Technology Waves

Converged Network Requirements

- Delivering on today’s requirements
  - Consistent end-to-end services
  - Scalability
  - Cost effective
  - High availability
  - Manageability
  - E/i-commerce services
Converged Network Requirements

- Flexible growth path to the future
  Voice
  Wireless
  Gigabit evolution
  New services
  Application recognition, policy forwarding, E/i-commerce

Catalyst Switching Evolution

- Catalyst family—delivering convergence
  Multilayer switching/routing
  Content networking
  Cisco AVVID
  End to end Cisco IOS network services
Delivering the Converged Network

Scaling Bandwidth
Content Awareness
Data/Voice/Video Integration
LAN/MAN/WAN Integration

Scaling Bandwidth

Enterprise Gigabit Networking

- 10 Gigabit Ethernet/OC-192 ATM/PoS
- Gigabit Ethernet/OC-12, 48 ATM
- Gigabit Multilayer Switching
- Switch/Router 100x
- Hubs/Router 10x
- Fast Ethernet/OC-3 ATM
- Ethernet FDDI

10,000x

1995
1997
1999
2001
10 GIGE

- 802.3ae 10 gigabit Ethernet standards project was formally approved in late February
- The 802.3ae task force held its first meeting on March 7th, 2000
- Standardization CQ2/3 ’01
  - 100 meters on “installed” multi-mode fiber
  - 10 km on single mode fiber
  - 40 km on single mode fiber

IEEE 802.3ae Task Force Milestones

HSSG = Higher Speed Study Group
PAR = Project Authorization Request
802.3ae = the name of the project and the name of the sub-committee of IEEE 802.3 chartered with writing the 10GbE Standard
Working group ballot = task force submits complete draft to larger 802.3 committee for technical review and ballot
LMSC: LAN/MAN Standards Committee ballot; any member of the superset of 802 committees may vote and comment on draft
10 GbE LAN Applications

- Cost-effective bandwidth for the LAN, switch-to-switch
- Aggregate multiple gigabit Ethernet segments
- 10 GigaEtherChannel will enable 20 to 80 Gbps (future)

10 GbE Over Metro Dark Fiber

- Enterprises
  Enables dark fiber to become 10 Gbps fat pipe for metro networks
  Examples: serverless buildings, remote backup, disaster recovery

- Service providers
  Enables Gigabit services at costs equal to T3 (44.7 Mbps) OC-3 (155 Mbps)
10 GbE over WAN

- Attachment to the optical cloud with WAN physical layer (WAN PHY)
- Compatibility with the installed base of SONET OC-192
- Interfaces and links between SP to IXC networks can be co-located
- No need for protocol conversion, traffic remains IP/Ethernet

Service Provider POP
San Jose, CA

Service Provider POP
New York, NY

10 GbE over WAN

10 GbE WAN PHY
(< 300 m)

DWD Mux

IXC WAN Transport Network

OC-192 SONET and DWDM: 1000’s km

SONET Framing

DWD Mux

10 GbE (WAN PHY)
(< 300 m)

Content Networking

Network Intelligence Evolution

Layer 3
Network Services
Cisco IOS Software
Cisco IOS Software
Static Network Services
Dynamic Network Services
Layer 2-3
Network Integration
CiscoFusion: Performance/Scalability
Layer 4-7
Intelligent Network Services
CiscoAssure: ERP Apps QoS
CiscoAssure: ERP Apps QoS
Layer 4
Application Aware Network Services
Cisco
Content Networking:
Internet Solutions
Cisco
Content Networking:
Internet Solutions
**Internetworking to Content Networking**

**Internetworking**
- Reaching a destination
- Host names/addresses
- Topology-destination based forwarding
- Policies for network resource management

**Content Networking**
- Accessing content
- WWW pages
- User-to-content based forwarding
- Policies for content
  - Caching, distribution,
  - Access, availability

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**Enabling Global Internet Business through Web Content Delivery**

**Content Networking**

**Enabling the Global Virtual Enterprise**

- Centralized Content
- Internet
- Extranet
- Distributed Content
- SLB
- LocalDirector/Catalyst/Arrowpoint
- New York
- London
- Content-Aware Policy Management
- NBAR
- Content-Driven Policy Management
- Access VPN
Cisco converged networks provide:

- Rapid application deployment
- High availability/scalability
- Lower cost of ownership
- Open standards

Catalyst IP telephony

- Enables MultiService networking
- Extends benefits to the campus

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**Catalyst Inline Power**

*Catalyst Inline Power—Provides DC Power over Standard Category-5 Ethernet*

Catalyst inline power Ethernet modules:

- Deployable in Catalyst 6500/6000 series or Catalyst 4006
- 48 Port 10/100BaseT ports per module (RJ45)
- Provides power over the same pairs as ethernet (pins 1,2,3,6)
- Inline power work-in-progress as IEEE 802.3af standard
- Use catalyst power patch panel for Catalyst 5000 and 2900 families
QoS Enables Integrated Data, Voice, and Video

- Require
  - Network wide QoS policy
  - Application/user detection

- Catalyst switches
  - Cisco IOS—intelligent services
  - Part of end-to-end capability
  - CiscoAssure—policy networking

Data/Voice/Video Integration
Voice and Data Evolution

Old World
- Legacy PBX
- Public Voice Network
- Legacy PBX or Key Systems
- ATM, Frame Relay, PPP, SONET
- Public Data Network
- Routers
- Ethernet Switches

New World
- Catalyst 6500
- Converged LAN/WAN/MAN Network
- Catalyst 4006
- Catalyst Switch
- ATM, Frame Relay, PPP, SONET

Catalyst switching solutions deliver:
- Network-based application recognition
- Class-based queuing for prioritized voice delivery
- Congestion management and queue scheduling
- Native voice compression and DS-0 switching to local Legacy PBX

WAN Services:
- Voice recognition
- Voice prioritization
- Bounded end-to-end delay
- Voice over IP Gateway to Legacy Voice
Today

Future

Enterprise WAN/MAN will Migrate Toward Higher Bandwidth Services

Outsourced/Centralized Content and Apps.

Today

Future

Enterprise WAN/MAN will Migrate Toward Higher Bandwidth Services

Optical Networking Enables the Enterprise

As Bandwidth Becomes Plentiful ...

... Prices Drop Dramatically ...

... and High-Speed Internet Access Use Skyrockets!
Catalyst 4000/5000/6000 Product Update

Introducing Catalyst 4006

- Catalyst 4000 solution: 6-slot chassis platform expansion
  - 240 ports fast ethernet
  - Modular wiring closet protection!
- Support for Content Networking
- Support for integrated AVVID VOIP

Catalyst 4003

More than 2 Million 10/100 Ports Shipped in 1999!

Catalyst 4006
Introducing Layer 3 Services Engine

- Requirement: Layer 3 multiprotocol routing and QoS marking
- Catalyst 4000 solution: integrated Layer 3 services platform expansion

Convergence Through Scalability: Modular Catalyst 4000 Family

Small-Medium Wiring Closet
24 Gbps Switching Engine
24 Gbps backplane
32–96 Fast Ethernet Ports
2–36 Gigabit Ethernet Ports
Layer 2 or Layer 3

Medium-Large Wiring Closet
24 Gbps Switching Engine
60 Gbps backplane
32–240 Fast Ethernet Ports
2 GE Uplink Ports built-in
Layer 2 or Layer 3

Same Line Cards
Modular Interface Flexibility

<table>
<thead>
<tr>
<th>Client/Server</th>
<th>48 x 10/100 RJ-45</th>
<th>New!</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>48 x 10/100 Telco</td>
<td>New!</td>
</tr>
<tr>
<td></td>
<td>24 x 100 FX</td>
<td>New!</td>
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<td>EtherChannel® Uplinks</td>
<td>4 x 100 FX</td>
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<td>High Function</td>
<td>18 x 1000-X Server</td>
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</tr>
<tr>
<td>Future</td>
<td>Voice Ready</td>
<td>New!</td>
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</table>

Functionally Transparent
Line Cards
Catalyst 4003 or 4006
Centralized L2/3/4 Services

Catalyst 4000 Hardware Roadmap

Higher Performance, Integrated Services, and Functionality

Switch DC Power Supply
SLB Module
12-1000T +2-GBIC
Backplane Channel Module
Multi-speed Gigabit Module
Wan Gateway Router (call manager 3600 VIC/WIC)
Inline Power 48-port 10/100 Voice
DC PEM (Power Entry Module)
Phone DC Power Supply
Supervisor III Module for Catalyst 4006 (2HCY01)

12-1000T (GE Copper)
12+2 1000T (GE Copper)
24-Port 100FX
48-Port 10/100 (Telco)
12-1000T +2-GBIC
18 Mpps 24 Gbps
48 Mpps 64 Gbps
Scalable Performance

1H CY ’00
2H CY ’00
CY ’01
The Evolving Catalyst 5000 Family

- Powerful switching solutions:
  - Consistent system architecture
  - Multilayer/Layer 3 switching
  - Integration of gigabit/ATM on a common platform
  - Support for CiscoAssure policy networking
  - High density LAN aggregation
  - Diverse media support (FDDI, TR, ATM, LANE/MPOA, ethernet)
New Intelligent QoS Modules

- Intelligent—QoS linecards
  - Classification w/NFFC-II
  - WRED drop threshold management
  - 50% greater Telco 10/100 density
  - 100% greater 100FX density
- Multiqueue uplink
  - Multiqueue QoS
  - Classification with NFFC-II
  - GBIC flexibility

Available Now

24 Port 10/100 RJ-45
36 Port 10/100 RJ-21 Single Slot

Available 3Q CY '00

2 Port GBIC Uplink with Multi-Queue QoS
24 port 100FX MT-RJ

Catalyst 6000 Family Overview

- Catalyst 6000 series:
  - 6- and 9-slot chassis
  - Cost-effective solution scalable to 32 Gbps for wiring closets
- Catalyst 6500 series:
  - 6- and 9-slot chassis
  - High-bandwidth solution scalable to 256 Gbps for server farms and campus backbones
- Catalyst 6509-NEB series:
  - 9-slot NEBS-compliant chassis
  - Vertical slot, front-to-back airflow solution scalable to 256 Gbps for service provider CO’s and POPs
Catalyst 6000 Family

- Key features include:
  - Wire-speed, multilayer switching scalable to 256 Gbps
  - Scalable IP, IPX, IPmc routing performance to 210 Mpps
  - Multiprotocol routing support for AppleTalk, DECnet, VINES
  - Support for Content Networking, all key network services like QoS, security, multicast and management
  - Support for Cisco IOS® software

Catalyst 6500 Series Architecture

- Supervisor
  - Scalable Multilayer Switching
  - Intelligent Services with Cisco IOS
  - High Availability

- Backplane Architecture
  - Scalable Switching to 256 Gbps
  - Redundant Options

- Line-Card Modules
  - Gigabit Ethernet
  - Fast Ethernet
  - WAN
Catalyst 6509 Backplane

- 32 Gbps data bus connectors on right
- Fabric connectors on left (256 Gbps at FCS)
- Support for all Catalyst 6500 line cards
- Support for redundant supervisor engines, power supplies and switching fabrics

Requirements for Catalyst 6500 with Crossbar

- Catalyst 6500 series chassis
- Supervisor engine II
- Crossbar switch fabric
- Crossbar enabled line cards
Catalyst 6500—Next Phase

Supervisor II Card

- Crossbar Switch Fabric
- Crossbar Enabled Line Cards
- Redundant Crossbar Switch Fabric
- Redundant Supervisor II
- Crossbar Enabled Line Cards

- Delivers 4x control plane performance
- Centralized forwarding up to 150+ Mpps (IP/IPmc)
- 256 Gbps switch fabric

Catalyst 6500 Series Chassis
Catalyst 6500—Next Phase

Requirements for Distributed Switching

- Catalyst 6500 series chassis
- Supervisor engine II
- Crossbar switch fabric
- Local switching daughter cards
Catalyst 6500—Next Phase

- Supervisor II
- Redundant Supervisor II
- Crossbar Enabled Line Cards
- Crossbar Switch Fabric
- Redundant Crossbar Switch Fabric
- Crossbar Enabled Line Cards
- Local Switching Daughter Card

Catalyst 6500 Series Chassis

- Distributed local switching up to 150+ Mpps (IP/IPmc)
- 256 Gbps switch fabric
- Enables local switching

Catalyst 6XXX Bandwidth Evolution CY 2000–2001

Shipping Now

- Catalyst 6000 Family
  - 32 Gbps
    - 15 Mpps Layer 2
    - 4–6 Mpps Layer 3
  - 15 Mpps QoS, ACLs

Shipping Now

- Catalyst 6000 Family
  - 32 Gbps
    - 15 Mpps Layer 2/3
    - 15 Mpps QoS

CY 2000

- Catalyst 6500 Series
  - 256 Gbps
    - 30–150+ Mpps Layer 2/3
    - 30–150+ Mpps QoS/ACLs

CY 2001

- Catalyst 6500 Series
  - Terabit Switching Distributed Fwd.

- 10/100 Aggregation
- Gigabit Aggregation
- 10 Gigabit Aggregation
Next Generation Routing Engine for Catalyst 6000 Family—MSFC2

- Available as a daughter card on Supervisor 1A
- ECC memory with 256 MB and 512 MB upgrade options
- RM7000 300 MHz processor
- Quadruples control plane performance of MSFC (500,000 PPS)

Catalyst 6000 Family Line Card Modules

- Ethernet
  - 24-port 10BaseFL
- Fast Ethernet
  - 48-port 10/100 (RJ-45 or RJ-21)
  - 24-port 100BaseFX
- Gigabit Ethernet
  - 8-port gigabit Ethernet (GBIC)
  - 16-port gigabit Ethernet
    - RJ-45 (category 5 UTP)
    - GBIC (MM or SM fiber, SC)
    - MT-RJ (multimode fiber)
- ATM
  - 1-port ATM OC-12 (Dual-PHY, MM or SM)
- WAN
  - FlexWAN (accepts 2 Cisco 7200/7500 WAN port adapters)
Catalyst 6000 Family FlexWAN Module

- Up to 8 FlexWAN modules per 6000 family chassis
- Up to 2 Cisco 7200/7500 series WAN port adapters per slot
  - T1/E1 (clear channel and channelized)
  - T3/E3 (clear channel and channelized)
  - HSSI
  - ATM (OC-3 and T3/E3)
  - Packet over SONET (OC-3)
- Wire-speed packet forwarding
- Intelligent distributed services
  - Access control lists
  - QoS: WRED, WFQ, CBWFQ, CAR

Flexible WAN Port Adapter Support

<table>
<thead>
<tr>
<th>ATM</th>
<th>T3/E3</th>
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<tbody>
<tr>
<td>OC-3c</td>
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<tr>
<td>PA-A3-OC-3MM</td>
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<tr>
<td>PA-A3-OC-3SMI</td>
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<td>PA-2T3+</td>
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<tr>
<td>PA-A3-E3</td>
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<tr>
<td>Packet over SONET</td>
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<td>OC-3c</td>
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<td>PA-2H</td>
<td>PA-4T+</td>
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<td>PA-8T-V35/232/X21</td>
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<td>PA-MC-8T1</td>
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<td>PA-MC-8E1/120</td>
</tr>
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</table>
Parallel eXpress Forwarding (PXF)

- Hardware engine that delivers high-touch services at wire-speed
- Cisco-developed PXF uses 16 pipelined processors in parallel
- Programmable architecture to allow for future feature upgrades

Catalyst 6000 Family Accelerated PXF Services

- Wire-speed forwarding at 40-byte packet & larger sizes
- MPLS
  - Label imposition, switching and removal
  - VPN (FIB table per VPN)
  - QoS classification and CoS-to-DSCP mapping
  - RRR traffic engineering
  - Fast reroute (50 ms route restoration)
  - Load balancing
- Ingress and egress traffic shaping
- Distributed QoS
  - 2,000 queues per linecard
  - Round-robin, priority or MDRR queue servicing
  - WRED per queue
- IPv4 NAT
- WCCP v2
Catalyst 6000 Family WAN Strategy
Smooth Migration to the Future

Distributed PXF Engine Enables
Wire-Speed, High-Touch WAN Services

Existing WAN
FT1 Thru OC-3

Future WAN
OC-3 Thru OC-192

Catalyst 6000 Family

FlexWan

Traditional WAN
Transport
OC-3
T3
T1
Fractional T1

Cisco IOS™
Service Consistency

PXF Enabled
High-Speed Optical
Transport
OC-192
OC-48
OC-12
OC-3

Catalyst 6000 IOS Services

Hardware Switched
- Standard access lists
- Extended access lists
- Reflexive access lists
- L3/4 policing (CAR) and classification
- Web cache control protocol
- Server load balancing
- IP multicast
- NetFlow accounting
- Policy-based routing

Software Switched
- TCP Intercept (TCP SYN-flood attack)
- NAT
- Unicast RFP check
- Encryption
Catalyst 6000 Hardware Roadmap

- Higher Performance, Integrated Services, and Functionality
- Scalable Performance

- Cisco 1000TX
- 256 Gbs Crossbar Distributed Switching Line Cards
- IDS/RMON Module
- Supervisor II (30 Mpps), MSFC2
- 2 Port 10Gige Module
- PXF Enabled Cards
- Voice Integration
- 10/100T with power
- Analog/Digital trunk
- Analog phone interface
- Conference modules

1H CY '00
2H CY '00

- Cisco 7200/7500 WAN Port Adapter Support
- 16-Port Gigabit Ethernet
- Supervisor II (30 Mpps), MSFC2
- 2 Port 10Gige Module
- PXF Enabled Cards
- Voice Integration
- 10/100T with power
- Analog/Digital trunk
- Analog phone interface
- Conference modules

Catalyst 6000 Family Software Roadmap

- Scalable Network Services Without Performance Sacrifice
- Services
  - NAT
  - Firewall/Intrusion Detection
  - Distributed Switching and Services
  - Multic和平 Support
  - DECSnet
  - AppleTalk
  - Multicast (IGMP, PIM)
  - QoS
  - Security
- QoS
- Security
- Directory
- Scalability
- QoS
- Security
- Directory

H1 CY '99
H2 CY '99
H2 CY '00
Cisco Campus Enterprise Solutions

Wiring Closet
- Catalyst 29xx < 50 ports
- Catalyst 400X <240 ports
- Catalyst 5/6K <384 ports

Data Center
- Mainframe
  - Catalyst 6000
  - Catalyst 29xx < 50 ports
  - Catalyst 400X <240 ports
  - Catalyst 5/6K <384 ports
  - Catalyst 6XXX—Backbone (10/100/1000)
  - Catalyst 8500—Multiservice Core (100/1000, ATM, PoS, WAN)

Campus Backbone
- Catalyst 8500
- Catalyst 7xxx
- Catalyst 6500
- Catalyst 4003
- Catalyst 29xx

Campus Backbone
- Cisco 7500
- LightStream 1010/
  Cisco IGX™ 8400

Catalyst Modular Switching Family Update
Session 2810
Please Complete Your Evaluation Form
Session 2810