Catalyst Campus Switching Technology Evolution
Catalyst 6000 and Catalyst 4000 Update
Session RST-141

Agenda

• Business Challenges
• Scaling the Bandwidth
• Evolving Intelligent Services
• Equipment Integration: LAN/MAN/WAN
• The Future Looks Bright
Internet Business Challenges
Scalability of Bandwidth and Intelligence

New Applications

Expanded User Base

Increased Access to Content

Scalability

Manageability

Security

Availability

End-to-End Catalyst Consistency
Modular Enterprise Design Strategy

Wiring Closets

Core

Catalyst 6000 Family

Catalyst 6500

Catalyst 6000

Catalyst 4006

Catalyst 4003

Catalyst 4000

Modular Flexibility Protection

Premium Solution

Alternative Solution

Enterprise Positioning

AVVID Network Services

Catalyst 4000

Integrated VoIP and Voice Services (DSPs)

Integrated WAN

Catalyst 6000

Integrated VoIP and Voice Services (DSPs)

Catalyst advantages

- Consistent WC and BB architecture
- IOS and voice network Services
- Integrated WAN and CM gateway
- Modular flexibility protection

Enterprise Positioning

Branch Office

Wiring Closet

Core
Catalyst 4000 Family Innovations

Catalyst 4000 Family High Performance Modular Switching

Catalyst 4000 Family Vision...
- Design and develop a modular chassis system with Gigabit Ethernet uplinks that hits the same price per port as competitor’s fixed stackable switches

Objectives...
- Target: Industry leading modular cost-effective solution
- Deliver mature, high-end enterprise features (CatOS/IOS)
- Extend Catalyst 6000 backbone strategy w/aggressively priced modular wiring closet solution

Hi

Flexibility

C4K target

Stackable

Lo

Market Evolution

Hi

Chassis
Introducing Catalyst 4000 Family Expansion

- 3-slot and 6-slot chassis platform expansion
- 240 ports 10/100 fast Ethernet, Gigabit uplinks
- Line card compatibility
- AC or DC redundant power

WS-C4006 Common Equipment

Common Equipment Includes:

- 6-slot chassis
- 24Gbps supervisor II (dual GE GBIC slots)
- Two power supplies, one fan tray
- Accessory pack and rack-mount kit
Scalable Bandwidth

Catalyst 4006: Modular Investment Protection

Switching Engine
- Scalable forwarding, 24Gbps, 18Mpps
- Wire-speed uni-, multicast switching
- Dynamic shared memory
- Low-latency (1.4us), centralized forwarding

Line-Cards
- Functionally transparent architecture
- Slot/chassis independent

Backplane
- 64Gbps capacity protection
- Scalable passive point-to-point architecture
- Voice ready
Catalyst 4000 Family: Scalable Architecture

- Forwarding Engine
  - Wire rate L2/L3 switching
  - Integrated L3

- Reliability Improvements
  - Higher MTBF from fewer components
  - Integrated L3 engine on-board
  - Compatible sparing across platform

- Evolved Line Cards
  - Backward/Forward LC Compatibility
  - Longer Window of Deployment for Lower Cost of Ownership

Catalyst 4000 Integrated Layer 3 Switching

Integrated Switching, Routing, and WAN

- Hardware-based MP routing: WS-X4232-L3
  - 6Mpps forwarding per engine
  - CEF architecture

- Software-based IP WAN routing: WS-X4604-GWY
  - 90Kpps forwarding
  - T1/E1, Serial, FXS

IP/IPX Multi-Protocol Router WS-4232-L3

WAN Router WS-X4604-GWY
## Layer 3 Engine Compatibility

<table>
<thead>
<tr>
<th></th>
<th>Catalyst 4003</th>
<th>Catalyst 4006</th>
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<tbody>
<tr>
<td>IP/IPX MP Routing</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>WAN Routing</td>
<td>YES</td>
<td>YES</td>
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</table>

### Layer 3 Services Module

#### System-Wide Multi-Protocol Routing

- High-performance (ASIC-based) layer 3 switching
  - IP, IPX, IP multicast at wire-rate
- **Microcoded** hardware flexibility and speed

**New routing protocols:**
- BGP4 (up to 64,000 prefixes)
- AppleTalk (phase I and II)

**Security/QoS/content:**
- Access control list
- QPM 2.x GUI support
Catalyst 4000 WAN Integration

“Router in a Switch”

Supports 2600/3600 router VIC and WIC modules
- Up to 6 T1/E1 ports
- Up to 48 Serial ports

Branch integrated WAN
- Mature IOS
- 90kpps fast performance
- Firewall
- Hardware-based encryption

WS-X4604-GWY Router

1Gbps Backplane Interface
Running IOS 12.0(x)
DSP Farm
HW Encryption

Modular Interface Flexibility

- RJ-45: Ethernet/Fast Ethernet
  48-port, 32-port
- Gigabit Ethernet
  24-port, 14-port
- RJ-21: Ethernet/Fast Ethernet
  48-port
- MT-RJ: Fast Ethernet
  48-port, 24-port
- GBIC: Gigabit Ethernet
  18-port, 6-port, 2-port

Functionally Transparent Line Cards
Catalyst 4003 or 4006
Centralized L2/3/4 Services
C4k 10/100/1000 Base-T

- Multi-layer switching
  L2/3/4 services,
  Multicast, IGMP,
  Protocol filtering
- High-performance
- Investment protection

Desktop migration from FE to GE
w/o need to touch wiring closet

Wiring Closet
4003/4006
2948G
2980G

Distribution
6500

Server Farm
6500
Catalyst 4000 Family
High Density 10/100/1000T (RJ45)

Data/Voice/Video Integration
Voice and Data Evolution

Old World
Public Voice Network
Legacy PBX
ATM, frame relay, PPP, SONET
Public Data Network
Ethernet Switch
Router

ATM, frame relay, PPP, SONET
Legacy PBX

WAN services:
- Voice recognition
- Voice prioritization
- Bounded end-to-end delay
- Voice over IP gateway to legacy voice

New World
Converged LAN/WAN/MAN Network
ATM, frame relay, PPP, SONET
Legacy PBX

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
Catalyst 4000 Family Voice Features

Catalyst inline power Ethernet module
- 48 Port 10/100BaseTX ports per module (RJ45)
- Provides 48V DC over the same pairs as Ethernet (pins 1,2,3,6)

FXS module
- 8 and 16 FXS ports (RJ21 connector)
- Provides analog connectivity for fax machines, speaker phones, analog telephone sets

Voice T1/E1 services module
- 6 T1/E1 ports for connections to the PSTN or PBX
- 48 Serial ports for WAN connections
- Provides voice services such as conferencing, compression, firewall, and call manager gateway

Facilitates Migration to VoIP and IP Telephony

Catalyst 4000 AVVID Benefits

- Single wire to the desk
- Power for the phone, no cubicle UPS
- Ease of IP Address assignment
- Ease of adds, moves, changes
- Voice quality of service
- Infrastructure protection for video, dynamic content, etc.
Software and Management Evolution

Roadmaps

• CiscoWorks 2000
• QPM 2.x
• SNMP 1/2/3
• RMON and RMON2

New!

Catalyst 4000 Management

Improved Network Management

• SW Release 6.2
  Private VLANs (same C6K)
  L2 Traceroute
  802.1x (port security)
• SW Release 6.3
  Remote SPAN
• SW Release 6.3
  Remote SPAN

• CiscoWorks 2000
• QPM 2.x
• SNMP 1/2/3
• RMON and RMON2
C4k Software Roadmap

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<tr>
<th>Year</th>
<th>Key West</th>
<th>Panama</th>
<th>Tampa (target)</th>
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<td>Q2C '01</td>
<td>6.2(1)</td>
<td>Private VLAN</td>
<td>RSPAN</td>
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<td>Q3C '01</td>
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<td>MIST</td>
<td>sc0 in PVLAN</td>
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<td>Q4C '01</td>
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<td>L2 Traceroute</td>
<td>802.3ad</td>
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<td>Q1C '02</td>
<td>VMPS Server</td>
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CatOS:
- ACL (Access control lists)
- AppleTalk
- BGP4

IOS:
- L3 Services
- HA Features
- WC Features

Native IOS Introduction!

Catalyst 4000 Hardware Roadmap

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<td>1H CY '00</td>
<td>18 Mpps</td>
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<td>2H CY '00</td>
<td>24 Gbps</td>
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<tr>
<td>CY '01+</td>
<td>Hi-Density 1000X Module</td>
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<td>AVVID DC PEM (Power Entry Module)</td>
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Catalyst 6000 Innovations

Catalyst 6500 Series Overview

- Multilayer switching scalable to 256Gbps
- Scalable IP, IPX, IP multicast routing performance up to 170Mpps
- Multiple routing protocols: RIP, OSPF, IGRP, BGP, EIGRP, IS-IS
- Intelligent network services: QoS, security, multicast
- Integrated LAN/MAN/WAN solution
Scalability: 3 Architectures, Shared Modules

Intelligent Services
Routing Scalability, Security, QoS, Multicast

Why Cisco Express Forwarding (CEF)? Scalability Proof
CEF Scaling the Control Plane

- Supports forwarding performance and intelligent network services (security, QoS, etc.) up to 30Mpps.
- Modular crossbar fabric
  - Scales data plane to 256G
  - Industry-leading availability through 2-levels of backplane redundancy
  - Modular approach enables future bandwidth enhancements using new SFM

Access to Switch Fabric

New Sup 2 w/MSFC2 Central CEF Engine

Distributed CEF (dCEF) Further Scaling the Control Plane

- Scales performance up to 170Mpps
- Distributed CEF-based control plane delivers forwarding table per module
- Eliminates supervisor from forwarding path (incl. card to card traffic)
- Enables local intelligent switching, supporting network services (security, QoS, etc)

New Modules Support dCEF Switching Intelligence
Catalyst 6500 Series Supervisor Engines

Supervisor Engine 1A
- Flow Based architecture providing 15Mpps of central forwarding

Cost-effective Wiring Closet
- L2 switching @ 15Mpps
- Multicast, IGMP, protocol filtering
- Enhanced GoS, ACLs, admission control via PFC

Small Enterprise Distribution/Core
- L2/L3 forwarding at 15Mpps via MSFC

Small Enterprise Server Farm
- Intelligent services such as SLB, security, PVLAN

Supervisor Engine 2
- Support for both bus and fabric
- CEF-based architecture providing 30Mpps of central forwarding
- dCEF enabled via DFC on line cards, scaling total system performance up to 170Mpps

Large Enterprise Backbone, WAN, and E-commerce Applications
- L2 L2/L3 forwarding via MSFC
- Scalable control plane
- Distributed intelligent services

High End Wiring Closet Solution
- Scalability
- Enhanced GoS, ACLs, admission control via PFC

Catalyst 6500 Series Interfaces Summary

- Ethernet
  - 24-port 10BaseFL
- Fast Ethernet
  - 48-port 10/100 (RJ-45 or RJ-21)
  - 24-port 100FX (MM or SM fiber)
- 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 (takes 2 Cisco 7200/7500 PAs)
  - Optical services modules
Catalyst 6500 Series
Raising the Bar for Intelligent Services

- High availability
- Security
  - Integrated intrusion detection services
- Manageability
  - Integrated network analysis module
- QoS for LAN and WAN
  - Dedicated queues for high-priority/voice traffic
  - Granular policing
  - Versatile traffic management system
- Content distribution
  - Multicast
  - Server load balancing

Catalyst 6500 Series High Availability

Result: Quick Recovery
Graceful router reload
No line card reboot required upon processor fail over
Standby processor activates CEF entries
Line cards begin forwarding packets

Goal: Non-Stop Availability
Online software upgrades
Upgrade software while router is active
Synchronized L3 protocol states
Synchronized QoS and Security ACL states
Logical redundancy
HSRP, Gigabit EtherChannel, Layer 3 load balancing, 1+1 SONET APS

Physical redundancy
With dual supervisors, and power, fabrics, clocks
**Catalyst 6500 Series Intrusion Detection Module**

- Protect revenue streams with real-time detection of denial-of-service attacks
  
  Dynamic security-policy tuning  
  (Ex: “Shunning”)  

- Enables centralized policy enforcement through Cisco secure policy manager  

- No impact on packet forwarding performance  

- Scalable traffic monitoring by load-sharing across modules  

- Full attack signatures set (more than 340+), avail. off Cisco-CCO  

  “IDS blade can monitor at even higher throughputs of up to 769.95M bit/sec”  
  - Network World

---

**Catalyst 6500 Series Network Analysis Module**

- Full network monitoring  

- Troubleshooting and traffic analyses  

- Server monitoring  

- Alerts and events notifications  

- Trend analysis and capacity management  

- Application response time monitoring  

- Integrated module  

- Occupies one slot  

- Uses SPAN/RSPAN functionality  

- Needs CatOS 5.5 minimum  

- Performance ~ 150Kpps+
Catalyst 6500 Series Network Analysis Module

- Full RMON1 and RMON2
  Host and conversation tables for the link, network and application layers
  Filter/capture, protocol distribution and address mapping
  Provides independent RMON/RMON2 groups for each SPAN source
- VLAN monitoring for ISL and 802.1Q
  Provides individual RMON/RMON2 statistics for each VLAN on a trunk link
- NetFlow data export monitoring
  NDE frames flow based statistics as flows are established and terminated
- EtherChannel(EC) monitoring
  Maps each port within etherchannel to another if entry

Also Supports
- SMON (RFC 2613)
- HC-RMON
- DSMON (Future)

Catalyst 6500 Series QoS Services

- Packet classification, marking and policing
  Granular policing enabling differentiated services on a per customer or application basis
- Congestion avoidance
  Protects high priority traffic during times of network congestion
- Smart packet queuing
  Strict priority queues for voice and other delay sensitive applications
- Versatile traffic management system for WAN interfaces
- Full instrumentation
  RSVP, MIB Implementations, Centralized Policy Management (QPM)
Catalyst 6500 Series Content Switching Module

- Specific L4-L7 feature set
- True URL/cookie switching
- 1 Million concurrent connections
- 4 Gbps line-rate NAT
- Integrated solution leveraging all 6500 services and enabling any/all ports for content switching
- All-in-one solution for MAN/POP design where rack space is at premium

Catalyst 6500 Series Voice Features

Catalyst inline power Ethernet module
- 48 port 10/100baseT ports per module (RJ45)
- Provides -48V DC over the same pairs as Ethernet (pins 1,2,3,6)

FXS module
- 24 FXS ports (one RJ21 connector)
- Provides analog connectivity for fax machines, speaker phones, analog telephone sets

Voice T1/E1 services module
- 8 T1 or E1 ports for connections to the PSTN or PBX
- Provides voice services such as conferencing or compression

200,000 CPS
Catalyst 6500 CSM

18 Billion Connections/Day!
Consolidated WAN Edge

Features
- WAN Interfaces: DS0 to OC-48/STM-16 POS
- LAN Interfaces: Ethernet to Gigabit Ethernet
- Integrated server load balancing
- Transparent cache redirection
- IP services: QoS, ACLs, traffic shaping, billing, MPLS (future), multicast
- IP routing: BGP4, IS-IS, OSPF

Catalyst 6500 Series
LAN/MAN/WAN Integration

Existing WAN Connectivity
- FlexWAN Port Adapters
  - T1/E1
  - T3/E3/HSI
  - Channelized Serial T1 or E1
  - OC-3/STM-1 ATM or POS
  - Channelized STM-1

New WAN Connectivity
- Optical Services Modules
  - OC-3/STM-1 POS
  - OC-12/STM-4 ATM or POS
  - OC-48/STM-16 POS
  - Gigabit Ethernet

Diverse LAN Connectivity
- Catalyst 6x00 Ethernet Modules
  - Ethernet
  - Fast Ethernet
  - Gigabit Ethernet
"CatOS"—SW Release 6.2(2)

- IOS firewall feature set
- 802.1x network security and authentication
- VVID w/VMPS
- BPDU filtering
- QoS data export
- VACL denied logging
- Bi-directional VACL per PVLAN community
- Local command accounting
- Min threshold for WRED
- Per-port utilization pkt%
- Non-RPF multicast fast drop
- New MIBS (PVLAN, QoS, ACL)

"CatOS"—SW Release 6.3(1)

- Private VLAN on sc0
- System warning on port counters
- Text config mode
- CDP enhancements
- SWITCH-ENGINE-MIB
- STP-EXTENSION-MIB
- RMON-CONFIG-MIB
- CAT6K-CROSSBAR-MIB
- ACL-QOS-MIB
Supervisor IOS Software Features

Sup IOS Ver. 12.1(5)EX

- Distributed multicast switching support (not the same as DCEF)
- Aggregation on a per-line card basis for per-VLAN and shared aggregate policing
- Per-EtherChannel VLAN-based QoS mode

Future Sup IOS Roadmap:

- Multiple firewall farms
- Private VLANs (PVLANs)
- VACLs (VLAN ACLs)
- VLAN database
- SPAN
- 8-way CEF balancing
- Egress QoS

Catalyst 6500 Series Hardware Roadmap

- Q1CY ’01
  - 24 port 100FX w/ X-bar Connection
  - OC-48 PGS
  - 8 and 16 port OC-3 POS

- Q2/Q3CY ’01
  - 12 and 4 port OC-12-POS
  - Distributed Routing and Switching
  - 4 GigE Network Services/Engine
  - 16 port GigE X-bar only
  - 13-slot Chassis

- Q1CY ’01
  - 2 and 4 port OC-12-POS
  - 48 port 10/100 w/ X-bar Connection
  - OC-12 ATM

- Q2/Q3CY ’01
  - 16 port/100/1000 w/ X-bar Connection
  - 10 Gigabit-Ethernet
  - Crossbar for 13-slot Chassis

- Q1CY ’01
  - SLB

- Q2/Q3CY ’01
  - 13-slot Chassis

- OC-12 POS
  - GigE Network Services/Engine
  - X-bar only
  - 16 port GigE
Cisco Campus Enterprise Solutions

Wiring Closet
- Catalyst 35xx/29xx
- Catalyst 4003
- Catalyst 5000
- Catalyst 4006
- Catalyst 4006 Wiring Closet (10/100/1000T)

Data Center
- Catalyst 29XXG < 80 ports
- Catalyst 400X <240 ports
- Catalyst 600X <576 ports

Mainframe
- Cisco 7500

Campus Backbone
- Catalyst 6500—Backbone (10/100/1000)
- Catalyst 8500—Multiservice (ATM)
- Cisco 7000
- LightStream 1010/
  Cisco IGX™ 8400

Cisco Campus Switching Technology Evolution
Catalyst 6000 and Catalyst 4000 Update
Session RST-141
Please Complete Your Evaluation Form
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