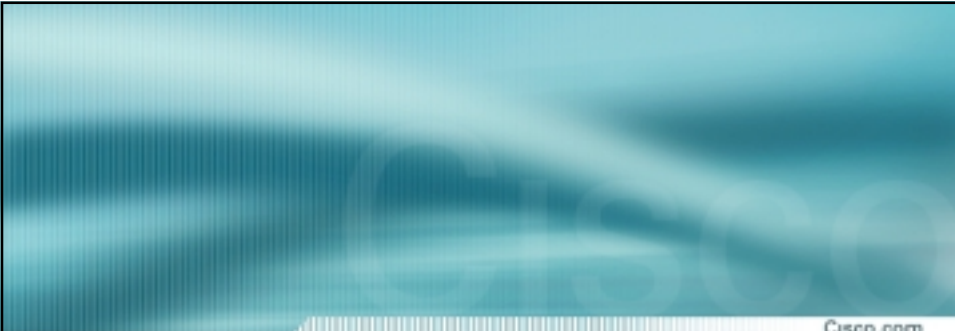
Cisco.com

- **PBR**
- **uRPF**
- **Per sub-interface features (i.e. per DLCI)**
- **MQC support**
- **L2VPN using either**
 - ATOM
 - Tunneling solutions
- **MPLS FRR**
- **MPLS Auto-bandwidth**
- **Multicast**
- **Support for various MIBs (SONET/SDH, MIB-II, CAR, MQC, etc.)**

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ISE Based Cards

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12K Series Edge Cards Offerings

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- **Concatenated Interfaces**
(16xOC3c/STM1, 4xOC12c/STM4c,
1xOC48c/STM16c)
- **Channelized Interfaces** (16xOC3/STM1,
4xOC12/STM4, 1xOC48/STM16)
- **CLI Configurable Framing** (SONET, SDH)

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12000 HA Update

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HA Evolution – Now

Cisco.com

- **RPR : Route Processor Redundancy a.k.a EHSA**
 - Startup config synced to standby
 - Resets line cards on switch over
 - Reloads LC images from RP after switch over
- **RPR+ (Phase 1):**
 - Startup and running configs synced to standby
 - Does not reset line cards on switch over
 - Interfaces are kept up during switch over
 - Forwarding disrupted
 - Support for E0/E2 POS, DS3 in 12.0(17)ST. Other line cards to be supported in subsequent releases

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RPR+ Performance

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Version	Switch Over	Traffic Recovery	LC Recovery
16.5ST1 RPR+	<5s	8s	n/a
16.5ST1 RPR	<5s	85-140s	
9S RPR	<5s	140s	75s

Switchover Time - Time required by the standby to become the active
 Traffic Recovery - Time required for complete traffic recovery. That is 100% of the traffic which was flowing before switchover flows after switchover
 Line Card Recovery - Time required for the interfaces on all line cards to come up

Test Condition - Traffic was sent at 90% of OC-48 line from an ingress port on a 1XOC-48 to an egress port on a 1X OC-48 on slot 7

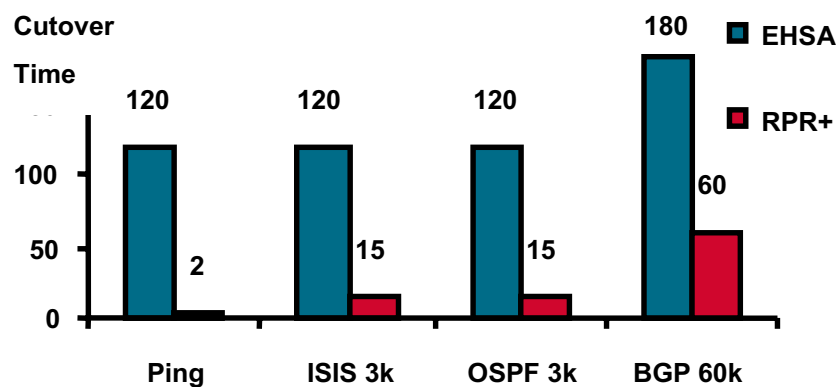
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HA Phase 1 (RPR+) Lab Results

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GSR 12400 Series Summary

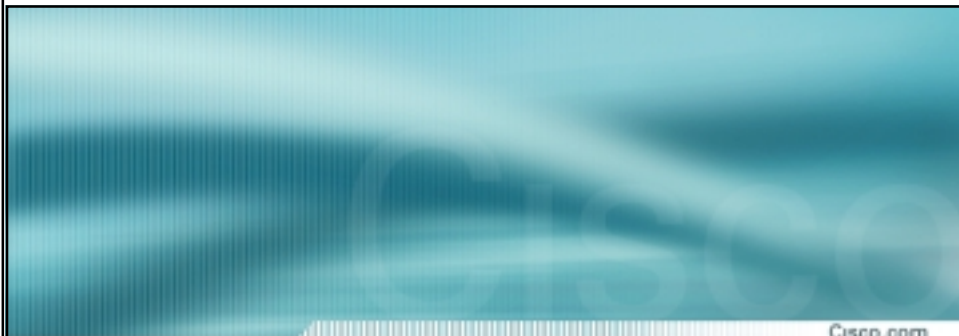
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- **Industry's Only 10G Portfolio**
 - The only complete solution for small to large POPs; backbone or edge
 - The only platforms supporting backbone- or edge-optimized line cards in the same chassis.
- **Only Proven Investment Protection**
 - Only vendor who delivers simple, low-cost field upgrades to higher switching capacities
 - All line cards are forward compatible
- **Highest Backbone and Edge Performance**
- **Only Guaranteed Priority Packet Delivery**
 - The industry's only complete IP QoS implementation that uniquely enables premium real time IP services such as VoIP and video.
- **Industry-leading products in the 12400 family include:**
 - CISCO 12416,12410,12406,12404

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CISCO 7600

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Cisco 7603

Cisco.com



32 Gbps Bandwidth Capacity, 16 Gbps per slot
 15 Mpps Centralized Forwarding
 Side-to-side airflow
 NEBS Level 3 Compliant (in process)
 Single-Side Connection Management- including power
 1+1 Power Configuration Option
 No Switch Fabric Module Support (No Cat 68xx Series)
 All other OSMs, FlexWAN and Cat modules supported

Up to eleven
 Chassis' per rack!

Supervisor required: Sup2 w/MSFC2
 Dimensions: 7x17.37x21.75" (4RU)
 Native IOS 12.1(8a)E3- no Hybrid
 MTBF 7 years

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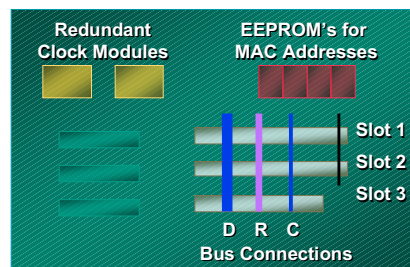
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Cisco 7603

Cisco.com



- 32 Gbps Bandwidth Capacity,
- 15 Mpps Centralized Forwarding



All other OSMs, FlexWAN and Cat modules supported

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Cisco 7606

Cisco.com



- 160 G bps Bandwidth Capacity
- 30 M pps Centralized Forwarding
- Side-to-side airflow
- NEBS Level 3 Compliant (in process)
- Single-Side Connection Management- including power
- 1+1 Power Configuration Option
- SFM, All OSMs, FlexWAN and Cat modules supported

Up to 6 Chassis'
per rack!

Supervisor required:

Sup2 w/MSFC2

Dimensions:

12.25x17.37x21.75" (7RU)

Native IOS

12.1(8a)E~~x~~- no Hybrid

MTBF

7 years

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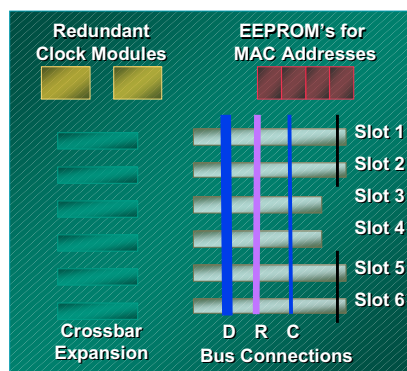
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Cisco 7606

Cisco.com



- 160 Gbps Bandwidth Capacity
- 30 Mpps Centralized Forwarding



Both SFM & SFM 2 +All OSMs, FlexWAN and Cat modules supported

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Supervisor Engine Overview

7600 Technical

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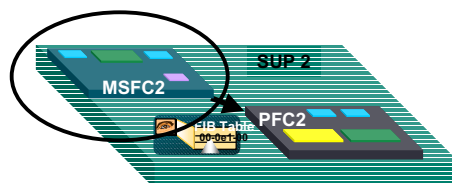
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Control Plane *MSFC2*

Cisco.com

MSFC2

- 680 Kpps
- 512 MB DRAM
- Routing Protocols
 - BGP4, IS-IS, OSPF, more
- IPv4 Multicast
 - PIM SM & DM
- IOS Features
 - GRE, WCCP v2, more



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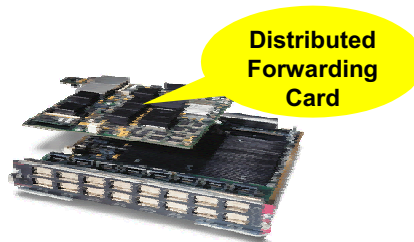
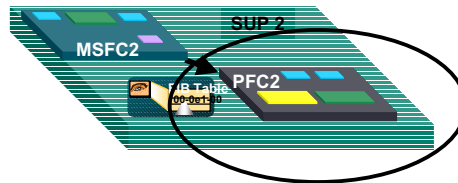
Forwarding Plane

PFC2 & Distributed Forwarding Card

CISCO.COM

PFC2 & DFC

- 30 Mpps forwarding, filtering, QoS
- IPv4 CEF forwarding & load balancing
 - 250,000 routes
 - 128,000 routes with unicast RPF
- Security ACLs
 - Standard, extended, dynamic, reflexive, time-of-day
- QoS ACLs
 - Classification, marking, policing
- Policy-based routing
- NetFlow v7, v8



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Line Card Architecture

7600 Technical

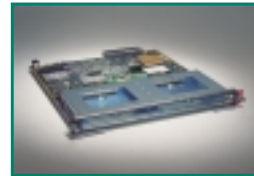
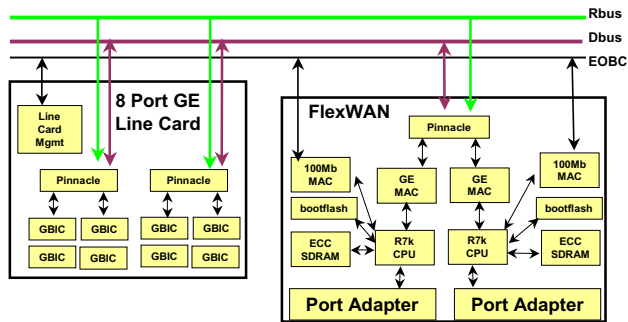
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Classic Line Cards Block Diagram (Including FlexWAN)

Cisco.com



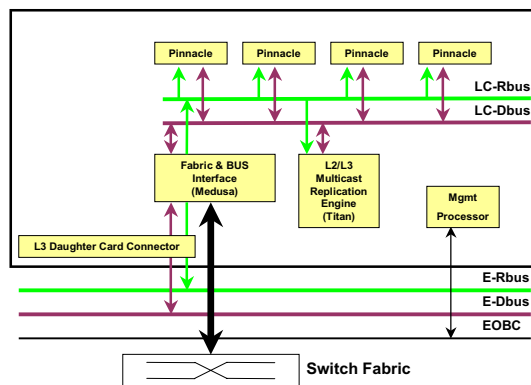
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Fabric Enabled Line Cards Block Diagram

Cisco.com



Utilizes Central PFC2
for forwarding decision

Catalyst 6500 WS-X6516-GBIC



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FlexWAN

Cisco.com



FlexWAN

- **Flexible Protocol Support**
 - Frame Relay
 - PPP, HDLC
 - ATM
 - Packet over SONET/SDH
- **Intelligent Network Services**
 - Distributed Quality of Service
 - Wire-Speed Access Control
 - Granular Traffic Control
- **Wire-speed Forwarding**
- **Distributed Services**
 - Classification, Marking & Policing (CAR)
 - Congestion Avoidance (WRED)
 - Queuing (CBWFQ, LLQ) & Traffic Shaping (GTS & FRTS)

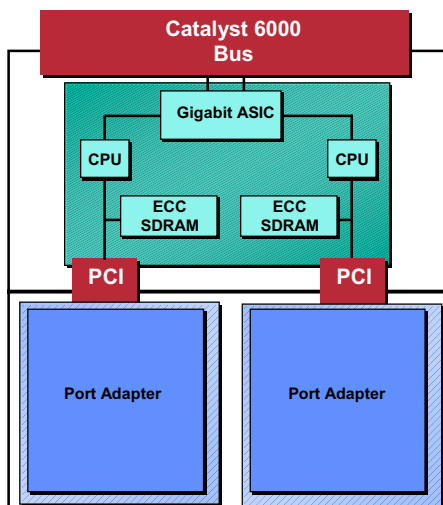
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FlexWAN Hardware Architecture

Cisco.com



- **Dual 263 MHz RM7000 RISC Processor Architecture**
 - CPU Handles WAN-to-LAN
 - Encapsulation/De-encapsulation
- **Up to 128 MB of ECC SDRAM Packet Buffer Memory per Port Adapter**
- **Wire-speed Forwarding**
 - 400 Kpps per Module
 - 200 Kpps per Port Adapter
- **Wire-Speed Security ACLs**
- **Distributed QoS**

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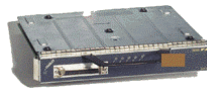
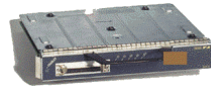
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FlexWAN Supported Port Adapters

CISCO.COM

- **ATM**
 - OC-3c
 - PA-A3-OC3MM
 - PA-A3-OC3SMI
 - PA-A3-OC3SML
 - T3/E3
 - PA-A3-T3
 - PA-A3-E3
- **Packet over SONET**
 - OC-3c
 - PA-POS-OC3MM
 - PA-POS-OC3SMI
 - PA-POS-OC3SML
- **HSSI**
 - PA-H
 - PA-2H
- **T3/E3**
 - Clear channel
 - PA-T3
 - PA-E3
 - PA-2T3
 - PA-2E3
 - Channelised
 - PA-MC-T3
 - PA-MC-E3
- **T1/E1**
 - Clear channel
 - PA-4T+
 - PA-8T-V35/232/X21
 - Channelised
 - PA-MC-8T1
 - PA-MC-8E1/120



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7600 HA

7600 Technical

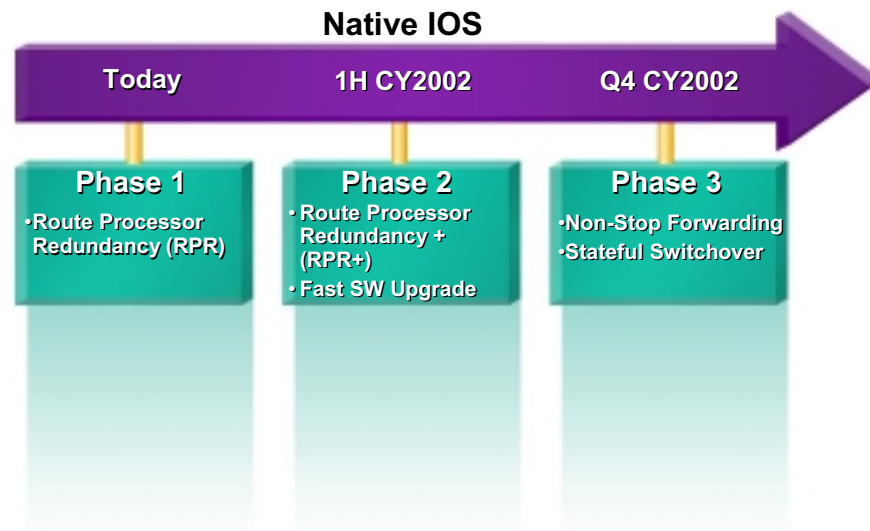
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Cisco 7600/7600 High Availability Road to Non-Stop Forwarding

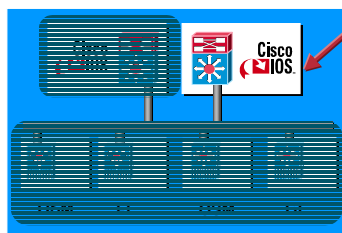
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C:

Route Processor Redundancy *Native Mode - Today*

Cisco.com



Accelerated standby Sup enabled and system recovery

Accelerated Switchover to Standby Supervisor

- Software image pre-initialized on standby Sup
- On active Supervisor failure:
 1. System switches to standby Sup 50% faster
 2. Linecard reload

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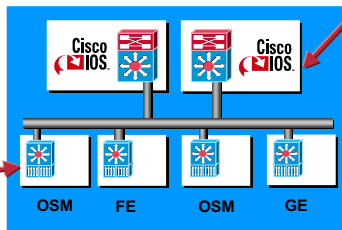
62

High Availability Supervisor IOS - Phase 1

Cisco.com

Q1'02

Line cards not Reloaded!



Redundant Supervisor RPR+ enabled = accelerated system recovery

Route Processor Redundancy +

- Full software image pre-initialized on redundant Supervisor
- Layer 2 linecards provide fast reset
- Layer 3 linecards stay up with NO reload/reinitialization
- Line protocols do not drop

Estimated recovery in 15 - 20 seconds

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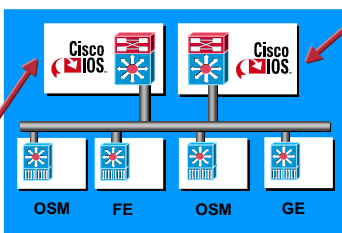
63

High Availability Supervisor IOS - Phase 1

Cisco.com

Q1'02

Primary Supervisor controls router until upgrade completed



Redundant Supervisor will be loaded with new Supervisor IOS release

Fast Software Upgrade

- Utilizes Route Processor Redundancy technology
- Minimizes downtime while loading new IOS image

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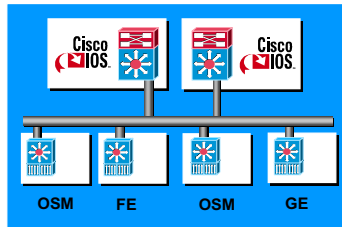
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High Availability Supervisor IOS– Phase 2

Cisco.com

Q3'02



SSO + NSF =
low customer
impact

Stateful Switchover

- Addresses route convergence time
- No impact to ATM, PPP, Frame Relay sessions

Non-Stop Forwarding

- CEF continues forwarding packets while routing protocols (BGP, OSPF & IS-IS) recover
- Once the routing protocols have re-converged, FIB is updated and stale route entries are deleted

SSO + NSF = Goal of 1 – 2 second recovery

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Cisco 7600 Summary


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- Uncompromised Performance
 - Sustained 30Mpps forwarding rates with simultaneous high-touch IP service delivery
- Widest Range of POP Applications
 - Ideal for integrating metro services, WAN aggregation and high-speed access to the backbone in a single platform.
- Highest Density DS3 and OC-3 in the Industry

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Cisco 7300

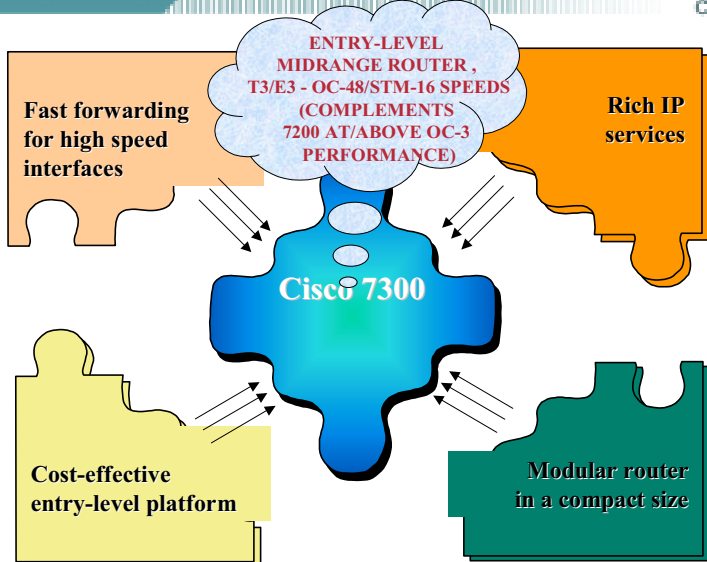
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Cisco 7300 Concept



The diagram illustrates the Cisco 7300 as a central blue puzzle piece labeled "Cisco 7300". It is surrounded by four other puzzle pieces, each with arrows pointing towards the center:

- Fast forwarding for high speed interfaces** (Orange piece, top-left)
- Rich IP services** (Orange piece, top-right)
- Cost-effective entry-level platform** (Yellow piece, bottom-left)
- Modular router in a compact size** (Green piece, bottom-right)

A cloud-shaped callout above the central piece contains the text: **ENTRY-LEVEL MIDRANGE ROUTER, T3/E3 - OC-48/STM-16 SPEEDS (COMPLEMENTS 7200 AT/ABOVE OC-3 PERFORMANCE)**.

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The Cisco 7300 Internet Router Physical characteristics

Cisco.com

- Modular, 4 slot chassis, half-slot linecards
- Compact (4RU), NEBS-3 chassis with front-to-back airflow
- Scalable backplane, 4Gbps point-to-point links to each slot
- Optional redundant AD or DC power (don't mix)
- Future support for redundant processors through software upgrade
- Interface speeds from OC-3 to OC-48 at FCS, from T3 post FCS

**Optimized for the
Optical Edge!**



Dimensions:
17.2" W x 20.5" D
x 7" H (4RU)

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Cisco 7300 Common Equipment Options

Cisco.com

Front View



Rear View



Forwarding Engine: Single NSE-100 support at FCS, dual NSE-100 support post FCS through software upgrade

System Memory: 128 MB (default), 256 MB, 512 MB

Compact Flash: 64 MB and 128 MB

Power supply: AC or DC (single or dual)

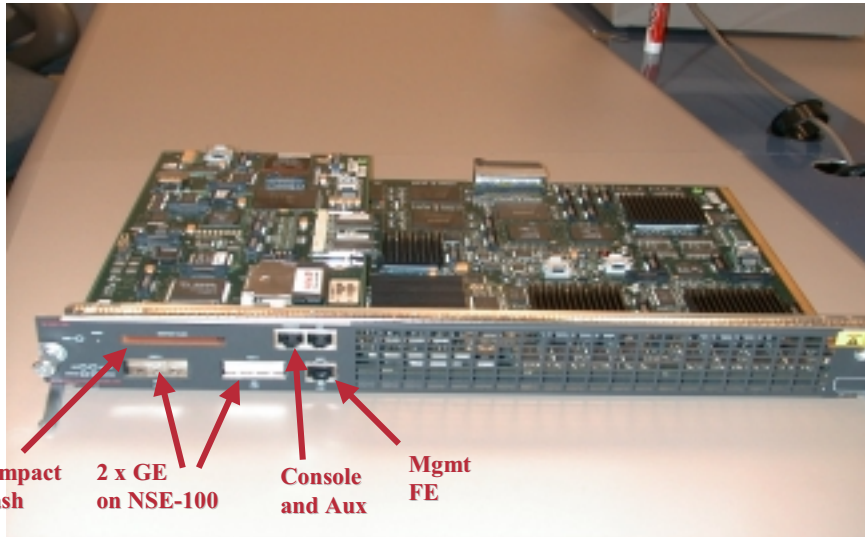
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Cisco 7300 NSE-100 with 2 x GE ports

Cisco.com



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Cisco 7300 Linecards

Cisco.com



4-port OC-3c/STM-1 POS Module



1-port OC-48c/STM-16 POS Module

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Linecards on the roadmap

Cisco.com

- T3 (6 port)
- OC-3/STM-1 ATM (4 port)
- OC-12 POS/STM-4 (1 or 2 ports)



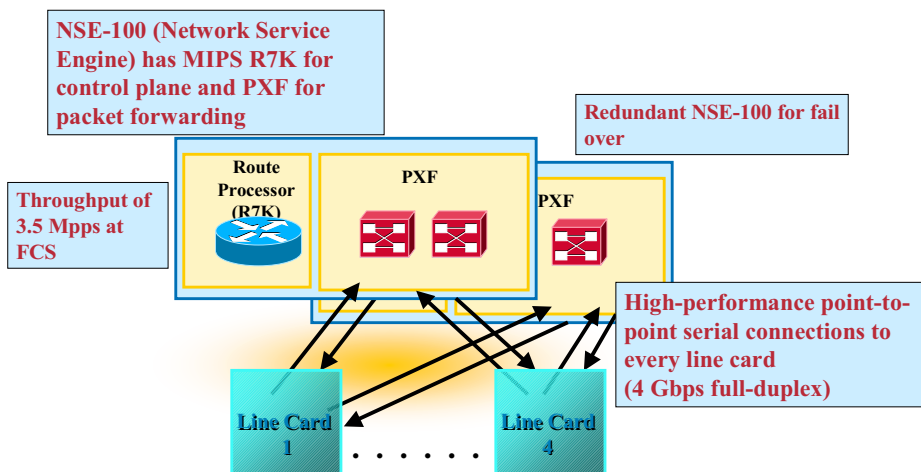
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Cisco 7300 Architecture

Cisco.com



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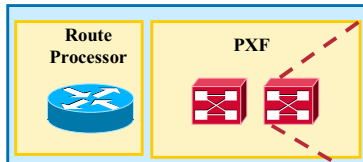
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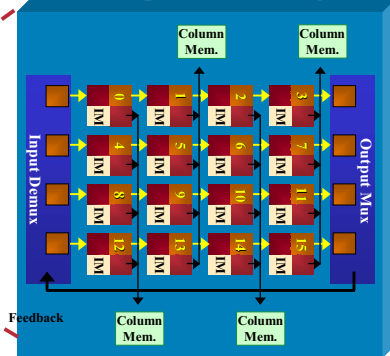
Cisco 7300 is Powered by PXF

Cisco.com

NSE-100: Cisco 7300 Forwarding Engine



Parallel eXpress Forwarding (PXF)



US Patent 6,101,599

Benefits of PXF

- Enhances performance, gives linear performance for IP forwarding when adding services
- Software upgradeable for new IP services

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The Cisco 7300 Internet Router Software

Cisco.com

- Initial software release will be X-release off 12.1(10)E/12.1(9)E
- High-speed IP forwarding with edge features through PXF
- Full IOS on RP including routing protocols (BGP, IS-IS, OSPF, EIGRP etc.) and multiprotocol (IPX, AppleTalk, DLSw etc.)
- Supported in Cisco Works 2000, Element Manager

Optimized for the Optical Edge!



~3.5 Mpps PXF
IP CEF forwarding
~450 kpps RP
IP CEF forwarding

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Cisco 7300 PXF Features

Cisco.com

- **PXF Features FCS**
 - Forwarding (CEF)
 - Statistics (Netflow)
 - Filtering (ACL)
 - Classification*
 - Marking*
 - Priority Queuing*
- **PXF Features Post FCS**
 - Policing
 - Congestion Control (WRED)
 - NAT
 - MPLS/MPLS VPN

***First interim release after FCS**

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Cisco 7300 Summary



Cisco.com

- **Price/performance optimized routing platform**
- **Compact and modular**
- **High-performance edge functionality in PXF**
- **Multiprotocol support on RP**
- **Scalability & High Availability in an entry level platform**
- **Compliments the Cisco 7200 for high-speed optical interfaces**

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Cisco 10000


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Cisco 10000 Series

- Overview -




Cisco's IP Edge Aggregation platform

- **IP Services**
 - Most comprehensive set of PXF-accelerated IP features enabling revenue generating services
- **Scalability**
 - Industry leading density, multiple form factors
- **Performance**
 - PXF-accelerated services deliver predictable IP performance
- **Carrier-Class Reliability**
 - Hardware and software designed for 99.999% availability



Cisco 10008



Cisco 10005

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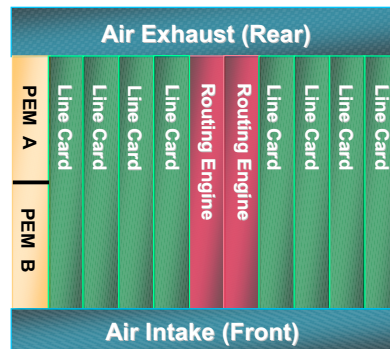
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Cisco 10000 Hardware Overview

Cisco.com

- 8 line card slots, 2 processor slots
- **Point-to-point backplane connections to each processor—25.6/51.2 Gbps backplane capacity**
- 12-in. depth, 21-3/4-in. height (six ESR chassis per 7 ft. rack)
- Front-to-back airflow
- Redundant AC or DC power
- NEBS Level 3 compliance



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Hardware Overview - Cisco 10000 Series -

Cisco.com

10008

10005

Line cards	8 slots + 2 PRE	5 slots + 2 PRE
Backplane	51.2 Gbps	32 Gbps
6 Units per 7ft rack	6 (back-to-back config)	6
Dimensions (HxWxD)	21.75 x 17.5 x 12 in.	11.9 x 17.5 x 24 in.
Density: T1/E1 (7ft rack)*	T1 - 12096 / E1 - 9072	T1 - 6048 / E1 - 4536
Route Engine (PRE) and Power	Redundant	Redundant
99.999% Architecture	Yes	Yes

Interfaces

- 6-port ChT3 module (DS0/DS1/DS3)
- ChOC-12 (DS0/DS1/DS3)
- 4-port ChSTM1 (E1/DS0/DS1/DS3)
- OC-12/STM4 POS
- Gigabit Ethernet
- OC-12 ATM/STM4
- OC-3/STM-1 POS

* Dual uplinks configuration

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Cisco 10000 ESR Port Densities

Cisco.com

Capabilities	Ports per Card		Ports per Chassis		Ports per 7' Rack	
	10008	10005	10008	10005	10008	10005
DS1 (CT3)	168	168	1008	504	6048	3528
DS1 (ChOC-12)	336	336	2000	1008	12000	7056
DS3 (CT3)	6	6	36	18	216	126
DS3 (ChOC-12)	12	12	72	36	432	252
E1 (ChSTM1)	252	252	1512	756	9072	5292

Note: DS1, DS3 and E1 interface densities assume dual uplinks

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Cisco 10000 Port Densities

Cisco.com

Capabilities	Ports per Card	Ports per Chassis	Ports per 7' Rack	Maximum Back-to-Back in 30" 7' Rack
DS1 (CT3)	168	1008	3024	6048
DS1 (ChOC-12)	336	2000*	6000*	12000*
DS3 (CT3)	6	36	108	216
DS3 (ChOC-12)	12	72	216	432
E1 (ChSTM1)	252	1512	4536	9072

Note: DS1, DS3 and E1 interface densities assume dual uplinks

* Presumes Frame Relay pt-to-pt sessions

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Qwest, Global Crossing and more!

- Cisco 10000 Series -

Cisco.com



- Cisco 10000 is field hardened
 - Qwest - our first customer has ordered over 40 units, deployed over 30, plus additional units in FYQ2 and coming in FYQ3
 - Added Global Crossing in Q2
- Plus over 18 customers

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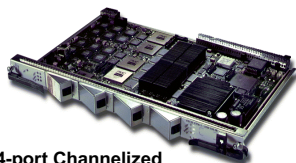
Cisco 10000 Series Interface Modules Shipping

Cisco.com

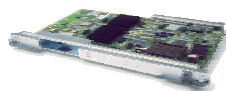
- 6-port channelized T3 module (DS0/DS1/DS3)
- OC-12 channelized to DS0, DS1, and/or DS3
- 4-port channelized OC3/STM1 to E1/DS0
- OC-12/STM-4c POS/SDH
- Gigabit Ethernet (GBIC support)
- OC-12c/STM-4c ATM
- 6 port OC-3/STM-1 POS



1-port Gigabit Ethernet



4-port Channelized
STM-1
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1-port STM-4
POS



6 port STM-1 POS

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Cisco 10000 Series Interface Modules Available soon

Cisco.com

- 8-port T3/E3 module (EFT Sept, FCS Nov)
- 4-port OC3/STM1 ATM (EFT Sept, FCS Nov)
- 24-port channelized copper E1/T1 (EFT Dec, FCS Feb)



8 Port DS3-E3



4port OC3/STM1 ATM

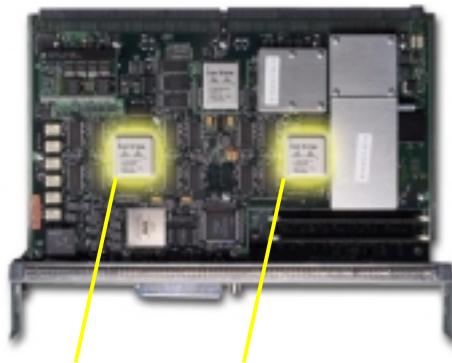
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PXF Powers Cisco 10000 ESR IP Services

Cisco.com



PXF network
processor

PXF network
processor

Each performance
routing engine has
2 PXF network
processors
running in parallel
and dedicated to
IP services

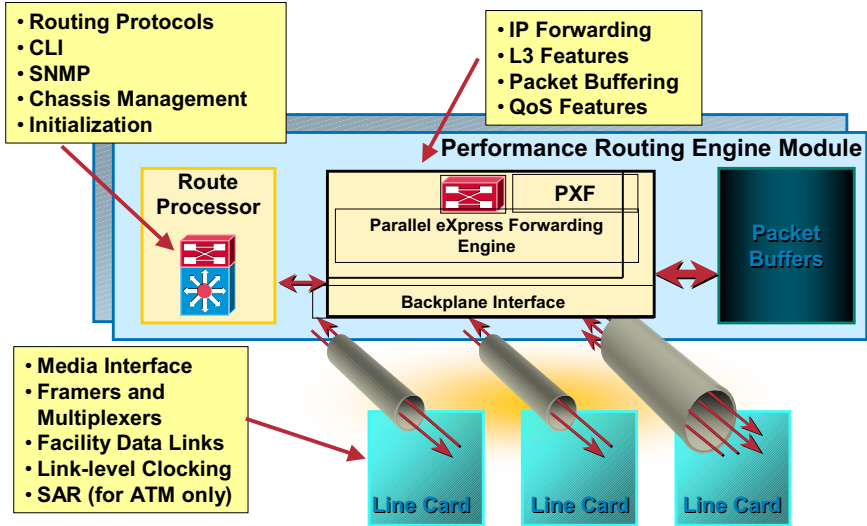
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Cisco 10000 Series Performance Routing Engine Architecture

Cisco.com



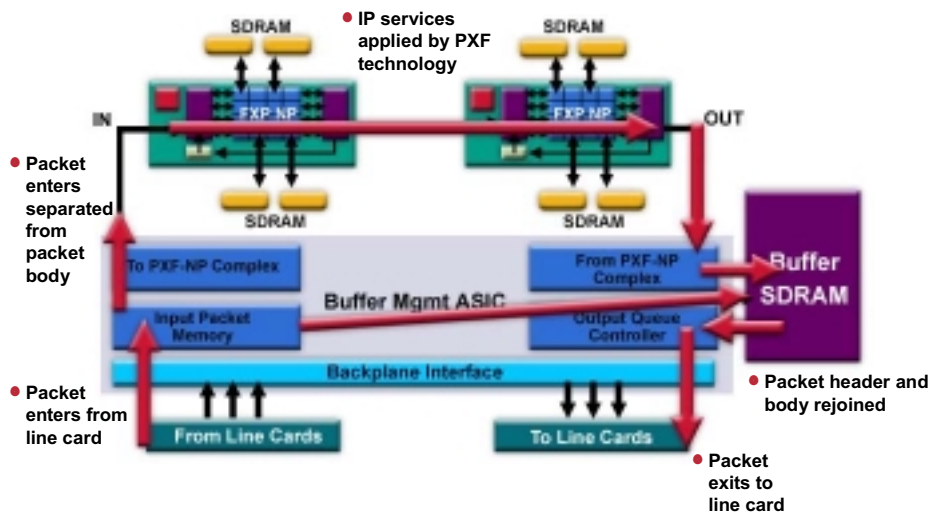
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Day in the Life of a Packet

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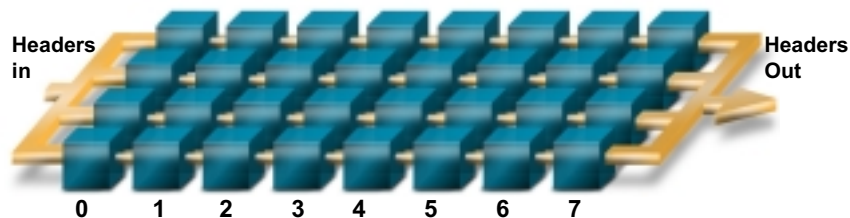
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Cisco 10000 Series Parallel Express Forwarding

Cisco.com



Column

- 0: Mac Classify, ICMP, per-channel stats
- 1: FIB switching, MPLS, RPF, Mcast
- 2: Security (Turbo) ACL, MLPPP
- 3: QoS Classify and PBR
- 4: Rate Limiting/policing, Packet Marking, IP Frag, Netflow
- 5: Mac ReWrite, Netflow
- 6: Buffer Mgmt, Flow Control, WRED (Congestion Avoidance)
- 7: Enqueue/Dequeue, Scheduling (WFQ and shaping)

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HA Update

Cisco.com

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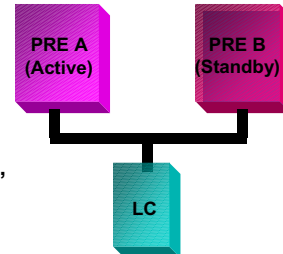
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PRE Redundancy - RPR+

Cisco.com

- Redundant PREs running IOS
 - Active PRE controls the router, runs routing protocols, presents mgmt interface
 - Standby PRE loads IOS image, reads config, identifies line cards (LCs), monitors active PRE, keeps running config in sync
- Switchover:
 - IronBus and LCs reconnect to standby PRE in msec
 - Line cards are not reset
 - Restore sessions & adjacencies, reconverge routing, resume traffic forwarding
 - Cutover time is better than 90 seconds
- **Cutover time reduced by 25-75%!**



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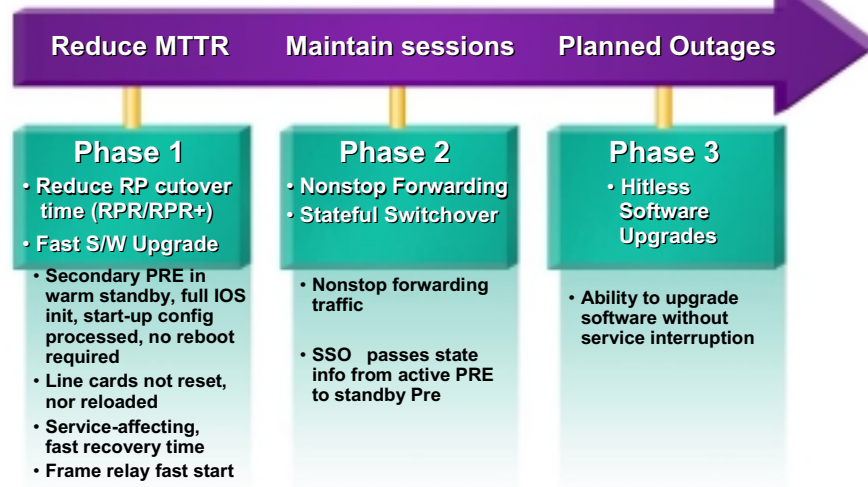
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3 Phase HA Software Program - Cisco 10000 Series -

Cisco.com

Projects in development will deliver 99.999% availability



(1) SSO = Stateful Switchover

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Phase II: Non-Disruptive Cutover For Selected Protocols

Cisco.com

- SSO
 - Maintenance of session continuity through an RP cutover (PH 2 - PPP, FR, ATM)
 - Passes state information from the Active RP to the Standby RP
- NSF
 - Maintenance of adjacency continuity (BGP, IS-IS, OSPF)
 - Uses the Forwarding Information Base (FIB) that was current at the time of the cutover.
 - Once the routing protocols have re-converged, FIB is updated and stale route entries are deleted.
 - Performance requirements
 - < 3 s for VoIP “no call drop”
 - < 10 s for IS-IS adjacency maintenance
 - < 20 s for OSPF adjacency maintenance

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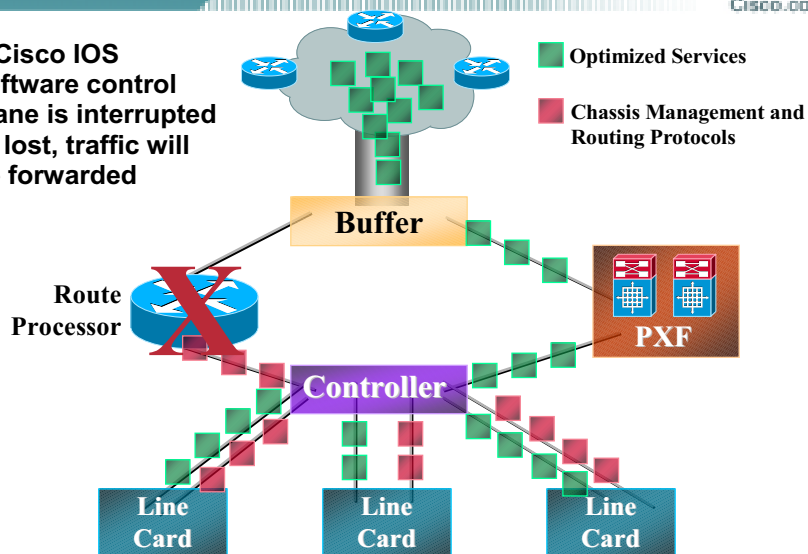
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Non-Stop Forwarding - Cisco 10000 Series -

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- If Cisco IOS software control plane is interrupted or lost, traffic will be forwarded



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CISCO 10000 Series Summary


Cisco.com

- **High Availability with 99.999% Uptime**
 - The industry's first IP router, both hardware and software architecture, that will deliver 99.999% uptime (RPR+ performance)
- **Deliver the industry's best T1/E1 density in a 7 foot rack**
 - up to 12,096 T1's in a 7 foot rack, up to 9,072 E1's in a 7 foot rack.
- **Radically simplifies network operations at the edge by integrating IP VPNs, IP services and leased line aggregation in a single platform.**
- **Reduces central office power consumption by up to 90%**
- **Reduces rack space requirements by up to 95%**

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Cisco 7400 Application Specific Router (ASR)

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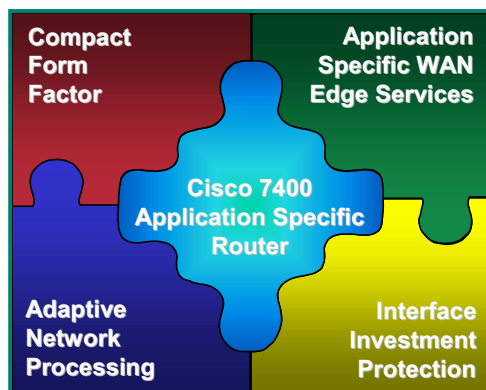
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Solution Requirements

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Cisco 7400 ASR



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Cisco 7400 ASR

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Leverages Cisco 7200 Series Infrastructure

NEBS Level 3-compliant Chassis

NSE-1 Processor

Wide range of 7x00 Interfaces

Application specific I.O.S.

350 Kpps CEF-based Internet Routing

Up to 512MB of memory for Internet routing tables

Stackable Form Factor

1 Rack Unit with Front to Back Airflow

Low power consumption - 50 Watts



Service Provider WAN Edge IP Routing

High-performance IP Routing with "Stackable" Bandwidth

High-touch IP Services

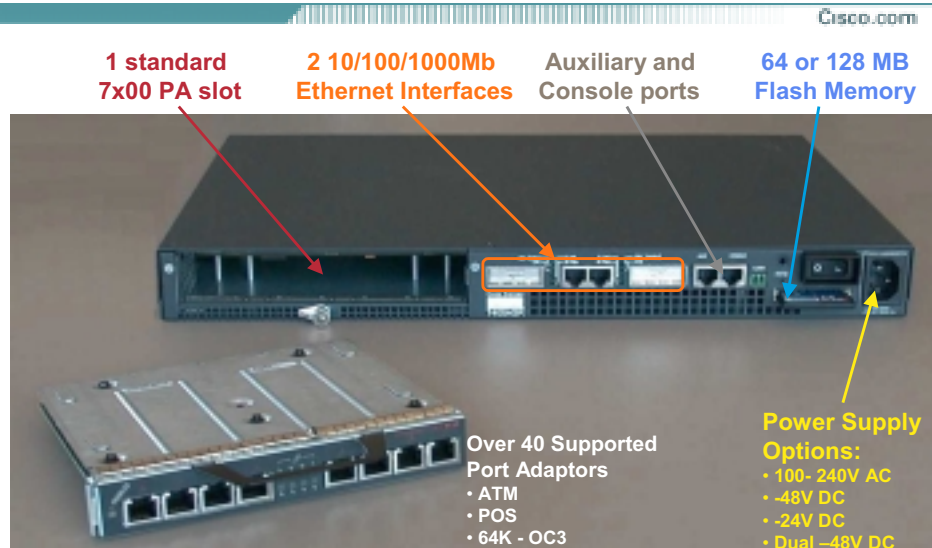
"Adaptive" Network Processing

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What is a Cisco 7400 ASR?



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Cisco 7400 ASR Features / Benefits

Feature		Benefit
Efficient Design	→	Stackable, low power draw
Hardware-based IP Service Application	→	High performance IP Services
Full MPLS and MPLS VPN Support	→	Flexible multi-protocol support
Support for 7x00 Port Adaptors	→	Ideal investment protection
"Adaptive" network processor	→	Flexible IP service implementation

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Cisco 7400 ASR Network Management

CISCO.COM



Cisco Element Management Framework (CEMF):

- Auto-discovery
- Web-enabled monitoring
- Port Adapter Configuration
- Fault Detection/Forwarding
- Range of Cisco & 3rd party solutions for provisioning

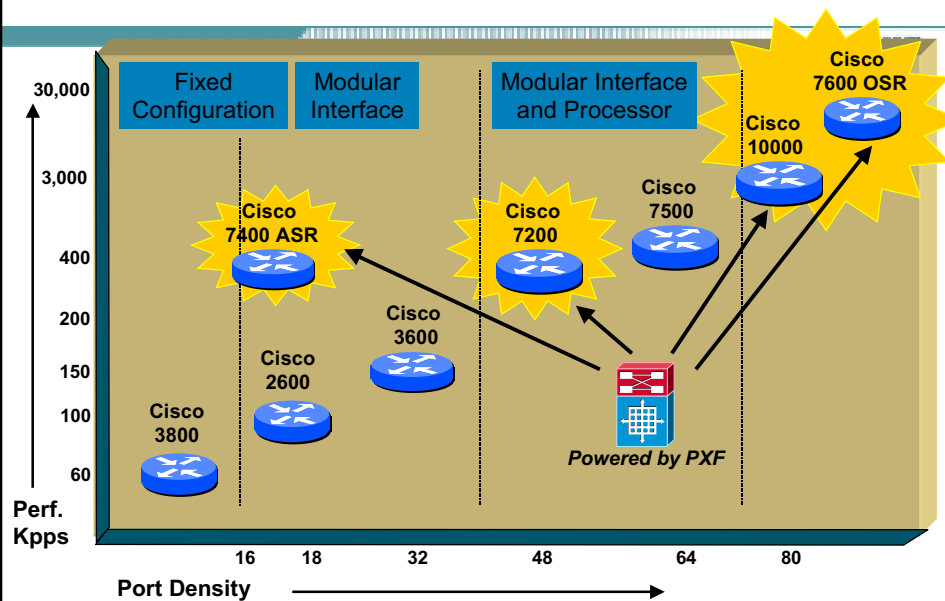


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Cisco's Edge Router Family



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Compact Form Factor



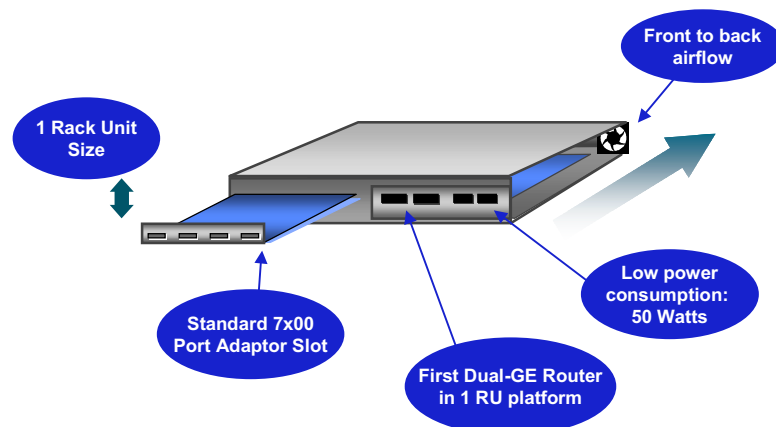
www.cisco.com

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Cisco 7400 ASR Compact Form Factor

Cisco.com

Highest performance 1 RU platform in the industry...



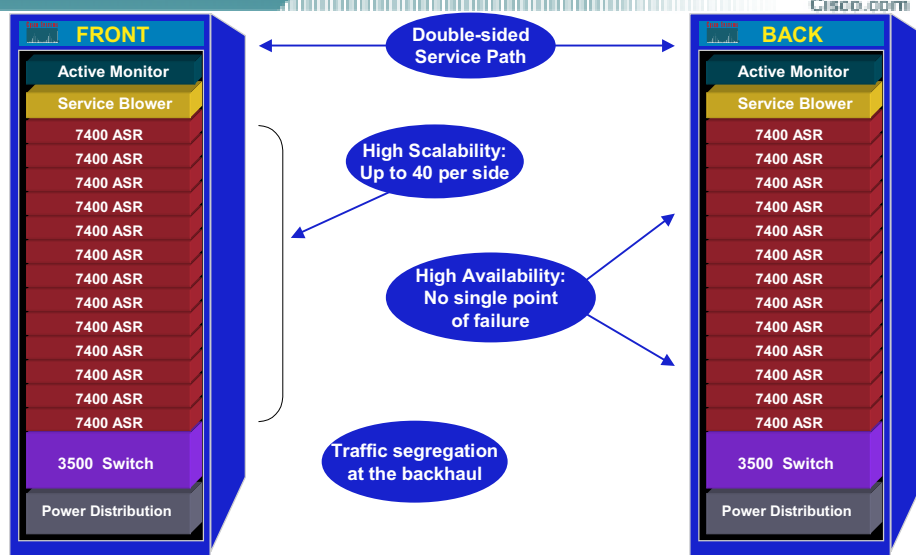
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Cisco 7400 ASR

The Stackable Appliance



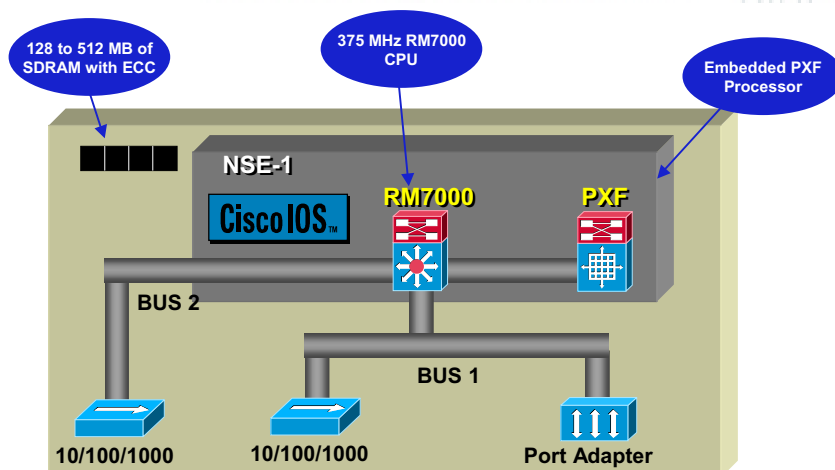
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7400 ASR Architecture

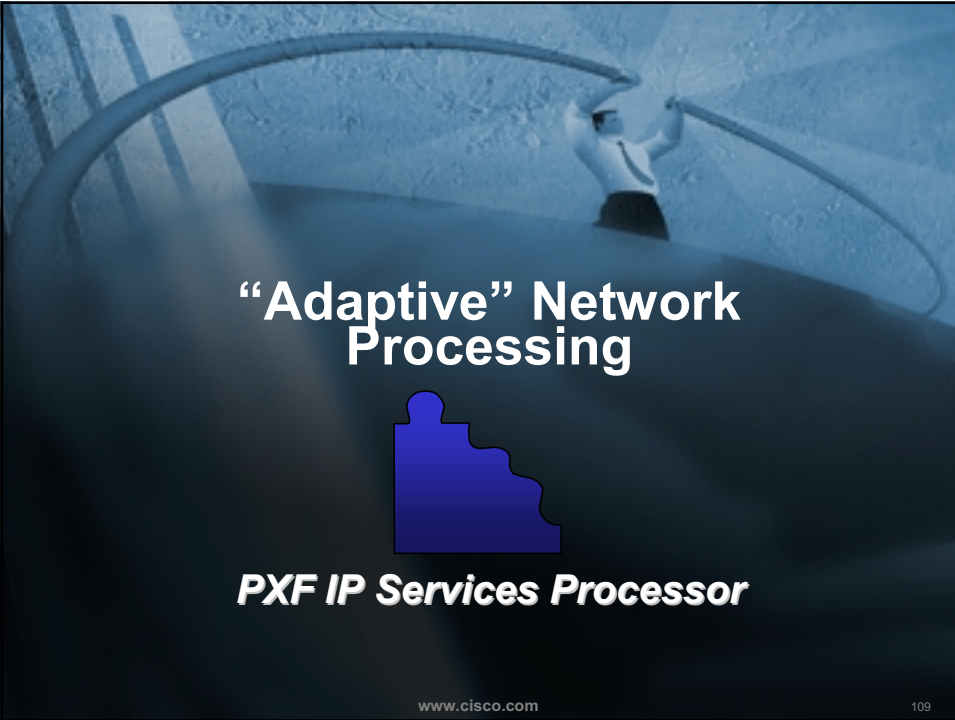
Network Service Engine (NSE-1)




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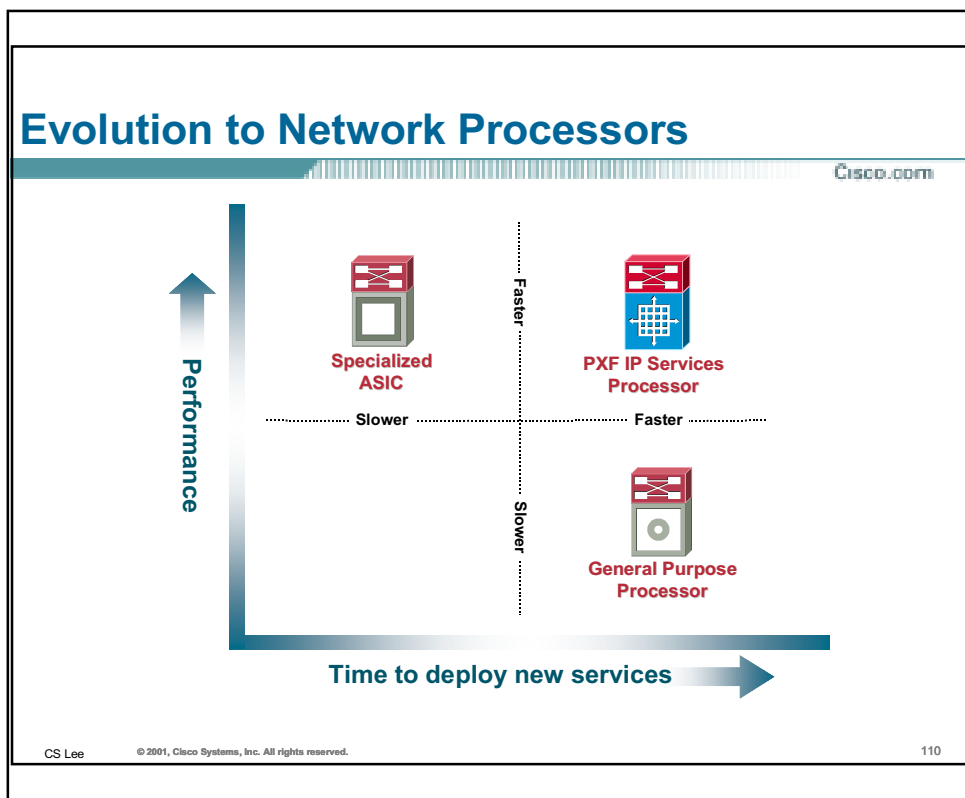
“Adaptive” Network Processing



PXF IP Services Processor

www.cisco.com

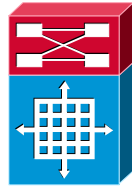
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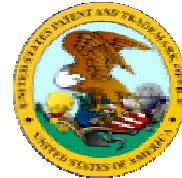
Cisco 7400 ASR Powered by PXF

Cisco.com

Parallel Express Forwarding (PXF) IP Services Processor



High-performance IP service application
"Adaptable" IP service implementation



US Patent 6,101,599



Microprocessor Report
Analyst's Choice 2001 Award for
Best Network Processor

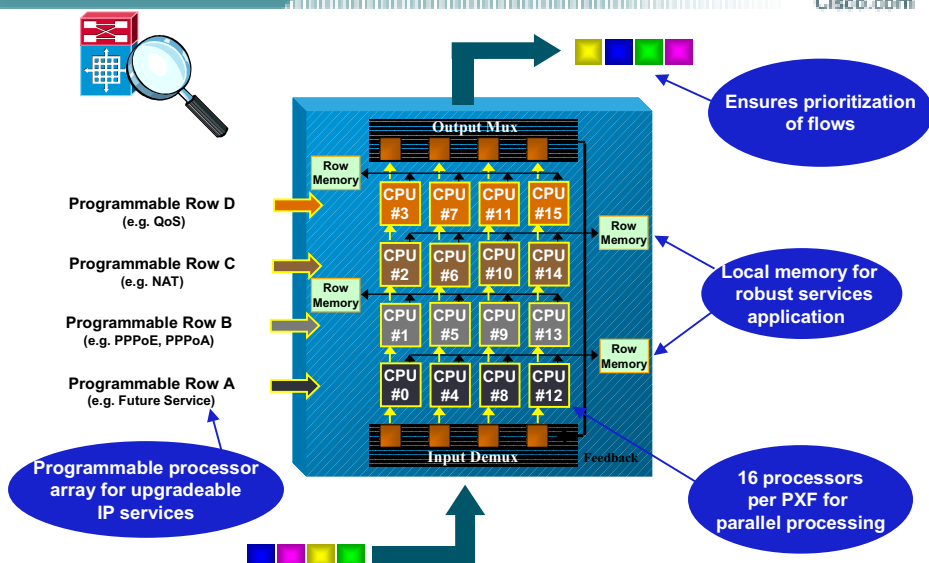
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PXF IP Services Processor Architectural View

Cisco.com



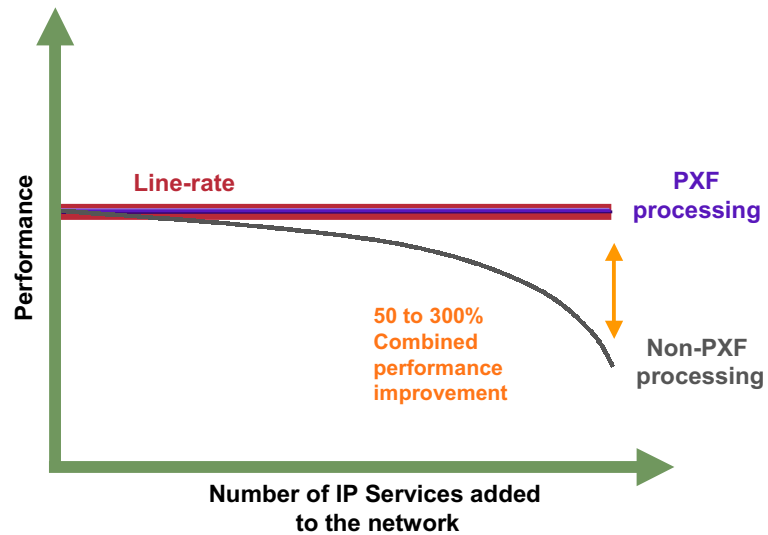
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Combined Services With Consistent Performance

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Interface Investment Protection



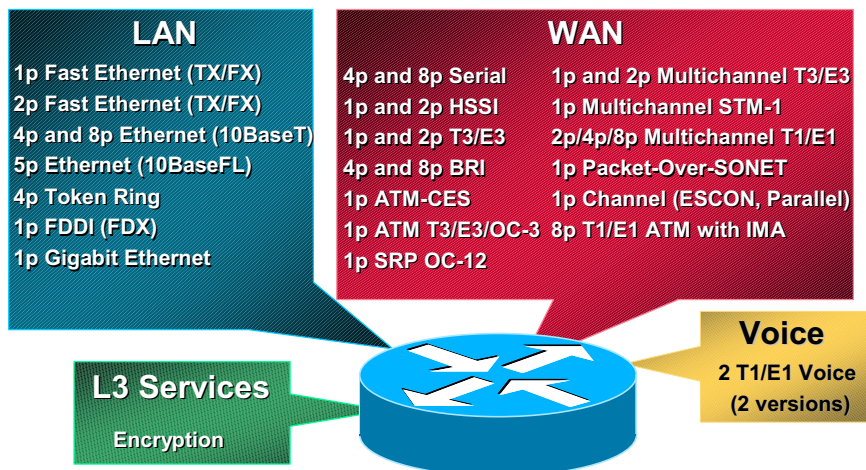
**Over 40 Supported
7x00 Port Adaptors**

www.cisco.com

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Cisco 7xxx Port Adapters

Cisco.com



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Cisco 7400 ASR Supported Network Interfaces

Cisco.com

Over 40 Port Adaptors to choose from:

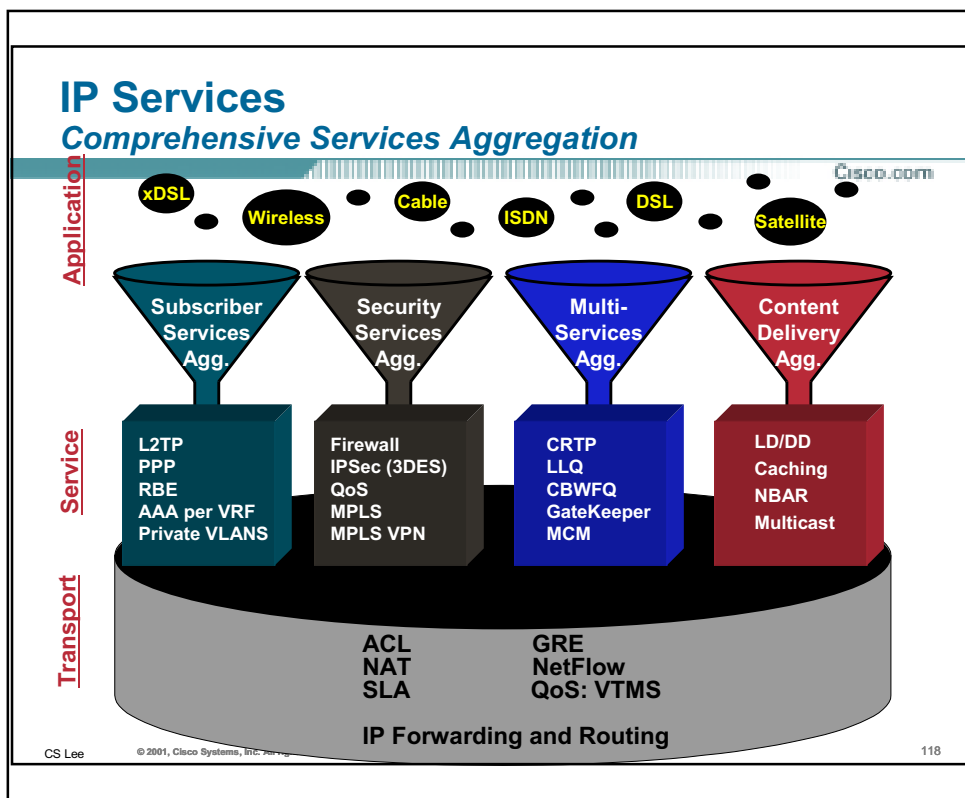
- Ethernet, Fast Ethernet, Gigabit Ethernet
- Serial and Multi-channel
- Channelized
- ISDN
- Frame
- ATM
- IP
- POS
- 64K to OC3



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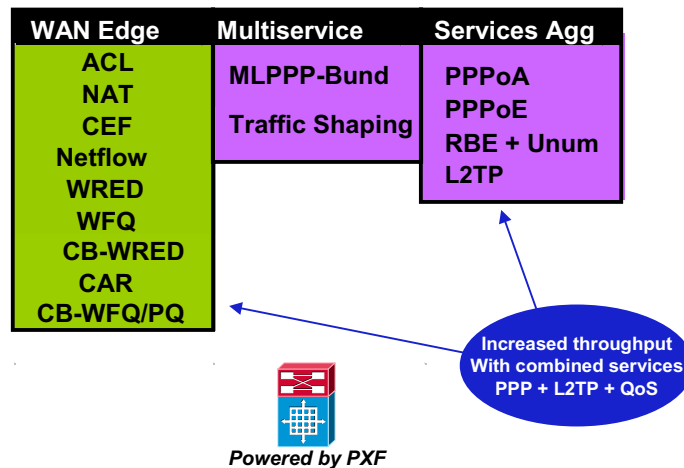


IP Services Powered by PXF

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Now Shipping

FCS CY Q2 '01



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Cisco 7400 ASR Summary

Cisco.com

Cisco 7400 ASR is the ideal application specific edge router for numerous applications.

Cisco delivers the highest performing stackable network appliance in the industry

Unique combination of stackable architecture, performance capabilities, wide-range of interfaces, and "adaptive" services.

Highest PPP density in the industry: a fully loaded 7' rack of 40 Cisco 7400 ASRs translates into over 640,000 simultaneous subscribers.

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